Learning area	Mathematics
Curriculum elements	Rationale/Aims Organisation Content descriptions Elaborations Achievement standards
Year levels	Kindergarten Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10 Year 10A

Mathematics | Rationale/Aims

Rationale

Learning mathematics enriches the lives of, and creates opportunities for, all Australians. The Australian mathematics curriculum provides students with essential mathematical skills and knowledge in number and algebra, measurement and geometry, and statistics and probability. It develops the numeracy capabilities that all students need in their personal, work and civic life, and provides the fundamentals required of mathematical specialists and professional users of mathematics.

Mathematics has its own value and beauty and it is intended that students will appreciate the elegance and power in mathematical reasoning. Mathematical ideas have evolved over centuries and across all cultures and they continue to expand. Digital technologies are contributing to this expansion of ideas and provide access to new tools for continuing mathematical exploration and invention. The Australian mathematics curriculum focuses on developing increasingly sophisticated and refined mathematical understanding, fluency, logical reasoning, analytical thought processes and problem-solving skills to enable students to respond to familiar and unfamiliar situations by employing mathematical strategies to make informed decisions and solve problems efficiently.

The Australian mathematics curriculum ensures that the links between the various components of mathematics, and to other disciplines, are made clear. Mathematics is composed of multiple but interrelated and interdependent concepts and systems which students apply in other disciplines. In science, for example, understanding sources of error and their impact on the confidence of conclusions is vital, as is the use of mathematical models; in geography, interpretation of data underpins the study of human populations and their physical environments; in history, students need to be able to imagine timelines and time frames to reconcile relativities of related events; and in English, deriving quantitative and spatial information is an important aspect of making meaning of texts.

The curriculum is written with the expectation that schools will ensure that all students benefit from access to the power of mathematical reasoning and be able to apply their mathematical understanding creatively and efficiently. The mathematics curriculum provides students with carefully paced, in-depth study of critical skills and concepts. It encourages teachers to facilitate students to become self-motivated, confident learners through inquiry and active participation in challenging and engaging experiences.

Aims

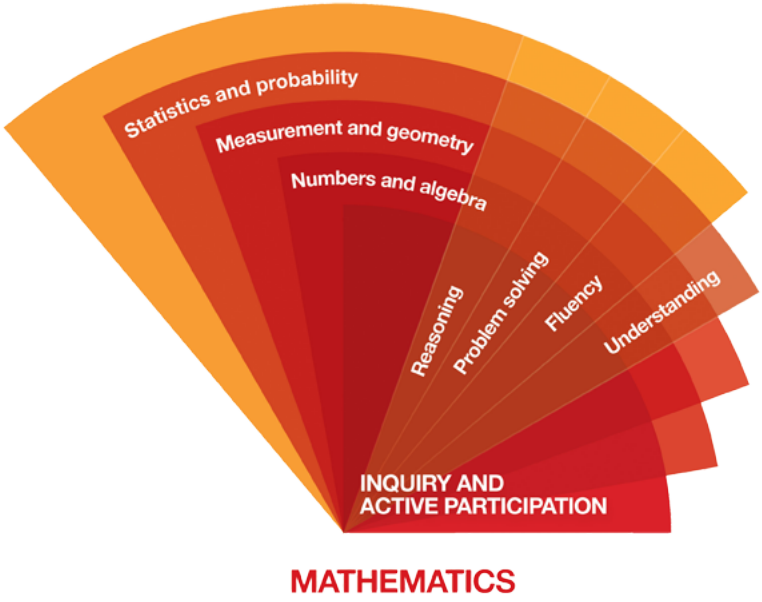
The Australian mathematics curriculum aims to ensure that students are confident, creative users and communicators of mathematics, able to investigate, represent and interpret situations in their personal and work lives and as active citizens.

It aims to ensure students develop increasingly sophisticated understanding of mathematical concepts and fluency with processes, able to pose and solve problems and reason in number and algebra; measurement and geometry; and statistics and probability.

It aims to ensure students recognise connections between the areas of mathematics and other disciplines and appreciate mathematics as an accessible and enjoyable discipline to study.

Mathematics | Organisation

Content strands



Content strand descriptors

The *Australian Curriculum: mathematics* is organised around the interaction of three content strands and four proficiency strands.

The content strands are Number and algebra, Statistics and probability, and Measurement and geometry. They describe 'what' is to be taught and learnt.

The proficiency strands are Understanding, Fluency, Problem solving, and Reasoning, and describe 'how' content is explored or developed ie the thinking and doing of mathematics. They provide the language to build in the developmental aspects of the learning of mathematics and have been incorporated into the content descriptions of the three content strands described above. This approach has been adopted to ensure students' proficiency in mathematical skills is developed throughout the curriculum and becomes increasingly sophisticated over the years of schooling.

Content strands

Number and algebra

Number and algebra are developed together since each enriches the study of the other. Students apply number sense and strategies for counting and representing numbers. They explore the magnitude and properties of numbers. They apply a range of strategies for computation and understand the connections between operations. They recognise pattern and understand the concepts of variable and function. They build on their understanding of the number system to describe relationships and formulate generalisations. They recognise equivalence and solve equations and inequalities. They apply their number and algebra skills to conduct investigations, solve problems and communicate their reasoning.

Statistics and probability

Statistics and probability initially develop in parallel. Progressively the curriculum builds the links between them. Students recognise and analyse data and draw inferences. They represent, summarise and interpret data and undertake purposeful investigations involving the collection and interpretation of data. They assess likelihood and assign probabilities using experimental and theoretical approaches. They critique the use of chance and data concepts and make reasoned judgments and decisions. They develop an increasingly sophisticated ability to critically evaluate

chance and data concepts and make reasoned judgments and decisions. They develop an increasingly sophisticated ability to critically evaluate statistical information and build intuitions about data.

Measurement and geometry

Measurement and geometry are presented together to emphasise their interconnections, enhancing their practical relevance. Students develop increasing sophistication in their understanding of size, shape, relative position and movement of two-dimensional figures in the plane and three-dimensional objects in space. They investigate properties and use their understanding of these properties to define, compare and construct figures and objects. They learn to develop geometric arguments. They make meaningful measurements of quantities, choosing appropriate metric units of measurement. They understand connections between units and calculate derived measures such as area, speed and density.

Proficiency strands

Understanding

Students build robust knowledge of adaptable and transferable mathematical concepts, make connections between related concepts and develop the confidence to use the familiar to develop new ideas, and the ‘why’ as well as the ‘how’ of mathematics.

Fluency

Students develop skills in choosing appropriate procedures, carrying out procedures flexibly, accurately, efficiently and appropriately, and recalling factual knowledge and concepts readily.

Problem solving

Students develop the ability to make choices, interpret, formulate, model and investigate problem situations, and communicate solutions effectively.

Reasoning

Students develop increasingly sophisticated capacity for logical thought and actions, such as analysing, proving, evaluating, explaining, inferring, justifying, and generalising.

Mathematics across K–10

Although the curriculum will be developed year by year, this document provides a guideline across three year-groupings:

Years K–2: typically students from 5 to 8 years of age

Years 3–6: typically students from 8 to 12 years of age

Years 7–10: typically students from 12 to 15 years of age

What follows for each year grouping is a description of the major content emphases either as points of exposure, introduction, consolidation or extension; some of the underlying principles (and rationale) that apply in these considerations; key models or representations; and possible connections across strands and year levels.

connections across strands and year levels.

Years K–2 (typically from 5 to 8 years of age)

The early years (5–8 years of age) lay the foundation for learning mathematics. Students at this level can access powerful mathematical ideas relevant to their current lives. Learning the language of mathematics is vital in these years.

Children have the opportunity to access mathematical ideas by developing a sense of number, order, sequence and pattern; understanding quantities and their representations; learning about attributes of objects and collections, position, movement and direction; developing an awareness of the collection, presentation and variation of data and a capacity to make predictions about chance events.

These understandings and the experiences in the early years provide a foundation for algebraic, statistical and multiplicative thinking that will develop in later years. They provide a foundation also for children to pose basic mathematical questions about their world, identify simple strategies to investigate solutions, and strengthen their reasoning to solve personally meaningful problems.

Years 3–6 (typically from 8 to 12 years of age)

These years focus on the importance of students studying coherent, meaningful and purposeful mathematics that is relevant to their lives. Students still require active experiences that allow them to construct key mathematical ideas, but there is a trend to move to using models, pictures and symbols to represent these ideas.

The curriculum develops key understandings by extending the number, measurement, geometric and statistical learning from the early years; building foundations for future studies by emphasising patterns that lead to generalisations; describing relationships from data collected and represented, making predictions; and introducing topics that represent a key challenge in these years such as fractions and decimals.

Particularly in these years of schooling, it is important for students to develop deep understanding of whole numbers to build reasoning in fractions and decimals and develop their conceptual understanding of place value. With these understandings, students are able to develop proportional reasoning and flexibility with number through mental computation skills. These understandings extend students' number sense and statistical fluency.

Years 7–10 (typically from 12 to 15 years of age)

Traditionally, during these years of schooling, the nature of the mathematics needs to include a greater focus on the development of more abstract ideas, for example, through explorations that enable students to recognise patterns and explain why these patterns apply in these situations. From such activities abstract thoughts can develop, and the types of thinking associated with developing such abstract ideas can be highlighted.

The foundations built in the previous years, provide a solid basis for preparing for this change. The mathematical ideas built previously can be drawn upon in unfamiliar sequences and combinations to solve non-routine problems and develop more complex mathematical ideas. However, to motivate them during these years, students need an understanding of the connections between the mathematics concepts and their application in their world in contexts that are directly related to topics of relevance and interest to them.

During these years students need to be able to represent numbers in a variety of ways; develop an understanding of the benefits of algebra, through building algebraic models and applications, and the various applications of geometry; estimate and select appropriate units of measure; explore ways of working with data to allow a variety of representations; and make predictions about events based on their observations.

The curriculum lists fewer detailed topics with the intention to encourage the development of important ideas in more depth, and promote the interconnectedness of the mathematical concepts. An obvious concern is the preparation of students who are intending to continue studying mathematics in the senior secondary years. It is argued that it is possible to extend the more mathematically able students appropriately using challenges and extensions within available topics and the expectations for proficiency can reflect this. This can lead to deeper understandings of the mathematics in the curriculum and hence a greater potential to use this mathematics to solve non-routine problems they encounter at this level and at later stages in their mathematics education.

The national mathematics curriculum will be compulsory to the end of Year 10 for all students. It is important to acknowledge that from Year 10 the curriculum should enable pathway options that will need to be created and available for all students. This will enable all students to access one or more of the senior years' mathematics courses.

Implications for teaching and learning

In mathematics, challenging problems can be posed using basic content, and content acceleration may not be the best way to extend students. Choosing engaging experiences as contexts for a variety of tasks assists in making mathematics inclusive, differentiating both for students experiencing difficulty and those who complete tasks easily. The proficiency strands apply expectations of the range and nature of how mathematical content is enacted, and can help in focusing teaching.

Teachers should base their teaching on what the students already know, should make explicit the subsequent key ideas, should ensure tasks are posed at an appropriate level of challenge, and should offer feedback on activities, standards and directions as often as possible.

The development of key ideas across the years enables teachers to make informed classroom decisions, including the use of digital technologies to enhance the relevance of mathematics content and processes for learning.

General capabilities

The Australian Curriculum, Assessment and Reporting Authority (ACARA) has identified 10 general capabilities that will be specifically covered in the curriculum. In mathematics, there is specific reference to five of these in the content descriptions and achievement standards.

Literacy is an important aspect of mathematics. There is a particular way of writing and interpreting mathematical texts. Students will be taught to interpret mathematical symbols, understand the meaning of the language of mathematics and to read and write reports of their investigations.

Numeracy is fundamentally the responsibility of mathematics and is applied in other learning areas. It is crucial that the mathematics curriculum provides the opportunity to apply mathematical understanding and skills in context, both in other learning areas and in real world contexts. A particularly important context for the application of number and algebra is financial mathematics. In measurement and geometry there is an opportunity to apply understanding to design. The world in the 21st century is information driven and statistics and probability provide opportunities for students to interpret data and make informed judgements about events involving chance.

Information and communication technologies (ICT) allow students to solve problems and perform tasks that previously have been onerous. Calculators of all types from the simple four operations versions to the more complex graphical and CAS calculators allow students to make calculations, draw graphs and interpret data in ways that previously have not been possible. There are spreadsheets, dynamic geometry programs and other software that can engage students and promote understanding of key concepts. It is expected that mathematics classrooms will make use of all available ICT in teaching and learning situations. Notwithstanding this, there will be occasions where teachers will ask students to undertake tasks without using the technology. For example, it is still important for students sometimes to make geometric constructions using a ruler and compass or to work out calculations using mental or written strategies.

Thinking skills are key to developing mathematical understanding. This general capability overlaps with the mathematics proficiency strands of reasoning and problem solving. The mathematics curriculum is designed to promote students thinking and reasoning about solutions to problems and the strategies they can use to find these solutions. Students will be encouraged to be critical thinkers, justifying for example, their choice of a particular calculation strategy or identifying the questions that need to be asked and answered when undertaking a statistical investigation.

Creativity is the essence of mathematical problem solving. The mathematics curriculum encourages approaching problems in different ways. For example, by identifying that a problem is similar to a previous one; that drawing diagrams could help; or that simplifying a problem to control some variables is a way of understanding and arriving at a solution.

The other general capabilities of self-management, teamwork, intercultural understanding, ethical behaviour and social competence are all relevant to the pedagogy used by teachers of mathematics.

It is important that students are encouraged to take responsibility for their own learning in mathematics and work collaboratively in teams.

Teamwork should be inherent in explorations and investigations, which are essential processes through which students learn to be mathematicians. There is also the opportunity for students to use mathematics to examine issues of *ethical behaviour* and *social competence*.

Intercultural understanding can be enhanced if students are exposed to other cultures' view of mathematics, for example, through examining Aboriginal and Torres Strait Islander peoples' perceptions of time and weather patterns, the networks embedded in family relationships and the algebraic concepts inherent in storytelling. It is equally important for mathematics classes to explore the influences and contributions of many cultures, from the early work on geometry by the philosophers of ancient Greece to the origins of algebra that can be found in ancient Indian mathematics.

Cross-curriculum dimensions

Cross-curriculum dimensions are not explicitly tagged in the content descriptions.

Aboriginal and Torres Strait Islander dimensions are included in the elaborations. It is imperative that all Australian students learn from the wisdom of the first Australians. For example, when considering the idea of seasons in measurement and geometry, the European tradition of four seasons can be compared and contrasted with the different constructs used by Aboriginal and Torres Strait Islander people in different parts of the country. The idea of using symbols as a way of generalising relationships can be enhanced by drawing on the perspectives of Indigenous Australians.

The cross-curriculum dimension of commitment to sustainable living and the knowledge and understandings related to Asia and Australia's engagement with Asia provide engaging and rich contexts for mathematics learning.

Links to other learning areas

The Australian National Numeracy Review Report (2008) identified numeracy as requiring an across-the-school commitment, including mathematical, strategic and contextual aspects. This across-the-school commitment can be managed by including specific reference to other curriculum areas in the mathematics curriculum, and identification of key numeracy capacities in the descriptions of other curriculum areas being developed. For example, the following are indications of some of the numeracy perspectives that could be relevant to history, English, and science.

English: One aspect of the link with English and literacy is that, along with other elements of study, numeracy can be understood and acquired only within the context of the social, cultural, political, economic and historical practices to which it is integral. Students need to be able to draw on quantitative and spatial information to derive meaning from certain types of texts encountered in the subject of English.

Science: Practical work and problem solving across all the sciences require the capacity to: organise and represent data in a range of forms; plot, interpret and extrapolate graphs; estimate and solve ratio problems; use formulas flexibly in a range of situations; perform unit conversions; and use and interpret rates including concentrations, sampling, scientific notation, and significant figures.

History: Learning in history includes interpreting and representing large numbers and a range of data such as those associated with population statistics and growth, financial data, figures for exports and imports, immigration statistics, mortality rates, war enlistments and casualty figures, chance events, correlation and causation; imagining timelines and timeframes to reconcile relativities of related events; and the perception and spatial visualisation required for geopolitical considerations, such as changes in borders of states and in ecology.

Mathematics | Strands

Kindergarten Content descriptions

Number and Algebra

1. Counting

Say, understand and reason with number sequences, initially to and from 20, and then beyond, moving to any starting point

Elaborations

saying the number words in sequence, backwards and forwards, and reasoning with the number sequences, establishes the language on which subsequent counting experiences can build

developing fluency with forwards and backwards counting in meaningful contexts including stories and rhymes

using a calculator to develop understanding of counting patterns (eg count by adding 1 each time, beginning with 0 and press +1 = = repeatedly)

understanding that numbers are said in a particular order and there are patterns in the way we say them which help us to remember the order (eg hear the teen part of the sequence in 14 to 19)

2. Numeration

Understand numbers to 10, including matching number names, numerals and quantities, and work fluently with small numbers including subitising and partitioning

Elaborations

making connections between the spoken number word representing the numerical value of the collection and the written number symbol (numeral)

understanding that each object must be counted once and only once, that the arrangement of objects does not affect how many there are and that the last number counted answers the ‘how many’ question

understanding single-digit numbers as groupings of other numbers (eg 7 can be thought of as 3 and 4 or 5 and 2, or 2 and 2 and 2 and 1)

immediately recognising the number of

Statistics and Probability

1. Data representation

Collect, represent and interpret data from simple questions with objects and drawings where one object or drawing represents one data value

Elaborations

understanding that data can be represented using objects and drawings and that this makes it easier to make sense of the data

answering questions such as, 'which is our favourite type of pet?' by looking at a prepared pictograph showing the classes’ preferences

constructing class pictographs with data generated by the students using drawings or images, ensuring each image is placed correctly on a prepared baseline and that each image is of the same size. This could include an activity such as writing names on kindergarten squares placed in columns to represent birth months in order to construct a class pictograph about birth months

2. Data investigation

Solve problems by collecting data and answering questions about obvious attributes of themselves and familiar objects and events

Elaborations

understanding that questions can be answered by representing data on pictographs and interpreting that data such as finding the most popular pet

proposing questions about themselves that can be answered with either ‘yes’ or ‘no’

making statements from the data relating back to the question posed such as ‘we asked the class what their favourite TV show was and this pictograph shows that the highest column is Cartoon Corner, so it is the favourite’

Measurement and Geometry

1. Geometry

Sort, describe, name, and represent familiar two-dimensional shapes and three-dimensional objects in the environment

Elaborations

understanding that two-dimensional shapes and three-dimensional objects have features such as number of sides or faces, and that these features can be used to describe the shapes and objects

naming familiar two-dimensional shapes and three-dimensional objects found in the environment and describing features of them using everyday language such as 'this block has straight edges'

selecting a shape or object to match a given characteristic or to match another shape or object such as identifying all objects with three straight sides and naming them as triangles

2. Comparison

Use direct and indirect comparison to decide which is longer, heavier and holds more and explain reasoning in everyday language

Elaborations

understanding that comparing is the most basic of measurement ideas and that the key idea is to compare like attributes

comparing objects directly, by placing one object against another to determine which one is longer or using pouring from one container to the other to see which one holds more

using suitable language associated with the measurement attributes, such as tall and taller, heavy and heavier, holds more and holds less

ordering things by direct comparison such as saying which of two children is taller by standing them back to back or holding an object in each hand and saying ‘this one is heavier than the other one’

immediately recognising the number of objects to subitise small collections of patterned arrangements (eg when shown 4 pebbles, children can answer the question 'how many are there?' without counting)

writing numbers for a purpose, using pencil and paper, calculators or computers or informal symbols

3. Comparing collections

Compare and order collections, initially to 20, and then beyond, and explain reasoning

Elaborations

comparing and ordering to understand the relative size of collections by relating this to the counting sequence, and by matching one to one, helping to develop important ideas about number

comparing collections to 10 using the words ‘more’, ‘less’, ‘same as’ and ‘not the same as’

understanding and using ‘first’, ‘second’ etc to indicate ordinal position in a sequence

4. Addition and subtraction

Model, represent and solve problems concerning additive and sharing situations involving combining, change and missing elements

Elaborations

creating representations of various practical situations in order to understand the models and the operations

understanding that simple story problems can be solved by modelling situations including adding to, taking some away, combining, finding the difference or sharing

combining and separating collections to represent small quantities in different ways (eg 'Sam has 10 bears. 7 of them are yellow and the rest are red. How many are red?' 'Sam had 7 bears and his brother had 3. What is the difference between the number of bears Sam and his brother had?')

understanding and modelling change situations (eg 'Sam had some bears then his brother gave him 3 more, now he has 10, how many did he have to start with?' 'Sam had 7 bears, but would like to have 10. How many more does he need to get?')

using indirect comparison to compare attributes (eg using streamers to test whether the teacher’s table is higher than the handle on the classroom door, or pouring water from a full glass into a cup to check which container holds more)

3. Time

Read time on the hour on digital and analogue clocks, and make connections between common sequences such as days of the week and other familiar events and actions

Elaborations

understanding that time can be described in different ways such as on analogue or digital clocks and that longer durations are described using days, weeks, months

reading and describing o’clock times on analogue and digital clocks including saying that the number before the double 0 tells us the hour on digital clocks

linking o’clock times to specific events during the school day and to familiar events in everyday life such as saying that school starts at 9 o’clock in the morning or recalling that a favourite TV program starts at 4 o’clock in the afternoon

recalling and saying the days of the week and linking specific days to familiar events, such as saying that there is no school on Sunday and we play tennis after school on Tuesdays

sequencing familiar events in time order, such as describing the evening routine

4. Location

Describe the position and movement of objects, including themselves

Elaborations

understanding that common words can be used to describe relative position and movement and this helps when we communicate with others

interpreting everyday language of location and direction, such as between, near, next to, forwards, towards

following and giving simple directions for moving around familiar environments, such as directing a friend to walk around an

more does he need to get?')	as directing a friend to walk around an obstacle path
sharing between two people by dealing out objects to recipients one-by-one, making sure that the amount each person gets is equal	
5. Pattern	
Sort and classify familiar objects, explain reasons for these classifications and copy, continue and create patterns with objects and drawings	
Elaborations	
recognising that mathematics is essentially about patterns and that sorting and classifying familiar objects develops reasoning and language	
observing patterns to develop understanding of order in the world around us (eg tiling patterns on a floor)	
selecting an attribute to sort by and making the sort according to that attribute (eg sorting objects according to colour or shape)	
recognising a pattern made with shapes or objects and continuing it (eg the next item in the sequence: star, triangle, heart, star, triangle, _____ is heart)	
creating and describing patterns using materials, sounds, movements or drawings (eg ‘my rule is red, blue; red, blue and I’ve made a repeating pattern using this rule’)	

Achievement standard (Kindergarten)

By the end of Kindergarten, students are able to confidently recall the sequence of numbers to 20, matching names and numerals and find the total of small collections by counting. They subitise small quantities, partition numbers to 10 and use one-to-one relations to share and count out quantities. Students collect data from straightforward questions about themselves and familiar events and, with assistance, can organise this data. They readily use everyday language to describe measurements found by direct comparison and sort and classify familiar shapes.

Year 1 Content descriptions

Number and Algebra

1. Counting

Say, understand and reason with number sequences to and from 100 by ones from any starting point, and say number sequences of twos, fives and tens starting from zero

Elaborations

saying number sequences emphasising 10 as a countable unit assists to develop an understanding of place value

developing fluency with forwards and backwards counting in meaningful contexts such as circle games (eg 'I'm going to start at 24 and when I get to 13, everyone will be sitting in a circle')

using a calculator to increase understanding of counting patterns (eg count by adding 2 each time, beginning with 0 and press +2 = = repeatedly)

understanding that skip counting (eg counting 5-cent coins) will also tell you how much money is in a collection and can assist with counting in a faster way

2. Numeration

Recognise, model and represent numbers to 100, and read, write and order those numbers

Elaborations

modelling numbers with a range of materials and images to establish an understanding of place value

relating the meaning of the digits to its representations using materials (eg the four in the number 42 means 4 tens and the two means 2 units and this is different to 24)

recognising and reading numerals on a chart and on a calculator

writing numerals for a purpose using pencil and paper or a calculator (eg recording of the number days from the beginning of the term as 23)

modelling and representing numbers with available materials (eg show the number 43 on a 120 bead string, on a calculator and with place value cards, represent it with sticks of

Statistics and Probability

1. Data representation

Represent data using pictographs where one picture represents one data value

Elaborations

understanding that representing data can help make sense of data

compiling class pictographs where each student contributes one picture

understanding the one-to-one nature of the data and its representation

2. Data interpretation

Read and make connections between lists, tables and pictographs

Elaborations

understanding that data can be represented in different ways and that the representations can be in objects, pictures, words or symbols

organising information from a list into a table or a pictograph as a class

reading information from lists, tables and graphs and conveying the story being told

understanding that the same information can be represented in different ways (eg a class collected data about the number of buttons on their clothing on a particular day. The data could be represented as a list, on a table, in a bar chart with a column for each student or on a graph on an interactive whiteboard showing the number of students against the number of buttons they have)

making statements from the data by comparing the number of items in categories (eg 3 children travel to school by bus and 19 walk, or the most popular pet is a dog)

3. Chance

Identify outcomes arising from familiar chance events and describe using everyday language such as yes, no or maybe

Elaborations

recognising that many familiar events have particular possible outcomes, and that it is

Measurement and Geometry

1. Geometry

Recognise, visualise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features such as number of corners or faces or length of sides

Elaborations

recognising features of shapes and objects as beginning of geometrical reasoning

recognising and classifying familiar two-dimensional shapes, such as identifying all the rectangles within a set of drawings or objects and say what distinguishes them from other shapes

describing familiar two-dimensional shapes using everyday language and drawing them, such as saying that circles are round or explaining that all triangles have three corners and three sides and drawing and making different triangles

locating all objects within a collection that belong in the same group as a specified object, such as grouping all the objects that are like a shoebox and saying that they all have six flat sides or faces

visualising and making reasonable models of familiar three-dimensional objects such as making models to match spheres (balls), cylinders (rolls of tape) and cubes (dice) using clay or plasticine and using everyday language to say how the models are different from each other

2. Length and capacity

Measure length and capacity using uniform informal units and compare measures explaining reasoning in everyday language

Elaborations

understanding that in order to compare objects the unit used must be the same size for the whole measurement and that there should be no gaps or overlaps

identifying the attribute being measured, explaining which informal units would be suitable for measuring this attribute

place value cards, represent it with sticks of linking cubes, using counters on 10 frames and with icy pole sticks and explains reasoning)

ordering numbers in sequences (eg on a number line or on a 1–100 grid)

3. Place value

Understand and work fluently with counting collections to 100 by grouping in tens, and counting the tens, and use place value to partition and regroup those numbers

Elaborations

understanding partitioning numbers, such as 7 is the same as 3 and 4 and 6 and 1, establishes thinking important in using mental strategies for calculation

counting collections of objects and materials such as 10-cent coins; understanding the importance of grouping in tens and explaining reasoning (eg organises collections of objects into groups of ten for easier counting)

understanding two-digit numbers as comprised of tens and ones/units and demonstrating using models, such as connecting cubes sticks in bundles, ten frames and bead strings (eg ‘I know that 43 is 4 tens and 3 units and I can show you with my ten frames’)

4. Fractions

Understand one-half as one of two equal parts, and recognise and create halves of collections

Elaborations

understanding that the name of a fraction is determined by the number of parts and that the parts must be equal is fundamental to the definition of fractions

sharing a collection of readily available materials into two equal portions, naming each portion as ‘one-half’, and understanding that each half must have the same number of items

splitting an object into two equal pieces, such as folding a kindergarten square, and describing how the pieces are equal, that each part is a half and that there are different ways of doing this, all being equivalent

possible to say whether events are likely to happen or not

describing events as likely or unlikely (eg it is unlikely that the prime minister will teach us maths today, but it is likely that we will go outside to play)

listing all outcomes from a chance event (eg throwing a die and being able to explain throwing a 1, 2, 3, 4, 5 or 6 are the only possible outcomes)

solving problems using informal measuring units (eg using hand-spans to measure the width of a cupboard and an open doorway and saying that the cupboard will fit through; or comparing the capacity of a bottle and a jug by filling the same glass until each container was empty and saying which filled the glass most times)

explaining that a length of a book can be used to measure the length of a table but another measuring unit, such as a cup, is needed to measure capacity

3. Time

Read analogue and digital clocks to the half hour and describe duration using months, weeks, days and hours

Elaborations

understanding that telling the time and the time it takes to do something is measured in different ways and that some representations are equivalent

using a calendar to describe duration, such as saying that it is nearly two months until my birthday

reading the time on an analogue clock and comparing this to the time on a digital clock and hence developing equivalences, such as saying it is one thirty because the hour hand is halfway between the 1 and the 2, and the minute hand is on the 6 and that this would be 1:30 on the digital clock

describing durations of familiar events using hours, weeks or months, such as saying that my birthday was two weeks ago

observing characteristics of ‘half-hour’ times on analogue clocks and saying the small hand is pointing half way towards the next hour and the big hand is pointing to the six, or saying that on digital clocks the last two digits are always 30 when we have ‘half past’ times

4. Money

Recognise, describe and order Australian coins

Elaborations

understanding that the first step in recognising Australian coins is to name the coins by recognising their characteristics

5. Addition and subtraction

Model, represent and solve problems involving additive and sharing situations using efficient strategies including counting on

Elaborations

demonstrating understanding that additive situations involve addition and/or subtraction and that these two operations are inverses and can undo each other

solving a range of additive problem types including missing element (eg 'Kate had some strawberries and mum gave her 4 more, now she has 13'); change ('Kate had 4 strawberries, mum gave her some more, now she has 13'); and combine ('Kate had 9 strawberries, mum gave her 4 more, how many does she have?')

recognising that additive situations involving subtraction can be classified as either takeaway (eg 'I have 12 peanuts. I eat 4 peanuts. How many do I have left?') or as difference (eg 'I have 12 peanuts and you have 4 peanuts. What is the difference between the number of peanuts that we have?')

developing flexibility in breaking up numbers into part-part-whole to see the connection between addition and subtraction (eg 11 can be thought of as 7 and 4, so 7 + 4 = 11, 11 - 4 = 7, 11 - 7 = 4)

developing a range of mental strategies for addition and subtraction problems, such as count on from a larger number, use doubles, make to 10

modelling sharing and grouping problems and solving with materials (eg ‘how many apples are there in 3 bags if there are 4 apples in each bag?'; if there are 12 apples and there are 4 in each bag, how many bags are there?; if 12 apples are shared between 3 bags, how many apples are there in each bag?’)

6. Number patterns

Copy, continue, create and describe patterns with objects and numbers to 100

Elaborations

creating and continuing number patterns can reinforce place value understanding

including the size, markings and colour

selecting any Australian coin from a collection and describing the features that distinguish that coin

understanding that different coins have different values

understanding that the value of Australian coins is not related to their size

5. Location

Give and follow directions to familiar locations

Elaborations

understanding that people need to give and follow directions to, and from, a place and that this involves turn, direction and distance

understanding the meaning and importance of words like clockwise, anticlockwise, forward and under when giving and following directions

creating directions within a familiar environment such as describing a safe pathway from the classroom door to the principal’s office

interpreting and following directions around familiar locations such as following the directions from another student to move from one classroom to another

reinforce place value understanding
using place value patterns beyond the teens to generalise the number sequence and predict the next number
investigating patterns in the number system, such as the occurrence of a particular digit in the numbers to 100
continuing a number pattern where a number is repeatedly added or subtracted (eg count forwards and backwards in tens to see the continuing pattern of a count of tens, eg 56, 66, 76, 86, 96, ...)

Achievement standard (Year 1)

By the end of Year 1, students are able to quantify collections to 20 and can count forwards and backwards to 100. They understand and are fluent with partitioning numbers to 10. They can read, write, order and model two-digit numbers and understand that these numbers are comprised of units of tens and ones. They are beginning to understand the relationship between addition and subtraction and use this knowledge to model and solve simple additive problems. Students collect data about themselves and their peers and represent these data in lists, tables and pictographs. They use everyday language to describe simple geometry and measurement ideas and use uniform informal units to measure and compare length and capacity and use hours and half-hours to describe time.

Year 2 Content descriptions

Number and Algebra

1. Counting

Say, understand and reason with number sequences increasing by twos, fives and tens from any starting point including using calculators

Elaborations

understanding that saying number sequences increases both confidence and fluency with numbers and calculations

counting on a calculator from any starting point increasing by twos, fives and tens (eg predict and count by adding 2 each time, enter 789 and then press + 2 = = repeatedly)

2. Numeration

Recognise, model and represent numbers to 130, and read, write and order those numbers

Elaborations

recognising that there are different ways of representing numbers, and to start to identify the patterns going beyond 100, seeing another set of patterns starting to emerge

recognising and reading numerals on a number chart, on a calculator and in other contexts

fluency with writing numbers in meaningful contexts such as recording the roll of a die in a game or keeping track of the temperature throughout the day

modelling and representing numbers with materials (eg showing the number 115 on a 200 bead string, on a calculator and with arrow cards; representing it with sticks of connecting cubes or bean sticks; using counters on multiple ten frames; with sticks) and explain reasoning

ordering numbers up to 130 using number lines, number tracks and number charts

3. Place value

Work fluently with counting increasingly larger collections up to 1000, grouping in hundreds and tens and counting the tens and hundreds and use place value to partition and regroup these numbers

Statistics and Probability

1. Data representation

Record data using tallies and represent data using tables, pictographs and bar and column graphs

Elaborations

understanding that different representations can be used for data but, while the data may be displayed differently, the information remains the same

sorting a list into an organised table such as using tallies to construct a table from a list

explaining interpretations of information from and make connections between lists, tables and graphs showing data from familiar events

drawing a class graph with one column for each child for categorical data such as the number of pets owned or the number of television hours watched yesterday

2. Data interpretation

Read and make connections between lists, tables and graphs showing data from familiar contexts, and explain interpretations

Elaborations

identifying that results in lists and tables can also be represented in graphs such as pictographs

explaining reasons for interpretations of data lists and displays (eg explaining that the least popular pet is a fish because this is the column in the pictograph that is the shortest)

3. Chance

Experiment with chance devices and describe outcomes as likely or unlikely and identify some events as certain or impossible

Elaborations

understanding that for a given chance device such as dice, playing cards or spinners, some outcomes are more likely than others and the outcomes with the higher occurrence are more likely

justifying that some events are certain or impossible such as saying choosing a red ball

Measurement and Geometry

1. Geometry

Describe features of two-dimensional shapes and three-dimensional objects, draw them and use materials to make models of these

Elaborations

identifying features of two-dimensional shapes and three-dimensional objects helps develop geometric reasoning and assists in making models

classifying familiar two-dimensional shapes, such as sorting circles, triangles and rectangles (including squares) into groups and explaining that the grouping is based on the number of straight sides each group has

describing the properties of three-dimensional objects such as saying that both cubes and rectangular prisms have six faces, twelve edges and eight vertices or corners

using materials to construct three-dimensional objects such as using twelve sticks to construct a model of a cube and understanding that the sticks need to be the same length

recognising and classifying familiar three-dimensional objects such as separating cones and pyramids into different groups, saying that only the pyramids have all flat faces, but explaining that they do have some similarities such as a flat base and a point at the top

using simple nets to construct three-dimensional objects and making links between the nets and the shapes they represent

2. Metric units

Measure and compare length and capacity using uniform informal and familiar metric units and measure mass using balance scales with familiar metric units

Elaborations

understanding that there are many advantages in using standard units to describe and compare objects, and that the metric system forms the basis of our formal

these numbers

Elaborations

understanding that the place value system allows us to count and represent collections efficiently, and that values such as tens and hundreds form the basis of the patterns that are our number system

fluency with grouping in hundreds and tens (eg counts a collection of 500 or more bottle lids, buttons or sticks by grouping by tens and hundreds and explaining reasoning)

partitioning and regrouping numbers (eg partition and regroup the number 500 in as many different ways as possible such as 5 hundreds, 50 tens, 500 ones, 100 fives etc and explain reasoning)

understanding three-digit numbers as comprised of hundreds, tens and ones/units, demonstrate using models, such as linking blocks, sticks in bundles, place value blocks and bead strings and explain/reasoning (eg 'I know that 540 is 5 hundreds 4 tens and 0 ones and I can prove it by showing you I know with bundles of sticks and place value blocks')

understanding the same number can be thought of in parts in different ways (eg 80 can be thought of as 79 and 1, 60 and 20, 70 and 6 and 4, 8 tens)

4. Fractions

Recognise and interpret common uses of halves, quarters and thirds of everyday shapes, objects and collections

Elaborations

understanding that some fractions are part of everyday language, and that they are represented differently from the counting numbers (eg one-half of a piece of paper is represented as ½ showing one of two equal parts)

understanding that we can partition objects and collections into two or more equal sized parts and that the partitioning can be done in different ways

relating the number of parts to the size of the fraction (eg folding a paper strip into halves results in bigger pieces than if the paper strip was folded into quarters)

impossible such as saying choosing a red ball from a bag containing blue and yellow ones is impossible because there are no red balls in the bag or there are more red balls in the bag so this is the more likely result

listing the possible outcomes from a chance device in order from certain to most likely or comparing the likelihood of events from different chance devices (eg saying that it is certain that a red ball will be selected from a bag containing all red balls, likely from a bag containing 6 red and 3 blue balls and unlikely from a bag containing 9 blue and 1 red ball)

units

making connections between the attributes being measured and the units and instruments used for measuring and beginning to work with metric units

measuring and comparing lengths using familiar metric units, such as using a metre ruler to measure the distances that students toss a beanbag; or using metres and centimetres to measure how far students jump in a competition and identify the three longest jumps; or determining the capacity of a range of containers by measuring using a litre jug; or using balance scales to decide whether the mass of different objects is more or less, or about the same as 1 kilogram

explaining that the smaller the unit for measuring, the greater the number that will be needed, and vice versa (eg a ruler is both 30cm and 300mm long)

measuring and comparing capacity using familiar metric units, such as determining the capacity of a range of containers by measuring using a litre jug

measuring mass using familiar metric units and uniform informal units, such as using balance scales to decide whether the mass of different objects is more or less, or about the same as 1 kilogram, or to find out how many marbles are needed to balance a tub of margarine or a 1 litre carton of milk

3. Area

Compare the area of regular and irregular shapes directly

Elaborations

understanding that area is the measure of the amount of surface, and that areas can be compared by covering one with the other

comparing the area of two objects such as a book and a folder and saying the folder is larger because the books fits inside it

4. Time

Read analogue and digital clocks to the quarter hour and to use a calendar to identify the date, and name and order months and seasons

Elaborations

was folded into quarters)

writing a fraction to show an everyday situation (eg making a sandwich, cutting it into 4 equal pieces and using fractional language and symbols to label it 'three-quarters' and ¾)

5. Addition and subtraction

Model, represent and make connections between simple additive situations, solving them using efficient written and calculator strategies and explaining the choice of strategy

Elaborations

understanding that some additive problems can be solved efficiently using particular strategies to manipulate the numbers but the efficiency of a strategy varies with the particular numbers

becoming fluent with a range of mental strategies for addition and subtraction problems, such as commutativity for addition, building to 10, doubles, 10 facts, adding 10

becoming fluent in partitioning numbers to see the connection between addition and subtraction (eg 11 can be thought of as 7 and 4, so 7 + 4 = 11, 11 - 4 = 7, 11 - 7 = 4)

modelling and representing simple additive situations using materials such as ten frames and twenty frames and empty number lines (eg using ten frames to find all possible tens facts and explaining reasoning)

using strategies such as building to 10, adding 10 using doubles and explaining why a particular strategy is efficient for particular situations (eg 32 + 29 can be thought of as 30 + 30 - 1)

6. Multiplication and division

Model, represent and make connections between simple multiplicative situations such as groups of, arrays, sharing, solving them using efficient mental and written strategies and calculators and explaining their choice of strategy

Elaborations

recognising that these two types of multiplicative situations (groups and arrays) are both similar and different, and that it is

understanding that the units suitable for measuring time vary according to the precision required and the size of the duration

reading times on analogue and digital clocks to the quarter hour and using the language of quarter past, half past and quarter to when reading those times and noticing equivalences

using a calendar to locate specific information, such as finding a given date on a calendar and saying what the day is or saying the names of the months that lie between June and December

investigating seasons used by Indigenous people and compare to those used in western society, recognising the connection to weather patterns

describing the characteristics of quarter-past times on an analogue clock and saying that the small hand is pointing just past the number and the big hand is pointing to the 3

5. Money

Count and order small collections of Australian coins

Elaborations

understanding that we often need to count collections of coins, and compare coin amounts, and we use this when we are buying things

ordering small collections of money, including identifying equivalences such two five-cent pieces is the same value as one ten-cent piece

understanding that ordering the size of a small collection of coins is not the same as ordering the same collection in terms of value

counting small collections of coins such as making up amounts of money using available coins to match price tags

6. Transformations

Predict and draw the effect of 1-step sliding, flipping and turning of familiar shapes and objects including using digital technology and identify half and quarter turns from any starting point

Elaborations

helpful to understand the way that situations can be modelled and represented

visualising a group of objects as a unit by using partial models (eg show 3 tennis balls in a bag and pose the problem, ‘here is a bag of 3 tennis balls, how many would there be in four bags?’)

assisting students to make connections between sharing and grouping problems (eg 'how many applesare there in three bags with 4 apples in each bag; if there are 12 apples and there are 4 in each bag, how many bags are there? if there are 12 apples shared between 3 bags, how many bags are there?') Solving them with mental and written strategies

solving a variety of multiplicative problems by imagining the situation and selecting the appropriate operation to key into a calculator to solve the problem and explain reasoning

modelling and representing array problems with materials and drawings and explaining reasoning (eg 'If I made an array of 24 tiles, what might it look like? Are there any other ways to make an array from 24 tiles?')

modelling 'groups of' situations using readily available materials such as ‘the teacher sorted the class into groups of three’ and comparing this to ‘the teacher sorted the class into three groups’

7. Number patterns

Copy, continue, create and describe patterns with numbers, especially place value patterns and identify missing elements

Elaborations

recognising that describing patterns is one of the key aspects of learning mathematics, and lays the foundations for later study of algebra

describing the rule for a number pattern, such as ‘add three’ for the pattern 3, 6, 9, 12, 15 ...

investigating the effect of repeatedly adding 10

describing the patterns generated by skip counting and observing the visual representation of these patterns on a hundred chart or number line

understanding that objects can be changed in location and orientation by sliding, flipping and turning but these actions do not change their size or features, and that these ideas form the basis of the precision that we use to describe shapes and their location

predicting and drawing the effect of 1-step sliding, flipping and turning of familiar shapes such as interpreting a pattern based around half turns of a shape and sketching the next element in the pattern, or drawing the result when a simple shape drawn on grid paper is flipped

using ICT to create flips, slides and turns of graphics in a word document

selecting from a number of drawings the one that best matches their prediction of a flip, slide or a turn

following and giving directions of movement involving turning, sliding, flipping such as playing ‘Simon Says’ (eg turn clockwise a half turn and then slide forward three steps)

7. Location

Interpret simple maps of familiar locations such as the classroom to identify the relative position of key features

Elaborations

understanding that we use representations of objects and their positions, such as maps to allow us to receive and give directions and descriptions

using simple maps of familiar locations to show the relative position of key features, such as locating key features on maps and using them as reference points for the accurate placement of other objects

constructing arrangements of objects from a set of directions, such as placing the red block near the door, the blue block under the table and the yellow block on the left of the blue block

making and continuing ‘growing patterns’, such as the triangular numbers and describing the pattern in words

making connections between patterns that are similar, such as observing the last digits when counting by 2s and counting by 4s

using the constant addition function on a calculator and describing the patterns observed

Achievement standard (Year 2)

By the end of Year 2, students are able to understand the sequence of numbers to 130, recognising patterns in units of 10 and 100. They apply this understanding to efficiently represent collections larger than 100 and to partition numbers into units of tens and ones. They describe and connect patterns of twos, fives and tens, solve multiplicative problems and model everyday simple functions. Students describe events produced by simple chance devices and understand different ways of representing data. Students compare lengths, capacities and masses using informal units and familiar metric units and areas by direct comparison. They identify and describe properties of familiar shapes and objects, can visualise and represent them, and can use simple maps.

Year 3 Content descriptions

Number and Algebra

1. Counting

Understand and reason with number sequences increasing and decreasing by twos, fives and tens from any starting point, moving to other sequences, emphasising patterns and explaining relationships

Elaborations

understanding relationships within and between patterns in counting by 2, 5 and 10 and using these for efficient counting

investigating, describing and recording the effects of counting by twos, fives and tens from any starting point (eg by using equipment such as calculators, number lines and hundreds charts)

developing fluency in saying number sequences of 2, 5 and 10 by recognising and using the patterns generated in investigations of number pattern

predicting missing numbers in sequences of 2, 5 and 10 and explaining reasoning

identifying patterns of numbers (eg 4) in the number sequence of 2s and justifying reasoning

2. Numeration

Recognise, model, represent and visualise numbers initially to 1000 and then beyond, and read, write and order those numbers

Elaborations

recognising and describing the base ten number system as a pattern of grouping in tens, where a group of ten is represented as one ten, ten tens is one hundred, ten hundreds is one thousand, and understanding that this pattern continues to create larger numbers

modelling numbers to 1000 using bundles, cubes or other devices

using place value understanding to read, write and order any number to 1000 fluently, such as reading 945 as ‘nine hundred and forty-five’ and writing 'four hundred and three' as 403, recognising the 'grouping by tens' pattern in structured materials, such as place

Statistics and Probability

1. Data investigation

Investigate data-oriented questions about familiar situations, predict what the data might show, carry out the investigation and report the results

Elaborations

beginning to understand statistical investigation including the framing of appropriate questions and drawing conclusions from the data is the basis of many of the real life decisions made by policy makers

asking data oriented questions about familiar situations (eg what are the most popular books in the school library? How far can Year 3 students jump?) Ensuring that the questions are unambiguous

making and explaining predictions about the answers to data oriented questions, such as saying ‘from our graph we don’t think that a new student to our class would be likely to come to school by bus because most of us live close to school and walk’

refining questions and planning investigations that involve collecting data and carrying out the investigation (eg narrowing the focus of a question such as, What is the most popular breakfast cereal? What is the most popular breakfast cereal among Year 3 students in our class? And then collecting and representing data from the class about cereal preferences and reporting results)

exploring meaningful and increasingly efficient ways to record data, and represent and report the results of investigations including using appropriate computer software

making and articulating conclusions based on data rather than personal experiences, preferences or beliefs

2. Data representation

Construct, read and make connections between tables, diagrams and graphs including dot plots with prepared baselines

Elaborations

Measurement and Geometry

1. Symmetry

Use symmetry, identifying its occurrence in the environment to create symmetrical patterns, pictures and shapes

Elaborations

understanding the importance of symmetry in geometry and its occurrence in the environment as a way of describing the world formally, laying the foundation for later study in geometry

using a number of techniques such as paper folding and repeating blocks to create symmetrical patterns

examining instances of symmetry in nature such as looking at petals on flowers and classifying these objects as (almost) symmetrical or not

2. Metric units

Use direct and indirect comparison to order and compare objects by length and develop ‘real life’ benchmarks for familiar metric units of length, mass and capacity including centimetre, metre, kilogram and litre

Elaborations

understanding that real life benchmarks are useful tools in estimating measurements such as knowing that 1 cm is approximately the length of a thumbnail or an orange weighs approximately 100 g

making direct comparisons of length, mass and capacity where it is suitable to compare objects, such as placing objects in the pans of a balance scale to see which is lighter, placing two books side by side to see which is taller, pouring water from one container to another to see which holds more

making indirect comparisons of length, mass and capacity and selecting and using suitable measuring instruments to measure and compare objects, such as using a tape measure to compare the lengths of two objects in the classroom, or using a litre measuring jug to compare the capacity of two containers with very different shapes

pattern in structured materials, such as place value blocks, number lines and metric scales and using these and their own representations to model numbers to 1000

extending understanding of numbers to 1000 to writing and visualising larger numbers

writing numerals for numbers expressed in words such as writing 3013 for the number three thousand and thirteen

3. Place value

Justify various uses of the place value system to describe numbers to 1000, using the hundreds and tens as units, and to partition and regroup those numbers to assist calculation and solve problems

Elaborations

understanding that there are flexible ways to perform many calculations, and that familiarity with tens, hundreds, and thousands is useful, as is partitioning numbers to assist in mental calculation

justifying choices about partitioning and regrouping numbers in terms of their usefulness for particular calculations (eg it is helpful to think of 319 as 31 tens and 9 ones when calculating 319-46, because subtracting 4 tens from 31 tens leaves 27 tens and subtracting 6 ones from 9 ones leaves 3 ones, so the answer is 27 tens and 3 ones, which is 273)

describing the composition of 3- and 4-digit numbers in a variety of ways such as 1000 = 1000 ones, 100 tens, 10 hundreds, or 90 tens + 100 ones

using the principles of place value flexibly to solve problems and to check reasonableness of answers (eg estimating the answer to 1000 - 101 by thinking of it as subtracting 1 hundred from 10 hundreds and then calculating it by subtracting 1 hundred from 10 hundreds, and then subtracting one)

4. Addition and subtraction

Model, represent and solve problems involving additive situations using efficient mental and written strategies and calculators

Elaborations

understanding that there are various ways of

Elaborations

understanding that different representations can be used for data and that some are more useful for particular purposes than others

understanding that graphs need to have a baseline with equally spaced intervals and a scale on the other axis

comparing different student generated data representations, including diagrams, tables and graphs, and describing their similarities and differences

creating pictographs and column graphs to display data (eg constructing a column graph by having each class member write his/her name on a sticky note and placing it above the name of the month of his/her birthday)

suggesting questions that can be answered by a given data table or graph and using data tables and graphs to answer questions (eg using a table of year levels and numbers of students to find out how many Year 3 students there are in the school)

creating pictographs and dot plots involving many to one ratios between symbols and data points such as (eg where one car symbol represents 10 cars and 15 cars is represented as one and half car symbols)

3. Chance

Conduct chance experiments and recognise that there will be variation in results as well as having expected outcomes

Elaborations

understanding that fundamental to many judgements we make is that while we can describe the possible outcomes from chance events, that is not always the way that it happens, and many judgements are based on our best guess

conducting repeated trials of chance experiments such as tossing a coin or drawing a ball from a bag and noticing the variation between trials

exploring the results of chance events such as dice rolling by recording the results of repeated sets of trials (eg noticing that the set of numbers obtained when a dice is rolled 20 times is usually different each time the 20 rolls are repeated)

estimating the length of an object such as a pencil using his/her thumbnail as an approximation to 1 cm

using direct comparison to order and compare objects according to their length, mass and capacity, such as using physical matching methods including lining up, hefting and pouring

observing that the relative order of the objects may change depending on the attribute being compared

3. Area

Measure and compare areas using uniform informal units, explaining reasoning in everyday language

Elaborations

understanding area as an attribute of surfaces and that area can be measured and compared using uniform informal units that cover shapes without gaps or overlaps

using words like bigger or smaller or covers more to compare areas

using indirect comparison to compare areas, such as counting the number of the same book required to cover two tables

4. Time

Read analogue and digital clocks to the five minutes and compare and order events according to their duration

Elaborations

understanding that there are equivalent ways of saying time and that some are more useful in particular situations than others, such as 5 minutes to 9 is more useful than 55 minutes past 8 if intending to catch a bus close to 9 o'clock

reading and interpreting times to the five minutes on analogue and digital clocks, such as identifying matching times on both kinds of clocks, and recognising and matching the same times recorded in different ways

comparing the relative time it takes to complete familiar tasks in minutes such as say an egg takes about 3 minutes to cook whereas it takes 10 minutes to cook a sausage

adding and subtracting numbers, and that efficient mental strategies are important as are ways of recording these in writing

exploring and developing increasingly efficient mental, written and calculator strategies for representing and solving problems involving additive (addition and subtraction) situations

choosing from a range of mental strategies, such as commutativity, counting on and back, doubling, near doubling and bridging to 10, and justifying the choice of strategy for particular problems

appreciating that addition is commutative but subtraction is not (eg 26 + 7 = 7 + 26 but 26 - 7 ≠ 7 - 26)

understanding the inverse relationship between addition and subtraction (ie that adding and then subtracting the same quantity does not change the amount)

understanding and using the relationship between addition and subtraction to assist with calculations (eg using the fact that 33 - 15 can be thought of as: 15, how many more to make 33 ie 15 + ? = 33)

applying place value understandings to partition numbers to facilitate efficient mental addition and subtraction (eg 42 - 26 can be calculated by subtracting 20 from 42 and then subtracting 6 from the result)

exploring and generalising patterns in repeated addition and subtraction (eg noticing that repeated addition of 9 from any starting point increases the tens digit by 1 and decreases the ones digit by 1 and this is related to place value and the strategy for adding 9 by adding 10 and then subtracting 1)

modelling word problems using symbols and/or concrete materials and solving these problems

5. Multiplication and division

Model, represent and solve problems involving multiplicative situations including 'for each' and 'times as many' using efficient mental and written strategies and calculators

Elaborations

modelling and representing multiplicative

rolls are repeated)

predicting likely sets of outcomes from a set of chance events and distinguishing these from surprising results (eg if 10 marbles are drawn from a collection containing 20 red and 20 blue marbles it would not be surprising to get 4 red and 6 blue or even 3 red and 7 blue but it would be surprising to get all of one colour)

ordering events according to their duration, such as walking to school, watching a DVD or getting dressed

comparing and ordering the durations of events by identifying starting and finishing times or dates of events and calculating their duration using simple timelines or calendars

5. Money

Represent money values in multiple ways and count out the change of simple transactions

Elaborations

understanding that there are equivalent ways of making a specific amount of money

representing money values in multiple ways, such as demonstrating that an amount such as $10.60 can be represented using coins and notes or by using only coins

calculating the change from whole dollar amounts in shopping situations, such as saying that when $2.00 is tendered for an 85 cents item, 85 cents plus 15 cents make 1 dollar so the change is $1.15

6. Angles

Create angles and recognise that equivalence in angles such as two quarter turns is the same as a straight angle

Elaborations

understanding that one of the important properties of shapes and objects is the angles that lines and surfaces make, and that learning to describe and measure angles is an important part of geometry

identifying the difference between clockwise and anticlockwise direction of turn and equivalences, such as making a quarter turn clockwise is equivalent to making a three-quarter turn anticlockwise

understanding the relationship between half turns and 30 minutes on an analogue clock

7. Location

Create and interpret simple maps to show position and pathways between objects

Elaborations

explaining that maps are representations of physical places and that they show the

(multiplication and division) situations to assist in developing efficient calculation strategies

exploring and developing increasingly efficient mental, written and calculator strategies for representing and solving problems involving multiplicative situations

solving everyday problems involving multiplication and division by modelling the situation such as determining different arrangements of 30 chairs in rows to seat an audience such as using number lines or arrays

appreciating that multiplication is commutative but that division is not (eg that 10 × 2 is equivalent to 2 × 10, but 20 ÷ 10 is not equivalent to 10 ÷ 20)

demonstrating the inverse relationship between multiplication and division (ie that multiplication by a number followed by division by the same number results in no change to the original number)

applying the relationship between multiplication and division to assist with calculations (eg using the fact that 35 ÷ 5 can be expanded as something multiplied by 5 makes 35)

using the distributive law to assist with multiplication and division calculations (eg 10 × 5 = 50, and three more fives make 65 so 65 ÷ 5 = 13; 5 × 7 is the same as 2 × 7 plus 2 × 7 plus one more 7, so 5 × 7 = 14 + 14 + 7 which is 35)

6. Fractions

Solve problems involving everyday uses of fractions as equal parts of regular shapes or collections and as numbers, building connections between the number of parts and the size of the fraction

Elaborations

understanding that fractions are a way of representing numbers that are not whole numbers, and that fractional numbers are described and compared differently from whole numbers

understanding the requirement for fractions to be equal parts and to begin to understand the meaning of the numerator and denominator

physical places and that they show the placement of objects from directly above (bird's-eye view)

using the key features of simple maps to locate other objects and to plan and guide pathways for movement around the environment of the map, such as checking the accuracy of their maps according to the placement of objects and a rough sense of scale or designing a maze

creating and following sets of directions for moving around the environment represented on a map, using the key features as reference points

creating simple maps and recording the key features such as roads, waterways, houses and parks

creating simple maps from visible objects, such as mapping several objects arranged on their desks, the layout of furniture in their classroom, the layout of buildings in their school

meaning of the numerator and denominator

understanding that fractions are numbers that can be ordered and compared and positioned on a number line

creating equal parts of shapes or collections to solve problems involving sharing such as same-size sectors of a circle or equal shares of a bag of marbles

linking the increasing number of parts to the decreasing size of the fraction (eg explaining that ⅓ is smaller than ½ because it is one of three equal parts rather than one of two equal parts)

using understanding of fractions as equal parts to solve everyday problems such as calculating the total time to finish a series of tasks that each takes one quarter of an hour and representing solutions in meaningful ways such as showing quarters on an analogue clock face or on a number line

partitioning areas, lengths and collections to create halves, thirds, quarters and fifths, such as folding same sized sheets to illustrate different unit fractions and comparing the number of parts with their sizes

exploring the relationship between families of fractions (ie halves, quarters and eighths or thirds and sixths) by folding a series of paper strips to construct a fraction wall

7. Calculation

Understand and become fluent with addition and related subtraction facts to 10 plus 10 and multiplication facts of 1, 2, 5 and 10

Elaborations

understanding and becoming fluent with a range of strategies for calculating addition and subtraction facts to 10 + 10 and multiplication facts of 1, 2, 5 and 10 in order to develop flexible thinking for solving problems

creating organised lists (of addition/subtraction facts to 10 + 10 using materials such as ten frames, number lines and connecting cubes and identifying and describing patterns in these lists and using these to develop sets of subtraction facts

using doubling, halving and commutativity to

calculate multiplication facts of 2 and 5 (eg understanding that multiplying by 5 is the same as halving the result of multiplying by 10)

exploring patterns in multiples of 1, 2, 5 and 10 and relating these to the multiplication facts (eg by using 100-boards or constructing and examining lists of multiples)

representing the multiplication facts of 1, 2, 5 and 10 as arrays and interpreting these arrays in terms of strategies (eg using an array to explain that multiplying by 5 is the same as doubling twice and adding one)

understanding that every multiplication fact is related to a number of division facts (eg 5 × 6 = 30 can be used to work out 30 ÷ 5 = ?; 30 ÷ 6 = ?; 30 ÷ ? = 6; and 30 ÷ ? = 5)

8. Number patterns

Copy, continue, create, describe and identify missing elements in patterns with numbers including patterns resulting from performing one operation and place value patterns

Elaborations

exploring number patterns and their connections with place value in order to develop understanding of the base 10 number system, flexible thinking for solving problems and intuitions about functional relationships (growing patterns)

generating and recording number patterns in number sequences, such as by using the constant function on a calculator 4 + 5 = = = to generate the pattern 9, 14, 19, 24, 29 and noticing that the units digit alternates between 4 and 9

recognising patterns in number sequences and describing the rules for these patterns in their own words (eg explaining the number sequence 47, 37, 27, 17 ... as subtracting by tens and to notice that the ones digit remains constant and using this to identify the next element in the sequence)

exploring patterns generated by counting with fractions (eg $^{1}/_{4}$, $^{1}/_{2}$, $^{3}/_{4}$, 1, $1\,^{1}/_{4}$ ... using number lines and recognising that this sequence can also be expressed as $^{1}/_{4}$, $^{2}/_{4}$, $^{3}/_{4}$, $^{4}/_{4}$ ...)

Achievement standard (Year 3)

By the end of Year 3, students are able to understand place value to 1000 and connect this to comparing and ordering length, mass and capacity. They apply this understanding to choose efficient strategies (mental, written and calculator) to solve problems in everyday situations. They understand the relationship between the number of parts and the size of fractions, and use this understanding to solve everyday problems including describing quarter and half turns. They use number patterns including those found in the multiples of 2, 5 and 10 and apply these in contexts such as reading clocks to five minutes and using money. Students collect, represent and interpret data in tables, graphs and diagrams and conduct simple chance events. Students estimate and order length, mass and capacity using personal benchmarks. They use symmetry in designs and can represent positions and direction using simple maps.

Year 4 Content descriptions

Number and Algebra

1. Factors and multiples

Work and reason with number sequences increasing and decreasing from any starting point, and to recognise multiples of 2, 5, 10 and factors of those numbers

Elaborations

exploring number sequences in order to develop fluency with, and understanding of, the multiples of 2, 5 and 10 and their factors (including 2, 5, 10) to form the basis on which the development of efficient calculation strategies can be built

investigating, describing and recording number sequences involving repeated addition or subtraction of numbers including 2, 5 and 10, and, relating the numbers in the sequence to the repeated addend and number of additions or subtractions (eg repeatedly adding rows of five to created an array and recognising 20, the 4^{th} number in the sequence 5, 10, 15, 20, 25, 30 …, as the product of 5 (the repeated addend) and 4 (the number of fives that have been added))

recognising that number sequences based on multiples can be extended indefinitely representing number sequences in order to explore relationships between factors and multiples of the repeated addend (eg using equipment such as different coloured connecting cubes placed in 2s to show that 4, 6, 8 and 10 are multiples of 2 and that 2 is a factor of each of those numbers)

representing related number sequences in order to explore relationships between them (eg aligning different coloured connecting cubes placed in twos with different coloured connecting cubes placed in fives to show that the sequences 4, 6, 8 and 10 and 5, 10, 15, include common elements [eg 10] which are multiples of both 2 and 5 and of which both 2 and 5 are factors)

discerning patterns which indicate which numbers are factors of 2, 5 or 20, such as noticing that 5 will be a factor of any number ending in 5 or 0 and that 2 is a factor of all even numbers

Statistics and Probability

1. Data investigation

Plan and undertake surveys, such as with the whole class, to answer questions posed, represent the data and report the results, including using ICT

Elaborations

understanding that data collected from an entire population, such as the whole class, can be used to determine information about the class and this is the way that governments and other decision makers sometimes gather information

posing questions that can be answered by surveying an entire group, such as the class or year level (eg what is the favourite TV show in our class?)

creating tables to record data collected through census surveys of the class or several classes

representing the results of census surveys using tables, column graphs, and dot plots using hand drawn and computer based methods

understanding that census surveys enable definite rather than approximate statements to be made about the population surveyed (eg a class survey of eye colour can allow us to make statements, such as the number of children in my class with brown eyes is three times the number of children with blue eyes)

using secondary data sets, such as those already collected by the teacher to answer questions about the class (eg 'What country was the most common place of birth for this class?')

2. Data representation

Construct, read, interpret and make connections between tables and simple graphs with many-to-one correspondence between data and symbols, including using ICT

Elaborations

understanding that data can be represented in different ways, sometimes with one symbol

Measurement and Geometry

1. Geometry

Generalise about the two-dimensional shapes that form the surfaces of common three-dimensional objects and make connections with the nets of these objects justifying reasoning

Elaborations

understanding that three-dimensional shapes have two-dimensional faces and that these faces can be used to classify the three-dimensional object

demonstrating three-dimensional objects can be made by folding certain arrangements of two-dimensional shapes (nets) but that not all arrangements fold to make a three-dimensional object

generalising about the two-dimensional shapes that form the surfaces of objects, such as saying that the family of prisms all have rectangular side faces but their identical end faces can be different polygons (ie saying that the number of triangular faces on a pyramid is the same as the number of sides on the base of the pyramid)

making connections with common three-dimensional objects and their nets, such as matching the nets of a range of prisms to their physical models and explain why each has been paired or explaining that there are many ways to draw the net of a cube and using several of them to construct the model

handling and making three-dimensional objects from provided nets, naming the shapes of the faces, and generalising about prisms, pyramids, cylinders and cones, to develop ability to recognise and name geometric shapes and describe three-dimensional objects

2. Metric units

Use metric units to estimate, measure and compare the length, mass and capacity of familiar objects reading scales to the nearest graduation

Elaborations

understanding that metric units are used so

2. Numeration

Recognise, represent, visualise and work fluently with reading, writing and ordering numbers to 1 million

Elaborations

extending place value understanding and number naming conventions in order to work fluently with numbers to 1 million, recognising the continuation of the pattern of multiples of 10

extending the pattern of grouping in tens using structured materials, such as place value blocks, number lines and metric scales and using these to represent numbers from 1000 to 1 000 000, explaining and justifying representations

recognising and demonstrating that the place value pattern is built on the operations of multiplication or division of tens

reading and writing any number to one million fluently, using the repeated grouping pattern of three places to break the numbers into manageable parts, such as reading 134 647 as ‘one hundred and thirty-four thousand, six hundred and forty-seven’ and writing 'four hundred and one thousand and forty-three' as 401 043

3. Place value

Justify various uses of the place value system to describe large numbers, and to partition and regroup those numbers to assist calculation and solve problems

Elaborations

using the principles of place value flexibly and partitioning and regrouping to solve problems and to check reasonableness of answers and to find efficient ways of calculating

describing the composition of 5-, 6- and 7-digit numbers in a variety of ways such as 10 000 as 10 000 ones, 1000 tens, 100 hundreds or 9000 + 900 + 90 + 10

justifying uses of place value in calculations and problems involving large numbers to develop flexible and efficient calculation strategies

extending the pattern of grouping in tens using structured materials, such as place

representing more than one piece of data and that it is important to read all information about a representation before making judgements

exploring ways of presenting data and showing the results of investigations including creating dot plots with many-to-one correspondence between data and symbols (eg creating a pictograph in which each stick figure represents 5 people)

comparing different student generated data representations, including diagrams, tables and graphs and describing their similarities and differences and commenting on the usefulness of each representation for interpreting the data

creating pictographs, column graphs, and dot plots with many to one correspondence between symbols and data points, using materials such as counters, written symbols and software

interpreting data representations in the media and other places where the symbols represent more than one data point

suggesting questions that can be answered by a given data table or graph and using data tables and graphs to answer questions (eg using a table of year levels and numbers of students to find out how many Year 1 students there are in the school)

suggesting questions that can be answered by a given pictograph, column graph, or dot plot including those with many to one correspondence between symbols and data points, and using pictographs and dot plots involving many to one correspondence between symbols and data points to answer questions

3. Chance

Predict the outcomes of chance experiments involving equally likely events, and compare and contrast the predictability of outcomes of experiments with small numbers of trials to those with large numbers including using ICT to generate the trials

Elaborations

understanding that the chance of an event occurring can be predicted if the complete set of equally likely possible outcomes are

understanding that metric units are used so that measurements and estimates can be compared consistently and that reading scales is an important aspect of this

using metric units to estimate the length, mass and capacity of familiar objects, such as referring to personal benchmarks when estimating the length of a school building or estimating the mass of a box of toys (consider having metric units in view (length and capacity) or available to heft (mass) and using them to judge or estimate the length, mass and capacity of familiar objects, such as the length of a school building or the mass of a box of toys)

choosing appropriate units and justifying the choice of instruments when measuring, such as saying that a flexible dressmaking tape showing metres and centimetres is better than a metre stick when measuring around a tree, also selecting graduated containers including jugs, measuring cups and eye droppers to measure and compare some capacities in litres and others in millilitres

reading and interpreting the graduated scales on a range of measuring instruments, reading measures to the nearest graduation, such as measuring the seam allowance on a patch for a class quilt to the nearest millimetre on a ruler, the mass of butter in a recipe to the nearest 5 grams on electronic scales, and daily rainfall to the nearest millilitre using a conical rain gauge

comparing lengths, masses and capacities of objects directly and indirectly using measurements, and calculating the difference between measurements (one -and two-digit numbers only)

3. Area and volume

Measure and compare area using familiar metric units and compare volumes using uniform informal units

Elaborations

understanding that area and volume can be compared using uniform, informal units ensuring no gaps or overlaps and that square metric units such as square cm are used to measure the area of a surface

comparing areas by counting the number of

using structured materials, such as place value blocks, number lines and metric scales and using these and their own invented systems to represent numbers from 1000 to 1 000 000, explaining and justifying their representations

4. Fractions

Compare and contrast everyday uses of halves, thirds, quarters, fifths, eighths and tenths, work fluently with renaming to find equivalent fractions and solve problems involving fractions as operators

Elaborations

understanding that comparing fractions is different from comparing whole numbers, and that the names of fractions are important, and that to compare, add or subtract fractions it is easiest if they have the same denominators

exploring everyday uses of fractions to develop understanding of equivalent fractions and the use of fractions as operators (eg $^{1}/_{2}$ of an amount is the same as $^{2}/_{4}$ of that amount)

comparing and ordering various representations of equal parts of any 'whole', such as positioning the symbols ¼, ½, ¾ on a number line at points located between 0 and 1, recognising that their positions partition the line into four equal parts

demonstrating equivalence of fractions such as on a number line

understanding that the sum of fractions obtained by dividing up a single object or collection is one (eg reasoning that if 3 quarters of our class come to school by bus and the others walk this means that 1 quarter walk)

calculating everyday fractions of quantities by relating unit fractions to division by the denominator (eg recognising that finding one third of a number is the same as dividing it by three, so $^{1}/_{3}$ of 12 is 4)

recognising that the relative size of a fraction is dependent upon the size of the whole (eg the thirds of a netball court are smaller areas than thirds of a football field)

solving problems involving fractions as an operator (eg a box of assorted chocolates

of equally likely possible outcomes are known, but that this does not mean that outcomes will happen in this way, but that the more trials we have, the more likely it is that the prediction will approach the predicted probability

conducting repeated trials of chance experiments and noticing the variation between trials and that the results tend to the prediction with longer trials

predicting likely outcomes from a run of chance events and distinguishing these from surprising results (eg if 10 marbles are drawn from a collection containing 20 red and 20 blue marbles it would not be surprising to get 4 red and 6 blue or even 3 red and 7 blue but it would be surprising to get 10 of one colour)

collating class data to obtain longer runs of equally likely chance events such as coin tossing and observing that the greater the total number of tosses the more closely the results represent equally likely outcomes

using repeated runs of chance events to refine predictions (eg estimating the numbers of each of three colours of counters in a hidden collection of 10 counters by repeatedly drawing, recording, and replacing random samples of 3 counters, and noticing that the more samples are taken the more accurate the prediction is likely to be)

commenting on the likelihood of winning simple games of chance by considering the number of possible outcomes and the consequent chance of winning

4. Unequal outcomes

Justify representations of simple situations with unequal outcomes such as constructing spinners using technology

Elaborations

understanding that not all chance events have equally likely outcomes, and that one way to explore this is by creating devices in which the outcomes are not equally likely

designing and trialling chance devices and explaining how the design relates to the relative chances of possible outcomes (eg using ICT to create a spinner in which the chance of spinning red is twice that of spinning blue)

uniform, informal units, such as books, needed to cover the surfaces and then comparing the counts

comparing areas using metric units such as counting the number of centimetre squares required to cover two areas by overlaying the areas with a grid

compare volumes of regular solids such as boxes by systematically filling with cubes, counting the number of cubes required and then comparing the counts

explaining the meanings of volume and capacity and being able to differentiate between these attributes (eg by saying the volume of this box is 10 units because it took 10 cubes to completely fill it but its capacity is 1 cup of water)

4. Time

Read analogue and digital clocks to the minute, understand equivalent representations of 12-hour time, and sequence daily and weekly events

Elaborations

sequencing daily and weekly events according to their start time and duration to the nearest minute, such as recording these events on simple timelines, in daily schedules, on calendars and in diaries. Understanding this is an important aspect of everyday organisation for most people

understanding the significance of 'past' and 'to' when describing times (eg if the train leaves at 4 minutes to 8:00am a person arriving at 4 minutes past will miss the train)

explaining the use of am and pm, such as understanding that 2:00 am is in the night whereas 2:00 pm is in the afternoon

reading times on analogue and digital clocks to the minute by matching minutes to the position of graduations on an analogue clock face, or matching the numbers on a digital clock to the movement of the minute hand around a clock face, and by noticing that the minutes on the digital clock are counted from 00 to 59 before showing 00 again to signal the next hour

solving problems by sequencing events such as listing in order the steps required to get

operator (eg a box of assorted chocolates was shared equally between eight children and three children received the only caramel chocolates. What fraction of chocolates were caramels?)

5. Counting – fractions

Understand fractions as rational numbers, including working fluently with counting by quarters, and halves including with mixed numbers, and representing these numbers on a number line

Elaborations

extending whole number understandings to fractions as representations of single quantities with unique positions on the number line and to which generalisations about whole numbers (eg commutativity) apply

developing understanding of fraction notation as representing a single number in which the numerator can be understood as the number of parts being considered and the denominator as the number of parts into which the whole has been partitioned

counting forwards and backwards by familiar fractions (halves, quarters, thirds, fifths and tenths) including renaming fractional equivalents of whole numbers (eg using number lines and equipment such as measuring jugs, to count by quarters and halves to 1 and beyond, positioning these fractions on a number line and noticing equivalence such as 4 quarters and 1)

converting mixed numbers to improper fractions and the reverse

6. Multiplication and division

Understand and become fluent with multiplication facts and related division facts of 2, 3, 5 and 10 extending to 4, 6, 8 and 9

Elaborations

understanding that multiplication and division factors can be derived from those previously known, such as understanding that the 2 and 3 factors can be extended to 4, 6, 8 and 9 and that fluency with these helps with problem solving and mathematics generally

exploring, explaining and applying patterns to the multiples of 3, 4, 6, 8 and 9 (eg by using spinning blue)

explaining why outcomes of a particular event are unequal (eg if a ball is chosen without looking from a bag containing 6 blue balls and 14 white balls, the chance of picking a blue ball is not the same as choosing a white ball)

as listing in order the steps required to get dressed in the morning or making a timetable for the sports day

5. Angle

Describe the connection between turns and angles and create and classify angles as equal to, greater than or less than a right angle

Elaborations

building on students' understanding of half and quarter turns to develop the concept of angle and define and name right angles and using right angles for comparison forms the basis of many later topics in geometry

identifying and describing amounts of turn and making the connections between angles and amounts of turn such as saying that a half turn is the same as two right angles and a quarter turn is the same as 1 right angle

identifying that angles have arms, that the size of an angle is the amount of turn for one arm to reach the other, and demonstrating how to draw angles representing a half turn and a quarter turn

classifying angles as acute, obtuse or right angles and being able to draw representations of these angles

6. Location

Create, interpret and use basic maps using simple scales and legends and directions such as left, right, forward and backward

Elaborations

reading and interpreting information contained on basic maps such as using the icons in the legend to both explain and locate the key features, interpreting simple scales, such as 1 cm = 1 km and using them to estimate distances, to the nearest gradation, between key features. Also using the information from the map to give or follow directions and find places

creating basic maps of familiar environments based on given scales (such as 1 cm = 1 m) and using legends and icons to represent and locate the key features

7. Visualising

the multiples of 3, 4, 6, 8 and 9 (eg by using 100-boards or creating and examining lists of multiples, eg 117 is a multiple of 9, because its digit sum is 9)

visualising the multiplication factors of 3, 4, 6, 8 and 9 as arrays and interpreting these arrays in terms of strategies (eg using an array to explain that multiplying a number by 6 is the same as doubling the result of multiplying that number by 3)

using known factors and strategies, such as commutativity, doubling and halving to calculate unknown multiplication factors (eg the multiplication factors of four can be found by repeated doubling, and the multiplication factors of six by doubling the three factors)

using known factors and strategies such as near doubles to calculate unknown multiplication factors (eg the multiplication factors of 9 an be found by multiplying by 10 and subtracting one of the number from the result)

using known multiplication factors to calculate related division factors (eg 72 ÷ 8 = 9 because 8 × 9 = 72)

7. Calculation

Select, explain, justify and apply mental, written strategies and use calculators to solve problems involving addition, subtraction and multiplication with one- and two-digit numbers and division by one digit numbers without remainders

Elaborations

understanding that solving problems involving quantities requires calculations, and that these calculations can be solved in various ways, so that a first step is to decide which is the best way to perform the necessary calculation

applying a range of mental and written strategies and the use of calculators to develop efficient strategies for calculation

solving problems involving division by transforming into a multiplication problem, such as thinking of three people share $36 as 3 times ? equals 36

estimating the answer to a calculation, comparing this with the answer obtained on a

Visualise the result of combining and splitting shapes and to represent all possible combinations of small numbers of triangles and squares

Elaborations

understanding that being able to visualise combinations of shapes, without having to actually combine them, is a useful life skill, as is being able to consider all of the possibilities of arrangements of particular shapes

understanding that small numbers of triangles and squares can be combined in different ways to make composite shapes but that some of these combinations are the same

experimenting to make the complete set of possible composite shapes (eg using tetrominos to combine 4 squares in different ways and identifying the complete set, removing any equivalences)

comparing this with the answer obtained on a calculator and judging if the answer obtained from the calculator is accurate or a key stroke error may have been made

identifying the correct operation or operations to solve a problem

8. Number patterns

Copy, continue, create, describe and identify missing elements in patterns with numbers including large numbers as well as patterns resulting from performing two operations

Elaborations

exploring number patterns and their connections with place value in order to develop understanding of the base 10 number system, flexible thinking for solving problems and developing understanding about functional relationships

recognising patterns in number sequences such as counting by 1000s and using them in contexts, such as reading the unlabelled gradations on measuring scales

creating and exploring patterns in number sequences, including those involving familiar fractions, generated by two operations (eg multiplying successive whole numbers by three and then halving the result to generate the number sequence 1½, 3, 4½, 6 … and recognising that the result of the two operations is the same as adding half of each number to itself)

investigating and recording patterns in number sequences arising from two operations found in everyday situations, such as the saying 'two steps forward and one step back' or a formula for cooking time, such as '20 min per kilo plus 10 minutes'

using strategies, such as number machines to find output numbers of functional relationships (growing patterns) and begin to describe these relationships using informal symbols

Achievement standard (Year 4)

By the end of Year 4, students are fluent with and evaluate the efficiency of mental and written strategies with one- and two-digit numbers and use these to solve problems. They identify and describe number patterns involving one or two operations and can find missing numbers in these patterns. Students pose questions that can be answered by data and plan and undertake data investigations, including the analysis of secondary data sets. They report their results using tables and graphs using one to one relationships between the data and the representation and evaluate their investigation. They can describe likelihood of familiar chance events using everyday language. They fluently choose appropriate tools and

their investigation. They can describe likelihood of familiar chance events using everyday language. They fluently choose appropriate tools and metric units to measure and compare the length, mass and capacity of objects and compare volumes using informal units. They can read scales to the nearest graduation. Their understanding of time extends to reading clocks to five minute intervals and to sequencing daily and weekly events, interpreting calendars and estimating duration. They confidently classify angles as equal to, greater than or less than a right angle and use these classifications to solve problems. They can identify obvious features of shapes and objects and visualise results of combining small numbers of squares and triangles.

Year 5 Content descriptions

Number and Algebra

1. Decimals

Recognise and represent numbers involving tenths and hundredths; read, write and order those numbers and connect them to fractions

Elaborations

understanding that the place value system extends to include decimal places

working fluently with numbers involving tenths and hundredths

connecting decimal and fraction representations of tenths and hundredths (eg understanding that 0.1 and $^{1}/_{10}$ are both representations of one tenth and that they occupy the same position on the number line)

reading and writing any number involving up to two decimal places, such as reading 23.57 as 'twenty-three point five seven' and writing 'five and six tenths' and vice versa

using place value understanding to compare and order numbers to two decimal places (eg determining the larger of 1.4 and 1.32 and explaining that 1.4 is larger because the whole number parts are equal and 4 tenths is more than 3 tenths and 2 hundredths; ordering times taken to run 100 metres, on a number line)

demonstrating and explaining the equivalence of fractional and decimal representations of numbers involving tenths and hundredths using structured materials or 10 × 10 grids

2. Place value

Justify various uses of the place value system to describe decimal numbers, and to partition and regroup those numbers to assist calculations and solve problems

Elaborations

justifying uses of place value in calculations and problems involving numbers to hundredths to develop flexible and efficient calculation strategies

extending the place value pattern of grouping in tens from whole numbers to tenths and hundredths (eg by using equipment such as place value blocks and the constant function

Statistics and Probability

1. Data investigation

Solve problems involving the collection of data over time, carry out the investigation and report the results, including using ICT, and justify conclusions about the relationship between the variables

Elaborations

beginning to explore bivariate data by considering the collection of data over time as a foundation for further work in statistics

creating tables to record data related to a variable changing over time and planning and using efficient methods to collect data (eg designing simple written surveys; creating a class table in which individuals record their data, locating appropriate data sets on the internet)

presenting results of investigations, including using ICT, to best illustrate how the data answers the question being investigated and justifies the choice of representation

interpreting graphical representations of the results of investigations and drawing conclusions about the questions posed

2. Summary statistics

Identify the mode and median in lists and on dot plots

Elaborations

understanding how to identify the mode and median of data sets and how these measures may represent the entire data set

understanding that representing data in a dot plot facilitates identifying the mode and median

understanding that dot plots represent ordered lists of data and hence the median can be found by counting along the plot to find the middle data point if the total number of data points is odd, and the point halfway between the two middle points if the total number of data points is even

discussing in everyday terms the effect of skewing and outliers on the median (eg use technology to create dot plots that include

Measurement and Geometry

1. Geometry

Make connections between different types of triangles and quadrilaterals using their features, including symmetry and explain reasoning

Elaborations

understanding that geometric features can be used to classify shapes and objects as the foundation of geometric reasoning and proof

classifying triangles and quadrilaterals according to their features, noting similarities and differences within and between the categories, such as all quadrilaterals have four straight sides and a square is like an equilateral triangle as both have equal sides

identifying symmetrical properties of different types of quadrilaterals and triangles

classifying triangles according to the lengths of their sides (equilateral, isosceles and scalene) and fold a paper triangle to show that angles in an equilateral triangle are equal and two angles in an isosceles triangle are equal

classifying quadrilaterals according to the length of their sides and shape (square, rectangle, parallelogram, rhombus, kite, trapezium)

2. Time

Solve realistic problems involving time duration including using 12- and 24-hour time

Elaborations

understanding that time can be expressed in different ways and identifying equivalences

making connections between 12-hour am and pm times and 24-hour times such as linking the key times in both systems including midnight (12:00 am and 0000) and the o'clock times (eg 2:00 am and 0200; 12:00 pm and 1200; 6:00 pm and 1800)

using 12- and 24-hour time to solve problems concerning time duration such as planning a holiday

3. Scales

place value blocks and the constant function on calculators to perform 100 ÷ 10 = = =)

describing the composition of numbers with one or two decimal places in a variety of ways, such as 1 = 10 tenths or 100 hundredths, or 9 tenths and 10 hundredths, and using this understanding to solve problems, such as 5.3 + 0.75 by recognising that 5.3 + 0.7 = 6, then adding 0.05, thus 5.3 + 0.75 = 6.05

3. Fractions and decimals

Solve problems involving making comparisons using equivalent fractions and decimals and everyday uses of percentages, relating them to parts of 100 and hundredths

Elaborations

understanding that there are equivalences between fractional, decimal and percentage representations of numbers and that choosing the form judiciously can aid in solving problems

representing decimal and percent equivalents of familiar fractions by using equipment, such as percentage strings, metre rulers, number lines, and 10 × 10 grids (eg counting 25 beads on a string of 100 to show $^{25}/_{100}$ or 25% to demonstrate that this is one quarter of the beads, and that it can also be written as 0.25 or ¼)

using equivalences with fractions to calculate 50%, 25% and 10% of quantities (eg recognising that 25% of 80 is the same as ¼ of 80 which is 20)

demonstrating equivalence between fractions, decimals and percentages using drawings, models or number lines

exploring equivalence among families of fractions by using a fraction wall or a number line (eg using a fraction wall to show that $^{2}/_{3}$ is the same as $^{4}/_{6}$ and $^{6}/_{9}$)

4. Multiplication and division

Solve realistic problems involving multiplicative situations with large numbers including division by one-digit numbers

Elaborations

applying strategies already developed for solving problems involving small numbers to

technology to create dot plots that include and exclude extreme values and noticing that the median remains about the same)

3. Data representations

Use and compare the effectiveness of a range of data representations including for specific situations

Elaborations

understanding that data sets can be represented in different ways and that the most appropriate representation depends on the data and the questions needing to be answered

comparing different data representations created to answer the same question and discussing the relative merits of each (eg noticing that comparing a variable across two groups, such as heights of bean and pea plants 3 weeks after sowing, requires the data for each group to be plotted on identical axes)

choosing, justifying and using data representations to display data such as using pie charts to display data about parts of a whole set of data

interpreting data in representations and considering if the representation provides an unbiased view of the data, such as the use of different colours or axes not starting from zero

using data representations to aid in making decisions, such as using tables to compare the costs of mobile phone plans

4. Chance

Quantify chance with fractions, and apply this to investigate complementary events

Elaborations

understanding that likelihood can be quantified using fractions and that this quantification can be used to determine complementary events

relating fractional representations of chance to the number of possible outcomes and the particular outcome of interest (eg the chance of obtaining a head from a coin toss is ½ because there are two possible outcomes and 1 of these is heads)

3. Scales

Read and interpret scales using whole numbers of metric units for length, capacity, mass and temperature

Elaborations

understanding that reading scales on measuring instruments is critical for measurement

recognising measurement of length, area, capacity, mass and temperature in everyday situations, such as using units both on measuring instruments and recorded as tables of data, and extending measurements to include area and temperature

4. Perimeter, area, volume

Explore different ways of calculating perimeter and area of rectangles and volume of rectangular prisms using metric units

Elaborations

understanding the meaning of perimeter, area and volume and exploring different ways to measure these attributes

using square metres and square centimetres to measure the areas of a range of shapes including the surfaces of objects such as laying a plastic square centimetre grid over some shapes drawn on paper and counting the squares, or using square metre units made from cardboard to measure the area of the floor by placing units side by side and counting the number needed to cover the surface

exploring efficient ways of calculating the perimeters of rectangles, such as measuring each of the four sides and finding a total, or saying that there are two lengths and two widths and finding the perimeter by doubling each dimension and adding them together

exploring efficient ways of finding the areas of rectangles, such as saying that a 4 by 3 rectangle on a square centimetre grid has three rows of four squares making the area 12 square centimetres; or observing the pattern that the number of squares is the same number as the length multiplied by width; or investigating all of the rectangular shapes that could have an area of 12 cm² and generalising about the relationship between length, width and area

those involving large numbers

applying a range of strategies to solve realistic problems and commenting on the efficiency of different strategies

becoming fluent with all multiplication facts including the 7 times table, and related division facts

understanding and explaining that halving and doubling can be used to solve multiplicative problems (eg calculating 30 × 180 by recognising that it is equivalent to 6 × 90 or 6 × 9 × 10)

understanding and using the fact that equivalent division calculations result if both numbers are divided by the same factor (eg 250 ÷ 50 is equivalent to 25 ÷ 5)

interpreting and representing the remainder in division calculations sensibly for the context (eg if we want to know how many 40-seat buses will be needed to transport 170 people the answer to 170 ÷ 40 is not 4¼ or 4.25, but at least 4 buses and a suitable vehicle to transport 10 more people)

applying the distributive law and using arrays to model its use in multiplication and division situations and to explain calculation strategies (eg a 13 × 24 array is comprised of four smaller arrays representing 10 × 20, 10 × 4, 3 × 20 and 3 × 4 and the solution to 13 × 24 is the sum of these 4 multiplications)

5. Fractions

Understand and become fluent with and solve realistic additive problems involving addition and subtraction of fractions with the same or related denominators and fractions as operators

Elaborations

understanding the processes for adding and subtracting fractions with related denominators and fractions as an operator in preparation for calculating with all fractions

solving realistic additive problems involving fractions to develop understanding of equivalent fractions and the use of fractions as operators

modelling and solving additive (addition and subtraction) problems involving fractions such

expressing the likelihood of all possible outcomes from chance devices as fractions, noticing that the total of all chances is 1 (eg expressing the chance of each possible outcome of a dice roll as $^1/_6$, noticing that the total of these chances is 1)

identifying complementary events and using the chance of one expressed as a fraction to calculate the chance of the other (eg in a dice game in which rolling a 6 is important, using the fact that the chance of rolling a 6 is $^1/_6$ to calculate that the chance of not rolling a 6 is $^5/_6$)

placing everyday expressions related to chance on a number line from 0, representing impossible, to 1, representing certainty and approximating each with a fraction (eg placing Buckley's chance close to zero and describing it as a very small fraction such as $^1/_{1000}$)

investigating games of chance and quantifying the chance of winning and hence of losing

length, width and area

exploring efficient ways of finding the volumes of rectangular prisms such as constructing prisms using identical blocks and observing the relationship between the number of blocks in the first layer, the number of layers and the total number of blocks needed; or making different shapes using 72 blocks and generalising about the relationship between length, width, height and volume

investigating the relationship between perimeter and area, such as designing a range of possible rectangular garden beds using a specific length of fencing material, and demonstrating that perimeter does not determine area and vice versa

exploring the effect of changing length measurements on rectangles and rectangular prisms and the effect on the area and volume, such as noticing that doubling all the lengths has the effect of multiplying the area by 4 and the volume by 8

5. Transformations

Visualise, demonstrate and describe the effects of translations, reflections, and rotations of two-dimensional shapes and describe line and simple rotational symmetry, including using ICT

Elaborations

understanding that translations, rotations and reflections can change the position and orientation of shapes and objects but not the geometric features or size

identifying and describing the line and rotational symmetry of a range of two-dimensional shapes, such as identifying which paper cut-outs of common two-dimensional shapes fold into matching halves and how many ways can each shape be folded to give matching halves; or tracing cut-outs of shapes and turning them around a centre point and counting how many times the turning model matches the traced outline during one revolution

visualising, demonstrating and describing the effects of transformations, such as using physical shapes and computer technology to visualise, test and record the movement of a range of two-dimensional shapes; or

as by jumps on a number line, or making diagrams of fractions as parts of shapes

using equivalence to add and subtract fractions with related denominators, such as $^{3}/_{4}$ and $^{5}/_{8}$ (eg using a fraction wall to equate $^{3}/_{4}$ with $^{6}/_{8}$ and then adding $^{6}/_{8}$ and $^{5}/_{8}$ to get $1^{4}/_{8}$)

calculating familiar fractions (eg $^{1}/_{3}$, $^{1}/_{2}$, $^{3}/_{4}$) of quantities by relating multiplication by unit fractions to division by the denominator (eg finding $^{3}/_{4}$ of 20 by first finding $^{1}/_{4}$ of 20 by dividing 20 by 4 and then multiplying by three to find $^{3}/_{4}$ of 20)

6. Estimation

Use estimation and rounding to check the reasonableness of answers

Elaborations

understanding the value of applying estimation for checking and obtaining approximate answers

using known or more easily calculable facts to estimate the results of less familiar calculations (eg 76 × 8 will be less than 76 × 10 = 760 but more than 380 which is half of 760 and hence 5 × 76)

applying the convention of rounding down if the digit is 4 or less and rounding up if the digit is 5 or more

rounding numbers to the nearest 10 to obtain estimates of the results of calculations (eg recognising that 52 × 9 is approximately 50 × 10 and so the result will be close to 500)

understanding that when both numbers in a multiplication calculation are rounded in the same direction the result will be an over or underestimate of the answer (eg approximating 27 × 7 with 30 × 10 will result in an estimate that is larger than the actual result)

applying mental strategies to estimate the result of calculations such as estimating the cost of a supermarket trolley load

7. Algebraic thinking

Copy, continue, create and describe patterns with numbers and use graphs, tables and rules to describe those patterns

designing a school or brand logo using transformation of one or more shapes

6. Location

Describe locations and routes using a coordinate system such as road maps, the four main compass directions and the language of direction and distance

Elaborations

understanding that coordinate systems and compass directions can help in the interpretation of maps and routes

using simple coordinate systems to place features on a map or plan and to locate features given their coordinates

giving and following directions, including using streets maps and digital tools like GPS systems and websites, and determining and comparing routes from one location to another

describing locations and routes that involve turns at intersections, to understand how coordinate systems are used and how they benefit navigation

Elaborations
identifying and generalising number patterns as a beginning of algebraic thinking
investigating additive and multiplicative patterns such as the number of tiles in a geometric pattern, or the number of dots or other shapes in 1, 2, 3 ... repeats of a strip or border pattern, looking for patterns in the way the numbers increase/decrease
recording patterns in tables, in which the first row/column represents the input number and the second row represents the output number
writing word rules that link the value of a variable to a position in a pattern (eg the number of tiles in the pattern is four more than the step number) and using the rules to predict values of the variable for particular steps
using informal symbols to describe rules for functional relationships
recognising that plotting points on a Cartesian plane can help in discerning the rule for a number pattern adhering to the convention that the input number is read off the horizontal axis and the output number on the vertical axis
8. Factors and multiples
Identify and describe properties of numbers including factors, multiples and composites and solve problems involving those properties
Elaborations
investigating and describing properties of whole numbers and relationships between various types of numbers to develop the ability to reason about numbers and solve problems
investigating additive and multiplicative relationships between even and odd numbers to make generalisations and solve problems (eg multiplying pairs of odd numbers to establish that the products of such multiplications is always odd; explaining why the sum of two odd numbers is always even)
investigating and reasoning about divisibility tests such as that a number is divisible by three if its digits sum to three, and that multiples of six are divisible by three and two and hence have digits that sum to three and

and hence have digits that sum to three and are even
becoming fluent with language to describe numbers, including factor, multiple, composite

Achievement standard (Year 5)

By the end of Year 5 students are able to describe the place value system for whole numbers and can extend its use to two decimal places. Students choose efficient mental and written strategies for calculations with whole numbers, solve additive problems with fractions and relate fractions to decimals and percentages. Students choose appropriate graphs for single variable data, and begin to represent change in data over time. They use representation of single variable data to describe distributions including the use of median, mode and range. They use measurements effectively including time and can devise and use efficient ways of calculating perimeter, area and volume. They can describe locations and routes and describe and demonstrate the effects of transformations.

Year 6 Content descriptions

Number and Algebra

1. Integers

Read, represent, write, interpret and order positive and negative integers

Elaborations

understanding that whole numbers can be positive and negative and continue indefinitely in both directions

investigating everyday situations which use positive and negative integers such as global temperatures, to understand how the positive numbers (whole numbers, fractions, decimals and percentages) can be extended to include negative numbers

using number lines to position and order positive and negative integers around zero

solving everyday additive problems involving positive and negative integers without developing formal rules for the operations (eg using a number line and counting to find the resulting outside temperature if it is 5°C at 7:00 pm and drops by 8°C overnight)

2. Decimals

Recognise and represent numbers involving thousandths, read, write and order those numbers, and connect them to fractions

Elaborations

extending and consolidating place value understanding to three decimal places to begin to develop an appreciation of the continuous nature of the set of real numbers

connecting decimal and fractional representations of numbers to thousandths (eg understanding that 12 thousandths, 0.012, and $^{12}/_{1000}$ are equivalent and that they occupy the same position on the number line)

reading and writing any number involving up to three decimal places, such as reading 3.147 as 'three point one, four, seven' and writing 'zero point seven, two, three' as 0.723

using place value understanding to compare and order numbers to thousandths (eg determining the larger of 0.6 and 0.076 and explaining that 0.6 is larger because 6 tenths

Statistics and Probability

1. Data representation

Construct, read and interpret tables and graphs including ordered stem and leaf plots, and construct pie charts and other simple data displays including using technology

Elaborations

understanding that some data representations are more appropriate than others for particular data sets and answering questions about those data sets

understanding that the stems of a stem and leaf plot group numerical data, such as understanding that the stems 0, 1, 2, 3, 4, 5, 6, 7 and 8 could be used to represent the tens digit in the number of runs scored by an Australian cricketer in successive innings and that scores of 46, 13 and 42 would be recorded by placing the digits 6 and 2 next to the stem, 4, and the digit 3 next to the stem, 1

using ordered stem and leaf plots to record and display numerical data collected in a class investigation, such as constructing a class plot of height in cm on a shared stem and leaf plot for which the stems 12, 13, 14, 15, 16, 17 have been provided

using technology to create pie charts, understanding that they show the proportions of data in various categories and that the whole 'pie' represents all of the data

creating an ordered stem and leaf plot, an ordered list of data, and using it to identify the median and mode of the data

2. Data interpretation

Interpret secondary data presented in the media and elsewhere, identifying misleading representations and distinguishing between samples and populations

Elaborations

developing understanding of sampling and the ability to interpret secondary data in order to critique data-based claims made in the media and elsewhere, including in advertising

investigating data representations in the media and discussing what they show and

Measurement and Geometry

1. Geometry

Visualise and solve problems relating to packing and stacking

Elaborations

visualising different views of three-dimensional objects assists in the solution of realistic problems including those relating to packaging

solving problems relating to packing and stacking such as making efficient cartons of cans

2. Measurement

Solve problems involving comparison of length, area, volume and other attributes using appropriate tools, scales and metric units

Elaborations

understanding that identifying the measurement attributes that are involved in a problem are necessary before choosing the tools and units involved in the solution

solving problems involving comparisons of length and area, such as investigating areas of rectangles that have the same perimeter and deciding that the shape with the greatest area would be a square, or saying that when the side lengths of squares increase by 1 cm, the perimeters increase by 4 cm each time but the areas grow by increasingly larger numbers of square centimetres each time

choosing the appropriate tools and units to use in solving problems dependent on the level of accuracy required and the context of the problem

solving problems involving comparisons of lengths and volumes, such as predicting the effect of increasing or decreasing the side length of a cube on the volume of the cube or interpreting realistic situations including the volume of concrete in a pathway given that the length and width are in metres and the depth is given in centimetres

3. Metric System

explaining that 0.6 is larger because 6 tenths is greater than 7 hundredths and 6 thousandths)

understanding that the length of the number does not denote its relative size (eg 3.701 is not larger than 3.72)

demonstrating and explaining the equivalence of fraction and decimal representations of numbers to thousandths using structured materials such as place value blocks, decimal squares, decimats, and metre rulers (eg locating 0.1 m, 0.01 m and 0.001 m on a metre stick or decimat and expressing these as tenths, tenths of tenths or hundredths, and tenths of tenths of tenths or thousandths)

3. Place value

Justify uses of the place value system to describe decimal numbers, and to partition and regroup those numbers to assist calculation and solve problems

Elaborations

understanding that the place value system extends in both positive and negative directions and that place value understanding is crucial for interpreting the number system

justifying uses of place value in calculations and problems involving numbers to thousandths to develop flexible and efficient computation strategies

extending the place value pattern of grouping in tens from whole numbers and numbers to hundredths, to thousandths (eg by using equipment, such as place value blocks)

describing the composition of numbers with up to three decimal places in a variety of ways, such as 1 = 10 tenths or 100 hundredths or 1000 thousandths and using this understanding to solve problems, such as 0.5 + 0.902 by recognising that 5 tenths and 9 tenths are 14 tenths or 1 whole and 4 tenths and hence the result is 1.402

4. Multiplication and division

Apply multiplication and related division facts to solve realistic problems efficiently using mental and written strategies and calculators justifying the reasonableness of answers and explaining reasoning

Elaborations

the messages that the people who created the representations might want to convey

understanding the importance of factors affecting data collection and display including: who created the representation; who funded the collection of the data; and whether or not the representation is part of an advertisement, in order to be alert to possible biases in data representations

identifying potentially misleading data representations in the media, such as graphs with 'broken' axes or non-linear scales, graphics not drawn to scale, data not related to the population about which claims are made, and pie charts in which the 'whole pie' does not represent the entire population about which claims are made

considering the need for *sampling* and circumstances in which a *census* of an entire *population* is not possible, or not necessary, and identifying examples of sampling in the media

3. Variation

Explore concepts of variation and error by collecting repeated measurements

Elaborations

understanding that variation is inherent in measurement and that there are limits to the possible precision of measurement to appreciate the need for, and basis of, statistics and probabilistic reasoning

collecting repeated measurements of the same attribute of a single object or person and discussing possible reasons for the variation in the results, such as by having each class member measure the arm span of a volunteer or the length of the room and collating the class data; having each individual measure the length of the room several times using a ruler and then several more times using a measuring tape

understanding that variation in measurements is affected by factors including the precision of measuring instruments and the accuracy of their use

4. Chance

List all outcomes for chance events and quantify probabilities using simple fractions,

Work fluently with the metric system to convert between metric units of length, capacity and mass, using whole numbers and commonly used decimals

Elaborations

understanding the decimal nature of the metric system and connecting place value understanding to the conversion of units

converting between metric units of length, capacity and mass such as recognising and using the most suitable equivalent representations involving whole units and halves, quarters and tenths

becoming fluent with the standard symbols used in the metric system and the connection between the prefix and the relative size of commonly used units such as mg, km and cm^2

4. Angles

Estimate, compare and measure angles

Elaborations

building on students' understanding of turn and rotation in the contexts of mapping and rotational symmetry, to measure, estimate and compare angles in degrees and classify angles according to their sizes

estimating, measuring and comparing angles, such as using knowledge of the magnitude of angles including 30°, 45°, 90°, 180° and 270° to make reasonable estimates of angles up to a complete turn of 360°, or using a protractor to measure angles to the nearest degree

identifying that angles have arms and a vertex, and the size is the amount of turn required for one arm to coincide with the other; the size is measured in degrees with a protractor using the two alternate conventions for naming angles

identifying that the size of a right angle is 90° and defining acute, obtuse and reflex angles and a rotation by relating them to right angles

5. Time

Create, interpret and use timetables and timelines including calculating elapsed time

Elaborations

understanding that there are various

Elaborations

understanding that there are a number of different strategies that can be used to solve problems and that the problem affects which strategies are more efficient

choosing among mental, written and calculator methods to solve realistic problems involving multiplication and division, and applying and justifying choices made

interpreting and representing the remainder in division calculations sensibly for the context, such as understanding that the result of 247 ÷ 9 is sensibly expressed as 27.4 if the context involves calculating the average height in cm of 9 plants; $27.44 if it represents the amount of money that each of 9 people will receive if they share $247 fairly; and 27 or 28 if it represents the number of students in each of 9 similarly sized classes in a school with an enrolment of 247

5. Ratio and rate

Recognise and solve problems involving unit ratio and everyday rates and check for reasonableness of answers

Elaborations

understanding some relationships are represented by ratios or rates which specify a multiplicative relationship between two quantities

applying the multiplicative relationships between parts represented by ratios and rates to solve everyday problems, such as 1 free cup of coffee for every 10 purchased means 2 free cups for 20 purchased and any numbers of free and purchased cups found by multiplying both 1 and 10 by the same number

calculating the size of a quantity given the size of another quantity to which it is related by a given ratio, such as if the proportions of boys and girls who play a particular sport is represented by the ratio 2:1, then if 36 boys are playing there must be 18 girls

understanding that rates are particular ratios between quantities measured in different units, such as speed is the ratio distance : time and pricing rate is cost

solving problems involving familiar rates by decimals and percentages

Elaborations

understanding that it is necessary to identify all possible outcomes (the sample space) before probabilities can be calculated

exploring and developing increasingly systematic procedures to list all of the possible outcomes of chance events (eg using organised lists, tree diagrams or two-way tables to identify all of the possible totals obtained from rolling two dice)

calculating the probability of winning a game of chance and commenting on the likelihood of losing or winning the game

understanding that there are various representations of time and that the calculation of elapsed time depends on how the times are expressed

interpreting and using timetables taking account of the format in which the times are expressed, such as accessing various airline timetables

taking account of time zones when planning journeys

creating, interpreting and using timelines ensuring that the scale is appropriate and the divisions are equally spaced, such as constructing personal timelines that record important events in a lifetime requires a scale in years for an older child but babies may be best represented in months

6. Measurement formulas

Understand and use the formulas for calculating perimeters and areas of rectangles, and volumes of rectangular prisms

Elaborations

understanding that there are efficient ways of calculating perimeter, area and volume and understanding why these work

identifying the attribute required to solve problems concerning the calculation of perimeter and area of rectangles and the volume of rectangular prisms

explaining why the formulas for calculating the perimeter and area of rectangles and the volume of rectangles work in every case

applying the formulas for calculating perimeter and area of composite rectangles and volume of composite rectangular prisms to solve problems

7. Transformation and symmetry

Describe patterns in terms of reflection and rotational symmetry, and translations including identifying equivalent transformations using ICT

Elaborations

understanding transformations to help with identifying movement of shapes and in identifying rotational and line symmetry

using tables, ordered lists and multiplication/division, such as calculating the time taken to read a 280-page book if I can read 20 pages in an hour by constructing a table using mental strategies for estimating the results of multiplication and division calculations to judge the reasonableness of calculations involving rate and ratio (eg understanding that if in a region there are approximately 430 kangaroos counted in an area of 216 hectares then the number of kangaroos per hectare will be 430 ÷ 216, which will be approximately 400 ÷ 200 = 2)

calculating a unit ratio and using this to compare, such as calculating the unit price of goods

6. Decimals

Understand and work fluently with decimal numbers to thousandths, and multiply and divide numbers including decimals by whole numbers to solve additive problems, including using technology

Elaborations

extending whole number strategies to explore and develop meaningful written strategies for addition and subtraction of decimal numbers to thousandths, and to represent and record calculations involving multiplication and division of decimals

exploring and practising efficient methods for solving problems requiring operations on decimals, to gain fluency with calculating with decimals and with recognising appropriate operations

interpreting and representing the remainder in division calculations, including non-integral remainders, sensibly for the context (eg understanding that the result of 6.5 ÷ 4 is sensibly expressed as: 1.625 km if the context involves dividing a 6.5 km running course into four equal legs; $1.63 if it represents the price of one item if four sell for $6.50)

understanding and using the fact that equivalent division calculations result if both numbers are multiplied or divided by the same amount (eg 34.87 ÷ 7 is equivalent to 3 487 ÷ 700)

using and explaining the use of multiplication

describing patterns and investigating different ways to result in the same transformational changes, such as using two successive reflections to provide the same result as a translation, or using ICT to experiment with, create and re-create patterns using combinations of flips, slides, turns and enlargements or reductions

building on students' understanding of the reflection and rotation of figures, and reflection and rotational symmetry, to identify combinations of transformations that produce the same result, and to distinguish this as an example of how mathematical results can often be obtained using multiple alternative methods

using grid paper and ICT to establish equivalent transformations

8. Location

Describe and interpret locations and give and follow directions, using scales, legends, compass points, including directions such as NE and SW, distances, and grid references

Elaborations

applying understanding of features of maps and compass points to further the understanding of mathematics of location

describing and interpreting locations, such as using a grid reference to indicate the exact position of an object, or using scales to estimate whether the distance between two points can be reached by a given time by a group which is on foot, or using compass directions and distances to plan a route to be followed by others

creating and interpreting a variety of everyday map types, such as those in sight-seeing brochures, topographical maps for bushwalking, road maps for touring Australia, and maps highlighting changes over time in places like the Great Barrier Reef, and describing their features which might include scales, legends, compass points and grids

interpreting maps to pinpoint locations by grid reference, to plan routes (using the scale to estimate distance), or to orienteer around a course with a compass and a sequence of directions (eg make a 90° clockwise turn and travel in a SSE direction for 100 m)

and division by powers of 10 to mentally multiply decimal numbers (eg 1.4 × 0.6 can be calculated by multiplying 14 by 6 and dividing the result by 100 because 1.4 is one tenth of 14 and 0.6 is one tenth of 6 and so their product will be a hundredth of the product of 14 and 6)

7. Fractions

Understand and work fluently with and solve additive problems involving fractions with unrelated denominators, compare and contrast fractions using equivalence

Elaborations

extending methods for adding and subtracting fractions with related denominators to develop methods for representing fractions with unrelated denominators in additive situations

comparing and ordering fractions by identifying equivalent representations with like denominators, such as identifying the larger of $^{3}/_{4}$ and $^{2}/_{3}$ by recognising that $^{3}/_{4}$ is equivalent to $^{9}/_{12}$ and $^{2}/_{3}$ is equivalent to $^{8}/_{12}$, ie constructing a 4 × 3 array to represent both quarters and thirds and using it to show that $^{3}/_{4} = {}^{9}/_{12}$ and $^{2}/_{3} = {}^{8}/_{12}$

exploring and developing efficient written strategies to solve additive problems involving fractions (eg by using fraction walls or rectangular arrays with dimensions equal to the denominators of the fractions to be added, to find equivalent fractions with a common denominator and then performing the calculation)

identifying the operations required to solve realistic problems involving fractions

8. Estimation

Estimate the outcomes of calculations involving decimal numbers and justify the reasonableness of answers

Elaborations

understanding that the strategies used to estimate the outcomes of calculations involving whole numbers apply equally to decimals

estimating answers mentally and using the estimates to check answers obtained from written and calculator strategies, to develop

written and calculator strategies, to develop understanding of the size and meaning of decimal numbers and of the value of estimation for checking and for obtaining approximate answers when written and calculator methods are not available or not needed

rounding decimal numbers to the nearest integer to estimate answers and judge the reasonableness of the results obtained from written and calculator strategies for calculations involving decimal numbers such as recognising that 5.3 × 0.88 is approximately 5 × 1 and so the result will be close to 5

understanding, applying and explaining how the relative sizes of decimal numbers can be used to estimate the results of calculations involving decimals and to appropriately place the decimal point (eg understanding that the result of 0.4 × 37 will involve the digits obtained by multiplying 4 and 37, and will be 14.8 rather than 1.48 or 148 because 0.4 is close to but less than one half)

understanding that when both numbers in a calculation are rounded in the same direction the result will be an over or underestimate of the answer (eg approximating 22.3 × 1.2 with 20 × 1 will result in an estimate that is less than the actual result)

9. Number properties

Identify and describe properties of numbers including prime, composite and square numbers

Elaborations

understanding that some numbers have special properties and that these properties can be used to solve problems

writing composite numbers as a product of their prime factors and using this form to simplify calculations by cancelling common primes

understanding that if a number is divisible by a composite number then it is also divisible by the prime factors of that number (eg 216 is divisible by 8 because the number represented by the tens and ones is divisible by 8, and hence 216 is also divisible by 2 and 4)

investigating properties of special numbers, such as square numbers, triangular numbers and patterns in Pascal's triangle

Achievement standard (Year 6)

By the end of Year 6, students are able to work with numbers including fractions and decimals to thousandths and apply their place value understanding to establish equivalences. They confidently solve realistic problems including those involving rate and ratio choosing appropriately written and mental strategies or calculators. They use estimation strategies to predict and check reasonableness of calculations. Students represent data choosing appropriate displays including stem and leaf plots and distinguish between sample and population data. They are beginning to quantify probability. Students can visualise and connect two- and three-dimensional shapes and objects. Their facility with maps extends to the use and interpretation of scales and legends. They are beginning to connect algebra and measurement, understanding the basis for formulas for perimeter, area and volume of simple polygons and rectangular prisms.

Year 7 Content descriptions

Number and Algebra

1. Indices

Understand and work fluently with index notation and represent whole numbers as a product of powers of prime numbers

Elaborations

understanding that index notation provides a powerful way of representing and working with numbers

connecting the power of a numerical expression to the number of terms in its expanded form, moving fluently between index and expanded forms of expressions and evaluating expressions with powers

expressing whole numbers as in place value notation, such as $31702 = 3 \times 10^4 + 1 \times 10^3 + 7 \times 10^2 + 0 \times 10^1 + 2$

defining and comparing prime and composite numbers and explaining the difference between them

applying knowledge of factors to strategies for expressing whole numbers as products of powers of prime factors, such as repeated division by prime factors or creating factor trees

solving problems involving lowest common multiples and greatest common divisors (highest common factors) for pairs of whole numbers by comparing their prime factorisation

2. Integers

Order, add and subtract integers fluently and identify patterns for multiplication and division including using ICT

Elaborations

understanding that the number system extends beyond positive numbers, and that rules for operations on integers can be developed from patterns

becoming fluent with operations with integers and identifying patterns

interpreting the use of integers in real world contexts, such as rise and fall of temperature, elevation above and below sea level and

Statistics and Probability

1. Data measures

Determine mean, median, and range and use these measures to compare data sets explaining reasoning including using ICT

Elaborations

understanding that summarising data by calculating measures of centre and spread can help make sense of the data

calculating mean, mode, median and range from listed data and from graphs that show individual data, with and without technology

determining the median and range using a dot plot or an ordered stem plot

using a dot plot or stem plot to identify outliers in a data set, that is the data values that seem to stand out from the majority of data values

using mean, median and range to compare data sets and explaining how outliers may affect the comparison

locating mean, median and range on graphs and connecting them to real life

2. Data investigation

Investigate questions involving the collection of univariate and simple bivariate data, including the use of back-to-back stem plots and scatter plots

Elaborations

understanding that undertaking statistical investigation involves formulating appropriate questions, collecting, representing and interpreting data and drawing conclusions in relation to the questions

using back-to-back stem plots and parallel dot plots to compare and contrast univariate data in terms of centre and spread, such as comparing the heights of girls and boys in a class

using column graphs to represent data over time (eg length of a shadow at half hour intervals), where each column represents a measurement at a particular time, and developing scatter plots and line graphs from

Measurement and Geometry

1. Geometry

Describe the properties of parallel and perpendicular lines, triangles and quadrilaterals to classify them and make geometric constructions including angle bisectors and perpendicular bisectors

Elaborations

describing properties of lines, triangles and quadrilaterals lays the foundation for geometric reasoning and can be applied in geometric construction

defining and classifying angles such as acute, right, obtuse, straight, reflex and revolutions, and pairs of angles such as complementary and supplementary and adjacent and vertically opposite angles

constructing parallel and perpendicular lines using their properties and a pair of compasses and a ruler and dynamic geometry software

defining and identifying alternate, corresponding and allied angles and the relationships between them for a pair of parallel lines cut by a transversal, including using dynamic geometry software

defining and classifying triangles such as scalene, isosceles, equilateral, acute, obtuse and right-angled and investigating their properties, such as angle sum; an exterior angle equals the sum of the opposite interior angles

identifying properties of different types of quadrilaterals and relationships between them, such as any square is a rectangle but not all rectangles are squares

solving numerical problems involving the properties of angles, including angles in parallel lines, and triangles, and using reasoning to justify results

2. Measurement formulas

Relate the formula for calculating the area of triangles to the formula for rectangles and parallelograms, to develop the formula for the volume of rectangular prisms, and use these to solve problems

elevation above and below sea level and simple examples of borrowing and paying back money

recognising and using the language of integers accurately and interpreting the different meaning of + and - signs depending on the context

comparing and ordering integers using strategies, such as locating them on a number line

using a range of strategies for adding and subtracting integers, including number lines and virtual manipulatives

investigating multiplication of positive and negative integers, using a range of strategies including patterning, multiplication as repeated addition with both concrete and virtual manipulatives, and identifying the processes for division as the inverse of multiplication

3. Calculation

Understand and become fluent with written, mental and calculator strategies for all four operations with fractions, decimals and percentages

Elaborations

understanding that quantitative situations involve decisions about the type of numbers and the operations required, and choices need to be made about each

justifying choice of written, mental or calculator strategies for solving specific problems including those involving large numbers

using rounding to estimate the results of calculations with whole numbers and decimals and understanding the conventions for rounding

solving problems using fractions and percentages, such as those that require calculating fractions or percentages of quantities

working with mixed numbers as whole numbers and a fractional part

expressing one quantity as a fraction or percentage of another to solve problems

developing scatter plots and line graphs from these when the data is continuous

identifying pairs of variables (eg height and arm span) that might be related, describing their possible relationships, and collecting bivariate data to check the relationships (eg that, in this class, taller students tend to have wider arm spans)

use a scatter plot to display and identify patterns in bivariate numerical data that indicate the variables displayed are related and describe the relationship such as taller people tend to be heavier

distinguishing positive and negative relationships in bivariate numerical data and the differences in the associated scatter plots

suggesting questions that could be answered by bivariate data, providing the answers, and justifying reasoning

3. Sample space

Construct sample spaces for single-step experiments with equally likely outcomes and use them to assign probabilities

Elaborations

understanding that is it possible to calculate the probability of some events happening by using the basic elements of the sample space

distinguishing between equally likely outcomes and outcomes that are not equally likely (eg if quarter sections on a spinner are coloured red, green, yellow, yellow, then red and green are equally likely but red and yellow are not)

expressing probabilities in common and decimal fractional and percentage forms

discussing the meaning of probability terminology (eg probability, sample space, favourable outcomes, trial, chance events and experiments)

understanding the advantages and limitations of calculating theoretical probabilities

calculating probabilities relating to games of chance

4. Relative frequency

Calculate relative frequencies, and recognise variation between results of chance

to solve problems

Elaborations

building on understanding of area of rectangles to develop formulas for the area of triangles and volume of rectangular prisms

using appropriate manual and ICT techniques to establish that the area of any triangle is half the area of an appropriate rectangle and using the formula $A = ½bh$ where b is the base and h is the perpendicular height of the triangle

using area formulas for rectangles and triangles to solve problems involving areas of surfaces, such as how many litres of paint will be needed to paint the back wall of a shed if each litre covers $16m^2$?

investigating volumes of cubes and rectangular prisms and establishing and using the formula $V = l \times b \times h$

understanding and using cubic units when interpreting and finding volumes of cubes and rectangular prisms

3. Transformations

Visualise, demonstrate and describe translations, reflections, rotations and symmetry in the plane, including using coordinates and ICT

Elaborations

building on students' understanding to include transformations in the Cartesian plane, and to develop an appreciation that this allows shapes to be described precisely and lays the foundations for later use in design, architecture and engineering

translating, reflecting and rotating shapes, describing the process, comparing and contrasting results and identifying equivalences and symmetries

visualising and demonstrating the effects of translations, reflections and rotations of shapes in the plane

identifying lines of symmetry of two-dimensional shapes on the Cartesian plane

identifying the order of rotational symmetry of two-dimensional shapes using dynamic geometry software or by rotating cut-out

4. Variables

Apply the associative, commutative and distributive laws and the order of operations to mental and written computation and generalise these processes using variables

Elaborations

understanding that arithmetic laws are powerful ways of describing and simplifying calculations and that using these laws leads to the generality of algebra

understanding that the laws that apply to number can be generalised using variables

applying effective strategies for a range of mental computations such as: 156 - 19 = 156 - 20 + 1

using combinations of the associative and commutative laws for effective mental and written computation (eg 36 + 23 + 14 = [36 + 14] + 23 and 25 × 46 × 4= [25 × 4] × 46)

identifying order of operations in contextualised problems, preserving the order by inserting brackets in numerical expressions, and then recognising how order is preserved by convention

moving fluently between algebraic and word representations as descriptions of the same situation

representing equivalences with algebraic equations, to begin to understand the use and meaning of algebraic notation

5. Linear equations

Use symbols to represent linear relationships and solve problems involving linear relationships where there is only one occurrence of a variable

Elaborations

using variables to symbolise simple linear equations and using a variety of strategies to solve them

recognising and explaining the difference between equations and expressions, interpreting the words ‘unknown’, ‘variables’, ‘simplify’ and ‘solve’ in a mathematical context

solving equations using concrete materials, such as the balance model, and explain the

variation between results of chance experiments

Elaborations

understanding that calculating relative frequencies assists in making predictions about chance experiments

counting favourable events (eg odd numbers when rolling a die) and determining them as a proportion of the total number of trials, to give relative frequency (eg an odd number was obtained 23 times when the die was rolled 50 times, so the relative frequency is $^{23}/_{50}$, 0.46 or 46%)

comparing counts and relative frequencies from repeated experiments, to understand that relative frequency of an event varies less for repeated experiments with large numbers of trials than for repeated experiments with small numbers of trials

simulating repeated single-step real-world chance events using materials (eg use a coin to simulate the boys and girls born from 50 births), to identify variation between results from repeated simulations

understanding the advantages and limitations of experimental probability

shapes in the outline of the shape

4. Time

Calculate duration using 12- and 24-hour time, explain and use time zones

Elaborations

understanding that time zones need to be considered when calculating durations and differences

making connections between 12-hour am/pm time and 24-hour time (eg connect 2:16 pm with 1416 and use this in realistic situations such as planning travel or booking meetings)

calculating travel times given the start and finish time in 12-hour and 24-hour time including where the start and end time are in different time zones

5. Location

Interpret and create maps and plans, including using legends and scales, describe relative position, and plan journeys

Elaborations

building understanding of maps to include interpretation of aspects of maps and plans according to given criteria

using maps to plan a journey within constraints (eg travelling only on sealed roads, minimising the distance travelled, taking in particular landmarks or facilities)

using scales provided on a map to estimate the straight line and road distances between two points

using a map to identify locations meeting specified criteria and referring to features of the map such as scale and legend to justify the choice (eg identifying the best place to locate a tourist centred business)

writing directions for travelling from point A to point B and evaluating them by comparing with directions for the same journey written by other students

identifying a location from information about its position in relation to, and/or, distance from particular features shown on a map and creating location problems for other students

such as the balance model, and explain the need to do the same thing to each side of the equation

using strategies, such as back tracking and guess, check and improve to solve equations

using substitution to check solutions

solving real life problems by using pronumerals to represent the unknown, writing an equation, estimating the answer, solving and checking solution

creating linear relationships to represent realistic situations such as converting temperature to Fahrenheit can be represented as $F = {}^{9}/_{5}\,°C + 32$

6. Coordinates

Plot points on the Cartesian plane using all four quadrants

Elaborations

understanding that the Cartesian plane provides a graphical or visual way of describing location, and can be used to represent relationships

plotting integer ordered pairs on the Cartesian plane and identifying the quadrant in which a point will lie

assigning integer ordered pairs to matching points on the Cartesian plane

plotting points from a table of integer values and recognising simple patterns, such as points that lie on a straight line

plotting points for tables of values from non-rule based data, such as water consumption over a month

Achievement standard (Year 7)

By the end of Year 7, students work fluently with index notation. They are able to use the operations to calculate accurately with integers, fractions and decimals, choosing appropriate operations when solving problems, and correctly applying the order of operations. They extend this understanding to algebraic representations, selecting and applying formulas for area and volume and begin to generalise arithmetic patterns, including linear functions, representing them algebraically and graphically. Students conduct systematic data-based enquiry using univariate and bivariate data, choosing appropriate graphs, calculating measures of spread and centre and drawing conclusions. They identify equally likely outcomes and calculate probabilities and relative frequencies from data. Students have a sound understanding of the geometric properties of angles, triangles and quadrilaterals and two-dimensional views of three-dimensional objects. They are beginning to construct logical geometric arguments about properties of triangles and quadrilaterals.

Year 8 Content descriptions

Number and Algebra

1. Ratio and rate

Solve problems involving use of percentages, rates and ratios, including percentage increase and decrease and the unitary method and judge reasonableness of results

Elaborations

understanding that rate and ratio problems can be solved using fractions or percentages and choosing the most efficient form to solve a particular problem

using percentages to solve problems, including those involving mark-ups, discounts, profit and loss and GST

expressing profit and loss as a percentage of cost or selling price, comparing the difference, and investigating the methods used in retail stores to express discount

using ratio to compare quantities of the same type, representing ratios in various forms such as 4:6, 4 to 6, $^{2}/_{3}$ and simplifying ratios, including those involving algebraic terms such as a:b where a and b are positive integers

applying the unitary method to solve real life problems involving ratios and percentages, including those where the whole is unknown (eg 'after a discount of 15%, an MP3 player was worth $183. What was its value before the discount?')

applying the unitary method to identify 'best buy' situations, such as comparing the cost per 100g

solving a variety of real-life problems using rates, such as those involving telephone rates, scoring rates in sport, or fuel consumption

applying equivalent ways of calculating percentage increase and decrease such as multiplying by 90% to calculate the amount paid after a 10% discount

2. Index laws

Understand, describe and use generalisations of the index laws with positive integral indices

Elaborations

Statistics and Probability

1. Statistical measures

Use a mean or median from a sample to estimate the mean or median of a population and to recognise the limitations of samples

Elaborations

developing understanding of the process of using sample averages (mean and median) to estimate population averages

interpreting sample mean and median values (eg as typical values around which data are centred), and interpreting spread as resulting from natural variation in phenomena (eg height varied between ... and ...) or from measurement or recording errors (eg an outlier may be data that was recorded incorrectly)

using sample properties (eg mean, median, range, large gaps visible on a graph) to predict properties of the population (eg use mean height for a class to predict year-group mean height), acknowledging uncertainty

recognising that population properties may not exactly match sample properties

collecting and comparing different-sized random samples from a population (eg multiple samples of 10, 20, 30 data points), to observe that mean and other properties of large samples tend to be close to population properties

discussing biased sampling and the consequence that the mean and other properties of the resulting samples may not apply to populations

discussing sampling reported in the media to identify whether or not the sample may have been biased or of insufficient size

2. Data investigation

Collect samples and construct tables and graphs including frequency column graphs with and without technology for grouped data, and to select and justify the choice of measure of centre and spread used

Elaborations

Measurement and Geometry

1. Congruence

Identify properties and conditions for congruence of plane figures, and use coordinates to describe transformations

Elaborations

understanding the properties that determine congruence of triangles and recognising which transformations create congruent figures

establishing that two figures are congruent if one shape lies exactly on top of the other after one or more transformations (translation, reflection, rotation) and recognising equivalence of corresponding sides and angles

solving problems using properties of congruent figures, justifying reasoning and making generalisations

investigating the minimal conditions needed for the unique construction of triangles leading to the establishment of the condition for congruence (SSS, SAS, ASA and RHS) and demonstrate which conditions do not prescribe congruence (ASS, AAA)

plotting the vertices of two-dimensional shapes on the Cartesian plane, translating, rotating or reflecting the shape and using coordinates to describe the transformation

2. Measurement formulas

Generalise from the formulas for perimeter and area of triangles and rectangles to investigate relationships between the perimeter and area of special quadrilaterals and volumes of triangular prisms and use these to solve problems

Elaborations

understanding that partitioning composite shapes into rectangles and triangles is a strategy for solving problems involving perimeter and area

using congruence and the formula for area of triangles to establish the formulas for areas of parallelograms, trapeziums, rhombuses and kites, and using the formulas to solve

understanding that index laws apply to variables as well as numbers

evaluating numbers expressed as powers of positive integers

generalising index laws for multiplication, division and raising a power to a power by expressing terms in expanded index form, recognising patterns, describing and formalising results, such as $4^3 \times 4^2 = (4 \times 4 \times 4) \times (4 \times 4) = 45$ and generalising the rule $n^a \times n^b = n^{(a+b)}$

using division or patterns to explain the meaning of an index of zero and confirming this is consistent with the division rule for indices

applying generalised index laws to simplifying algebraic expressions with positive integral powers

3. Calculation

Solve problems involving fractions, decimals and percentages, including those requiring converting and comparing, and judge the reasonableness of results using techniques such as rounding

Elaborations

connecting fractions, decimals and percentages as different representations of the same number, moving fluently between representations and choosing the appropriate representation for the problem being solved

comparing and ordering sets of numbers involving fractions, decimals and percentages, including their placement on number lines

recognising terminating, recurring and non-terminating decimals and choosing their appropriate representations

working fluently with a range of strategies, including the use of technology, for multiplying and dividing fractions and decimals

working fluently with a range of strategies, including the use of calculators and technology, for multiplying and dividing fractions and decimals

4. Algebra

understanding that sample data is sometimes collected rather than population data and that, if the sample is carefully chosen, data about the population can be inferred from the analysis of the sample data acknowledging uncertainty

organising large samples of data into a frequency table and construct a frequency column graph with, and without, using technology

using tables and graphs to identify the modal category

using data representations to describe the shape of a data distribution as symmetrical or skewed and identify any possible outliers

understanding that if the data is approximately symmetrical then the mean and median will be approximately equal so that either can be used as a representative value

determining averages and spread of ungrouped data, using technology for large data sets

identifying and formulating questions for statistical investigation, planning and collecting data (primary or secondary) and drawing and justifying conclusions in relation to the questions

3. Probability

Identify complementary events and use the facts that probabilities range between 0 and 1 and sum to 1 over the sample space to check probabilities

Elaborations

understanding that probabilities range between 0 to 1 by convention and that calculating the probability of an event allows the probability of its complement to be identified

identifying the complement of familiar events (eg the complement of getting a head on a coin is getting a tail, the complement of winning a game is not winning the game)

calculating probabilities for sample spaces for single-step experiments (eg drawing a marble from a bag with 2 black and 3 white marbles)

4. Representing probability

problems

investigating the relationship between volumes of rectangular and triangular prisms, explaining that the volume of triangular prisms is half that of corresponding rectangular prisms and establishing and using the formula V = Ah

3. Circles

Investigate the relationship between features of circles such as circumference, area, radius and diameter and generalise these to solve problems involving circumference and area

Elaborations

investigating circumference and area of circles with materials or by measuring, to establish understanding of formulaes

investigating the relationship between circumference and diameter of circles developing the formula for the circumference of a circle, and using this to solve problems

investigating the area of circles using a square grid or by rearranging a circle divided into sectors, developing the formula for the area of a circle and using this to solve problems

4. Congruence

Explain properties for congruence of triangles and apply these to investigate properties of quadrilaterals

Elaborations

understanding that congruence provides an example of the precision of geometrical language and helps form the basis of reasoning and proof

constructing accurate triangles, using compass, ruler and protractor and ICT, according to specifications SSS, SAS, ASA, RHS, SSS and AAA, demonstrating which are unique

using the conditions for congruence of triangles (SSS, SAS, ASA and RHS) to solve problems and using reasoning to justify results

defining and classifying special quadrilaterals such as parallelograms, rhombuses, rectangles, squares, trapeziums and kites and identifying relationships between them,

Generalise the distributive law to expansion and factorisation of simple algebraic expressions and use the four operations with algebraic expressions

Elaborations

understanding that the distributive law can be applied to algebraic expressions as well as numbers and also understanding the inverse relationship between expansion and factorisation

connecting the numerical use of the distributive law to its application with algebraic terms: just as $28(100 + 1) = 28 \times 100 + 28 \times 1$, so then $4(5x + 7) = 4 \times 5x + 4 \times 7$ and describing and generalising the results

applying the distributive law to the expansion of algebraic expressions using strategies, such as the area model

recognising that factorising is the opposite of expanding, identifying the greatest common divisor (highest common factor) of numeric and algebraic expressions and using a range of strategies to factorise algebraic expressions

understanding the process of substitution into algebraic expressions and evaluating expressions after substitution

recognising like terms, adding and subtracting like terms to simplify algebraic expressions and explaining why unlike terms cannot be added and subtracted

understanding and applying the conventions for simplifying multiplication of single term algebraic expressions, including those with positive integral indices, such as $3m^3 \times 2m = 6m^4$

understanding and applying the conventions for simplifying division of algebraic terms which can be expressed as a single fraction, including those with positive integral indices

determining whether a simplified expression is correct by substituting numbers for variables

5. Linear equations

Create, solve and interpret linear equations, including those using realistic contexts using algebraic and graphical techniques

4. Representing probability

Use Venn diagrams or two-way tables to illustrate 'and', 'or', 'given' and 'not' criteria, and to calculate simple probabilities

Elaborations

understanding that representing data in Venn diagrams or two-way tables facilitates the calculation of probabilities

using Venn diagrams and two-way tables to calculate probabilities for events satisfying 'and', 'or', 'given' and 'not' conditions

posing 'and', 'or', 'not' and 'given' probability questions about objects or people (eg what is the probability that a student selected at random from the class likes hamburgers given they like fried chicken?), collecting data to answer the questions using Venn diagrams or two-way tables

and identifying relationships between them, such as a square is a rectangle but the reverse is not true

using congruent triangle properties to investigate angle, side and diagonal properties of special quadrilaterals

5. Location

Solve problems involving interpreting and creating maps and plans using scales

Elaborations

understanding that scales and legends need to be considered when solving problems relating to maps

interpreting unit ratio scales (eg 1:100 000) and analysing scaled maps and plans to determine distances and areas and solving related problems

creating a map or plan of a familiar area such as home, classroom or school grounds, including a scale and legend

identifying compass directions from a standing position or on a map (8 point compass)

6. Visualisation

Create, interpret and use two-dimensional representations of three-dimensional objects, including projections, isometric views and plans

Elaborations

understanding relationships between different two-dimensional views of three-dimensional objects

investigating and using real life two-dimensional representations of three-dimensional objects such as buildings

identifying three-dimensional shapes given their projections, isometric views and plans

drawing two-dimensional representations of three-dimensional objects, such as projections, isometric views, plans and elevations

7. Pythagoras

Use Pythagoras theorem to solve simple problems involving right-angled triangles

Elaborations

identifying patterns from sets of numbers represented in a table, as a sequence and in diagrammatic form, such as those that can be constructed using matchsticks, describing the patterns in words and with algebraic equations

solving, and checking results for, equations with more than one occurrence of a variable and equations involving grouping symbols such as: *2x + 3(x - 7) = 14* and *3a + 1 = a + 15*

generalising word problems to create linear equations and functions and solving the problem in a number of ways, such as algebraically, by using a table of values or by graphing the function using technology (eg 'the cost of printing invitations for a birthday party is $18 plus 15 cents for each invitation. What is the cost of printing 150 invitations? How many invitations can be printed for $32?')

6. Coordinates

Plot graphs of linear functions and use these to find solutions of equations including using ICT

Elaborations

understanding the connection between the graph of a linear function and the solution of linear equations, that is the solution of f(x) = 0 is also the x-intercept of the graph of the linear function

generating a table of values from a linear function given in algebraic form, recognising the ordered pairs and plotting the corresponding points

determining linear rules from suitable diagrams, tables of values and graphs and describing them both with words and algebra

comparing graphs of linear functions using technology, identifying similarities and differences and relating these to the equations of the graphs, such as noticing that parallel lines have the same gradient and that the y-intercept is represented by the constant term b in the gradient intercept form of the straight line y = mx + b

identifying the algebraic representation of

Elaborations

understanding that Pythagoras' theorem is a useful tool in determining unknown lengths in right angled triangles and has widespread application

using Pythagoras' theorem in right-angled triangles: $a^2 + b^2 = c^2$, where a and b represent the lengths of the shorter sides and c represents the length of the hypotenuse

solving problems involving the calculation of unknown lengths in right-angled triangles

applying understanding of Pythagoras' theorem to determine if a triangle is right-angled

straight line graphs parallel to either axis

using graphs of linear functions to solve corresponding equations

Achievement standard (Year 8)

By the end of Year 8, students are able to use number, algebraic conventions and formulas and apply this understanding to problem solving with ratios and scale, percentage increase and decrease, perimeters and areas of triangles, quadrilaterals and circles and volumes of triangular prisms. Students readily connect tabular, graphical and algebraic representations of linear functions, and choose appropriate models for solving real life problems. They use numerical and graphical summaries of data, interpret these to draw conclusions and calculate probabilities. They apply mathematical reasoning including congruence and transformations to solve geometric problems and generalise formulas for the perimeter for triangles and rectangles to other quadrilaterals and develop understanding of the volumes of simple prisms. They are able to visualise three-dimensional objects from two-dimensional representations including isometric drawing and plans.

Year 9 Content descriptions

Number and Algebra

1. Financial maths

Solve problems in financial mathematics including applications of simple and compound interest including using ICT and judge reasonableness of results

Elaborations

understanding that financial decisions can be assisted by mathematical calculations

choosing efficient strategies, such as using appropriate software, for calculating and comparing incomes for specified time periods

understanding normal and overtime rates of pay, bonuses and holiday pay, reading and completing payslips involving these and choosing appropriate software to calculate gross income including using spreadsheets

explaining the purpose of taxation and calculating personal income tax and net income, using appropriate strategies such as relevant software

calculating simple interest and applying the formula to problems

calculating compound interest using repeated multiplication for yearly compounding only including using spreadsheets

solving problems related to purchasing, such as choosing best buys and discounted and sale items and the use of credit cards

connecting and applying knowledge of wages, salaries and taxes, saving and spending to design suitable budgets, using appropriate technology

2. Index laws

Work fluently with index laws, in both numeric and algebraic expressions and use scientific notation, significant figures and approximations in practical situations

Elaborations

understanding that the use of index notation is an efficient way of representing numbers and symbols and has many applications particularly in science

Statistics and Probability

1. Data investigation

Investigate problems requiring data-based inquiry, collecting univariate and bivariate data, including from secondary sources, and justify conclusions

Elaborations

undertaking a basic investigation to appreciate the components of a data-based inquiry

understanding that statistical investigations include posing questions, collecting data, representing and analysing the data and drawing conclusions

investigating bivariate numerical data where the independent variable is time (eg population, number of car crashes annually for the Australian States), identifying independent and dependent variables, and constructing line graphs to identify and describe trends

investigating bivariate numerical data, identifying the independent and dependent variables, and constructing scatter plots to display, identify and describe any relationships

using technology strategically to obtain, record, sort and graph data, calculate mean and median, describe variation and report results

2. Sample space

Calculate probabilities for two- and three-step experiments with equally likely outcomes which involve ‘with replacement’ and ‘without replacement’

Elaborations

understanding there are situations where it is possible to calculate probability and developing the tools for doing this

developing methods for listing sample spaces where there are equally likely outcomes including tables and tree diagrams

comparing sample spaces involving 'with replacement' situations to those involving 'without replacement' situations

Measurement and Geometry

1. Geometry

Investigate properties of polygons and circles, including lines and angles, forming generalisations, explaining reasoning and solving problems

Elaborations

understanding the principles of geometric reasoning as way of explaining deductive thinking

classifying polygons justifying classifications using geometric reasoning

using triangle properties to develop geometric proofs that involve polygons

using technology and other techniques to investigate relationships between lines, angles and circles

proving chord and angle properties of circles such as the angle at the circumference is twice the angle at the centre, standing on the same arc; angles in the same segment are equal; the perpendicular from the centre to a chord bisects the chord

2. Pythagoras

Solve problems involving right angled triangles using Pythagoras’ theorem and trigonometric ratios and justify reasoning

Elaborations

understanding that Pythagoras’ theorem and trigonometry are useful tools in determining unknown lengths and have widespread application

establishing the validity of Pythagoras’ theorem using one or more proofs

recognising that right-angled triangle calculations may generate results that can be integral, fractional or irrational numbers known as surds

understanding and applying trigonometric ratios to find unknown lengths in right-angled triangles

using ICT to explore Pythagorean triples and reasoning that multiples of a Pythagorean

connecting different strategies for simplifying expressions with indices to illustrate the meaning of negative indices, such as applications of index laws $x^2 \div x^5 = x^{-3}$; and expanding and simplifying results

moving fluently between representations of numeric and algebraic terms with negative indices, and applying understanding of negative indices to calculations

applying knowledge of index laws to algebraic terms and simplifying algebraic expressions using both positive and negative integral indices

representing extremely large and small numbers in scientific notation and numbers expressed in scientific notation as whole numbers or decimals

3. Linear and quadratic functions

Understand simplification techniques for linear and quadratic functions including collecting like terms, common factors, the expansion of binomial products and simple binomial factorisation

Elaborations

using the area model working fluently with expanding products involving one binomial expression, such as: 2x(x + 5) and applying this idea to factorisation

factorising a range of expressions by taking out a common factor, including those where the common factor is a binomial expression, such as: 5x(x - 7) + 3(x - 7)

working fluently with numerical examples of the distributive law, using the area model as required and including examples involving pairs of binomial expressions, such as 99 × 52 = (100 - 1) (50 + 2)

using a range of strategies such as the area model and algebraic techniques to expand binomial products that will result in a quadratic expression such as (x + 5) (x - 2)

4. Linear equations

Solve problems involving linear equations and inequalities and substitution into, and rearrangement of formulas

Elaborations

'without replacement' situations

developing an understanding of the principles behind P(A)P(A given B) = P(A and B) using tree diagrams or other counting devices

calculating probabilities from sample spaces with equally likely outcomes (eg the sample space for tossing a coin twice is HH, HT, TH, TT so the probability of HH is 1 out of 4 or ¼)

3. Probability

Compare theoretical and experimental probabilities for two- and three-step experiments

Elaborations

understanding that the longer the trial, the more likely the experimental probability will be closer to the theoretical probability

estimating probabilities from experiments involving equally likely outcomes and comparing this to theoretical probabilities calculated from a sample space

exploring the length of runs of repeated single-step experiments to understanding that the length of runs is linked to probability

4. Sampling

Evaluate non-random and random sampling techniques

Elaborations

understanding that many publicly reported statistical conclusions are based on samples and that such conclusions may be of limited validity depending on the sample selected

considering the selection of samples and how they may, or may not be, representative

using randomisation techniques such as coin tossing, selecting names out of a hat, using a random number generator to generate random samples from a given population and using the sample average to estimate the population average

understanding that, even with representative samples, the sample average may not match the population average

triple will produce a Pythagorean triple and similar triangles

using Pythagoras' theorem to calculate unknowns and solve problems in two dimensions

3. Similarity

Apply transformations to triangles to explain similarity and congruence, to establish geometric properties

Elaborations

understanding that similarity and congruence helps to describe relationships between geometrical shapes and forms the basis of reasoning and proof using the enlargement transformation to establish similarity. Establishing the conditions for similarity of two triangles and comparing this to the conditions for congruence

using the properties of similarity and ratio, and correct mathematical notation and language, to solve problems involving enlargement (eg scale diagrams)

establishing the relationship between areas of similar figures and the ratio of corresponding sides (scale factor)

using congruence to prove geometric properties, such as the diagonals of a rhombus bisect the internal angles

4. Circles

Solve problems involving circumference and area of circles and part circles, and the surface area and volume of cylinders and composite solids

Elaborations

building on the understanding of area and volume to become fluent with calculation, and identifying that area and volume relationships are used in the workplace and everyday life

analysing nets of prisms and cylinders to establish formulas for surface area

using proportion to determine the perimeter and area of sectors of circles and solving related problems

using formulas for area and volume to solve problems involving surface area and volume of prisms, cylinders and composite solids

evaluating algebraic expressions after substitution, including those with positive and negative integral indices

solving a wide range of linear equations, including those involving one or two simple algebraic fractions, and checking solutions by substitution such as 3(2x + 1) + 2x = 17; 6m - 11 = 3(m - 4); representing word problems, including those involving fractions, as equations and solving them to answer the question (eg 'two fifths of a class choose visual arts as an elective, one fifth chooses French. This totals 15 students. How many students are in the class, if no student chooses both electives?')

solving equations that are the result of substitution into common formulas from mathematics and elsewhere, including those that involve rearrangement solving linear inequalities such as 2m - 7 ≤ 15, checking the solution by substitution into the inequality and representing the solution on a number line

representing word problems with simple linear inequalities and solving them to answer questions

5. Simultaneous equations

Solve problems involving linear simultaneous equations, using algebraic and graphical techniques including using ICT

Elaborations

recognising equations of the form y = mx + b as linear functions that result in straight lines and identifying the gradient and intercept from the equation and the graph

understanding that only two points are required to sketch a straight line

solving pairs of simultaneous linear equations graphically and using tables of values, including with graphing software, and connecting the point of intersection with the solution

using simple algebraic techniques to solve pairs of linear simultaneous equations, generalising pairs of equations from word problems and choosing an appropriate strategy for solving them simultaneously to solve the problem

of prisms, cylinders and composite solids

5. Location

Interpret and create maps and plans, including relative location, directions and bearings, and optimal paths

Elaborations

extending students' understanding of mapping to include specifying compass directions, true bearings, and relative location

interpreting a map or street directory to describe alternate routes from one point to another and evaluating each to determine and justify the best path

analysing and interpreting maps to estimate relative location, that is distance and direction (16-point compass direction) from one point to another

6. Visualisation

Construct and identify elevations and cross-sections of three-dimensional objects, and explain reasoning

Elaborations

developing understanding of the relationship between three-dimensional objects and various two-dimensional views and representations of these objects

identifying three-dimensional objects given their elevations and/or cross-sections and explaining reasoning

drawing elevations and/or cross-sections of given three-dimensional objects

understanding that the cross-section is dependent on the way the object is sliced

Achievement standard (Year 9)

By the end of Year 9, students are able to skilfully use number and algebra in problem-solving situations involving finance, right-angle triangle geometry and the calculation of area and volume. They have a sound understanding of linear functions and index laws, and are developing fluency with quadratic and simple non-linear functions. Students choose appropriate techniques, including sampling, in data-based inquiry and confidently represent sample spaces and use these to determine theoretical probabilities. They are confident users of maps and plans, and are developing the use of formal proofs in geometric contexts. They apply Pythagoras' theorem to the solution of right-angled triangles and have a basic understanding of trigonometric ratios.

Year 10 Content descriptions

Number and Algebra

1. Financial maths

Solve problems in financial mathematics including ones using recursive techniques, and extend these techniques to investigate growth and decay including using ICT

Elaborations

understanding that in financial mathematics, calculations are made repeatedly and that recursive techniques are used to perform these calculations

understanding the need to change both the rate and the number of time periods when the compounding period is not annual and applying this to problem solving

choosing suitable strategies, such as applications of the formula or appropriate software, to compare the effects of changing the length of the compounding periods on the future value of an investment or loa,n and justifying the choice of investment or loan

comparing effective and nominal interest rates by reading from tables, applying technology or using the formula and solving related problems

recognising contexts, such as population decay or a slump in the stock market, where repeated applications of depreciation are required to find future value and choosing appropriate strategies to solve problem

understanding that compound interest and depreciation formulas are connected to repeated applications of simple interest or depreciation and applying this to problem solving

2. Proportion

Solve problems involving direct and inverse proportion

Elaborations

understanding the difference between direct and inverse proportion, identifying these in real-life contexts and using these relationships to solve problems, recognising that direct proportion where both variables are linear, can be represented by a straight

Statistics and Probability

1. Data representation

Construct and interpret box plots and compare data sets represented by parallel box plots

Elaborations

understanding that box plots are an efficient and common way of representing and summarising data and can facilitate comparisons between data sets

finding the five-number summary (minimum and maximum values, median and upper and lower quartiles) and using its graphical representation, the box plot, as tools for both numerically and visually comparing the centre and spread of data sets

ranking whole data sets in *range* and order of spread, by intuitively judging spread visible on dot plots, and by using interquartile range, to understand why interquartile range is used to judge whether one data set is more or less spread than another data set

2. Data investigation

Pose data-orientated questions, plan sampling, data collection and representation, make and justify conclusions, report the investigation and evaluate choices

Elaborations

modelling the process of statistical investigation to make informed judgements

choosing to sample or to conduct a census and justifying the choice

collecting primary data by observation, measurement, survey, experiment or simulation, or secondary data from media or directly from a source such as a website, and choosing graphs and measures of centre and spread to suit data analysis purposes

acknowledging uncertainty when using samples to predict population properties

evaluating the appropriateness of inquiry methods (eg research questions, sampling methods and sample size, data collection, recording and analysis methods, and suggesting alternative methods)

Measurement and Geometry

1. Geometry

Use formal mathematical language to classify shapes and objects including congruence and similarity

Elaborations

presenting formal geometric arguments to develop skills in mathematical reasoning

presenting reasoned arguments (proofs), using mathematical language and notation, based on congruence, similarity and other relationships to deduce properties of geometric figures (eg the base angles of an isosceles triangle are equal)

distinguishing between a practical demonstration and a proof (eg demonstrating triangles are congruent by placing them on top of each other, as compared to using congruence tests to establish that triangles are congruent)

2. Trigonometry

Work fluently with trigonometric ratios and solve problems requiring their use in right-angled triangles including direction and angles of elevation and depressions using the three trigonometric ratios

Elaborations

identifying that trigonometric ratios, together with Pythagoras Theorem, allow the calculation of lengths and angles that are unknown or cannot be measured in right-angled triangles, and are used in surveying and design

understanding the terms adjacent and opposite sides in a right-angled triangle

establishing the trigonometric ratios sine (sin), cosine (cos) and tangent (tan) in right-angled triangles using similar triangles

selecting and accurately using the correct trigonometric ratio to find unknown sides (adjacent, opposite and hypotenuse) and angles in right-angled triangles

using true bearings (eg 047° to specify directions and moving between true bearings and compass directions)

line graph of the form y = mx, finding the constant of proportionality and solving real-life problems

recognising direct proportion with an algebraic representation of the form k/x using algebraic strategies to find the constant of proportionality and solving problems, such as 'if 1.5 kg of minced beef makes bolognaise sauce for 12 people, how much minced beef will be needed to feed the 108 students at the Year 10 camp?'

recognising that inverse proportion where both quantities are linear can be represented by a graph of the form y = a/x using graphical strategies to find the constant of proportionality and solving real-life problems such as those involving the speed/time/distance relationships

transforming situations involving inverse proportion to a situation where there is direct proportion such as considering speed as being directly proportional to $1/t$ where t represents the time taken

3. Coordinate geometry

Understand and use graphical and analytical methods of finding distance, midpoint and gradient of an interval on a number plane

Elaborations

developing fluency with coordinate geometry calculations to lay the foundation for connecting graphical and analytical representations using graphical techniques, including investigations with dynamic software, to find the distance between two points on a number plane, recognising the formula as an application of Pythagoras' theorem and choosing an appropriate strategy, such as applying the formula to find distance

using graphical techniques, including investigations with dynamic software, to find the midpoint of an interval joining two points on the number plane, identifying the x and y coordinates of the midpoint as being the average of the x and y coordinates of the two points respectively and using an appropriate strategy, such as applying the formula, to find the coordinates of the midpoint

applying knowledge of gradient to identify and suggesting alternative methods)

3. Chance

Identify, whether two events of the sample space are independent or not, or mutually exclusive, for one- and two-step experiments with equally likely outcomes

Elaborations

recognising and identifying that some sets of chance events are dependent on a previous result and others are not and that this distinction is important when calculating probabilities and that if events are independent if P(A) x P(B) = P(A and B)

distinguishing that event A is mathematically dependent on event B if the occurrence of event B affects the chance of occurrence of event A (eg selecting a ball from a bag where one ball has already been taken and not replaced)

representing sample spaces with lists, tables, Venn diagrams with two overlapping circles and tree diagrams, and using these to calculate probabilities and investigate dependence and independence

establishing independence for two events by showing the probability of each event is the same whether or not the other occurs (eg when a die is rolled twice, the events 'a sum of 7' and 'a 2 first' are independent because P(a sum of 7) = P(a sum of 7 if 2 is first) = ⅙, and P(2 first) = P(2 first if the sum is 7) = ⅙))

recognising that two events are mutually exclusive if they are disjoint, such as rolling a die and tossing a coin

4. Data interpretation

Evaluate statistical reports in the media and other places by linking claims to displays, statistics and sampling

Elaborations

evaluating media reports that refer to data from a range of contexts, where the evaluation allows students to demonstrate their statistical literacy

evaluating whether graphs in a report could mislead, and whether graphs and numerical information support the headlines and conclusions

and compass directions)

interpreting written problems and producing diagrams, not necessarily to scale, to represent the situation and to support reasoning

solving problems using trigonometry in two dimensions, finding sides and angles, including cases which may also involve using Pythagoras' theorem

3. Surface area and volume

Solve problems involving surface area and volume of pyramids, cones and spheres

Elaborations

building on understanding of surface area and volumes of prisms and cylinders, to include pyramids, cones and spheres and so completing common volume calculations relevant to everyday life

establishing and applying the volume formula for right pyramids and cones

fluently using formulas for surface area and volume of pyramids, cones and spheres to solve problems

4. Latitude and longitude

Solve problems involving latitude, longitude, and distances on the Earth's surface, using great circles

Elaborations

developing understanding of similarities and differences between two-dimensional and three-dimensional, and planar and spherical geometries and the implications for calculation and geometrical reasoning

using technology to investigate latitude, longitude and distances on the Earth's surface

understanding the difference between great circles and other paths on the Earth's surface

fluently using a map to match latitude and longitude and points on the Earth's surface and solving problems involving distances on great circles along lines of longitude or the equator

create equations for lines that are parallel or perpendicular and solve related problems

4. Quadratic expressions

Understand how to expand and factorise quadratic expressions using a variety of strategies

Elaborations

developing fluency with algebraic techniques associated with quadratics to facilitate describing relationships and solving problems

identifying and using common factors, including binomial terms, to factorise algebraic expressions

using the technique of grouping in pairs to factorise algebraic expressions with four terms

using expansion patterns for the special binomial products $(a + b)(a - b)$ and $(a \pm b)^2$ inversely to factorise quadratic expressions

using a range of strategies, including the area model inversely, to factorise quadratic expressions of the form $ax^2 + bx + c$, where $a = \pm 1$

exploring the method of completing the square to factorise quadratic expressions and solve quadratic equations

5. Functions

Connect algebraic and graphical representations of functions and relations such as parabolas, circles and exponentials

Elaborations

understanding that there are a range of equivalent forms of functions and relations

using a range of strategies, including appropriate technology, to investigate the effect of multiplying by a constant term, including negative numbers connecting the graphical and algebraic representations and describing the resulting transformation

identifying, matching and describing algebraic and graphical representations of parabolas, rectangular hyperbolas, exponential functions and circles, including those that have undergone a single transformation

sketching the graphical representations of

evaluating the appropriateness of sampling methods and sample size in reports where statements about a population are based on a sample

identifying misconceptions about samples that are evident in reports (eg a wrong assumption that there is no variation between the properties of a sample and properties of the corresponding population; a wrong assumption that chance outcomes reflect probabilities regardless of sample size)

parabolas, exponential functions and circles

6. Equations

Solve non-linear equations algebraically and graphically and using technology

Elaborations

developing an understanding that many relationships are non-linear and that these can also be represented graphically and algebraically

identifying the connection between algebraic, and graphical solutions of equations (eg understanding that the x-intercepts are the solutions of $f(x) = 0$)

solving quadratic equations such as $x^2 - 4 = 0$, $x^2 - 3x - 4$ and simultaneous equations such as $y = x^2$ and $y = 4x - 4$ including using technology

solving realistic problems that can be modelled by quadratic and exponential functions, including using technology

Achievement standard (Year 10)

By the end of Year 10, students are able to skilfully use number and algebra in problem-solving situations involving finance, proportion, trigonometry and the calculation of area, volume and distances on the Earth's surface. They readily interpret and connect algebraic and graphical representations of functions and use these to analyse and solve equations. Students choose appropriate numerical, technological and graphical techniques to interpret and compare data sets presented to them and confidently determine theoretical probabilities for one- and two-step experiments and understand the concept of independence. They readily interpret and construct geometric proofs involving the application of congruence and similarity. They routinely communicate solutions in appropriate formats and can judge the reasonableness of results and evaluate the strategies and techniques used.

Year 10A Content descriptions

Number and Algebra

1. Surds

Work fluently with operations with surds and fractional indices and solve simple exponential equations

Elaborations

understanding that the real number system includes irrational numbers and that certain subsets of the real number system have particular properties

recognising like surds, and adding and subtracting expressions involving surds

understanding that rational numbers can be multiplied and divided by other rational numbers, and irrational numbers can be multiplied and divided by other irrational numbers, and simplifying expressions involving multiplication and division of surds

applying the index laws to numeric and algebraic expressions and evaluating or simplifying them as required

solving simple exponential equations such as $2^x = 8x - 1$

2. Recursion

Apply recursive techniques to arithmetic integer sequences, generalise the nth term and solve related problems

Elaborations

understanding that some relationships are recursive and that there are mathematical techniques that can be used to describe these relationships

recognising arithmetic sequences, representing them in explicit and recursive forms and connecting the representations (eg the sequence ... 2, 5, 8, 11 ... can be represented as $T_n = 3a – 1$ and $T_1 = 2$, $T_n = T_{n-1} + 3$)

understanding that arithmetic sequences are defined by the recursive formulas $T_1 = a$ and $T_n = T_{n-1} + d$ where d is the common difference and deriving and using the formula for the nth term, $T_n = a + (n - 1)d$

using the formula for the nth term of an

Statistics and Probability

1. Bivariate data

Model linear relations in bivariate numerical data sets using the least squares line of best fit and interpret the result including using ICT

Elaborations

enabling students to model linear relationships in bivariate data and use this to make predictions

using a scatter plot to describe the relationship between two numerical variables in terms of direction (positive or negative), form (linear/non-linear) and strength (strong/moderate/weak)

identifying the dependent and independent variable as a first step to fitting a line to the data including using technology

interpreting the intercept and slope of the least squares line in terms of the relationship being modelled

distinguishing between interpolation and extrapolation when using least squares lines to make predictions

Measurement and Geometry

1. Trigonometry

Use the unit circle to graph trigonometric functions and solve simple trigonometric equations

Elaborations

understanding that trigonometric functions are periodic and that this can be used to describe motion

building on students' understanding of trigonometric ratios to include ratios of angles that are greater than 90°

using the unit circle to define trigonometric functions (sin, cos and tan) for angles of any magnitude, and establishing symmetry properties such as sin(180 - A) = sinA

graphing the three trigonometric functions y=sinx, y=cosx and y=tanx on the coordinate plane including using ICT

solving simple trigonometric equations (eg sinx = 0.5 graphically and algebraically within specified domains)

using the notions of periodicity and symmetry to consider an infinite number of solutions

2. Sine and cosine rule

Understand the sine and cosine rules and apply these to solve problems involving non-right-angled triangles

Elaborations

understanding that trigonometry has application to non-right-angled triangles and can be used to solve all triangles

understanding how the sine rule is derived, recognising that it involves pairs of opposite sides and angles and applying it to problem solving, including questions involving the ambiguous case

understanding how the cosine rule is derived, recognising that it involves three sides and one angle and the relationship between sides and angle and applying the rule to problem solving

deriving the area rule for non-right-angled

using the formula for the nth term of an arithmetic sequence to find its explicit formula, when given the sequence or when given any two of the term number and specific term, the first term and the common difference

solving problems that require the application of the recursive or the explicit formulas, or the formula for the nth term

3. Functions and relations

Solve a wide range of quadratic equations and construct graphs of parabolas and circles

Elaborations

understanding that there are different techniques for solving quadratic equations; the efficiency of each technique depends on the form of the equation and that some techniques assist in identifying certain features of graphs

understanding that 'completing the square' is helpful in both determining solutions and identifying features of graphs

understanding the development of the quadratic formula and applying the formula to the solution of quadratic equations

using a range of strategies, including appropriate technology, to construct parabolas of the form $y = a^x + bx + c$

recognising the equation $(x - h)^2 + (y - h)^2 = r^2$ as representing circles of the form $x^2 + y^2 = r^2$ that have been translated to the new centre (h, k) and constructing graphs of circles with the equation $(x - h)^2 + (y - h)^2 = r^2$

triangles using it to find the area of irregular shapes

applying knowledge of sine, cosine and area rules to realistic problems such as those involving simple surveying

Achievement standard (Year 10A)

In addition to the Year 10 achievement standard, by the end of 10A students are able to reason mathematically in a wide range of contexts. Their understanding of the real number system is extended to irrational numbers including surds. They can use algebraic, including recursive, techniques to solve equations including quadratics and simple exponential equations. They can model linear relationships in bivariate data and are able to solve trigonometric equations and use trigonometric relationships to solve problems involving non-right-angled triangles.