COURSES

derived from

The Common Curriculum Framework

for

K–12 MATHEMATICS

Grade 10 to Grade 12

Western Canadian Protocol for Collaboration in Basic Education

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Call for Resources

JUNE 1996

APPLIED MATHEMATICS 10

derived from

The Common Curriculum Framework

for

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APPLIED MATHEMATICS 10: GENERAL OUTCOMES, AND SPECIFIC OUTCOMES WITH ILLUSTRATIVE EXAMPLES, ORGANIZED BY STRAND AND SUBSTRAND

This section elaborates on the general outcomes and specific outcomes by providing illustrative examples, by strand and substrand, for the Applied Mathematics 10 course.

The coding for mathematical processes follows the same scheme as in the *Common Curriculum Framework.*

CLUSTERS IN THE APPLIED MATHEMATICS 10 COURSE

There are 5 clusters identified, each representing 20 to 25 hours of instructional time for an average student taking the cluster.

Common clusters, numbered C1 to C3, are part of the mathematics expected of all students completing a K to 12 mathematics program.

Applied clusters, numbered A1 to A2, emphasize applications of mathematics rather than precise mathematical theory. The approaches used are primarily numerical and geometrical.

CODING FOR ILLUSTRATIVE EXAMPLES (IEs)

The illustrative examples (IEs) listed on the following pages are organized by strand and substrand and have been correlated to specific outcomes (SOs). The numbers are taken directly from the *Common Curriculum Framework.*

NUMBERING SYSTEM

The specific outcomes are cross-referenced to the General Outcomes and Specific Outcomes section (pages 30 to 59 of the *Common Curriculum Framework*). For example, $\underset{(PR53)}{C2-6.}$ is the 6th specific outcome in Common Cluster 2 and the 53rd specific outcome in the Patterns and Relations strand.

Strand: Number (Number Concepts)

Students will:

- use numbers to describe quantities
- represent numbers 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
Analyze the numerical data in a table for trends, patterns and interrelationships.	C1–1. (N1) Use words and algebraic expressions to describe the data and the interrelationships in a table with rows that are not related recursively (not calculated from previous data). [C, CN]	1.1

Price	GST	PST	Total
$120.00	$ 8.40	$12.84	$141.24
$275.00	$19.25	$29.43	$323.68

a) What is the rate of GST?
b) What could be the rate of PST?
c) What could be the rule for calculating PST?
d) What is the total GST paid on the two items in the table?
e) What is the total PST paid on the two items in the table?

1.2 National Hockey League (NHL)
Western Conference: February 1, 1996

	W	L	T	Points
Detroit	35	9	4	74
Colorado	26	14	9	61
Chicago	25	15	11	61
Toronto	22	19	9	53
St. Louis	21	20	8	50
Winnipeg	21	24	4	46
Vancouver	17	20	12	46
Los Angeles	17	22	11	45
Calgary	18	23	9	45
Edmonton	18	25	6	42
Anaheim	17	27	5	39
Dallas	14	24	10	38
San Jose	11	35	4	26

What happens to the NHL standings if wins are worth three points and ties are worth one point?

(continued)

Strand: Number (Number Concepts)

Students will:

- use numbers to describe quantities
- represent numbers 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)	C1–2. (N2) Use words and algebraic expressions to describe the data and the interrelationships in a table with rows that are related recursively (calculated from previous data). [C, CN]	2.1 The following table provides data on the repayment of a $100 000 farm loan. The farmer has negotiated for one annual payment to be made each year after harvest and for the right to make an extra payment, if the harvest is good. Use the table to answer the questions.

Year	Opening Balance	Interest Rate (%)	Interest Charged	Regular Payment	Extra Payment	Closing Balance
1	$100 000.00	8	$8000.00	$14 902.95		$93 097.05
2	$ 93 097.05	8	$7447.76	$14 902.95		$85 641.87
3	$ 85 641.87	8	$6851.35	$14 902.95		$77 590.27
4	$ 77 590.27	8	$6207.22	$14 902.95		$68 894.54
5	$ 68 894.54	8	$5511.56	$14 902.95		$59 503.15
6	$ 59 503.15	8	$4760.25	$14 902.95		$49 360.46
7	$ 49 360.46	8	$3948.84	$14 902.95		$38 406.34
8	$ 38 406.34	8	$3072.51	$14 902.95		$26 575.90
9	$ 26 575.90	8	$2126.07	$14 902.95		$13 799.03
10	$ 13 799.03	8	$1103.92	$14 902.95		$ 0.00

a) What is the period of the loan?
b) What is the amount of the annual payment?
c) How much of the annual payment at the end of Year 5 went toward the opening balance? Show how to determine the answer in two different ways.
d) Create an algebraic expression to find the answer in c).
e) If the interest rate went up to 11% in Year 10, how much would be owing at the end of Year 10?
f) What extra payment at the end of Year 4 would pay the loan off at the end of Year 8?

Strand: Number (Number Concepts)

Students will:

- use numbers to describe quantities
- represent numbers 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
Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system.	C1–3. (N3) Classify numbers as natural, whole, integer, rational or irrational, and show that these number sets are nested within the real number system. [C, R, V]	3.1 Explain why the number 1.112111211112 . . . is irrational. 3.2 Given a set of numbers, place them in their appropriate box in a nested Venn diagram. 3.3 Describe, orally and in writing, whether or not a number is irrational. 3.4 Demonstrate that a particular real number, such as $\sqrt{3}$, is rational or irrational.
	C1–4. (N4) Use approximate representations of irrational numbers. [R, T]	4.1 Compare the results of using different approximations for $\sqrt{2}$ in calculations. a) Calculate $\sqrt{2} \times \sqrt{2}$ as 1.4×1.4. b) Calculate $\sqrt{2} \times \sqrt{2}$ as 1.41×1.41. 4.2 Use a calculator to get the approximate value, to four decimal places, of $\sqrt{8}$ and of $2\sqrt{2}$.

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
Use basic arithmetic operations on real numbers to solve problems.	C1–5. (N5) Communicate a set of instructions used to solve an arithmetic problem. [C]	5.1 Write a set of instructions that will allow another student to find: a) $1 + 2 \div 3$ b) $9 \times 4 \div 3 \times 5$ c) the reciprocal of a square root of a number, using a scientific calculator d) a 5% commission on a sale of $40 200.
	C1–6. (N6) Perform arithmetic operations on irrational numbers, using appropriate decimal approximations. [E, T]	6.1 Mahal indicates that $\sqrt{2} + \sqrt{8}$ has an approximate value of 3.16. Use estimates to show whether Mahal's answer is reasonable, and use a calculator to verify the accuracy of Mahal's answer. 6.2 Find a decimal approximation of $\left(\frac{3}{\sqrt{5}-\sqrt{2}}\right)$ to three decimal places. 6.3 Arrange the following in order of value from least to greatest: $7,\ 2\sqrt{13}\ ,\ 3\sqrt{6}\ ,\ 4\sqrt{5}\ ,\ 5\sqrt{2}$. Use decimal approximations. 6.4 Evaluate $\sqrt[3]{128} + 4\left(\sqrt[3]{16}\right)$ to three decimal places. 6.5 Find the length of the base and the height of an equilateral triangle of area 24 cm^2.

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 arithmetic operations on tables to solve problems, using technology as required.	C1–7. (N7) Create and modify tables from both recursive and nonrecursive situations. [PS, T, V]	7.1

Price	GST	PST	Total
$120.00	$ 8.40	$12.84	$141.24
$275.00	$19.25	$29.43	$323.68

a) Modify the table to allow for a PST of 6.5% of the price before taxes.
b) If the price after both taxes is $138.00 and PST is charged on the $120.00 price before taxes, what is the rate of PST?

7.2 In 1993, sales of a particular video game doubled every month. The game was released in May 1993 with sales of 32 000 for May. Prepare a table to illustrate the 1993 monthly sales figures. How many video games were sold in December 1993? Identify the assumptions you made when determining the solution.
In 1994, the demand for the video game peaked. Starting in January 1994, and every month thereafter, sales were cut to one quarter of what they were in the previous month. How many video games were sold in April 1994? If April 1994 was the last month of sales, how many video games were sold over the entire twelve months?

(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)	C1–8. (N8) Use and modify a spreadsheet template to model recursive situations. [PS, T, V]	8.1 Modify the given template for a 10-year, $85 000 farm mortgage with fixed annual payments, to allow for a change in interest rate.

Year	Opening Balance	Interest Rate (%)	Interest Charged	Regular Payment	Closing Balance
1	$85 000.00	8	$6800.00	$12 667.51	$79 132.49
2	$79 132.49	8	$6330.60	$12 667.51	$72 795.59
3	$72 795.59	8	$5823.65	$12 667.51	$65 951.73
4	$65 951.73	8	$5276.14	$12 667.51	$58 560.36
5	$58 560.36	8	$4684.83	$12 667.51	$50 577.68
6	$50 577.68	8	$4046.21	$12 667.51	$41 956.39
7	$41 956.39	8	$3356.51	$12 667.51	$32 645.39
8	$32 645.39	8	$2611.63	$12 667.51	$22 589.52
9	$22 589.52	8	$1807.16	$12 667.51	$11 729.17
10	$11 729.17	8	$ 938.33	$12 667.51	$ 0.00

a) What alternatives are open to the farmer, if the interest rate increases?
b) What alternatives are open to the farmer, if the interest rate decreases?

8.2 Modify the template in illustrative example 8.1 to reflect a 25-year home mortgage with monthly payments that gives the customer the option of making an annual extra payment of $1500 at the end of any year. Interest is charged monthly.

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 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
- 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)*	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.

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)*	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: Patterns and Relations (Relations and Functions)

Students will:

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

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

General Outcomes	Specific Outcomes	Illustrative Examples
Examine the nature of relations with an emphasis on functions.	C1–9. (PR47) Plot linear and nonlinear data, using appropriate scales. [C, V]	9.1 The mass of a beaker is recorded when the beaker contains varying volumes of ethanol. The results of the experiment are recorded in the table below.

Volume of Ethanol (mL)	Mass of Beaker and Liquid (g)
0	90
50	129
100	168
150	207
200	246

Measurements may be assumed correct to the nearest mL and to the nearest g.

Plot this data on a scatterplot, using appropriate scales, and answer the following questions.

a) Assuming that this pattern continues, determine the mass of the beaker and liquid when 250 mL of ethanol is present.
b) When a volume of 200 mL of ethanol is in the beaker, determine the mass of the ethanol alone.
c) The density of a liquid is defined as the mass of 1 mL of the liquid. Determine the density of the ethanol.

9.2 Nannook's Pizza uses the following price structure.

Diameter (inches)	Cost ($)
8	6.50
10	10.20
12	14.65
14	19.90
16	26.00

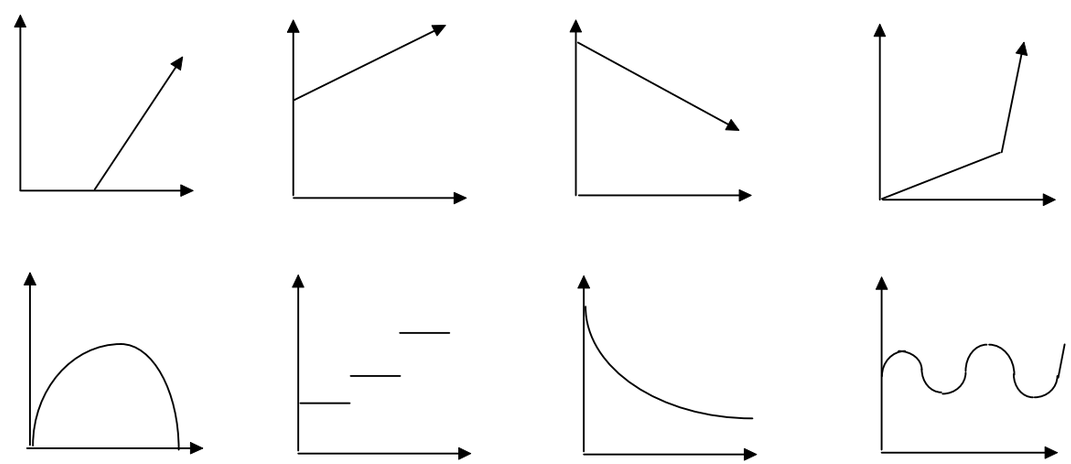
Plot this data on a scatterplot, using appropriate scales, and describe the pattern.

Strand: Patterns and Relations (Relations and Functions)

Students will:

- use algebraic and graphical models to generalize patterns, make predictions and solve problems.

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

General Outcomes	Specific Outcomes	Illustrative Examples
Examine the nature of relations with an emphasis on functions.	C2–1. (PR48) Represent data, using function models. [CN, PS, V]	1.1 Sketch graphs to illustrate the following situations. If sufficient information is given, represent the situation by a suitable equation. Sketch and, if possible, represent by an equation: a) the area of a circle as a function of its radius b) the cost of mailing a letter as a function of the mass of the letter c) the cost of renting a car for one day as a function of the kilometres driven d) the population of Canada as a function of the year e) the length of daylight as a function of the date. 1.2 For each of the following graphs, describe a practical situation that could be represented by the graph. In describing the situation, state the meanings of any intercepts, slopes, maxima and/or minima. 

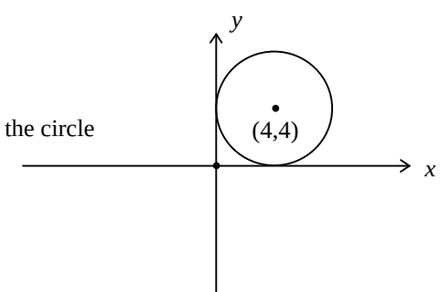
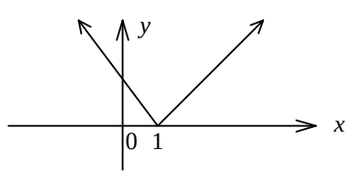
(continued)

Strand: Patterns and Relations (Relations and Functions)

Students will:

- use algebraic and graphical models to generalize patterns, make predictions and solve problems.

[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)	C2–2. (PR49) Use a graphing tool to draw the graph of a function from its equation. [C, T, V]	2.1 Graph the function $y = x + 1$, using a graphing tool. 2.2 Graph the function $y = x^2 + 100$, using a graphing tool. Explain the process used, so that the graph appears on the screen.
	C2–3. (PR50) Describe a function in terms of: • ordered pairs • a rule, in word or equation form • a graph. [C, CN, V]	3.1 Describe the parking charges at a parkade in terms of ordered pairs, a rule and a graph.
	C2–4. (PR51) Use function notation to evaluate and represent functions. [C, PS]	4.1 If $f(x) = x^2 - 5x + 3$, find $f(2)$. What is an ordered pair describing the point on the graph having a y-coordinate of $f(2)$? 4.2 If $f(x) = 3x^2 - 6x + 5$, find $f(\sqrt{3})$, $f(2x)$ and $f(3t + 2)$.
	C2–5. (PR52) Determine the domain and range of a relation from its graph. [PS, V]	5.1 If the coordinate axes touch the circle, what is the domain and range of the circle shown in the graph to the right?  5.2 Determine, from its graph shown below, the domain and range of the function $y = \|x - 1\|$. 

Strand: Patterns and Relations (Relations and Functions)

Students will:

- use algebraic and graphical models to generalize patterns, make predictions and solve problems.

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

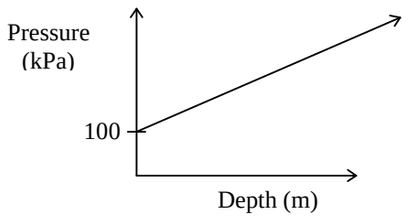
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	C2–6. (PR53) Determine the following characteristics of the graph of a linear function, given its equation: • intercepts • slope • domain • range. [PS, V]	6.1 A tanker truck drives on a weigh scale and then is filled with crude oil. The mass M, measured in kilograms, of the truck and the volume V, measured in barrels, of crude oil are related by the formula: $M = 14\,000 + 180\,V;\ V \leq 500.$ a) Draw the graph with V on the horizontal axis and M on the vertical axis. b) The tank has a maximum capacity of 500 barrels. What is the mass of the truck when it contains 500 barrels of oil? c) What is the mass of the empty truck? Where is this value found on the graph? d) Find the slope, and give an interpretation for it. e) Give the domain for this problem. f) Express the range in words. 6.2 Graph each of the following equations; and indicate intercepts, slope, domain and range. a) $y = 2x;\ x = (0, 1, 2, 3, 4, 5, 6)$ b) $y = -\frac{1}{3}x;\ x =$ a real number c) $y = 3$ d) $x = 3$ e) $y = \frac{1}{3}x + 5;\ x =$ a real number f) $y = mx + b;\ x =$ a real number

Strand: Patterns and Relations (Relations and Functions)

Students will:

- use algebraic and graphical models to generalize patterns, make predictions and solve problems.

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

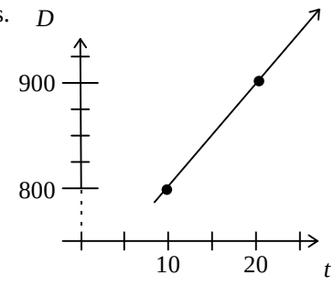
General Outcomes	Specific Outcomes	Illustrative Examples
Represent data, using linear function models. *(continued)*	C2–7. (PR56) Use direct variation and arithmetic sequences as applications of linear functions. [CN, PS, V] *(continued)*	7.1 A hydrologist studied the relationship between the pressure on an object and its depth of submersion in a liquid. The following graph was sketched. Draw conclusions based upon the sketch.  7.2 Simple interest varies directly with the amount borrowed. a) If the interest is \$5 for \$100 borrowed, what would the interest be for \$325 borrowed? b) Graph the relation, and write the equation of the graph. 7.3 A jet ski rental operation at Lake Okanagan charges a fixed insurance premium, plus an hourly rate. The total cost for two hours is \$50 and for five hours is \$110. a) Graph the relation. b) Determine the fixed insurance premium and the hourly rate to rent the jet ski. 7.4 With new equipment coming on line, a soft drink manufacturer has been increasing its production each day according to the following table. Assume a maximum daily output of 25 000 cans. Day 1 2 3 4 Units 4000 4200 4400 4600 a) Graph the relation. Hint: this is a discrete case. b) On what day will they be able to produce 20 000 cans, if this trend continues?

Strand: Patterns and Relations (Relations and Functions)

Students will:

- use algebraic and graphical models to generalize patterns, make predictions and solve problems.

[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)	*(continued)*	7.5 Given the distance–time graph shown, answer the following questions. a) If $D = 850$, what is t? b) If $t = 25$, what is D? c) If $D = 1500$, what is t? d) Write the equation of the function. e) Verify the accuracy of your estimates in a), b) and c), using the equation of the function.  7.6 Given the data in the table, predict the fuel consumption for the following engines: a) 2.5 L b) 5.0 L. Engine Size (L) — Consumption (L/100 km) 2.2 — 6.4 3.0 — 7.5 3.8 — 8.1 4.1 — 8.6 7.7 A video game operator gives all her change in quarters. From a \$20 bill, she gives 56 quarters change for a \$6 purchase. She gives 8 quarters change from a \$20 bill for an \$18 purchase. a) Graph the number of quarters given as change N on the vertical axis and the amount of the purchase P on the horizontal axis. Assume that a \$20 bill was given. b) What is the domain and range of the function? c) How does the graph change, if a \$10 bill is used?

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

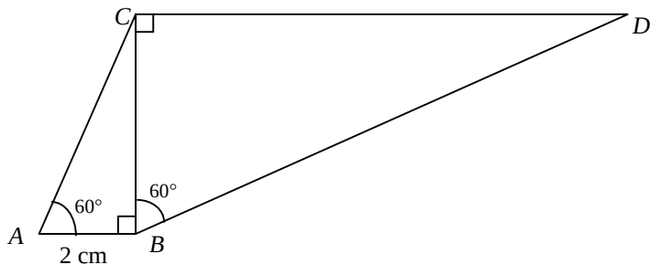
General Outcomes	Specific Outcomes	Illustrative Examples
Demonstrate an understanding of scale factors, and their interrelationship with the dimensions of similar shapes and objects.	C3–1. (SS1) Calculate the volume and surface area of a sphere, using formulas that are provided. [CN, PS, V]	1.1 Calculate the volume and surface area of a beach ball of radius 15 cm. 1.2 A hot air balloon has a spherical shape and a diameter of 4 m. If 30 additional cubic metres of air are pumped into the balloon, what will be the new values for the diameter, volume and surface area?
	C3–2. (SS2) Determine the relationships among linear scale factors, areas, the surface areas and the volumes of similar figures and objects. [CN, PS, R, V]	2.1 The area of a region in a plane is 10 cm^2. By what factor must each of the dimensions of this region be multiplied to increase the area by 20 cm^2? 2.2 A model train is built to a scale of 1:50. If the length of the model engine is 20 cm and the area of sheet metal used to cover the outside surface of the model is 180 cm^2, what is the actual length of the engine and the actual area of the sheeting used to cover the engine? If the volume displaced by the model engine is 126 cm^3, what is the volume displaced by the real engine, in m^3? 2.3 It is improbable that a giant human, 6 m in height (three or four times normal human height), could exist. Which biological systems are most likely to break down? Explain your answer.

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

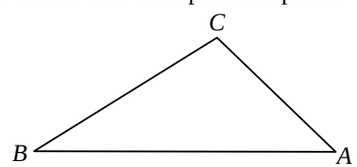
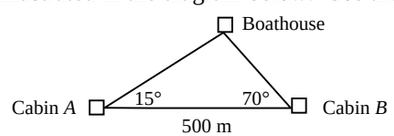
General Outcomes	Specific Outcomes	Illustrative Examples
Solve problems involving triangles, including those found in 3-D and 2-D applications.	C3–3. (SS4) Solve problems involving two right triangles. [CN, PS, V]	3.1 From the top of a 100 m fire tower, a fire ranger observes two fires, one at an angle of depression of 5° and the other at an angle of depression of 2°. Assuming that the fires and the tower are in a straight line, determine the distance between the fires for the following: a) when the fires are on the same side of the tower b) when the fires are on opposite sides of the tower. 3.2 The triangles *ABC* and *BCD* have right angles at *B* and *C* respectively. Calculate the length of side *CD*, and state the ratio of length *BD* to length *AC*.  3.3 Canada's highest waterfall is Della Falls on Vancouver Island. An observer standing at the same level as the base of the falls views the top of the falls at an angle of elevation of 58°. When the observer moves 31 m closer to the base of the falls, the angle of elevation increases to 61°. Find the height of Della Falls.
	C3–4. (SS5) Extend the concepts of sine and cosine for angles from 0° to 180°. [R, T, V]	4.1 Find sin 130°. 4.2 Use a calculator to find multiple solutions for angle *A*, if sin *A* = sin 130°. Use trial and error to find as many solutions as possible. Summarize the pattern found in the solutions.
(continued)	*(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)*	4.3 Find the value(s) for A ($0° \le A \le 180°$) when $\sin A = \frac{1}{2}$. Find the value(s) for A ($0° \le A \le 180°$) when $\cos A = \frac{1}{2}$. Find the value(s) for A ($0° \le A \le 180°$) when $\cos A = -\frac{1}{2}$.
	C3–5. (SS6) Apply the sine and cosine laws, excluding the ambiguous case, to solve problems. [CN, PS, V]	5.1 An electric transmission line is planned to go directly over a pond. The power line will be supported by posts at points A and B. A surveyor measures the distance from B to C as 580 m, the distance from A to C as 337 m and $\angle BCA$ as 105.34°. What is the distance from post A to post B?  5.2 Two cabins are located 500 m apart on the same side of a river. Across the river from the two cabins is a boathouse. This situation is illustrated in the diagram below. Use the measurements to find the width of the river.  5.3 A farmer has a field in the shape of a triangle. From one corner, it is 530 m to the second corner and 750 m to the third corner. The angle between the lines of sight to the second and to the third corners is 53°. Find the perimeter and area of the field. 5.4 A sailboat leaves the dock at Gibson's Landing on a bearing of S57°W. After sailing for 8 km, the ship tacks and travels S31°E for 5 km. a) How far is the sailboat from Gibson's Landing? b) What direction would it have to sail to return to the dock at Gibson's Landing? Bye et al., *Holtmath 11*, p. 313. Reprinted with permission.

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

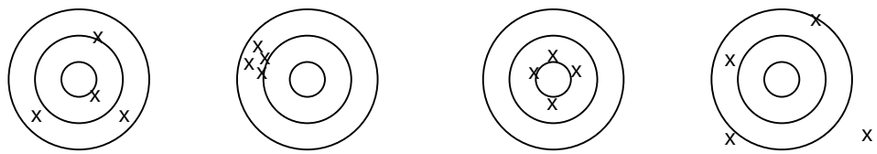
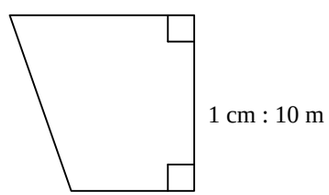
General Outcomes	Specific Outcomes	Illustrative Examples
Use measuring devices to make estimates and to perform calculations in solving problems.	A1–1. (SS8) Select and apply appropriate instruments, units of measure (in SI and Imperial systems) and measurement strategies to find lengths, areas and volumes. [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)*	

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

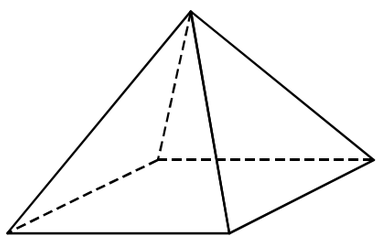
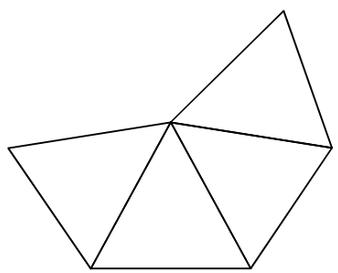
General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	*(continued)*	2.2 Of the four diagrams revealing shots on a target, which best represents accuracy and precision? 
	A1–3. (SS10) Solve problems involving length, area, volume, time, mass and rates derived from these. [C, E, PS]	3.1 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.  1 cm : 10 m 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)	

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)*	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.

Strand: Shape and Space (Measurement)

Students will:

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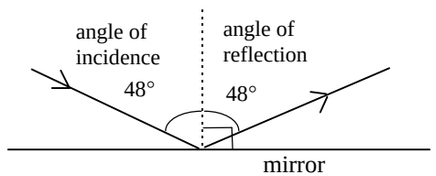
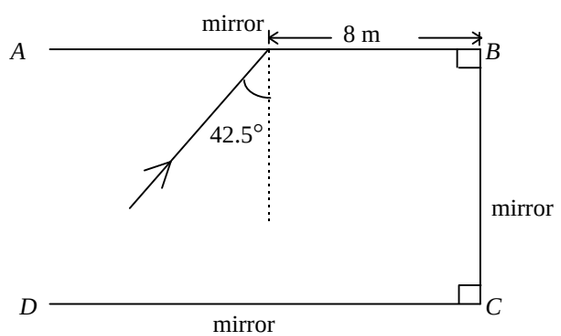
[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

General Outcomes	Specific Outcomes	Illustrative Examples
(continued)	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)	

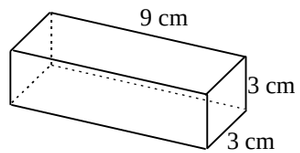
Strand: Shape and Space (Measurement)

Students will:

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

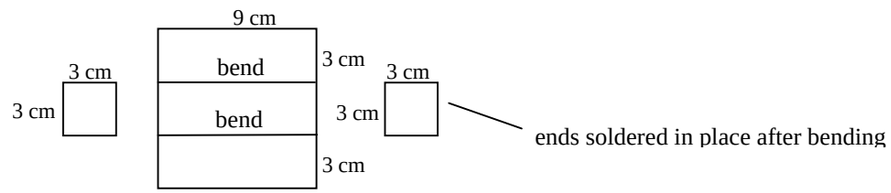
[C] Communication
[CN] Connections
[E] Estimation and Mental Mathematics
[PS] Problem Solving
[R] Reasoning
[T] Technology
[V] Visualization

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

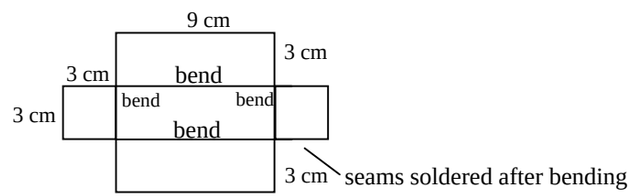


Two methods of construction are shown.

a)



b)



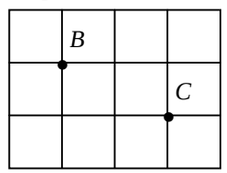
The material cost is \$2.50/cm^2, and soldering costs \$0.70/cm.
For each method of construction, calculate the cost for the box.

Strand: 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 coordinate geometry problems involving lines and line segments.	C1–10. (SS19) Solve problems involving distances between points in the coordinate plane. [PS, V]	10.1 Bob and Christine want to meet; see map below. Each block has dimensions of 120 m by 120 m. Assuming the roads are of negligible width, how far does Bob *B* have to travel to get to Christine *C*? Find two separate answers, one for a path along the roads and one for a direct path. 
		10.2 Plot the points (–4, –2) and (1, 5) on the coordinate plane. Describe two different ways to calculate the distance between the two points.
		10.3 Generate a method of determining the distance between any two points in the coordinate plane without having to plot the points. Justify your method.
		10.4 Program a calculator or computer to accept, as input, the coordinates of two points and to give, as output, the distance between the two points. Document the program so that someone else can use it without assistance.
	C1–11. (SS20) Solve problems involving midpoints of line segments. [PS]	11.1 Explain to a partner the meaning of the midpoint of the line segment joining two points without using the word midpoint.
		11.2 On a map with numerical coordinates in kilometres, the village of Sundown is at (6.3, 2.9), while the town of Sunup is at (4.7, 13.2). It was decided to construct a water main on the direct line joining Sunup with Sundown. Each community was responsible for the cost of construction from the community to the midpoint. Find the coordinates of the midpoint and Sundown's costs, if Sundown spent $63 475 per kilometre for construction. Determine alternative methods that could be used to solve the problem.
	C1–12. (SS21) Solve problems involving rise, run and slope of line segments. [PS, V]	12.1 If the slope of a line is 6 ($m = 6$) and the line passes through the points (2, 5) and (1, k), what is the value of k?
		12.2 If two points on a line are (4, 3) and (6, 4), find one other point on the line. Use a graphing utility to demonstrate the reasonableness of your answer.

(continued)

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
(continued)	C1–13. (SS22) Determine the equation of a line, given information that uniquely determines the line. [PS, V]	13.1 Use a graphing device to examine changes in the graph of $y = mx + b$ as the values of m and b are changed. Use the results to explain why the equation $y = mx + b$ is called the slope and y-intercept form of a linear equation. 13.2 Write a clear explanation of the nature of the following lines: $x = a$, $y = b$, $x = y$. 13.3 Manipulate the standard form of a straight line ($Ax + By + C = 0$) into the slope and y-intercept form of the same line. Determine rules that connect A, B and C to the slope (m) and to the intercepts. 13.4 Find the equation of a line passing through the points (–1, 3) and (4, 2). 13.5 Given the graph of an oblique line, determine an equation for the line. 13.6 A spring with no masses attached is 25.2 cm long. For each 1-g mass attached to the spring, the spring's length increases by 4 mm. Graph this scenario, label the axes, and find an equation for the graph.
	C1–14. (SS23) Solve problems using slopes of: • parallel lines • perpendicular lines. [CN, PS, V]	14.1 Graphically examine the slopes of various lines, all of which are perpendicular to the line $y = \frac{2}{3}x + 2$. Describe the slopes, and make a rule for finding the slope of a perpendicular to a given line. 14.2 Two perpendicular lines intersect on the x-axis. The equation of one of the lines is $y = 2x - 6$. Find the equation of the second line.

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
Implement and analyze sampling procedures, and draw appropriate inferences from the data collected.	C3–6. (SP1) Choose, justify and apply sampling techniques that will result in an appropriate, unbiased sample from a given population. [C, PS, R]	6.1 A toothpaste company advertises that three out of four dentists prefer their product. Analyze this statement for its completeness and its accuracy in terms of population, sample, possible sampling technique, validity and bias. 6.2 A school cafeteria wants to introduce a new dessert. Describe how a survey could be conducted to decide which of three choices should be the new dessert. 6.3 To predict a winner in a federal election, a magazine compiled a list of about 200 000 names from sources, such as telephone books, lists of automobile owners, club membership lists and its own subscription lists. The magazine mailed a questionnaire to everybody on the list, and 4000 returned it. The 4000 responses became the sample. Discuss the potential sources of bias.
	C3–7. (SP2) Defend or oppose inferences and generalizations about populations, based on data from samples. [C, PS, R]	7.1 To determine a preference for spending $50 in either a clothing store, an electronics shop or a restaurant, customers were surveyed one Saturday morning at the mall. Fifty-nine per cent preferred spending in a clothing store, 32% in an electronics shop and 9% in a restaurant. What generalizations can be made from these results? Does the sample adequately represent the population to be surveyed? Design a more reliable sampling method to obtain this information, and include details of the questionnaires used and the method of selecting the sample. 7.2 Search through various forms of media to find examples of generalizations that have been made about populations, based on data from samples. Do you agree or disagree with the generalizations? Explain why.

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
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?

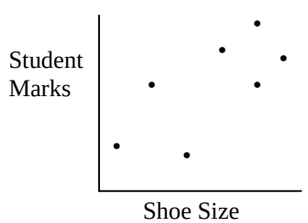
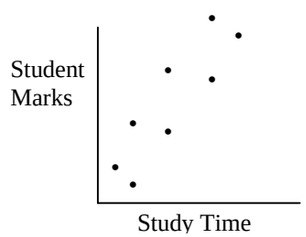
(continued)

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)	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.