Strand: Shape and Space (Measurement)

Students will:

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
Use measuring devices to make estimates and to perform calculations in solving problems.	A1–1. (SS8) Select and apply appropriate instruments, units of measure (in SI and Imperial systems) and measurement strategies to find lengths, areas and volumes. [E, PS, T]	1.1 Find a rule that relates hectares to acres. Is there a rule of thumb that can be used for estimates? Estimate the area of a plot of land shown in a plan, using both units of measurement. 1.2 Use a micrometer to measure the thickness of 10 sheets of paper. Use the results of this measurement to determine the thickness of one sheet of paper. 1.3 Use a micrometer to measure the thickness of a human hair. 1.4 Calculate the area of a flat rectangular surface measuring 21 m by 14 m. Give the answer in cm^2, m^2 and dm^2. 1.5 Estimate the volume of a water bed bladder having a depth of 300 mm, a width of 1.8 m and a length of 210 cm. 1.6 Given a cylindrical pipe of known length, choose appropriate measuring devices to find the internal and external diameters of the pipe. Find the volume of metal in the pipe. Explain your measurement and calculation procedures. 1.7 Measure the internal dimensions of a rectangular container, and calculate its volume in cm^3. Find its volume, in litres or in millilitres, using a calibrated cylinder. 1.8 Use a vernier caliper to measure the inside diameter of a piece of PVC pipe. 1.9 Measure the angle between two faces of a pyramid to the nearest degree. 1.10 Measure the angle of a bevel to the nearest tenth of a degree, using a vernier bevel protractor.
	A1–2. (SS9) Analyze the limitations of measuring instruments and measurement strategies, using the concepts of precision and accuracy. [C, R]	2.1 Which ruler is most precise? a) a ruler divided into tenths of an inch b) a ruler divided into eighths of an inch c) a ruler divided into millimetres.
(continued)	*(continued)*	

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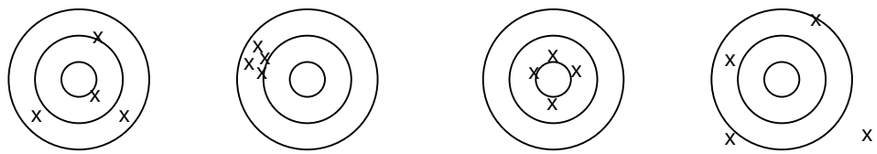
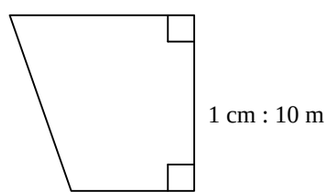
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.2 Of the four diagrams revealing shots on a target, which best represents accuracy and precision? 
	A1–3. (SS10) Solve problems involving length, area, volume, time, mass and rates derived from these. [C, E, PS]	3.1 A room is 16 feet long, 12 feet wide and 8 feet high. The walls and ceiling are to be painted. There are two doors in the room, each 6 feet 6 inches high and 30 inches wide. There are two windows, each 2 feet by 4 feet. Information on the paint can states that you should allow 3.79 L for every 38 m^2 of smooth surface. Two coats of paint are needed. How many cans of paint are needed, if each can contains 3.79 L? If the painter is able to paint 3 m^2 in 10 minutes, how long will it take to paint the room? 3.2 A person buys a property that is irregularly shaped. See scale drawing below.  What is the total area, in m^2, of the lot? 3.3 A car has a highway fuel consumption of 34 miles per Imperial gallon. What is this in litres per 100 kilometres? Explain the conversion strategy used.
	(continued)	

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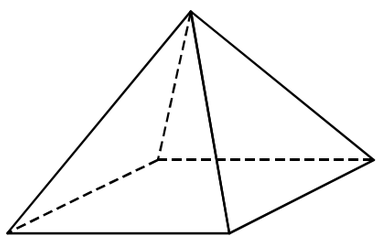
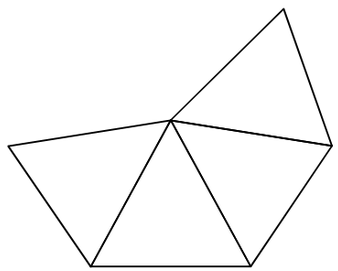
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	3.4 A sheet metal worker must fabricate a pyramidal cap for a square column. The base of the cap is 1.5 m by 1.5 m and the height is 5 m. Determine the area of material required.   3.5 A building contractor is to provide wheel chair access to a new building. A space of 10 m by 10 m is available, on the west side of the entrance stairs, for a ramp. Municipal building codes specify that wheel chair ramps must have a minimum width of 1.5 m and a maximum slope of 10°. The vertical rise needed is 2 m. Construction costs for ramps of this kind average $300 per linear metre. a) Design a ramp to meet the above specifications. b) Make a plan or drawing of the proposed ramp showing the measurements, including the slopes, of the various parts. c) Give an estimate of the cost of construction.

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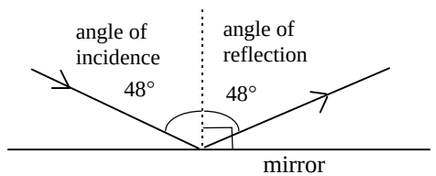
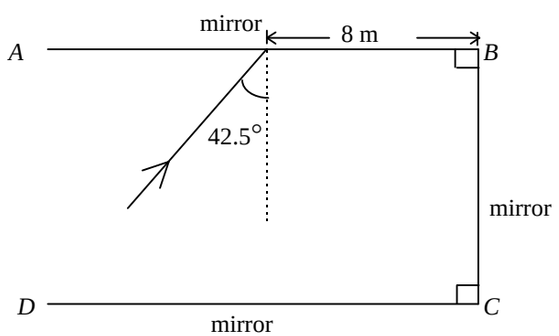
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A1–4. (SS11) Interpret drawings, and use the information to solve problems. [C, PS, V]	4.1 The law of reflection states that when a ray of light is reflected at a surface, the angle of reflection is equal to the angle of incidence. Therefore, if light hits a mirror at an angle of incidence of 48°, the angle of reflection will also be 48°.



The following diagram of the interior of a hall of mirrors shows a ray of light hitting mirror *AB* at a point 8 m from *B* and at an angle of incidence of 42.5°. Using the law of reflection, and either trigonometric relationships or scale drawings, find the angle of reflection from mirror *CD* and the distance from *C* at which the ray will hit mirror *CD*, if mirror *BC* is 12 m long.



(continued)

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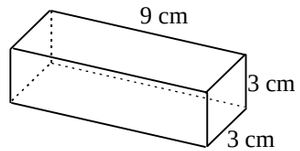
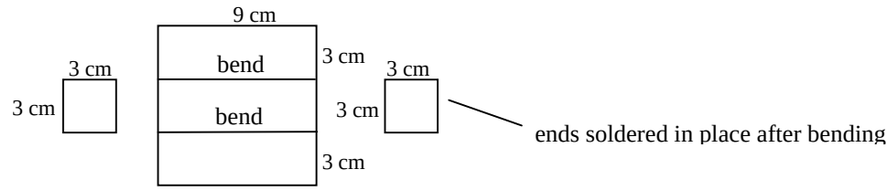
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	4.2 A silver box, with dimensions as outlined below, is made from sheet metal.

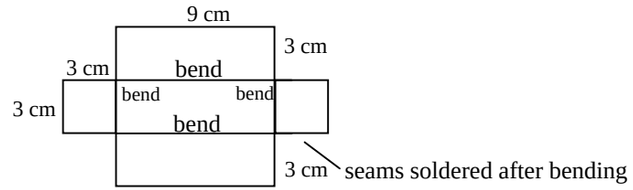


Two methods of construction are shown.

a)



b)



The material cost is \$2.50/cm^2, and soldering costs \$0.70/cm.
For each method of construction, calculate the cost for the box.

Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication
[CN] Connections
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General Outcomes	Specific Outcomes	Illustrative Examples
Describe and apply arithmetic operations on tables to solve problems, using technology as required. *(continued)*	A2–1. (N9) Solve problems involving combinations of tables, using: • addition or subtraction of two tables • multiplication of a table by a real number • spreadsheet functions and templates. [PS, T, V] *(continued)*	1.1 The following is an income and expenses report for a business for the year ending December 31. *(continued)*

	Year 1	Year 2	Year 3	Year 4	Year 5
Sales					
Laundry	$135 000	$148 000	$150 000	$148 000	$140 000
Dry Cleaning	45 000	47 000	48 000	45 000	45 000
Repairs and Sundry	10 000	11 000	11 000	10 000	9 000
Total Sales	$190 000	$206 000	$209 000	$203 000	$194 000
Operating Expenses					
Salaries and Wages	$ 94 000	$ 99 000	$101 000	$101 000	$ 96 000
Operating Supplies	22 000	24 000	25 000	24 000	23 000
Repairs and Misc.	4 000	5 000	6 000	8 000	5 000
Accounting and Legal	2 000	2 000	2 000	2 000	2 000
Advertising	2 000	2 000	2 000	2 000	2 000
Sundry	4 000	5 000	5 000	4 500	4 000
Total Operating Expenses	$128 000	$137 000	$141 000	$141 500	$132 000
Profit Before Overhead	$ 62 000	$ 69 000	$ 68 000	$ 61 500	$ 62 000
Overhead Expenses					
Rent	$ 12 000	$ 14 000	$ 16 000	$ 18 000	$ 18 000
Utilities	6 000	7 000	8 000	9 000	10 000
Insurance	3 000	3 000	3 000	3 000	3 000
Taxes and Licenses	3 000	3 000	4 000	4 000	5 000
Depreciation – Equip.	10 000	8 000	7 000	6 000	5 000
Total Overhead Exp.	$ 34 000	$ 35 000	$ 38 000	$ 40 000	$ 41 000
Profit Before Tax	$ 28 000	$ 34 000	$ 30 000	$ 21 500	$ 21 000
Income Tax	$ 7 000	$ 8 500	$ 7 500	$ 5 375	$ 5 250
Net Profit	$ 21 000	$ 25 500	$ 22 500	$ 16 125	$ 15 750

Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
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General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	1.1 *(continued)* Enter the data from the previous page onto a spreadsheet template provided to students. 1.1.1 a) Calculate the dollar change in total sales, total operating expenses and total overhead expenses, between each year in the table. b) Which is the greatest dollar change? 1.1.2 a) Calculate the percentage change in total sales, total operating expenses and total overhead expenses, between each year in the table. b) Which is the greatest percentage change? 1.1.3 a) Determine the percentage change for each item for each year. b) Predict the figures for each type of income and expense for year 6, and predict the net profit for year 6. 1.1.4 Prepare a line graph showing the annual sales, operating expenses and overhead expenses for the five year period. Use the graph to determine which item has the greatest rate of increase, and which item has the greatest rate of decrease. 1.1.5 For the five year period, use a line of best fit procedure to determine equations of lines of best fit for total sales, total operating expenses and total overhead expenses. Use these equations to predict the values in year 6. From these values, predict the net profit in year 6. 1.1.6 Calculate the net profit as a percentage of sales for each of the five years. In which year did the net profit represent the highest proportion of sales? 1.1.7 Derive a formula relating total sales, total operating expenses, total overhead expenses, income tax and net profit.

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General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	1.2 A banker needs to provide clients with information on foreign exchange. Use the foreign exchange chart provided, or a current chart from a newspaper, to answer the following questions. a) Calculate the cost in Canadian dollars of a refrigerator that costs $850 US. b) Calculate the cost in US dollars of an outboard motor selling in Canada for $1200. c) Hans receives a cheque for 100 Swiss francs from his uncle in Berne. How many Dutch guilders would he get for this cheque? How many Canadian dollars? d) Elsa is going on a holiday to Venezuela. She is told that she will have to pay $3.48 US for every 100 bolivars. How many bolivars will she get for $500 Canadian?

February 1, 1996

Foreign Exchange
Cross Rates

	Canadian dollar	US dollar	British pound	German mark	Japanese yen	Swiss franc	French franc	Dutch guilder	Italian lira
Canada dollar	–	1.3743	2.0762	0.9227	0.012850	1.1337	0.2686	0.8241	0.000865
US dollar	0.7276	–	1.5107	0.6714	0.009350	0.8249	0.1954	0.5997	0.000629
British pound	0.4816	0.6619	–	0.4444	0.006189	0.5460	0.1294	0.3969	0.000417
German mark	1.0838	1.4894	2.2501	–	0.013927	1.2287	0.2911	0.8931	0.000937
Japanese yen	77.82	106.95	161.57	71.81	–	88.23	20.90	64.13	0.067315
Swiss franc	0.8821	1.2122	1.8313	0.8139	0.011335	–	0.2369	0.7269	0.000763
French franc	3.7230	5.1165	7.7297	3.4352	0.047841	4.2208	–	3.0681	0.003220
Dutch guilder	1.2134	1.6676	2.5194	1.1196	0.015593	1.3757	0.3259	–	0.001050
Italian lira	1156.07	1588.79	2400.23	1066.71	14.855491	1310.64	310.52	952.72	–

Strand: Statistics and Probability (Data Analysis)
Students will:
- collect, display and analyze data to make predictions about a population.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
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General Outcomes	Specific Outcomes	Illustrative Examples
Apply line-fitting and correlation techniques to analyze experimental results.	A2–2. (SP3) Determine the equation of a line of best fit, using: • estimate of slope and one point • median–median method • least squares method with technology. [CN, PS, T, V]	2.1 Below are the heights, in metres; and masses, in kilograms, of 13 students. Student — Height (m) — Mass(kg) *a* 1.50 51 *b* 1.51 56 *c* 1.52 54 *d* 1.54 58 *e* 1.56 56 *f* 1.58 62 *g* 1.60 91 *h* 1.61 65 *i* 1.64 66 *j* 1.65 70 *k* 1.66 71 *l* 1.70 74 *m* 1.72 74 Plot the data and determine lines of best fit, using: a) estimation b) median–median method c) least squares method and a computing tool. Calculate the slope and intercept of each of the lines, and compare the results. 2.2 Oil changes per year: 3, 5, 2, 3, 1, 4, 6, 4, 3, 2, 0, 10, 7 Cost of repairs: $300, 300, 500, 400, 700, 400, 100, 250, 450, 650, 600, 0, 150 a) Use graphing technology to prepare a scatterplot. Draw a line of best fit. b) From the line of best fit, make predictions of the repair cost with eight oil changes and with 14 oil changes. c) How reliable are these predictions? d) Beyond what point are the predictions unreliable?

(continued)

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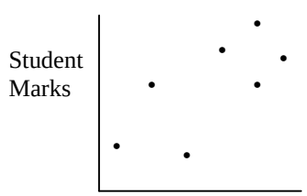
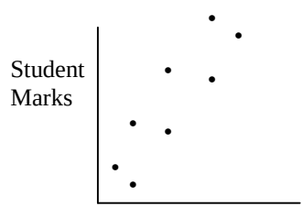
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A2–3. (SP4) Use technological devices to determine the correlation coefficient *r*. [T]	3.1 Measure the height of each person in a class and the distance, from fingertip to fingertip, of their outstretched arms. a) Record this data as a set of ordered pairs, with height as the first element and fingertip to fingertip distance as the second. b) Plot the data on a coordinate system. c) By examining the data, predict a value for the correlation coefficient *r*. d) Using a calculating tool, determine the correlation coefficient *r* for this data.
	A2–4. (SP5) Interpret the correlation coefficient *r* and its limitations for varying problem situations, using relevant scatterplots. [C, R, V]	4.1 What do the following scatterplots and corresponding *r*-values represent? Scatterplot (1)  Scatterplot (2)  Scatterplot (1) is the plot of student marks on their last test against their shoe size. The value for *r* was calculated to be 0.2. Scatterplot (2) is the plot of student marks on their last test against the time spent studying. The value for *r* was calculated to be 0.8. Describe the relationship between the values of *r* and the shape of the scatterplots.

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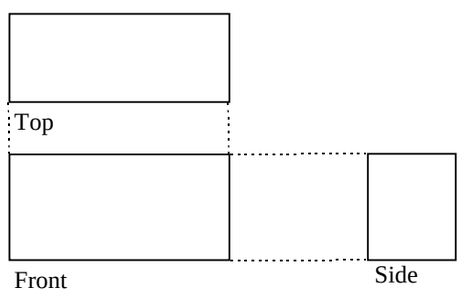
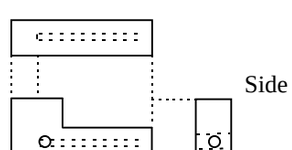
General Outcomes	Specific Outcomes	Illustrative Examples
Demonstrate an understanding of scale factors, and their interrelationship with the dimensions of similar shapes and objects.	A3–1. (SS3) Enlarge or reduce a dimensioned object, according to a specified scale. [C, CN, PS, V]	1.1 A classroom has dimensions of nine metres by eight metres. Produce a scale drawing of the classroom to a scale of 1:50. 1.2 Using surveyor's chains, tapes or other linear measuring devices, measure a chosen plot of land, and calculate its area. Make a scale drawing, using the same measurement system for the drawing as was used with the measurement instruments. 1.3 From the scale drawing below, construct an actual sized model of the box.  Scale = 1:3 1.4 To better visualize an object, architects often build clay models. Use molding clay to build a model of the object that is shown in the plan below. Scale = 2:3 

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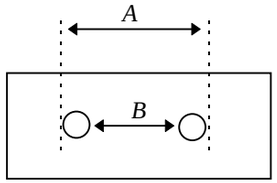
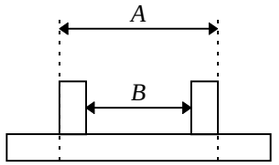
General Outcomes	Specific Outcomes	Illustrative Examples
Use measuring devices to make estimates and to perform calculations in solving problems.	A3–2. (SS12) Calculate maximum and minimum values, using tolerances, for lengths, areas and volumes. [PS, R, V]	2.1 The diagrams represent the top and side views of a drawer handle. If the tolerance specifications are as shown below, determine the maximum and minimum dimensions for the distance between the two centres.  Figure 1: Top View  Figure 2: Side View $A = 10.50 \pm 0.02$ cm $B = 8.20 \pm 0.04$ cm 2.2 To carry a high electric current to an LRT car, a wire must have a cross-sectional area of 45 ± 2 mm^2. What are the maximum and minimum diameters allowed for this wire? 2.3 Steel ball bearings have a diameter of 0.80 ± 0.02 cm. Find the volume of one ball bearing, in cm^3, with the tolerance included. What is the maximum number of such ball bearings that can be made from 1000 cm^3 of steel?
	A3–3. (SS13) Solve problems involving percentage error when input variables are expressed with percentage errors. [PS, R, V]	3.1 A rectangular table was measured to be 420 cm long and 170 cm wide. The length was measured with an error of 1.5% and the width with an error of 2%. Calculate the maximum and minimum possible areas, and estimate the percentage error in the calculated area. 3.2 An experiment is done to find the density of a ball bearing. The mass is measured to be 473 g, with a percentage error of 4%. The diameter is measured to be 5.1 cm ± 2%. a) Calculate the density of the ball bearing, showing its percentage error. b) Which is more effective in reducing percentage error: using a new balance that gives a mass of 473 g ± 1.5%, or using a new calliper that gives a diameter of 5.1 cm ± 1%? Justify your answer with appropriate calculations.

(continued)

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General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A3–4. (SS14) Design an appropriate measuring process or device to solve a problem. [E, PS, V]	4.1 Design and construct a measuring device; e.g., a planimeter with a horizontal vernier scale and cardboard wheel, graduated accordingly. Apply the constructed instrument to find, according to scale, the areas of large, irregular shapes. 4.2 To calculate the loss of wheat after a hailstorm, a farmer counts the number of broken wheat heads in a small area, calculates the proportion of broken heads in the sample and extrapolates this proportion to the entire field. Explain the process used to gather the data, and explain how the estimate of loss is determined.

Strand: Shape and Space (3-D Objects and 2-D Shapes)

Students will:

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

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[E] Estimation and Mental Mathematics
[PS] Problem Solving
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General Outcomes	Specific Outcomes	Illustrative Examples
Develop and apply the geometric properties of circles and polygons to solve problems. *(continued)*	A3–5. (SS27) Use properties of circles and polygons to solve design and layout problems. [CN, PS, V] *(continued)*	5.1 The pattern on a piece of vinyl flooring consists of a square and four equilateral triangles. Each equilateral triangle has as its base one side of the square. Circles are inscribed in each triangle and in the square. a) Start with a square of side length 6 cm. Draw the design, full size. b) Determine the ratio of the area of the small circle to the area of the large circle. 5.2 A standard sheet of paper is 22 cm by 28 cm. The margins are 3 cm on the left, on the right and at the top. The bottom margin is 4 cm. A project summary consists of one table that is 10 cm by 6 cm, three tables that are 8 cm by 5 cm each and 50 cm^2 of text that can be arranged in any shape(s). a) Prepare a possible layout, assuming that the tables can be oriented with their long sides parallel to any edge of the paper. b) Prepare a possible layout, assuming that the long side of any table must be parallel to the top edge of the paper. c) What is the maximum area of text that can be included with the four tables, if each table must have at least 1 cm margins? 5.3 A school has 325 students, all of whom have pictures to be put in the yearbook. The yearbook pages are 9.5 inches by 12 inches. The inside margins are 1.5 inches, the outside margins are 1 inch, the top margin is 1.2 inches, and the bottom margin is 1.5 inches. Each photograph is 53 mm by 35 mm. The minimum space between sides of pictures is 0.5 inches and between the bottom of one picture and the top of the next is 0.9 inches. a) How many photographs can be put on a single page? b) If the number of pages used must be divisible by 8, design a layout so that all 325 photographs can be included, without having any blank pages.

Strand: Shape and Space (3-D Objects and 2-D Shapes)
Students will:
- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
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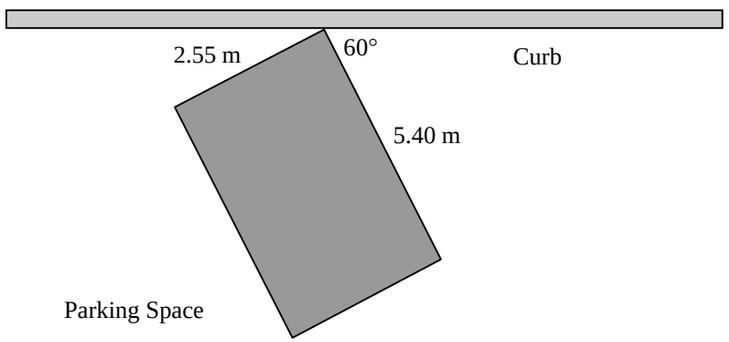
[V] Visualization

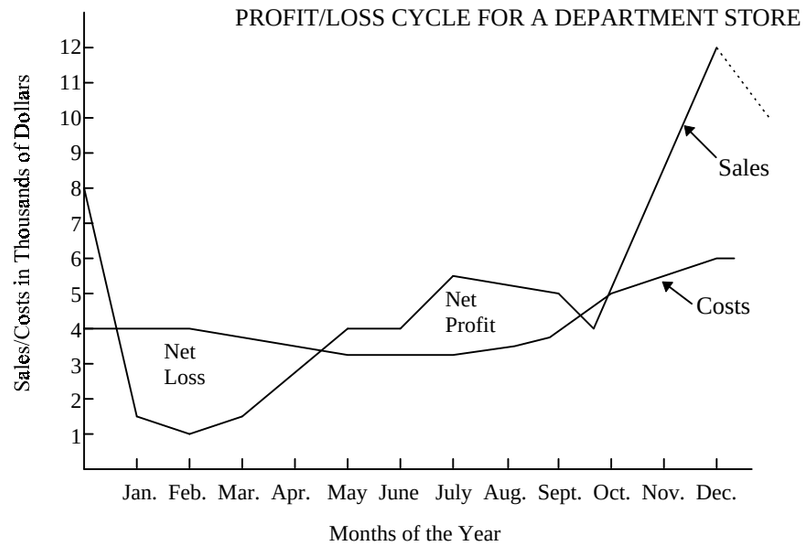
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	5.4 An average automobile requires an angle parking space with dimensions of 2.55 m wide and 5.40 m long. If spaces are being calculated for parallel parking, each automobile will require an additional length of 1.20 m as manoeuvring room. A small town's main street currently uses 60° angle parking.  The town council has contracted you to provide information for town planning decisions regarding parking capacity. 1. Develop a formula for the number of spaces *N* for a given curb length *L* for 60° angle parking. 2. Two years later, increased traffic along the main street makes angle parking unsafe. The town council wants to know how many spaces *N* they will have for a given curb length *L*, if they switch to parallel parking. The town's main street is 200 m long. If the town council wants to retain the same parking capacity as before, how many additional spaces will have to be developed away from the main street in order to offset the spaces lost by the switch to parallel parking? Alberta Education, *Mathematics at Work in Alberta*, p. 9. Adapted with permission. 5.5 A cylindrical can is 12 cm high and 6 cm in diameter. The can is closed, top and bottom. It is cut from a rectangular sheet of metal, and then the pieces are sealed together to form the can. a) Determine the smallest rectangle that can be used to make one can. b) What percentage of the metal is wasted in part a)? c) If seams require 2 mm of extra metal per join, what are the new dimensions of the smallest rectangle?

Strand: Statistics and Probability (Data Analysis)

Students will:

- collect, display and analyze data to make predictions about a population.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
Analyze graphs or charts of given situations to derive specific information.	A4–1. (SP6) Extract information from given graphs of discrete or continuous data, using: • time series • glyphs (custom pictorial representations) • continuous data • contour lines. [C, CN, E, PS, R, V]	1.1 Sometimes points representing discrete data are joined, even though specific values for intermediate points may not be available. Give examples where such a practice is acceptable and other examples where it is not. 1.2  A department store may experience “peaks” and “troughs” in its revenue (sales). Christmas season and summer holidays are the two strongest periods. January to April can be the weakest period. If net profits are greater than net losses over the year, the business can stay in operation. a) During periods of net loss, what might the business do for finances? b) Over which of the two curves, Sales or Costs, does the business have the most managerial control? c) Discuss the net profit for May.
(continued)	*(continued)*	

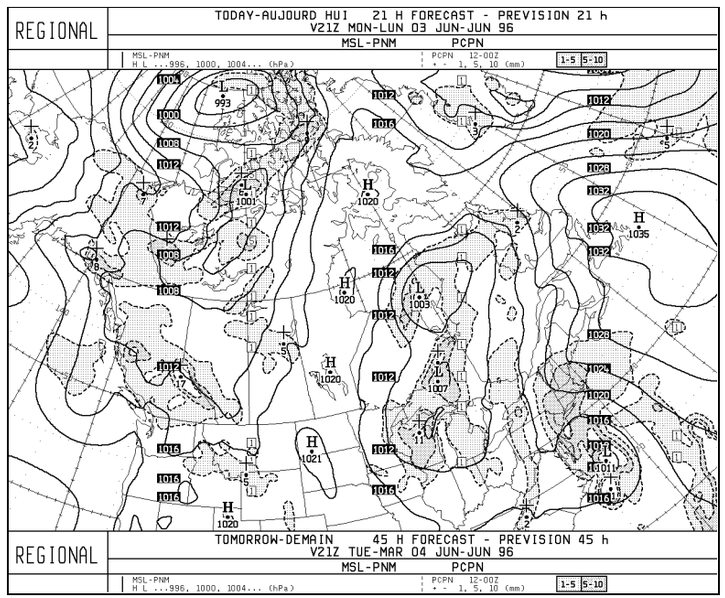
Strand: Statistics and Probability (Data Analysis)

Students will:

- collect, display and analyze data to make predictions about a population.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	1.3 The map below shows the atmospheric pressure, measured in hectopascals, forecast at various weather stations for June 3, 1996. A current Environment Canada map can be found on the Internet at: http://www.cmc.doe.ca/cmc/images/charts/125_100.gif



From Environment Canada, on line, June 2, 1996, with permission.

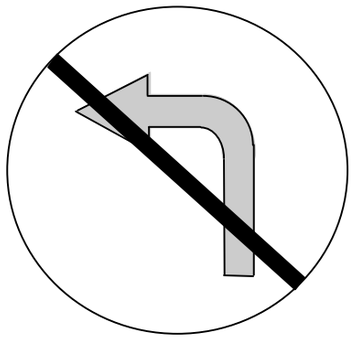
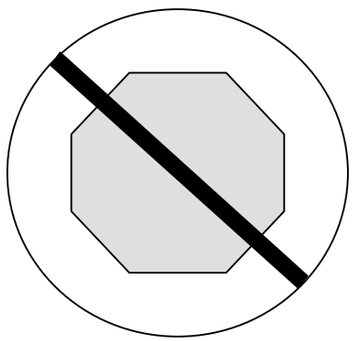
a) Using a current map, estimate the forecasted atmospheric pressure at your location.
b) What is the lowest pressure recorded in Canada for the date on your map?
c) What is the highest pressure recorded in Canada for the date on your map?
d) Shaded areas show where rain is falling. What connection is there between atmospheric pressure and rainfall?

Strand: Statistics and Probability (Data Analysis)

Students will:

- collect, display and analyze data to make predictions about a population.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	1.4 Pictorial road signs, as used in Canada and most other countries, are examples of glyphs. They use shapes and sizes to convey the type of sign; then levels of symbols are used to convey meaning. Thus, the sign for *no left turn*, shown in the diagram below, is a two-level glyph that has a circular shape, a left turn arrow and a bar through the arrow.  a) What does the circular shape represent? b) What does the bar mean? c) What is the meaning of the sign below, and how is the meaning conveyed?  d) Design a three-level glyph for *no right turn for trucks*. Why is there no such sign in provincial operator manuals?

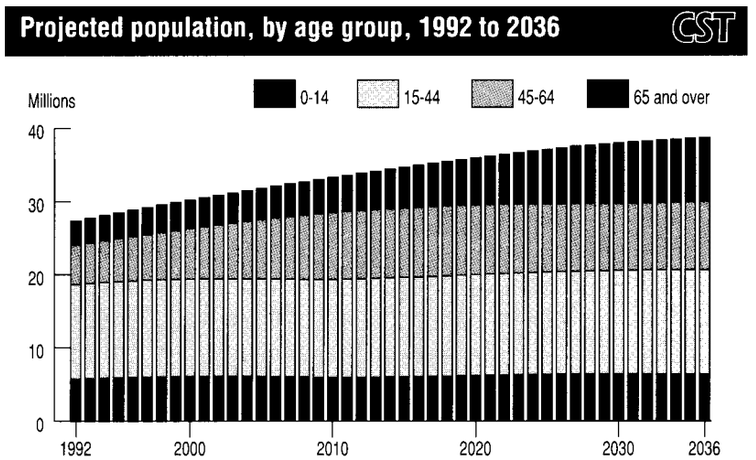
Strand: Statistics and Probability (Data Analysis)

Students will:

- collect, display and analyze data to make predictions about a population.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A4–2. (SP7) Draw and validate inferences, including interpolations and extrapolations, from graphical and tabular data. [CN, E, PS, V]	2.1 The bar graph below shows the projected Canadian population, by age group, for the period from 1992 to 2036.



Source: Statistics Canada, Demography Division, unpublished data, projection 3 modified to use T.F.R. of 1.84, annual immigration of 250,000, annual emigration of 86,886.

Reproduced by authority of the Minister of Industry, 1996, Statistics Canada, *Canadian Social Trends*, Catalogue 11–008E, Number 29 Summer 1993, p. 6.

a) What year is Canada's population expected to reach 30 million?
b) Describe the rate of increase of Canada's population, both overall and by age group.
c) Estimate the median age of the Canadian population in 1992 and in 2036.
d) Estimate when Canada's population will reach 40 million.

(continued)

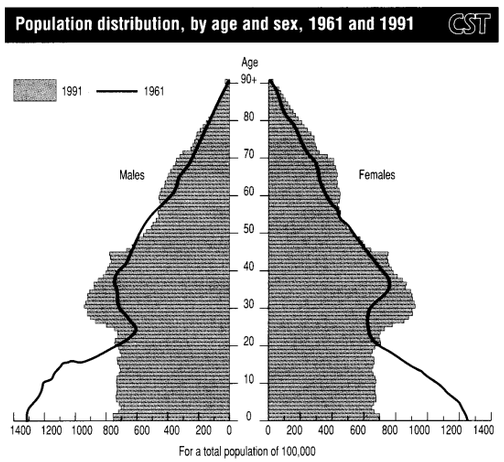
Strand: Statistics and Probability (Data Analysis)

Students will:

- collect, display and analyze data to make predictions about a population.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.2 The population pyramids shown below are for Canada for 1961 and 1991. Separate data are shown for males and females.



Source: Statistics Canada, Demography Division.

Reproduced by authority of the Minister of Industry, 1996, Statistics Canada, *Canadian Social Trends*, Catalogue 11–008E, Number 29 Summer 1993, p. 6.

a) What is the approximate ratio of male births to female births? Has this ratio changed from 1961 to 1991? Describe any change, and make a hypothesis for the change.
b) The baby boom was a period of time that was characterized by a greater number of births than in the years before or after. What evidence is there for a baby boom, and what were the years of the baby boom?
c) The birth rate was low during the years of the Depression (1931–39) and World War II (1939–45). Where is there evidence for this?
d) The shapes of the population pyramids, especially the 1961 pyramid, show a marked lack of symmetry between the data for males and the data for females. Identify where the lack of symmetry is greatest, and make hypotheses for the lack of symmetry. How could these hypotheses be tested?
e) Sketch a population pyramid for the year 2011, identifying any assumptions made. Use the graph from illustrative example 2.1 as necessary.

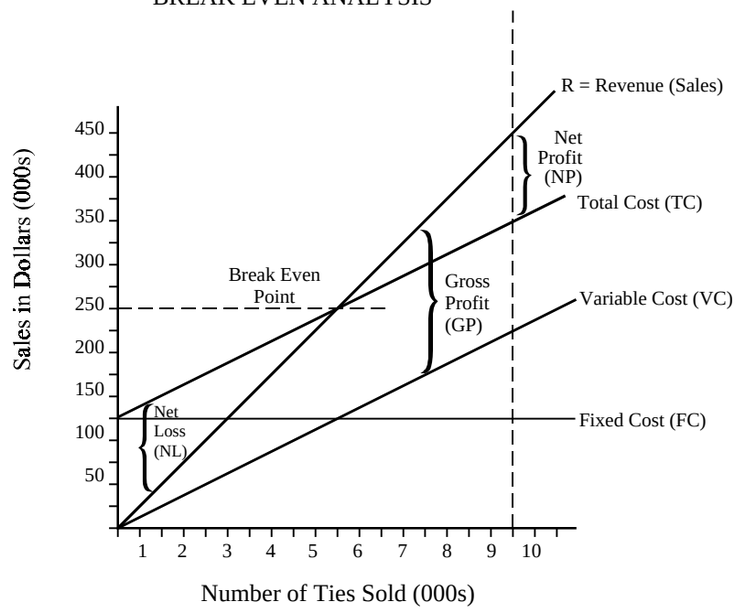
Strand: Statistics and Probability (Data Analysis)

Students will:

- collect, display and analyze data to make predictions about a population.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.3 BREAK EVEN ANALYSIS



A small store in a shopping mall sells neckties for $50 each. The ties cost the merchant $25 each. Yearly operating expenses, such as wages, rent, utilities and insurance, are $125 000.

VC + FC = TC, R – VC = GP, GP – FC = NP, R – TC = NP (or NL)

If the store sold 100 ties, the sales (R) would not pay for the expenses; therefore, the store would be losing money. At $250 000 in sales, the store's sales just cover all the cost of the goods sold (VC) and expenses (FC). Therefore, the store just breaks even. If the store sells 9000 ties in a year:

a) What is the net profit?
b) What is the gross profit?
c) What is the fixed cost?

Strand: Statistics and Probability (Data Analysis)

Students will:

- collect, display and analyze data to make predictions about a population.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A4–3. (SP8) Design different ways of presenting data and analyzing results, by focusing on the truthful display of data and the clarity of presentation. [C, CN, T, V]	3.1 Collect an example from a newspaper or magazine in which a graph has been presented in a potentially deceptive manner. Identify the source from which the graph was taken. Explain briefly the ways in which the graph might have been deceptively presented and then show ways the data might be presented more fairly or in a less distorted fashion. Include the graph with the project, and cite its source. Excerpted and adapted with permission from *Data Analysis and Statistics* (*Curriculum and Evaluation* Addenda Series, Grades 9–12), copyright 1992 by the National Council of Teachers of Mathematics. All rights reserved. 3.2 **3.2 CANADA'S POPULATION[1] (THOUSANDS)** Reproduced by authority of the Minister of Industry, 1996, Statistics Canada, *Canada Year Book 1994*, Catalogue 11–402E/1994, p. 112. Using data for 10-year intervals, starting in 1921 and ending in 1991, design an honest presentation of the data that can be included in different term papers dealing with each of the following topics: a) the increase in Canada's population b) the westward shift of Canada's population c) the population of Saskatchewan d) the dominant position of Ontario and Quebec within Canada. Explain your choice of data selection and data presentation.

	Nfld.	PEI	NS	NB	Que.	Ont.	Man.
1921	. . .	88.6	523.8	387.9	2,360.5	2,933.7	610.1
1931	. . .	88.0	512.8	408.2	2,874.7	3,431.7	700.1
1941	. . .	95.0	578.0	457.4	3,331.9	3,787.7	729.7
1951	361.4	98.4	642.6	515.7	4,055.7	4,597.6	776.5
1956	415.1	99.3	694.7	554.6	4,628.4	5,404.9	850.0
1961	457.9	104.6	737.0	597.9	5,259.2	6,236.1	921.7
1966	493.4	108.5	756.0	616.8	5,780.8	6,960.9	963.1
1971	522.1	111.6	789.0	634.6	6,027.8	7,703.1	988.2
1976	557.7	118.2	828.6	677.3	6,234.5	8,264.5	1,021.5
1981	567.7	122.5	847.4	696.4	6,438.2	8,624.7	1,026.2
1986	568.3	126.6	873.2	710.4	6,540.2	9,113.0	1,071.2
1987[2]	568.1	127.3	878.0	712.3	6,592.6	9,265.0	1,079.0
1988[2]	568.8	128.5	881.9	714.3	6,640.8	9,431.1	1,084.1
1989[2]	571.1	129.9	888.3	717.8	6,698.2	9,589.6	1,086.3
1990[2]	572.7	130.7	895.1	722.6	6,768.2	9,749.6	1,089.0
1991[2]	575.7	131.2	901.0	727.6	6,847.4	9,917.3	1,094.4
1992[3]	577.5	130.5	906.3	729.3	6,925.2	10,098.6	1,096.8

	Sask.	Alta.	BC	YT	NWT	Canada
1921	757.5	588.5	524.6	4.1	8.1	8,787.4
1931	921.8	731.6	694.3	4.2	9.3	10,376.7
1941	896.0	796.2	817.8	5.0	12.0	11,506.7
1951	831.7	939.5	1,165.2	9.1	16.0	14,009.4
1956	880.7	1,123.1	1,398.5	12.2	19.3	16,080.8
1961	952.2	1,332.0	1,629.1	14.6	23.0	18,265.3
1966	955.4	1,463.2	1,873.7	14.4	28.7	20,014.9
1971	926.2	1,627.9	2,184.6	18.4	34.8	21,568.3
1976	921.3	1,838.0	2,466.6	21.8	42.6	22,992.6
1981	968.3	2,237.3	2,744.2	23.2	45.7	24,341.7
1986	1,010.2	2,375.1	2,889.0	23.5	52.2	25,353.0
1987[2]	1,015.8	2,377.7	2,925.0	24.5	52.0	25,617.3
1988[2]	1,013.5	2,388.7	2,980.2	25.2	52.2	25,909.2
1989[2]	1,006.7	2,425.9	3,048.3	25.5	52.9	26,240.3
1990[2]	997.1	2,473.1	3,132.5	26.0	53.9	26,610.4
1991[2]	994.2	2,521.6	3,212.1	26.7	55.2	27,004.4
1992[3]	993.2	2,562.7	3,297.6	27.9	56.5	27,402.1

[1] *As of June 1.*
[2] *Final postcensal estimates.*
[3] *Updated postcensal estimates.*

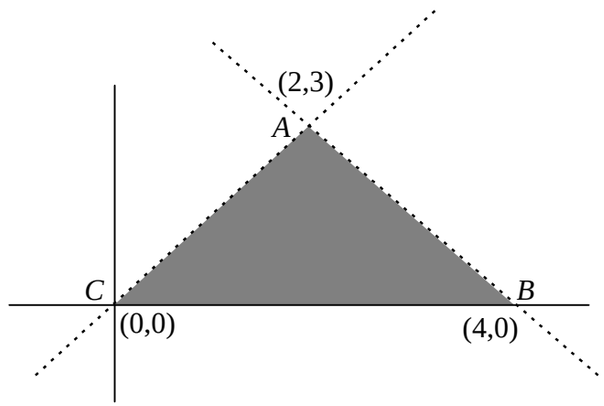
Sources
Employment and Immigration Canada
Statistics Canada

Strand: Patterns and Relations (Variables and Equations)

Students will:

- represent algebraic expressions in multiple ways.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

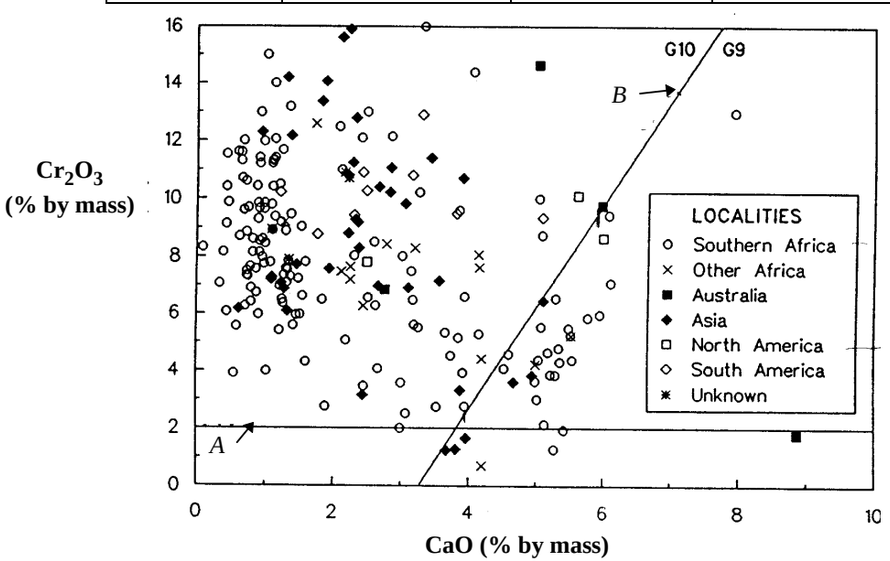
General Outcomes	Specific Outcomes	Illustrative Examples
Use linear programming to solve optimization problems.	A5–1. (PR36) Solve, graphically, systems of linear inequalities, in two variables, using technology. [CN, PS, T, V]	1.1 Graph the solution to the following system of inequalities: $3x - y > 4$ $2x + y \leq 6$. 1.2 Given the following diagram, provide the system of inequalities whose solution is the interior of ΔABC. 
	A5–2. (PR37) Design and solve linear and nonlinear systems, in two variables, to model problem situations. [C, CN, PS, R, V]	2.1 A farmer has chickens and turkeys. He has fewer than 100 birds. He sells chickens for \$10 each and turkeys for \$30 each, and he earns more than \$1500. Represent the situation graphically, and shade the region containing possible solutions. 2.2 A desktop publisher has to design formats for rectangular data tables and uses graphing grids as a design tool. Shade the region on the grid that represents the possible dimensions of rectangles in which the length is less than twice the width, the perimeter is at most 48 cm, and the area is at least 32 cm^2.
(continued)	*(continued)*	

Strand: Patterns and Relations (Variables and Equations)
Students will:
- represent algebraic expressions in multiple ways.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.3 Diamond prospecting is done by testing the garnets found in rocks called kimberlites for the per cent content of Cr_2O_3 and CaO. The following graph shows the Cr_2O_3 to CaO ratio for diamond-bearing rocks worldwide. Diamonds occur 85% of the time with garnets classed as G10. This G10 area is defined by the function lines *A* and *B*. a) Define the system of linear inequalities that determines the G10 area. b) Which of the following samples would indicate that further prospecting is warranted?

Garnet Sample No.	Garnet mass (g)	Cr_2O_3 mass (g)	CaO mass (g)
1	16.1	1.71	1.35
2	8.7	0.094	0.72
3	4.2	0.35	0.051
4	12.0	1.80	0.61



Strand: Patterns and Relations (Variables and Equations)
Students will:
- represent algebraic expressions in multiple ways.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A5–3. (PR38) Apply linear programming to find optimal solutions to decision-making problems. [C, PS, R, T, V]	3.1 An agricultural club has a 10 ha plot of land available for a market garden project. It has selected corn and potatoes to plant and has $4000 for the project. The corn will cost $300/ha to grow and will generate $375/ha gross income. The potatoes will cost $500/ha to grow and will generate $650/ha gross income. a) Construct the function that describes the revenue from the project. b) Construct the inequalities that describe the restrictions. c) Plot this system of inequalities. d) Identify the feasible solutions. e) Determine the optimal solution. 3.2 A manufacturing company originally has three employees. The company directive is to hire additional persons to build widgets. Widgets can only be built by teams of 2 people. Eight teams can produce 500 widgets and 10 teams can produce 600 widgets. It is assumed that a linear relation exists between the number of teams and the number of widgets produced. The plant has the capacity to produce 1000 widgets. The Department of Health limits the total number of employees in the building to 15, due to the air quality problem. Using multimedia techniques and linear programming, write a presentation to the board of directors explaining how to optimize production. 3.3 Find the maximum and minimum values of the quantity C, where $C = 2x - 5y$, given the constraints: $x \geq 0$ $y \geq 0$ $x \leq 12$ $y \leq x + 8$ $x + 2y \leq 28$ $3x + y \leq 39$.

Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
Describe and apply operations on matrices to solve problems, using technology as required. *(continued)*	A6–1. (N17) Show an understanding of matrices and perform the operations of addition, scalar multiplication and matrix multiplication. [C, T]	1.1 Calculate each of the following: a) $\begin{pmatrix}4 & 6\\ 2 & -1\end{pmatrix}+\begin{pmatrix}3 & 8\\ 2 & -5\end{pmatrix}$ b) $4\begin{pmatrix}2 & 3 & -4\\ 1 & 0 & 5\end{pmatrix}$ c) $\begin{pmatrix}3 & 2\\ -1 & 4\end{pmatrix}\begin{pmatrix}4 & 1 & -2\\ 3 & 5 & 0\end{pmatrix}$. 1.2 Represent a real-world situation, using a matrix. a) For towns participating in a local hockey league, create hockey standings, including home, away and combined records. b) Diagram various networking strategies, such as those found in an office, in a telephone system, in a roadway system. 1.3 Singh's Grocery sells several different kinds of breakfast cereal, each at a different price. Cereal A is 2.65/bx. Cereal B is 3.73/bx. Cereal C is 3.15/bx. Cereal D is 2.99/bx. Write the price list as a row matrix. On Wednesday, they sold the following: 5 boxes of Cereal A 8 boxes of Cereal B 7 boxes of Cereal C 10 boxes of Cereal D. Write Wednesday's sales as a column matrix. Use matrix multiplication to find Wednesday's total revenues.

Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication **[CN]** Connections **[E]** Estimation and Mental Mathematics **[PS]** Problem Solving **[R]** Reasoning **[T]** Technology **[V]** Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A6–2. (N18) Solve problems, using the operations of addition, subtraction, scalar multiplication and matrix multiplication on matrices. [PS, R, T, V]	2.1 A store sells items that are tax-free, items that have a 7% GST charge on the base price and items that have both a 7% GST and a 9% PST charge on the base price. A weekend's sales, before tax, can be represented by: $\boldsymbol{S} = \begin{matrix}\text{Tax free}\\ \text{GST only}\\ \text{GST and PST}\end{matrix} \begin{matrix}\text{Saturday}\quad\text{Sunday}\\ \begin{pmatrix}500 & 700\\ 1250 & 400\\ 800 & 700\end{pmatrix}\end{matrix}$ a) What does the matrix $\boldsymbol{A} = \begin{pmatrix}0 & 0\\ 1250 & 400\\ 800 & 700\end{pmatrix}$ represent? b) What does the matrix $\boldsymbol{B} = \begin{pmatrix}0 & 0\\ 0 & 0\\ 800 & 700\end{pmatrix}$ represent? c) What does the matrix $(\boldsymbol{S} + 0.07\boldsymbol{A} + 0.09\boldsymbol{B})$ represent? d) Write a matrix to represent the total tax collected. What are the entries for this matrix? e) Budgets change the tax rates to 5% for GST and 12% for PST. Write a new matrix for the total taxes collected in this new situation. What are the entries for this new matrix? 2.2 Sales of economy cars were 200 in 1993 and rose by 3% in 1994. Sales of midsize cars were 300 in 1993 and rose by 10% in 1994. Sales of luxury cars were 40 in 1993 and fell by 5% in 1994. Show that 1994 sales can be represented by the matrix multiplication shown. $\begin{pmatrix}1.03 & 0 & 0\\ 0 & 1.10 & 0\\ 0 & 0 & 0.95\end{pmatrix}\begin{pmatrix}200\\ 300\\ 40\end{pmatrix} = \begin{pmatrix}206\\ 330\\ 38\end{pmatrix}$
	(continued)	

Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.3 Soccer has been experimenting with using league standings to discourage tie games, especially those with no goals. The traditional scheme of 2 points for a win and 1 point for any tie has been replaced by 3 points for a win and 1 point for any tie. Proposed schemes have included 3 points for a win, 1 point for ties that have goals scored and 0 points for ties with no goals; as well as a scheme with 5 points for a win, 3 points for a tie with goals scored and 0 points for a tie with no goals. In a local soccer league the top four team records after 42 games are:

	Wins	Ties with Goals	Ties with no Goals	Losses
Tigers	30	2	8	2
Irish	24	9	2	7
Colts	25	7	0	10
Jets	26	1	10	5

a) Multiply the matrix above by $\begin{pmatrix} 2 \\ 1 \\ 1 \\ 0 \end{pmatrix}$ to get the traditional points.

b) Multiply the matrix above by $\begin{pmatrix} 3 \\ 1 \\ 1 \\ 0 \end{pmatrix}$, by $\begin{pmatrix} 3 \\ 1 \\ 0 \\ 0 \end{pmatrix}$ and by $\begin{pmatrix} 5 \\ 3 \\ 0 \\ 0 \end{pmatrix}$ to get the points under the alternative systems.

c) Which of the alternative scoring systems can make the Irish second in the standings?
d) Which of the alternative scoring systems can make the Colts second in the standings?
e) Which of the alternative scoring systems can make the Jets second in the standings?
f) Design a system that would drop the Tigers out of first place. Is it a fair system?

Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.4 Diplomacy in the Asia-Pacific region is complicated by different alliances. The exchange of diplomats in 1996 can be represented by the matrix ***D***, where: $$\boldsymbol{D} = \begin{array}{c} \\ \text{North Korea} \\ \text{South Korea} \\ \text{China} \\ \text{Taiwan} \\ \text{Canada} \end{array} \begin{array}{c} \begin{array}{ccccc} \text{NK} & \text{SK} & \text{Ch} & \text{T} & \text{Can} \end{array} \\ \begin{pmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 \end{pmatrix} \end{array}$$ An entry of 1 represents an exchange of ambassadors; an entry of 0 represents no exchange of ambassadors. a) Draw a network diagram to represent the matrix. Powers of the matrix ***D*** represent the number of diplomatic channels available for the exchange of data. The matrix $\boldsymbol{D}^2$ represents channels with one intermediary, matrix $\boldsymbol{D}^3$ represents channels with two intermediaries, and matrix $\boldsymbol{D}^4$ represents channels with three intermediaries. The channels can be listed after the number of channels are identified. *(continued)*

Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.4 *(continued)* b) Verify that the matrix $\boldsymbol{D}^2$ is given by: $\begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 2 & 1 & 0 & 0 \\ 0 & 1 & 2 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 1 & 2 \end{pmatrix}$ Explain why there are no zero entries along the diagonal between top left and bottom right. c) Verify that $\boldsymbol{D}^3$ is the matrix: $\begin{pmatrix} 0 & 1 & 2 & 0 & 0 \\ 1 & 0 & 0 & 2 & 3 \\ 2 & 0 & 0 & 1 & 3 \\ 0 & 2 & 1 & 0 & 0 \\ 0 & 3 & 3 & 0 & 0 \end{pmatrix}$ Trace the channel between China and Taiwan. d) The matrix $\boldsymbol{D}^4$ is given by: $\begin{pmatrix} 2 & 0 & 0 & 1 & 3 \\ 0 & 5 & 4 & 0 & 0 \\ 0 & 4 & 5 & 0 & 0 \\ 1 & 0 & 0 & 2 & 3 \\ 3 & 0 & 0 & 3 & 6 \end{pmatrix}$ Trace out the path that a message would take to go from North Korea to Taiwan, using three intermediaries. *(continued)*

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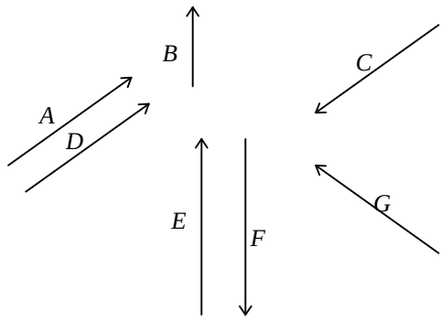
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.4 *(continued)* e) The matrix $\boldsymbol{D} + \boldsymbol{D}^2 + \boldsymbol{D}^3$ is given by: $\begin{pmatrix} 1 & 1 & 3 & 0 & 1 \\ 1 & 2 & 1 & 3 & 4 \\ 3 & 1 & 2 & 1 & 4 \\ 0 & 3 & 1 & 1 & 1 \\ 1 & 4 & 4 & 1 & 2 \end{pmatrix}$ This matrix represents all those channels that need two or fewer intermediaries. Trace out the one channel between Canada and Taiwan and all four channels between Canada and South Korea.
	A6–3. (N19) Use matrices and matrix operations to model and to solve consumer, network and schedule problems. [C, CN, PS, R, T, V]	3.1 A washing powder is sold in 6 L and 10 L packages. Market research shows that 7% of the users of the 6 L size switch to the 10 L size for their next purchase, and 3% of the users of the 10 L size switch to the 6 L size for their next purchase. a) If the original market share was 60% for 6 L and 40% for 10 L, what is the market share for each size in the next round of purchases? b) What is the market share for each size for the third round of purchases? c) Rewrite the processes for a) and b) in terms of a 2×2 transition matrix and a 2×1 market share matrix. d) What would be the final market share? e) Use iteration to estimate how quickly the final market share for each size is approached. 3.2 A car manufacturer makes three models of car: full size, compact and economy. Of full size car buyers, 13% will switch to compact and 2% to economy. Of compact car buyers, 5% will switch to full size and 4% to economy. Of economy car buyers, 21% will switch to compact and 3% to full size. a) If the initial market share is 30% full size, 20% compact and 50% economy, what is the market share for each model for the next round of purchases? b) What is the market share for each model for the third round of purchases? c) Write a 3×3 matrix $\boldsymbol{T}$ that represents the switching behaviour. d) Find the final market share for each model.

Strand: Shape and Space (3-D Objects and 2-D Shapes)
Students will:
- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
Solve problems involving polygons and vectors, including both 3-D and 2-D applications.	A6–4. (SS30) Use and give 3-D and 2-D examples of vector terminology and notation, including: • vector (direction, magnitude) • scalar • unit vector • collinear vectors • opposite vectors • parallel vectors • resultant vectors. [C, CN]	4.1  Given the above vectors, complete the following chart. opposite vectors parallel vectors resultant vectors collinear vectors 4.2 Car *A* is travelling at 110 km/h and Car *B* is travelling at 100 km/h. a) Give an example where the magnitude of $A - B$ is equal to 210 km/h. b) Give an example where the magnitude of $A - B$ is equal to 10 km/h. c) If *A* and *B* are at right angles, what is the magnitude of $A - B$?

(continued)

Strand: Shape and Space (3-D Objects and 2-D Shapes)
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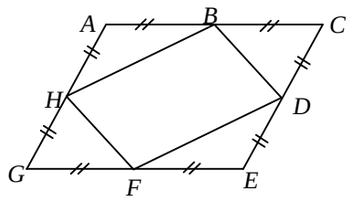
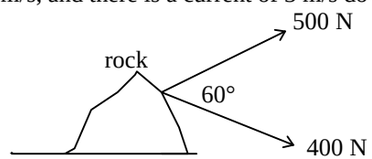
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A6–5. (SS31) Assign meaning to the multiplication of a vector by a scalar. [CN]	5.1 The vector $\vec{a}$ is 40 km/h east. Make a scale drawing of each of the following vectors: a) $3\vec{a}$ b) $7\vec{a}$ c) $-3\vec{a}$ d) $1.6\vec{a} + 4\vec{a}$. 5.2 A price list is represented in Canadian dollars by the vector $\vec{p}$ = (27, 38, 14, 26). If the Canadian dollar is worth \$0.71 US, what does the vector $\vec{q} = 0.71\vec{p}$ represent?
	A6–6. (SS32) Perform vector additions and subtractions, using triangle or parallelogram methods. [V]	6.1  Using the above diagram of a rhombus *ACEG*, determine the vector addition of each of the following: a) *AH* + *HG* b) *GF* + *BC* c) *GF* + *CB* d) *FD* + *DE*. 6.2 A ski jumper encounters a horizontal friction of 85 N backward, a vertical weight of 750 N downward and an air resistance of 340 N upward. Draw the vector addition of these forces, and use the drawing to find the magnitude and direction of the resultant force.
	A6–7. (SS33) Determine the magnitude and direction of a resultant vector, using triangle, parallelogram or component methods. [CN, T, V]	7.1 A boat is travelling across a river with a forward velocity of 14 m/s, and there is a current of 3 m/s down the river. How fast is the boat travelling? 7.2 John and Marie are using two ropes to pull a rock. Draw a vector diagram to estimate the magnitude and direction of the resultant force. Verify the estimate by a calculation, using components. 

Strand: Shape and Space (3-D Objects and 2-D Shapes)
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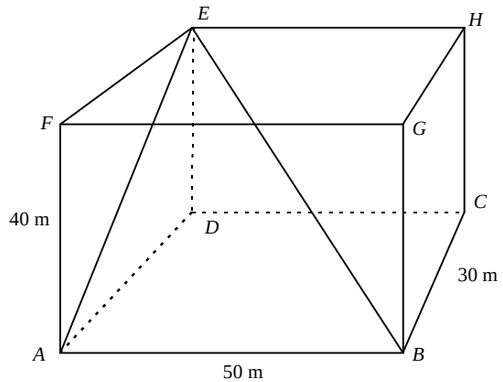
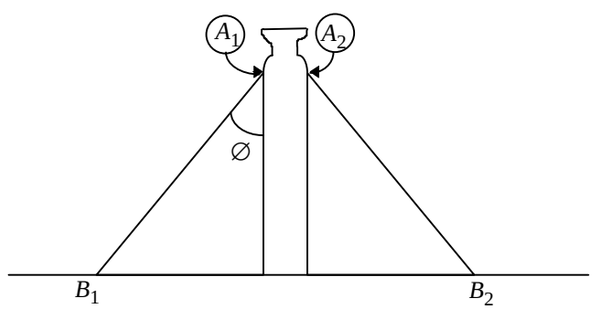
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A6–8. (SS34) Use vector diagrams and trigonometry to analyze and solve practical problems in 3-D and 2-D. [CN, PS, V]	8.1 In the diagram, *ED* is a vertical transmission tower. *EA* and *EB* are two of the guy wires. Use the information in the diagram to calculate the angle between guy wires *AE* and *EB*.
		
		8.2 The support cables for a gas plant flare attach at points A_1 and A_2. The angle of attachment (∅) is 28°. If a horizontal wind from left to right exerts a force of 1200 N at point A_1, what is the force lifting the anchor at point B_1?
		
		8.3 An aircraft flying horizontally on a heading of 285° is pushed by a wind from 195°. Angles are measured clockwise from north. The indicated air speed of the aircraft is 300 km/h. The wind is constant at 90 km/h. After 1 hour and 15 minutes of flight, what will be the aircraft's change in location?
	(continued)	

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General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	8.4 Model, by drawing a diagram, Jack's jogging route, if he jogs north at 15 km/h for 30 minutes and then turns east and jogs at 12 km/h for 20 minutes. How far has he jogged in total? How far is he from his starting point? In what direction does he need to go to return to the start by the shortest path?

Strand: Patterns and Relations (Patterns)

Students will:

- use patterns to describe the world and to solve problems.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
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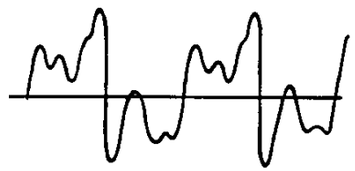
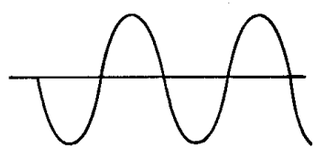
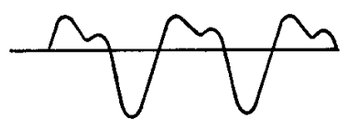
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
Generate and analyze cyclic, recursive and fractal patterns.	A7–1. (PR10) From cyclic data produce a periodic graph. [C, PS, V]	1.1 Research the sunrise time for a period of one year, and graph it. From your graph, determine the time of sunrise for March 12.
	A7–2. (PR11) Predict results from graphs that represent periodic events. [E, R, V]	2.1 The following are graphs showing the patterns produced on an oscilloscope when four different musical instruments are played.  violin  clarinet  tuning fork  organ pipe From *Fundmentals of Physics* by Martindale et al. Reprinted by permission of ITP Nelson Canada. For each instrument: a) find the amplitude b) find the period c) sketch the graph, if the instrument is played louder d) sketch the graph, if the instrument is used to play a higher note.

(continued)

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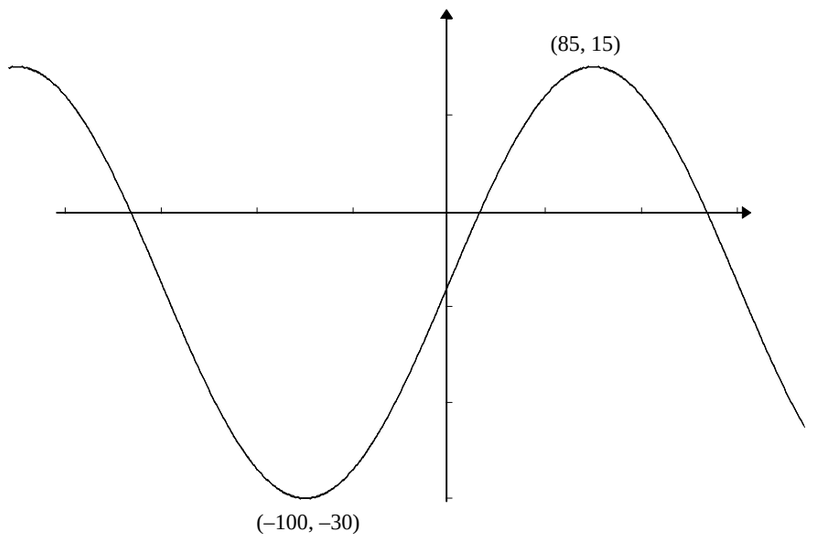
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A7–3. (PR12) Describe periodic events, including sinusoidal curves, using correct terminology. [C, V]	3.1 A temperature–time graph was drawn for a northern Saskatchewan town. The variable plotted on the horizontal axis is the calendar date, with April 1 as zero and the unit being days. The variable plotted on the vertical axis is the temperature in degrees Celsius. The graph is drawn below. Find the: a) amplitude b) period c) maximum and minimum values d) vertical shift e) date for the maximum temperature f) date for the minimum temperature. 

Strand: Patterns and Relations (Patterns)

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[C]	Communication	**[PS]**	Problem Solving
[CN]	Connections	**[R]**	Reasoning
[E]	Estimation and Mental Mathematics	**[T]**	Technology
		[V]	Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A7–4. (PR13) Collect sinusoidal data; sketch the graph of the data; and, using degrees, represent the data with an equation of the form: • $y = a \sin(kt) + c$ **OR** • $y = a \cos(kt) + c$. [CN, PS, T, V]	4.1 Collect data from real-world situations, such as: a) hours of daylight b) low tide and high tide c) average low and average high temperatures on different dates of the year. Plot the data, and determine an approximate equation for the data in the form of: $y = a \sin(kt) + c$ **or** $y = a \cos(kt) + c$.
	A7–5. (PR14) Develop sinusoidal equations, using degrees, to represent periodic behaviour. [CN, PS, T]	5.1 Sketch a graph, and build an equation to represent the following situation. The average daily maximum temperature in Vancouver follows a sinusoidal pattern with a highest value of 24°C and a lowest value of 8°C. The highest value occurs on July 15 and the lowest value on January 15.

Strand: Patterns and Relations (Patterns)

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General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A7–6. (PR15) Use technology to generate and graph finite or infinite sequences whose recursive definition may or may not be given. [PS, T, V]	6.1 For the Fibonacci sequence 1, 1, 2, 3, 5, . . . , determine a recursive form. 6.2 Find the 20^{th} term of the sequence $t_n = t_{n-1} + 2$, where $t_1 = 1$, by generating a table or graph. 6.3 A sequence is defined by $t_n = 3t_{n-1} + 2t_{n-2}$. Determine the value of t_9, given $t_0 = 5$ and $t_1 = 3$. Use a spreadsheet to find t_{100} and the first term of the sequence that has a value of more than 1 million.
	A7–7. (PR16) Identify sequences that appear to be: • divergent • convergent • oscillating • static. [C, V]	7.1 Calculate several terms of the following sequences where the n^{th} term is defined as follows: a) $a_n = 6^{n+1}$ b) $a_n = (-2)^n$ c) $a_n = 6$ d) $a_n = \frac{1}{2n}$. Graph the results. Use this information to hypothesize each of the sequences as divergent, convergent, oscillating or static. 7.2 The monthly closing balances of a loan form a sequence. Under what conditions will these balances form a divergent sequence? 7.3 Regular polygons of n sides are inscribed in a circle of radius 10 cm. The perimeters P_n of these regular polygons form a sequence. Is this sequence convergent? Estimate the value of P_n, if n is very large.

Strand: Patterns and Relations (Patterns)

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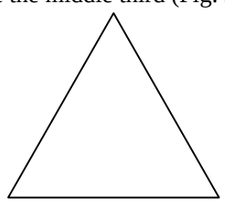
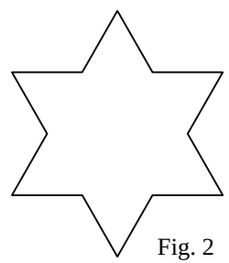
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A7–8. (PR17) Construct a fractal pattern by repeatedly applying a procedure to a geometric figure. [CN, R, V]	8.1 The following example is the Koch snowflake curve. Construct an equilateral triangle (Fig. 1). Trisect each side, construct an equilateral triangle on each middle third, and delete the middle third (Fig. 2).  Fig. 1  Fig. 2 For each segment in Fig. 2, repeat the above. 8.2 Construct your own fractal pattern.
	A7–9. (PR18) Use the concept of self-similarity to compare and/or predict the perimeters, areas and volumes of fractal patterns. [CN, R, V]	9.1 For illustrative example 8.1, predict the perimeter of the fifth pattern.
	(continued)	

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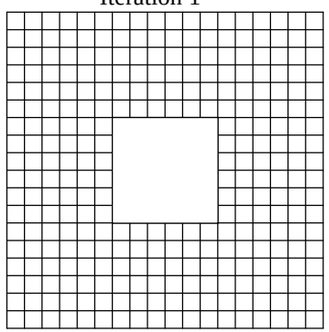
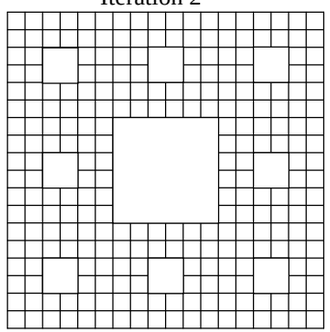
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	9.2 Fractal Carpet A fractal can be generated by a pattern of iteration. This fractal design is called the Sierpinski carpet after the mathematician who invented it in 1916. The general rule is to start with a square and take a square out. Look at the first iteration and describe the rule that was used to determine the size of the square that was removed. Now compare the first two iterations and describe the rule that was used to construct the second from the first. Apply the rule you have stated to construct the third iteration in the space provided. Iteration 1  Iteration 2  Iteration 3 Now examine the third iteration you have constructed, and record the length of the side of the new squares you drew. Compare this length to the lengths of the sides of the previous squares. Write the lengths of the sides of all the squares in descending order. If you construct the fourth iteration, what will the lengths of the sides of the squares need to be? Now look at the first iteration again. What is the area of the square that was removed? What is the area of each individual square that was removed in the next two iterations? Write these areas in descending order. What is the area of each individual square to be removed in the fourth iteration? Challenge: Find the perimeter of all the squares in the third iteration. Find the area of the figure that remains once all the squares are removed in the third iteration.

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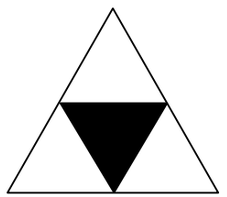
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	9.3 The Sierpinski triangle can be created by using dilations and isometries. You may begin with an arbitrary triangle. An equilateral triangle is used for the procedures described below. a) Draw an equilateral triangle. b) Reduce the triangle by a factor of ½. Make three copies of the reduced triangle. c) Place the three reduced similar triangles on the original, one at each vertex. d) Eliminate the remaining portion of the original triangle by blackening it.  Your work should result in the figure shown here. Answer the following questions: a) Let the area of the original triangle be 1 area unit. What area remains? What area has been removed? b) Let the side of the original triangle be 1 length unit. What is the perimeter of the figure with the dark region removed? Repeat steps a) through d) of the original procedure for each of the triangular regions remaining in the figure shown. Sketch the result of your work. Answer the following questions: a) What is the area of the remaining triangular region? b) What is the perimeter of the new "holey" triangular region? c) What would the next iteration of the procedure look like? Make a sketch. d) Write an expression for the area of the Sierpinski triangle after carrying out the procedure *n* times. e) Write an expression for the perimeter of the Sierpinski triangle after carrying out the procedure *n* times. f) How would your expressions differ, if you began with a triangle other than an equilateral triangle?

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General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	9.4 Construct a cylinder with the dimensions: r = 10 cm, h = 20 cm. A second figure is constructed by halving the previous radius and height. A third is constructed by halving the second and so on. a) Predict the surface area and the volume of the sixth pattern. b) Write an expression for the surface area after carrying out the procedure n times. c) Write an expression for the volume after carrying out the procedure n times.

Strand: Number (Number Operations)

Students will:

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
Design or use a spreadsheet to make and justify financial decisions.	A8–1. (N20) Design or modify a financial spreadsheet template to allow users to input their own variables. [C, PS, T]	1.1 For the following invoice, develop a spreadsheet that calculates the totals and that requires the operator to input a minimum number of entries.

ACME AUTO PARTS

Customer Inquiries

Item No.	Auto Parts	Quantity	Unit Price	Total	Labour	
1	Brake Pads	1	26.34	26.34	O/H Front Brakes 1.5 hrs. @ 37.00/hr.	51.25
2	Wheel Seals	2	5.25	10.50	Machined and Replaced Rotor	10.00
3	Rotor	1	30.16	30.16		
					Total Labour	61.25
					Total Parts	67.00
			Total Parts	67.00	PST on Parts (8%)	5.36
					GST (7%)	8.98
					TOTAL	142.59

(continued)

Strand: Number (Number Operations)
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General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A8–2. (N21) Use spreadsheets to analyze renting or buying an increasing asset (home) under different sets of circumstances. [C, PS, T]	2.1 The Wong family is faced with a move and has the choice of buying a home for $145 000 with a $25 000 down payment, or renting a similar house for $975 per month. Four options are available. 1. Buy the house with a 20-year mortgage and continue investing at the same rate after the mortgage is paid. 2. Buy the house with a 30-year mortgage. 3. Rent a house and invest the $25 000. 4. Rent a house and invest both the $25 000 and the difference each month between the rent and the mortgage payment. The analysis spreadsheets must include the following inputs: a) mortgage interest rate, taking 8.5% as a starting value b) taxation rate, taking 1.5% of market value as a starting value c) annual rent increase, taking 5% per annum as a starting value d) annual increase in house value, taking 4% per annum as a starting value e) investment return, taking 7.0% as a starting value. Try different scenarios, varying from 1 year to 30 years. Summarize circumstances in which buying makes sense, and summarize circumstances when renting makes sense.
	A8–3. (N22) Use spreadsheets to analyze leasing or buying a decreasing asset (vehicle, computer) under different sets of circumstances. [C, PS, T]	3.1 A car lease runs for 36 months at $305 per month, with a down payment of $1105, a lease-end value of $7105 and an interest rate of 11.6%. Maintenance is the purchaser's responsibility. Set up a spreadsheet to include the monthly values of the opening balance, interest paid, lease payment and closing balance. Use the spreadsheet to answer the following questions. a) What part of the $305 is used to pay the interest on the $7105? b) What total price is being charged for the car? c) What is the change in the monthly lease payment, if the lease-end value is reduced to $5700? d) What is the monthly payment for a straight purchase over 36 months with a 20% down payment? e) What is the annual percentage depreciation rate assumed with the $7105 lease-end value?

Strand: Number (Number Operations)
Students will:
- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A8–4. (N23) Use spreadsheet(s) to analyze an investment or life insurance portfolio, applying such concepts as capital gains, interest rate, inflation rate, risk, total rate of return and after-tax rate of return. [C, PS, T]	4.1 The time needed for an investment to double in value can be estimated using the rule of 72, which states that $n = \frac{72}{i}$ where i is the annual percentage interest rate and n the number of years. a) Compare the rule of 72 doubling time with the exact doubling time for the following interest rates: • 4% per annum, compounded annually • 8% per annum, compounded annually • 24% per annum, compounded annually. b) What general conclusion can be drawn as to the accuracy of rule of 72 calculations? 4.2 An average car in 1996 costs $20 000. a) If this money were invested for 15 years at 8% per year, compounded yearly, and cars did not increase in price, how many cars could be bought in 2011? b) If the average inflation rate were 3.5% per year, how many cars could be bought in 2011 with the proceeds from the investment? c) What is the real, after inflation, rate of return for the investment? d) How do the answers change, if 40% of the interest is taken in income tax every year? 4.3 A retirement portfolio of $300 000 is to be invested for a 10-year period. A middle-risk stock has a probability of 0.80 of making a 110% capital gain and paying annual dividends of 3.2%; there is a 0.20 probability of making a 30% capital loss and paying no annual dividends. Term deposits are guaranteed to pay interest at 7.5% per year, compounded annually. a) What is the best net worth, if all the capital is invested in stocks and the stocks make the maximum capital gain? b) What is the worst net worth, if all the capital is invested in stocks and the stocks take the maximum capital loss? c) Compare the expected net worth from the stocks to the guaranteed net worth from the term deposits. d) How would the numbers in the problem be different for high-risk stocks and for low-risk stocks? e) Modify the calculations to allow for 40% of the gains to be paid yearly in income tax.

Strand: Number (Number Operations)
Students will:
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[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

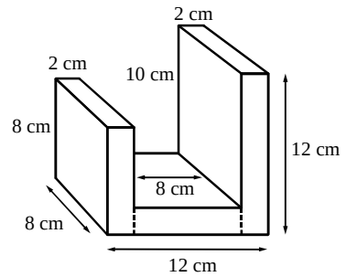
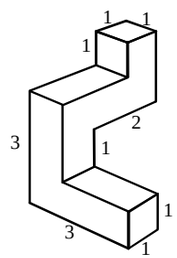
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	A8–5. (N24) Analyze car or house insurance needs and premiums, using such concepts as loss, probability of loss, compulsory coverage, optional coverage, deductible and claims record. [CN, E, R, T]	5.1 Obtain collision damage figures for inexperienced drivers and for experienced drivers from an insurance company, and then calculate a fair insurance premium for $1 000 000 liability, $250 deductible collision and $100 deductible comprehensive theft/glass coverage. Do the calculation twice, once for each type of driver. What change in premium would be fair, if the deductible for collision were raised to $1000? 5.2 At what point is it worth it to drop collision coverage on an older vehicle? Show a strategy, and explain the supporting calculations. 5.3 How long does a home security system need to be installed before the cost of the system is paid for by the savings in insurance premiums? Obtain data for your area from an insurance agent. Show a strategy, and explain the supporting calculations.

Strand: Shape and Space (Measurement)

Students will:

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
Analyze objects, shapes and processes to solve cost and design problems. *(continued)*	A9–1. (SS15) Use dimensions and unit prices to solve problems involving perimeter, area and volume. [E, PS, V] *(continued)*	1.1 Determine the volume of the plastic book end shown below.  If the book end is constructed using an injection mold, find the development cost if the plastic ingredients cost 6¢ per cubic centimetre. 1.2 In the following diagram of an outside storage system component, all the angles are right angles and the lengths are in centimetres. Find the volume.  A special aluminum latex coating is applied to all outside surfaces of the object. What is the cost of the latex coating, if it costs 28¢ per cm^2?

Strand: Shape and Space (Measurement)
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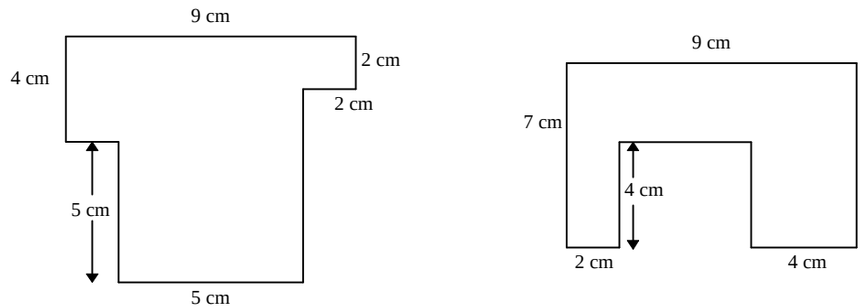
[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	1.3 A dressmaker cuts pairs of the following shapes from a rectangular piece of gabardine that is 1 m by 0.5 m. Determine the maximum number of pairs that can be cut from the piece of gabardine. Identify any assumptions. 
	A9–2. (SS16) Solve problems involving estimation and costing for objects, shapes or processes when a design is given. [C, E, PS]	2.1 A swimming pool is 50 m by 21 m. The deep end is 4.0 m deep and extends out 12 m. The shallow end is 1.2 m deep and extends out 12 m. There is a uniform slope connecting the deep and shallow ends. a) Draw scale diagrams showing the top view and the side view of the pool. b) Calculate the cost of filling it with water at $\$2.00/m^3$. c) Waterproofing of the underwater surfaces costs $\$17/m^2$. Determine the cost of waterproofing. 2.2 A window cleaner has been asked by the owner of a large office tower to submit a quotation for cleaning the windows of the building. The window cleaner has the following information: a) there are 24 floors b) there are 14 windows per side on each floor c) there are 4 sides to the building. From experience, the window cleaner knows that the transfer time between windows on the same floor and same side of the building is 60 seconds. The transfer time between sides of the building is 120 seconds and between floors is 30 seconds. The time to clean one window is 120 seconds. The window cleaner has a base charge of $120. The maximum period of time he works at one stretch is 3 hours, then he takes a 30 minute rest. In addition to his rate of $25/hour, he wants to make 25% profit from the job for reinvestment in his business. What would be the best quote?
	(continued)	

Strand: Shape and Space (Measurement)

Students will:

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.3 To satisfy the building code, an auditorium has to have 1200 m^2 of washroom space. In a washroom for males, the average space needed is 1.9 m^2 per user and the average usage time is 97 s. In a washroom for females, the average space needed is 2.4 m^2 per user and the average usage time is 145 s. Determine the required washroom space: a) on the basis of equal areas for males and females b) on the basis of equal users per hour for males and females.
	A9–3. (SS17) Design an object, shape, layout or process within a specified budget. [PS, R, V]	3.1 Tin plate for making cylindrical cans comes in sheets that are 240 cm by 160 cm and costs $3.20 per sheet. Cans are 6 cm in diameter and 11 cm high, and they have 3 seals each. Seals cost 0.8¢ each to make. One sheet of tin plate is used for making pieces for ends, and two sheets are used for making pieces for sides. a) How many ends and how many sides can be made from the three sheets of tin plate? b) How many cans can be made from the three sheets, and what is the cost per can? c) Is there another way of making more cans from the three sheets, or the same number of cans from less tin plate? d) How much money is saved doing it the second way?
		3.2 To produce a voters' list for a riding, a sum of $1.70 per voter is allocated. Four methods of enumerating are possible:

Method	Cost per Voter	Probability of Return
Hand deliver enumeration form, mail return	$0.91	0.700
Mail form both ways	$1.07	0.740
Telephone until voter reached	$2.21	0.920
Enumerator calls until voter reached	$5.26	0.995

For a total of 40 000 voters, find the maximum number of voters who can be enumerated within the budget and the minimum budget needed to be sure of enumerating 98% of the potential voters.

Note: This problem connects to outcomes in clusters A5 and C6.

(continued)

Strand: Shape and Space (Measurement)

Students will:

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication
[CN] Connections
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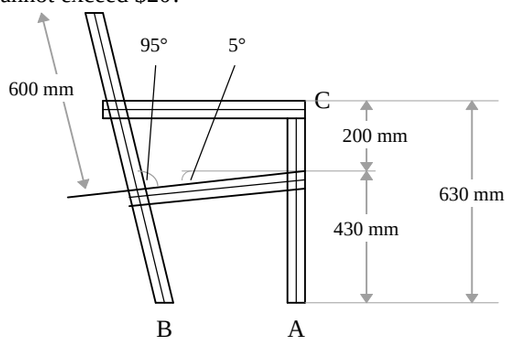
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	3.3 One side of a wooden chair is being built. The front of the seat should be 430 mm above the ground and should slope back at 5° from the horizontal. The seat depth is 450 mm, and the angle between the seat and the back of the chair is 95°. The required length of the back of the chair, measured from the seat, is 600 mm. The height of the horizontal chair arm is 200 mm above the front of the seat. Draw a scale diagram, and use it to calculate the lengths of wooden components A, B and C. What is the maximum cost per metre for the wood needed to make this side of the chair, if the cost cannot exceed $20? 
	A9–4. (SS18) Use simplified models to estimate the solutions to complex measurement problems. [E, V]	4.1 Estimate the area of the Yukon Territory, by: a) counting squares b) splitting the area into rectangles and triangles. Which method is most accurate? Which type of map gives the most reliable estimate for the area of the Yukon Territory? Where are the main sources of error in the estimate? 4.2 A water tank is a sphere of diameter 3.6 m. Estimate the volume of water in the tank, if the depth of water is 24 cm.