

January 2001



Applied Mathematics 30
Grade 12 Diploma Examination

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Description

Time: This examination was developed to be completed in 2.5 h; however, you may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 33 multiple-choice and 6 numerical-response questions, of equal value, worth 65% of the examination
- 3 written-response questions worth 35% of the examination

This examination contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

Tear-out data pages are included near the back of this booklet.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work. No marks will be given for work done on the tear-out pages.*

Instructions

- You are expected to provide a graphing calculator approved by Alberta Learning.
- You are expected to have cleared your calculator of all information that is stored in the programmable or parametric memory.
- Use only an HB pencil for the machine-scored answer sheet.
- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- Read each question carefully.
- Consider all numbers used in the questions to be **exact** numbers and not the result of a measurement.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Learning.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

A particular matrix operation produces the equation

$$2 \begin{bmatrix} 1 & 0.5 \\ 1.5 & 4 \end{bmatrix} = \begin{bmatrix} a & b \\ c & 8 \end{bmatrix}$$

In the equation above, the value of

a is _____ (Record in the **first** column.)

b is _____ (Record in the **second** column.)

c is _____ (Record in the **third** column.)

(Record **all three digits** of your answer in the numerical-response section on the answer sheet.)

Value to be recorded: 213

Record 213 on the answer sheet

→

2	1	3	
---	---	---	--

	•	•	
0	0	0	0
1	●	1	1
●	2	2	2
3	3	●	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Correct-Order Question and Solution

Four different sets of data produce the following standard deviations.

1 0.3

2 2.4

3 1.6

4 1.9

When these four standard deviations are arranged in order from **lowest** to **highest**, the order is ____, ____, ____, ____.

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Value to be recorded: 1342

Record 1342 on the answer sheet

→

1	3	4	2
---	---	---	---

	•	•	
0	0	0	0
●	1	1	1
2	2	2	●
3	●	3	3
4	4	●	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Written Response

- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers must address **all** aspects of the question.
- Descriptions and/or explanations of concepts must be correct and include pertinent ideas, diagrams, calculations, and formulas.
- Your answers must be presented in a well-organized manner using complete sentences and correct units.

Use the following information to answer the first question.

A 6-sided green die has two sides labelled with a 1, two sides labelled with a 2, and two sides labelled with a 3. A red die has 6 sides. Each side of the red die is labelled with one of the numbers 1, 2, 3, 4, 5, and 6, with each number used only once.

1. The sample space for rolling each of these dice once would **not** include rolling a
 - A. 2 on each die
 - B. 1 on the green die and a 3 on the red die
 - C. 2 on the green die and a 5 on the red die
 - D. 4 on the green die and a 6 on the red die

2. An example of dependent events is drawing a red marble out of one jar and drawing a
 - A. red marble out of another jar
 - B. green marble out of another jar
 - C. red marble out of the same jar, after replacing the first marble
 - D. green marble out of the same jar, without replacing the first marble

Use the following information to answer the next question.

Malaga, Spain, lies in a region of Europe known as the Costa Del Sol (Coast of the Sun). The probability of sunshine on any given day in this region is approximately 0.89.

Numerical Response

- 1.** In a non-leap year of 365 days, the average number of days of the year that a tourist could expect to experience weather **other** than sunshine, to the nearest whole number, is _____.

(Record your answer in the numerical-response section on the answer sheet.)

- 3.** At a concert, a random sample of ticket buyers revealed that the amount of time they had waited in line to purchase their tickets was normally distributed with a mean of 185 minutes and a standard deviation of 15 minutes. What percentage of people stood in line for 180 min or less?

- A. 33%
- B. 37%
- C. 63%
- D. 67%

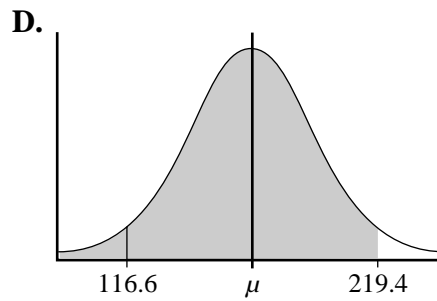
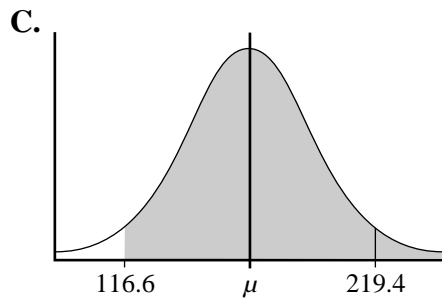
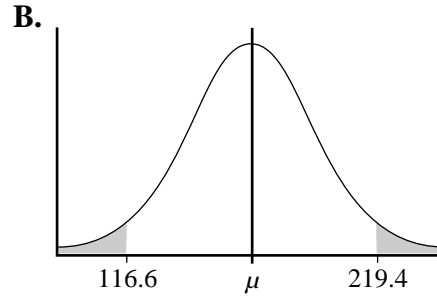
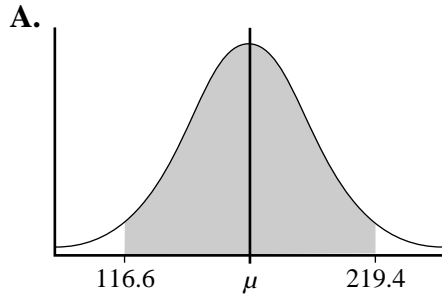
- 4.** In a particular town, 70% of the students are bused to school. In a random sample of 1 000 students, the mean of the number of students bused to school is expected to be 700, with a standard deviation of 14.49. The probability that in any given sample of 1 000 students, 720 or more students are bused to school is

- A. 0.08
- B. 0.38
- C. 0.62
- D. 0.92

Use the following information to answer the next question.

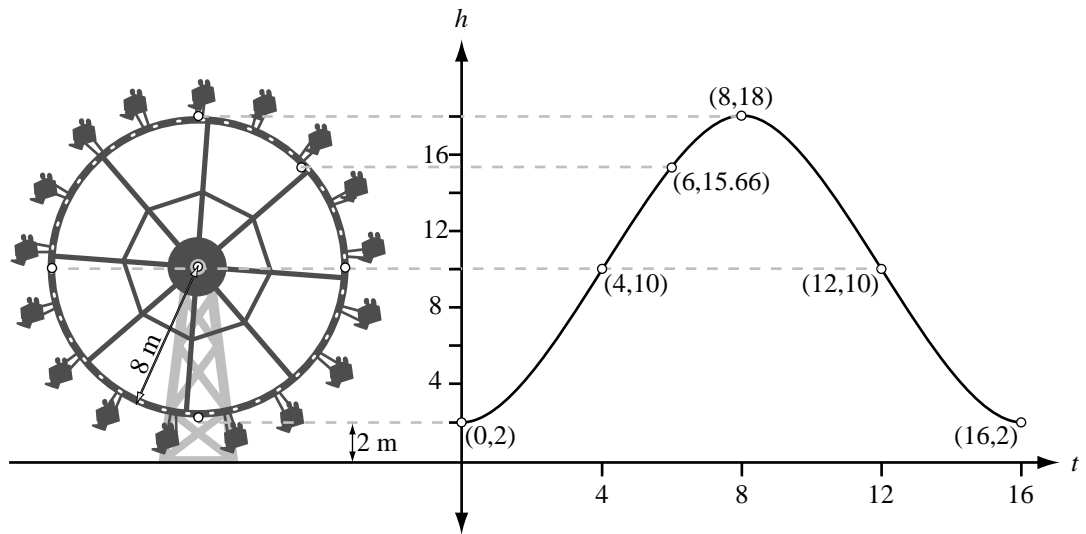
During a quality control test, 20 batteries are picked at random from an assembly line. The symmetric 95% confidence interval for the average life span of each battery is 116.6 h to 219.4 h.

5. Which of the following graphs has a shaded region indicating this symmetric 95% confidence interval?



Use the following information to answer the next two questions.

The height, h , in metres, of a point on a ferris wheel at time t , in seconds, can be represented by a sinusoidal function in the form $h = a \sin(bt + c) + d$, as shown below.



6. The function that **best** describes the height of the point on the ferris wheel is

- A. $h = 8 \sin(0.39t + 1.57) + 10$
- B. $h = 8 \sin(0.39t - 1.57) + 10$
- C. $h = 8 \sin(t + 4.02) + 10$
- D. $h = 8 \sin(t - 4.02) + 10$

7. The amplitude of this sinusoidal function is

- A. 10 m
- B. 8 m
- C. 4.02 m
- D. 1.57 m

Use the following information to answer the next question.

The height of a chair on a **different** ferris wheel follows the equation

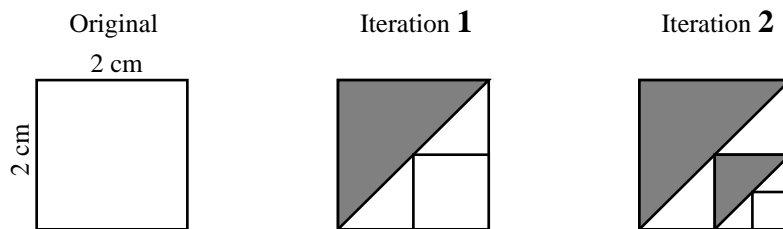
$$y = 5.7 \sin(0.31x) + 7.9$$

where y is the height (in metres) and x is the time (in seconds).

8. A student wants to determine when the chair will be at a height of 15 m. The student could graph the given sine function and look for the
- A. x -intercepts
 - B. y -intercepts
 - C. points where $x = 15$
 - D. points where $y = 15$
-

Use the following information to answer the next question.

A student has a 2 cm by 2 cm square piece of paper. The student draws a diagonal of this square and shades the region of the square above this diagonal. In the unshaded region, the student then draws a second square by using the midpoint of the diagonal as one corner. This process produces iteration 1 shown below. The process is then continued with the smaller square, as shown in iteration 2.



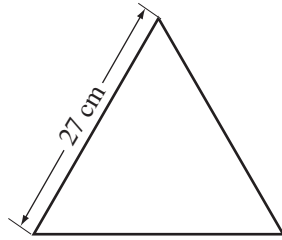
Numerical Response

2. The total area of the shaded regions shown in the diagram for iteration 2, correct to the nearest tenth, is _____ cm^2 .

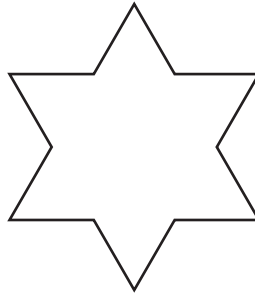
(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next two questions.

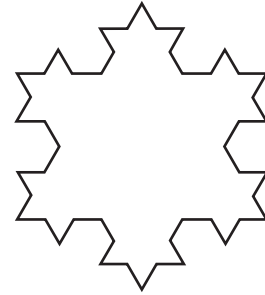
The following diagrams show the original triangle and the first two iterations in the construction of a Koch snowflake. The original triangle is an equilateral triangle with 27 cm sides.



Iteration 0
(Original)



Iteration 1



Iteration 2

The following chart shows the relationship between the added perimeter and the total perimeter for the Koch snowflake.

Iteration	Added Perimeter (cm)	Total Perimeter (cm)
0	0	81
1	27	108
2	36	144
3	48	

Numerical Response

3. The total perimeter of iteration 3, to the nearest centimetre, will be _____ cm.

(Record your answer in the numerical-response section on the answer sheet.)

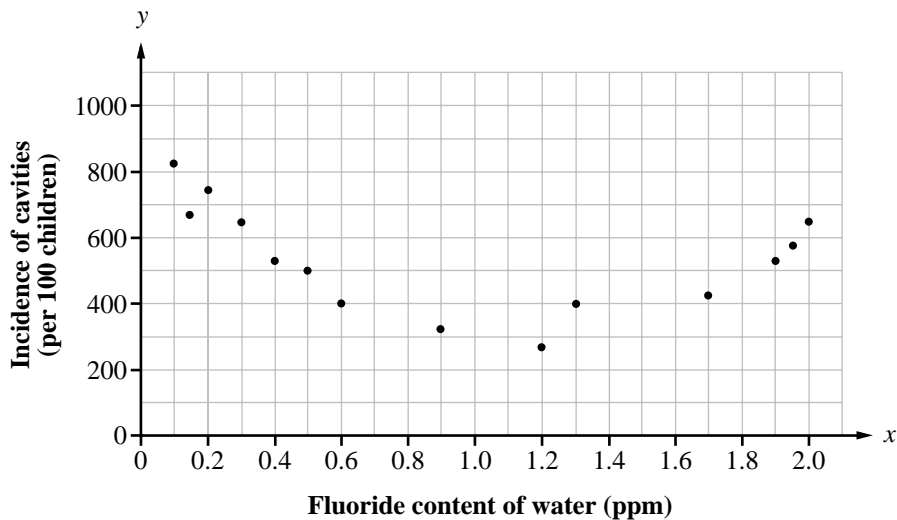
Use the following additional information to answer the next question.

Exponential regression can be used to relate iteration number to **total** perimeter and to determine the perimeter of a particular iteration of this Koch snowflake.

9. Based on an exponential regression of the perimeters of iterations 0, 1, and 2, the perimeter, to the nearest centimetre, of iteration 10 will be
- A. 1 918 cm
 - B. 1 081 cm
 - C. 1 438 cm
 - D. 123 cm

Use the following information to answer the next question.

The scatter plot below compares the incidence of cavities per 100 children and the fluoride content of water in parts per million (ppm) in a particular area.



10. Which of the following regression equations is **most appropriate** for the given data?
- A. Linear
 - B. Quadratic
 - C. Sinusoidal
 - D. Exponential

Use the following information to answer the next question.

A rectangular plot of land is 200 m by 400 m. The owner wishes to develop a campground where each campsite must be at least 5 m by 10 m. The county allows the owner to develop 70% of the property as campsites.

Numerical Response

4. The greatest number of campsites that the owner can develop on this property is _____.

(Record your answer in the numerical-response section on the answer sheet.)

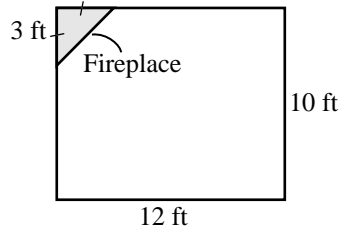
Use the following information to answer the next question.

In a parkade, cylindrical concrete pillars that will be 0.8 m high and have a radius of 0.3 m are to be built. Each pillar will house a rectangular electrical box that measures $0.2\text{ m} \times 0.2\text{ m} \times 0.1\text{ m}$. The pillars will be solid concrete except for this electrical box.

11. If concrete costs $\$134/\text{m}^3$, then the cost of concrete for each pillar will be
- A. \$29.77
 - B. \$30.85
 - C. \$31.60
 - D. \$32.70
- _____
12. A plumber installs a drainage line that uses 2 elbow pieces that cost \$5.15 each, 1 trap that costs \$8.40, and 4.95 m of straight pipe that costs \$4.05/m. The total cost of the components in this drainage line is
- A. \$47.15
 - B. \$38.75
 - C. \$33.60
 - D. \$17.60

Use the following information to answer the next question.

A family has moved into a new home. A room with the dimensions shown below requires carpeting. The portion of the floor under the fireplace requires no carpet and is not included in the cost. The cost of the carpet they want is $\$2.48/\text{ft}^2$.



13. The cost of carpet for the room will be
- A. \$156.24
 - B. \$275.28
 - C. \$286.44
 - D. \$297.60
-

Use the following information to answer the next question.

The family would like to repaint the room and buy some new furniture and wall hangings for it. Their budget for this project is \$2 500. The items that they would like to buy are listed below along with their prices (including taxes).

sofa	\$799	television	\$527
loveseat	\$504	VCR	\$238
chair	\$280	wall hangings	\$478
lamps	\$177	paint	\$31/gallon (need 3 gallons)

14. To remain within their budget, the family could choose to **not** buy
- A. any wall hangings
 - B. the chair and lamps
 - C. the loveseat and paint
 - D. wall hangings and paint

Use the following information to answer the next question.

A student has been given a budget of \$120 to make a banner acknowledging the victory of the school's wrestling team in the district playoffs.



The combined cost of the material and the dowel is \$86.59, and the cost of the logo is \$20.00.

Numerical Response

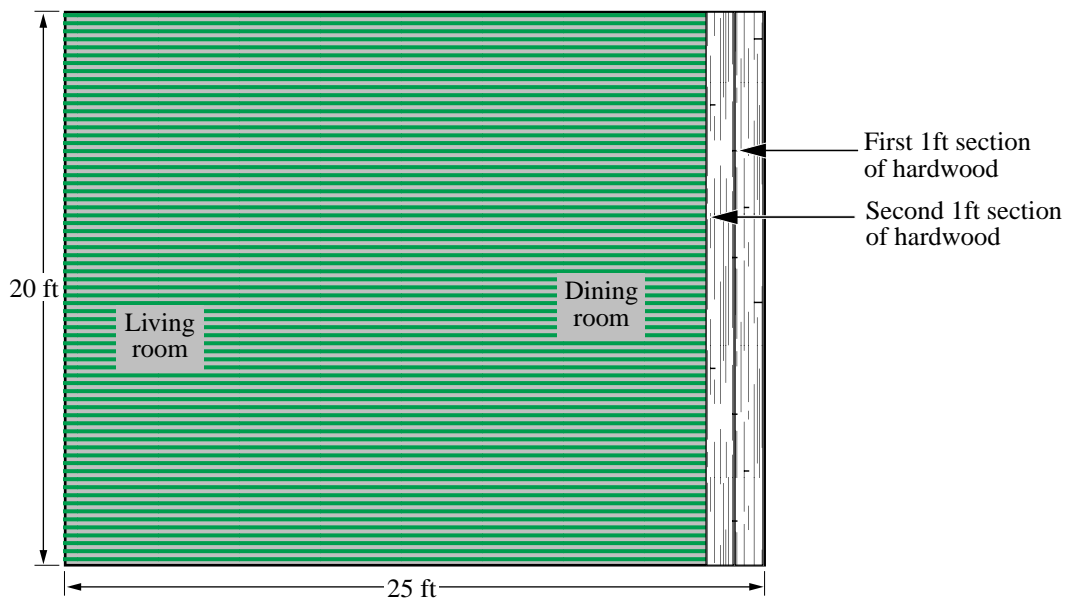
5. If lettering, priced at \$0.23 per letter, is also to be placed on the banner, then the maximum number of letters that the student can buy is _____ letters.

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

A family is planning to cover their 20 ft \times 25 ft living room/dining room with carpet and hardwood. Their budget for this project is \$5 000. The cost of the carpet is \$7.25/ft², and the cost of the hardwood is \$12.50/ft².

The family would like to cover the entire area with hardwood, but they know that it would cost more than the budgeted amount. In order to determine the maximum area of hardwood that they can afford, they calculated the total cost of the flooring each time a 1 ft wide section of hardwood was added to the room, as shown below.



Written-response question 1 continues on the next page.

The family used the following spreadsheet to calculate costs and to determine the maximum area of hardwood that they could afford.

	A	B	C	D	E
1	Area of floor with hardwood (ft²)	Area of floor with carpet (ft²)	Cost of hardwood @ \$12.50/ft²	Cost of carpet @ \$7.25/ft²	Total cost of flooring
2	500	0	\$6 250	\$0	\$6 250
3	480	20	\$6 000	\$145	\$6 145
4	460	40	\$5 750	\$290	\$6 040
5	440	60	\$5 500	\$435	\$5 935
6	420	80	\$5 250	\$580	\$5 830
7	400	100	\$5 000	\$725	\$5 725
8	380	120	\$4 750	\$870	\$5 620
9	360	140	\$4 500	\$1 015	\$5 515
10	340	160	\$4 250	\$1 160	\$5 410
11	320	180	\$4 000	\$1 305	\$5 305
12	300	200	\$3 750	\$1 450	\$5 200
13	280	220	\$3 500	\$1 595	\$5 095
14	260	240	\$3 250	\$1 740	\$4 990
15	240	260	\$3 000	\$1 885	\$4 885
16	220	280	\$2 750	\$2 030	\$4 780
17	200	300	\$2 500	\$2 175	\$4 675
18	180	320	\$2 250	\$2 320	\$4 570
19	160	340	\$2 000	\$2 465	\$4 465
20	140	360	\$1 750	\$2 610	\$4 360
21	120	380	\$1 500	\$2 755	\$4 255
22	100	400	\$1 250	\$2 900	\$4 150
23	80	420	\$1 000	\$3 045	\$4 045
24	60	440	\$750	\$3 190	\$3 940
25	40	460	\$500	\$3 335	\$3 835
26	20	480	\$250	\$3 480	\$3 730
27	0	500	0	\$3 625	\$3 625

Written Response—10%

1. a. Explain the relationship between the values in columns A and B.

b. Show, by writing a statement or a formula, how the value in cell E9 (\$5 515) was calculated. Make reference to other cells in row 9.

c. If the family is to remain within their budget, what is the maximum area of hardwood that they can place into this living room/dining room area?

Use the following additional information to answer the next part of the question.

The family decided that they would finish one half of the floor in carpet and one half in hardwood.

d. • What is the total cost for this plan?

• Will the family remain within their budget? Explain.

Use the following information to answer the next two questions.

The following spreadsheet shows the beginning of an amortization table for 5 equal monthly payments to be made on a \$900 loan with an interest rate of 1% per month.

	A	B	C	D	E
1	Payment Number	Payment	Interest Payment	Payment to Principal	Balance Remaining
2	1	\$155.29	\$9.00	\$146.29	\$753.71
3	2	\$155.29	\$7.54	\$147.75	\$605.96
4	3	\$155.29			
5	4				
6	5				

15. How much of payment number 3 is payment to principal?
- A. \$147.75
 - B. \$149.23
 - C. \$155.29
 - D. \$161.35
16. Which of the following formulas can be used to calculate the value of cell D4?
- A. =B4 + C4
 - B. =E3 – B4
 - C. =B4 – 0.1*E3
 - D. =B4 – 0.01*E3

Use the following information to answer the next two questions.

A person has invested \$20 000 with an investment firm. In the first year, her portfolio gives the following returns:

Type	Percent Invested	First-Year Profit
Guaranteed certificates	20%	4%
Blue-chip stocks	50%	9.25%
High-risk stocks	30%	-7.5%

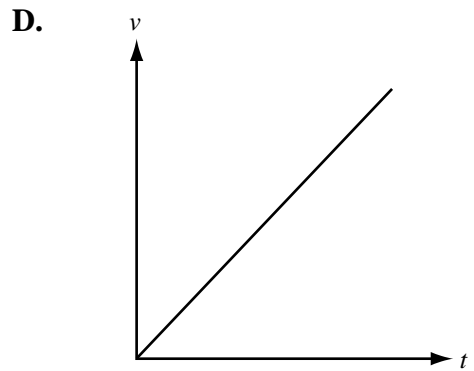
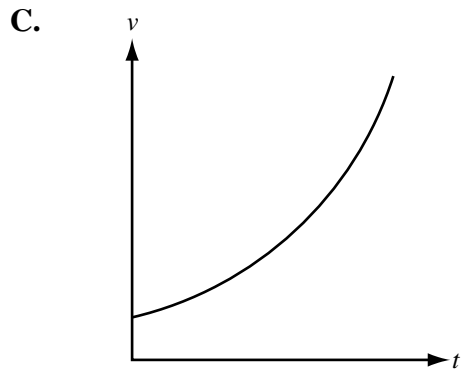
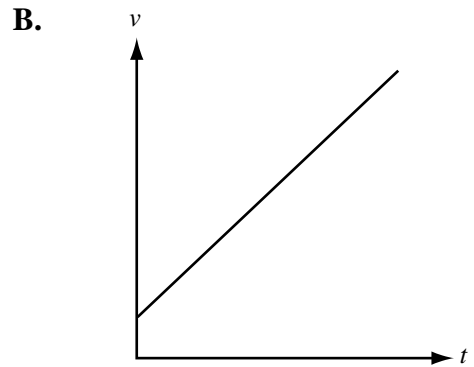
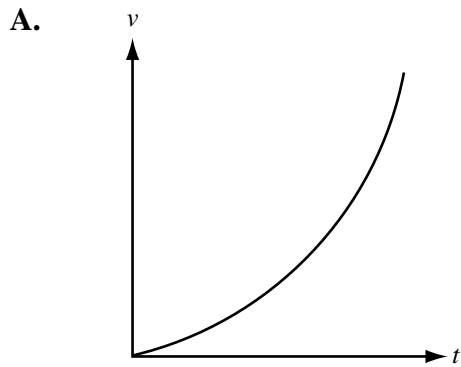
17. For this portfolio, the rate of return, to the nearest tenth of a percentage, is
- A. 20.8%
 - B. 5.8%
 - C. 3.2%
 - D. 1.9%
18. The investor's total return for the first year is
- A. \$317.50
 - B. \$635.00
 - C. \$1 066.50
 - D. \$1 150.00

Use the following information to answer the next question.

A couple plans to buy a house for \$175 000. They will make a \$30 000 down payment and take out a 25-year mortgage at 7.5% per annum, compounded semi-annually. The monthly payments on the mortgage will be \$1 060.75 per month.

19. The total amount of interest that the couple will pay for this mortgage is
- A. \$188 125
 - B. \$173 225
 - C. \$155 875
 - D. \$143 225

20. In most cases, a house is an increasing asset whose value, v , increases exponentially over time, t . Which of the graphs below represents the pattern of the expected value of a house?



Use the following information to answer the next question.

To buy a new boat, a person takes a loan of \$7 400 over 60 months at 8.75% per annum, compounded monthly.

21. Which of the following spreadsheets should the person use to correctly calculate the balance in cell F2?

A.

	A	B	C	D	E	F
1	Months	Loan	Interest Rate	Interest Charge	Monthly Payment	Balance
2	1	7 400	0.0875	$= (B2 * C2) / 12$	152.72	$= B2 - D2 - E2$
3	2	$= F2$	0.0875		152.72	

B.

	A	B	C	D	E	F
1	Months	Loan	Interest Rate	Interest Charge	Monthly Payment	Balance
2	1	7 400	0.0875	$= B2 * C2$	152.72	$= B2 + D2 - E2$
3	2	$= F2$	0.0875		152.72	

C.

	A	B	C	D	E	F
1	Months	Loan	Interest Rate	Interest Charge	Monthly Payment	Balance
2	1	7 400	0.0875	$= (B2 * C2) / 12$	152.72	$= B2 + D2 - E2$
3	2	$= F2$	0.0875		152.72	

D.

	A	B	C	D	E	F
1	Months	Loan	Interest Rate	Interest Charge	Monthly Payment	Balance
2	1	7 400	0.0875	$= B2 * C2$	152.72	$= B2 + D2 + E2$
3	2	$= F2$	0.0875		152.72	

Use the following information to answer the next question.

The owner of a small amusement park represents the number and type of vehicles that are in his parking lot on a particular Thursday, Friday, and Saturday using the matrix below.

		Type of Vehicle		
		Car	Bus	
Matrix A:	Day of	T	85	12
	Week	F	43	17
		S	102	33

He makes a second matrix to indicate the parking cost of \$8 per car and \$22 per bus.

		Parking Cost	
		Car	Bus
Matrix B:	Type of Vehicle	Car	8
	Bus	22	

Written Response—10%

2. a. What does the value 33 in matrix A represent?

b. Use matrix multiplication to calculate the revenue for each of the three days. Write a statement that describes the result of this multiplication.

c. Use matrix operations to calculate an increase of 10% in the daily parking price. Show all calculations.

d. How much **more** money would the owner have made on Saturday as a result of a 10% price increase?

Use the following information to answer the next two questions.

Three major countries produce cars to be purchased in Canada: Canada, Japan, and Germany. A poll of car owners in Canada revealed that of people who presently own a Canadian-produced car, 51% would purchase another Canadian-produced car the next time they purchase a car. Of people who presently own a Japanese-produced car, 30% would purchase a Canadian-produced car the next time they purchase a car.

The following matrix shows detailed results of the poll.

	CA	JA	GR	Other
CA	0.51	0.32	0.12	0.05
JA	0.30	0.50	0.12	0.08
GR	0.35	0.15	0.40	0.10
Other	0.20	0.25	0.15	0.40

22. The entry in row 3 and column 2 indicates that
- A. 15% of people who presently own a Japanese-produced car would purchase a German-produced car the next time they purchase a car
 - B. 12% of people who presently own a German-produced car would purchase a Japanese-produced car the next time they purchase a car
 - C. 15% of people who presently own a German-produced car would purchase a Japanese-produced car the next time they purchase a car
 - D. 12% of people who presently own a Japanese-produced car would purchase a German-produced car the next time they purchase a car
23. The probability that a current owner of a Canadian-produced car will **not** buy a Japanese-produced or German-produced car on his or her next purchase is
- A. 0.44
 - B. 0.56
 - C. 0.65
 - D. 0.71

Use the following information to answer the next question.

The Hawaiian alphabet has only twelve letters:

Vowels	<i>a, e, i, o, u</i>
Consonants	<i>h, k, l, m, n, p, w</i>

24. The number of 3-letter “words” that can be made using the Hawaiian alphabet if every “word” must have the pattern of consonant-vowel-consonant, and if letters can be repeated, is
- A. 19
 - B. 175
 - C. 245
 - D. 1 728

Use the following information to answer the next question.

$$\begin{bmatrix} 2 & 0 & 3 \\ 5 & 0 & -2 \\ 3 & -1 & -2 \\ 1 & 0 & 4 \end{bmatrix} \times \begin{bmatrix} 1 \\ -5 \\ 2 \end{bmatrix} = B$$

Numerical Response

6. In matrix B above, the entries that result from the matrix multiplication, in order from top to bottom, are _____ , _____ , _____ , and _____ .

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

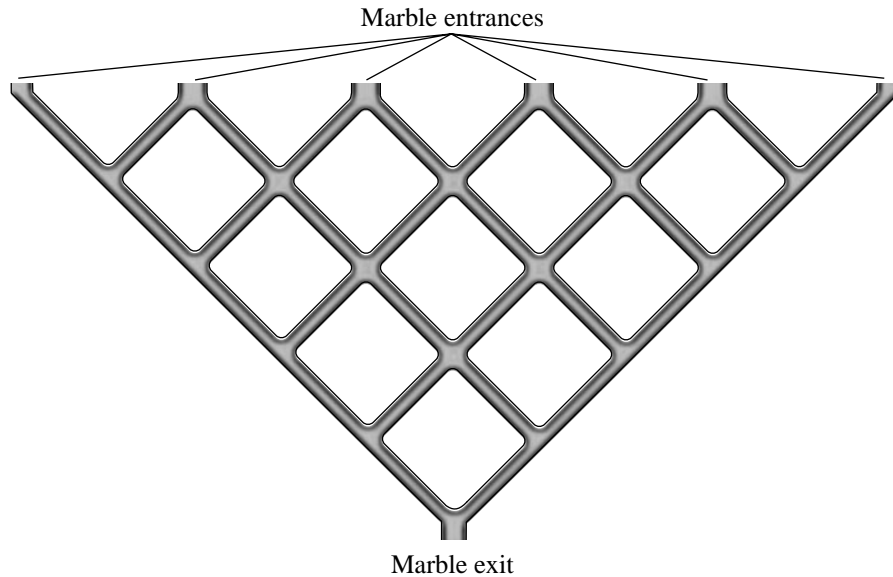
A manufacturing company stores items in a number of warehouses, as modelled in the matrix below.

Warehouse	Item				
	I	II	III	IV	V
A	40	23	9	24	13
B	20	5	12	10	14
C	10	28	38	61	12
D	15	41	62	14	10

25. The sum of the values in row 2 represents the total number of
- A. items in warehouse B
 - B. items in all warehouses
 - C. item II in warehouse B
 - D. item II in all warehouses

Use the following information to answer the next question.

A children's game consists of a maze through which a marble travels downward, as shown below.



26. If the marble can enter through any of the 6 entrances, then the total number of different paths that a marble can take through the maze is

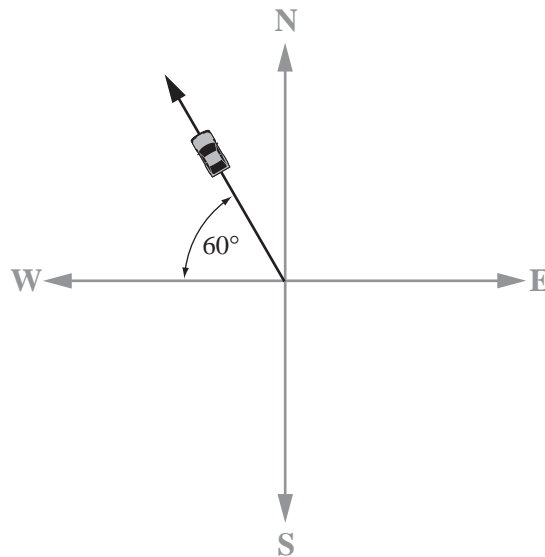
- A. 21
- B. 30
- C. 32
- D. 120

-
27. Which of the following statements about vectors is **false**?

- A. A vector diagram consists of directed line segments.
- B. The vector sum of two vectors is called the resultant.
- C. Two vectors are equal if they have the same magnitude and opposite directions.
- D. The scalar multiplication of a vector by n , $n > 0$, keeps the direction of the vector the same but alters its magnitude by a factor of n .

Use the following information to answer the next question.

The path of a particular vehicle is shown below.



28. The direction in which the vehicle is travelling is

- A. N30°W
- B. N60°W
- C. on a bearing of 60°
- D. on a bearing of 300°

Use the following information to answer the next question.

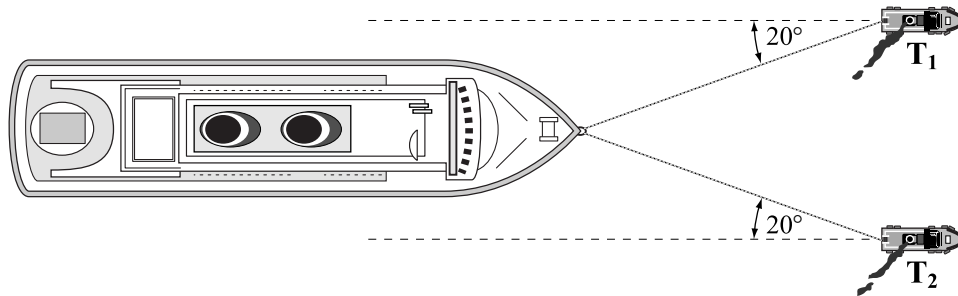
Three forces are simultaneously acting on an object. The first force is 1 200 N upward, the second force is 700 N to the east, and the third force is 500 N to the west.

29. As a result of these three forces, the object will

- A. move up and to the east
- B. move up and to the west
- C. move straight up
- D. not move

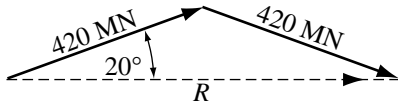
Use the following information to answer the next two questions.

Two tugboats are pulling a ship, as shown below. Each tugboat exerts a force of 420 MN.

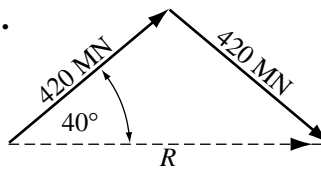


30. If R represents the resultant force, then which of the following diagrams is an appropriate vector diagram for this situation?

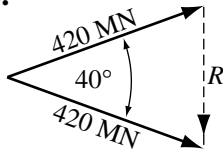
A.



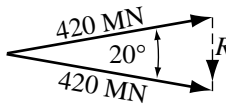
B.



C.

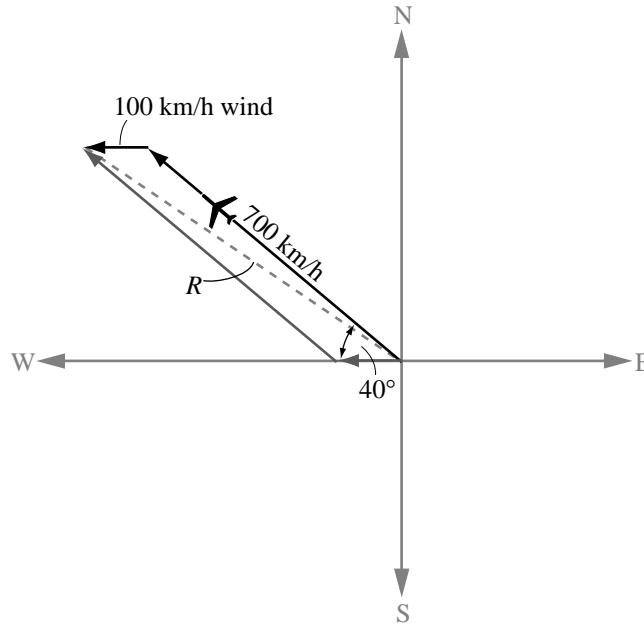


D.



Use the following information to answer the next question.

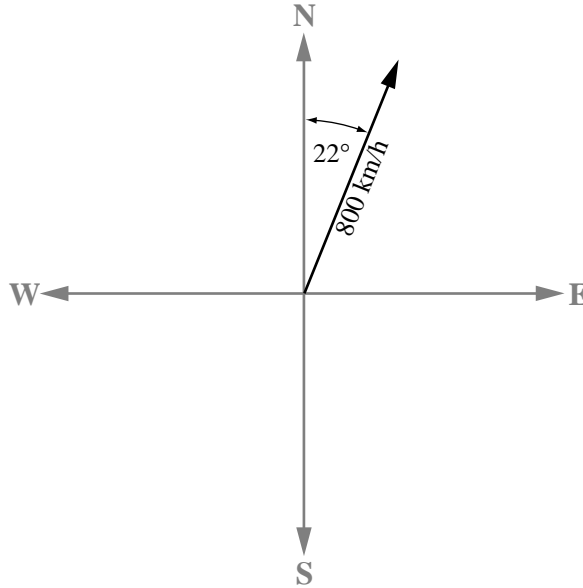
A 737 aircraft is flying on a bearing of 310° with an air speed of 700 km/h. It is being affected by a 100 km/h wind blowing from the east, as shown in the diagram below.



31. The distance, R , relative to the ground, that the plane has travelled after 1 hour is, to the nearest kilometre,
- A. 627 km
 - B. 640 km
 - C. 707 km
 - D. 779 km

Use the following information to answer the next question.

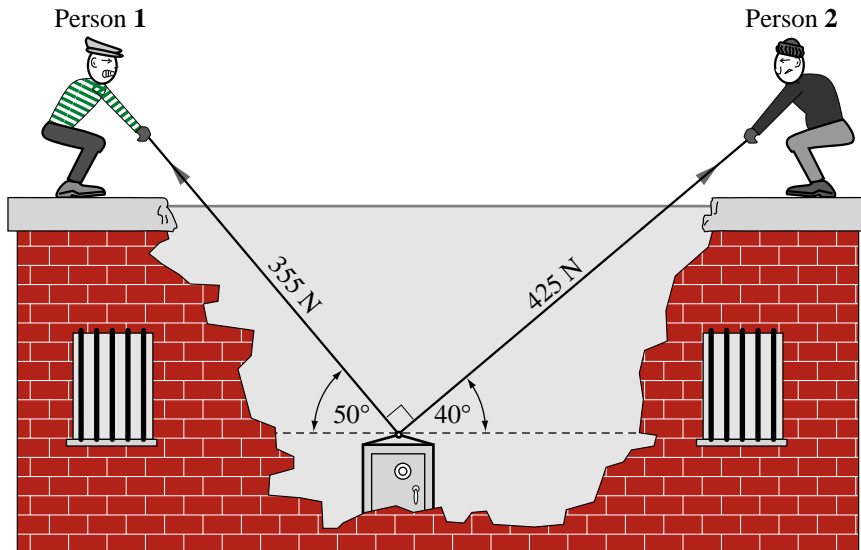
An aircraft sets a course with a bearing of 22° and a speed of 800 km/h , as shown in the diagram below. A horizontal wind blowing from the west at a speed of 110 km/h causes the aircraft to fly off-course with a speed of 847 km/h by an angle θ .



32. The angle, θ , by which the aircraft is flying off-course is, to the nearest degree,
- A. 7°
 - B. 22°
 - C. 61°
 - D. 68°

Use the following information to answer the next question.

Two people are trying to raise an object from a hole using two ropes, as shown in the diagram below. Person 1 exerts a force of 355 N, and Person 2 exerts a force of 425 N.



33. The total amount of resultant force applied by the two people is
- A. 273 N
 - B. 336 N
 - C. 554 N
 - D. 780 N

Use the following information to answer the next question.

The diameter of wire, in millimetres, is described by a gauge number. The following table relates selected gauge numbers and the corresponding wire diameter.

Gauge Number	Diameter of Wire (in mm)
0	8.25
5	4.62
10	2.59
15	1.45
20	0.81

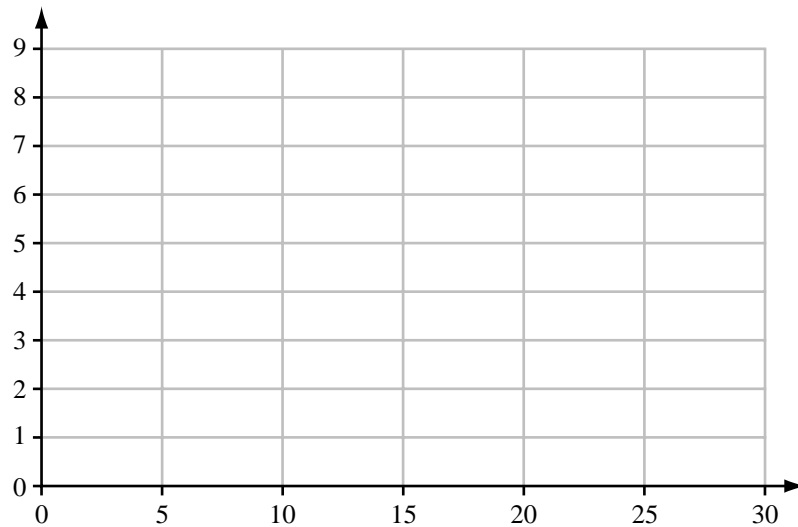
Written Response—15%

- 3.** a. • Input the data above into two of your calculator lists, and graph the data with the window settings

$$x: [0, 30, 5]$$

$$y: [0, 9, 1]$$

- Plot the information from your graphing calculator on the coordinate plane below.



Written-response question 3 continues on the next page.

- b.**
- Perform an exponential regression on the data and sketch this regression model on the coordinate plane on the previous page.
 - State the exponential regression equation in the form $y = ab^x$. Round the values of a and b to the nearest hundredth.
- c.** What do the variables x and y represent in the context of this question?
- d.** Determine the diameter of a 40-gauge wire, to the nearest hundredth of a millimetre.

Use the following information to answer the next part of the question.

The forces of a drag on a car are measured by how much the speed drops during a 10-s interval of coasting without power. The results of some time trials are shown below.

Speed (km/h)	Drag force (N)
20	290
30	300
40	340
50	380
60	430

- e. Use your graphing calculator to perform an exponential regression on this data. Compare the graph of this relationship with the graph relating wire gauge and diameter.

***You have now completed the examination.
If you have time, you may wish to check your answers.***

Applied Mathematics 30 Formula Sheet

The following information may be useful in writing this examination.

Cost and Design

$$A = \pi r^2$$

$$A = 4\pi r^2$$

$$A = 2\pi r^2 + 2\pi r h$$

$$A = \pi r^2 + \pi r s$$

$$A = \frac{h(b_1 + b_2)}{2}$$

$$A = \frac{b \cdot h}{2}$$

$$A = b \cdot h$$

$$V = \frac{4}{3} \pi r^3$$

$$V = \pi r^2 h$$

$$V = B \cdot h, \text{ where } B \text{ is the area of the base}$$

$$V = \frac{1}{3} \pi r^2 h$$

$$V = \frac{B \cdot h}{3}, \text{ where } B \text{ is the area of the base}$$

Graphing Calculator Window Format

$$x: [x_{\min}, x_{\max}, x_{\text{sc1}}]$$

$$y: [y_{\min}, y_{\max}, y_{\text{sc1}}]$$

Trigonometry and Vectors

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

Statistics and Probability

$$\mu = np$$

$$\sigma = \sqrt{np(1-p)}$$

$$z = \frac{x - \mu}{\sigma}$$

$$P(A \text{ or } B) = P(A) + P(B)$$

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

Regression Models

$$y = a \cdot \sin(bx + c) + d$$

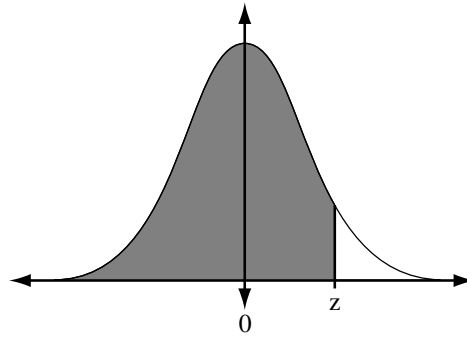
$$\text{period} = \frac{2\pi}{b}$$

$$y = ax^2 + bx + c$$

$$y = ax + b$$

$$y = a \cdot b^x$$

$$z = \frac{x - \mu}{\sigma}$$



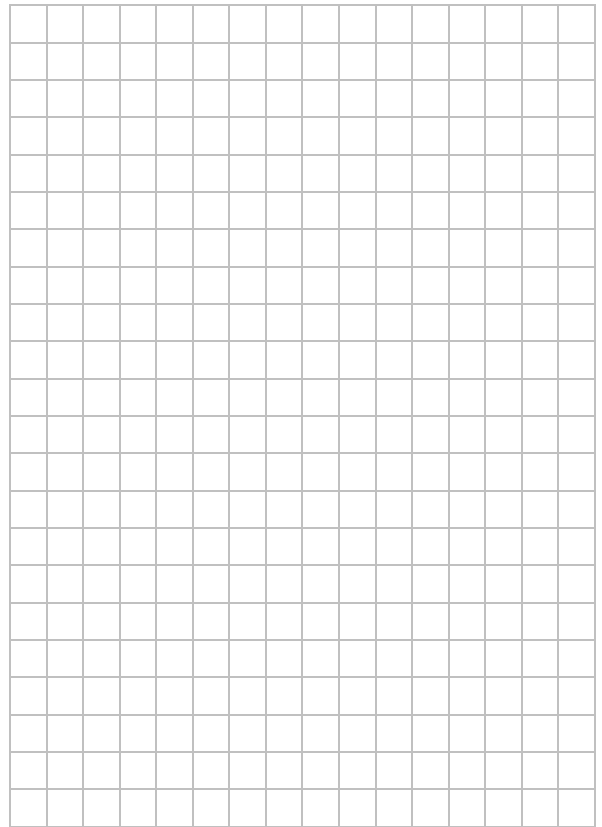
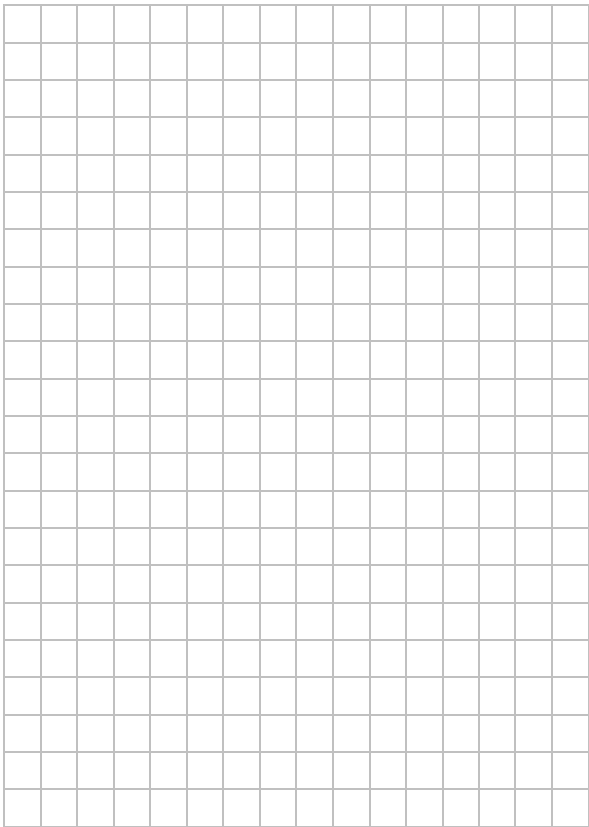
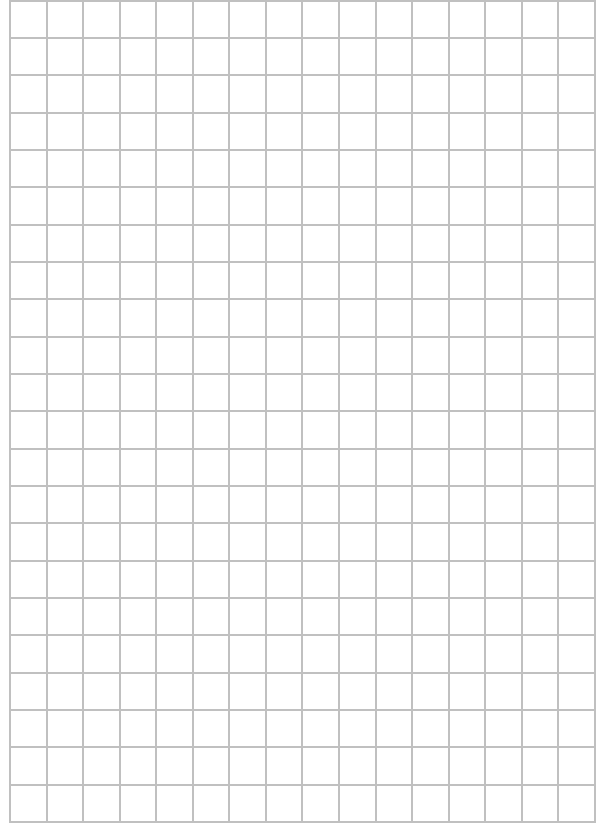
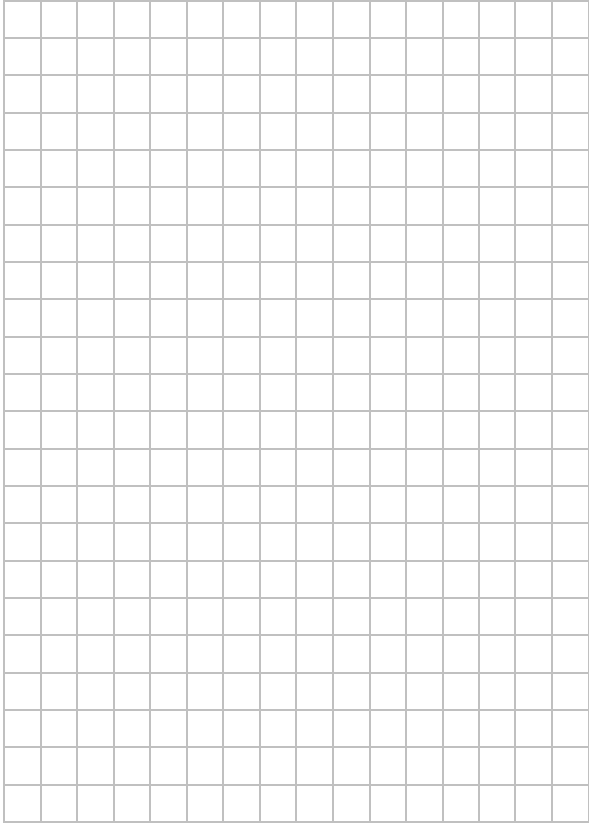
Areas under the Standard Normal Curve

z	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00
-3.4	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
-3.3	0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
-3.2	0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007
-3.1	0.0007	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0010
-3.0	0.0010	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013
-2.9	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019
-2.8	0.0019	0.0020	0.0021	0.0021	0.0022	0.0023	0.0023	0.0024	0.0025	0.0026
-2.7	0.0026	0.0027	0.0028	0.0029	0.0030	0.0031	0.0032	0.0033	0.0034	0.0035
-2.6	0.0036	0.0037	0.0038	0.0039	0.0040	0.0041	0.0043	0.0044	0.0045	0.0047
-2.5	0.0048	0.0049	0.0051	0.0052	0.0054	0.0055	0.0057	0.0059	0.0060	0.0062
-2.4	0.0064	0.0066	0.0068	0.0069	0.0071	0.0073	0.0075	0.0078	0.0080	0.0082
-2.3	0.0084	0.0087	0.0089	0.0091	0.0094	0.0096	0.0099	0.0102	0.0104	0.0107
-2.2	0.0110	0.0113	0.0116	0.0119	0.0122	0.0125	0.0129	0.0132	0.0136	0.0139
-2.1	0.0143	0.0146	0.0150	0.0154	0.0158	0.0162	0.0166	0.0170	0.0174	0.0179
-2.0	0.0183	0.0188	0.0192	0.0197	0.0202	0.0207	0.0212	0.0217	0.0222	0.0228
-1.9	0.0233	0.0239	0.0244	0.0250	0.0256	0.0262	0.0268	0.0274	0.0281	0.0287
-1.8	0.0294	0.0301	0.0307	0.0314	0.0322	0.0329	0.0336	0.0344	0.0351	0.0359
-1.7	0.0367	0.0375	0.0384	0.0392	0.0401	0.0409	0.0418	0.0427	0.0436	0.0446
-1.6	0.0455	0.0465	0.0475	0.0485	0.0495	0.0505	0.0516	0.0526	0.0537	0.0548
-1.5	0.0559	0.0571	0.0582	0.0594	0.0606	0.0618	0.0630	0.0643	0.0655	0.0668
-1.4	0.0681	0.0694	0.0708	0.0721	0.0735	0.0749	0.0764	0.0778	0.0793	0.0808
-1.3	0.0823	0.0838	0.0853	0.0869	0.0885	0.0901	0.0918	0.0934	0.0951	0.0968
-1.2	0.0985	0.1003	0.1020	0.1038	0.1056	0.1075	0.1093	0.1112	0.1131	0.1151
-1.1	0.1170	0.1190	0.1210	0.1230	0.1251	0.1271	0.1292	0.1314	0.1335	0.1357
-1.0	0.1379	0.1401	0.1423	0.1446	0.1469	0.1492	0.1515	0.1539	0.1562	0.1587
-0.9	0.1611	0.1635	0.1660	0.1685	0.1711	0.1736	0.1762	0.1788	0.1814	0.1841
-0.8	0.1867	0.1894	0.1922	0.1949	0.1977	0.2005	0.2033	0.2061	0.2090	0.2119
-0.7	0.2148	0.2177	0.2206	0.2236	0.2266	0.2296	0.2327	0.2358	0.2389	0.2420
-0.6	0.2451	0.2483	0.2514	0.2546	0.2578	0.2611	0.2643	0.2676	0.2709	0.2743
-0.5	0.2776	0.2810	0.2843	0.2877	0.2912	0.2946	0.2981	0.3015	0.3050	0.3085
-0.4	0.3121	0.3156	0.3192	0.3228	0.3264	0.3300	0.3336	0.3372	0.3409	0.3446
-0.3	0.3483	0.3520	0.3557	0.3594	0.3632	0.3669	0.3707	0.3745	0.3783	0.3821
-0.2	0.3859	0.3897	0.3936	0.3974	0.4013	0.4052	0.4090	0.4129	0.4168	0.4207
-0.1	0.4247	0.4286	0.4325	0.4364	0.4404	0.4443	0.4483	0.4522	0.4562	0.4602
-0.0	0.4641	0.4681	0.4721	0.4761	0.4801	0.4840	0.4880	0.4920	0.4960	0.5000

Areas under the Standard Normal Curve

<i>z</i>	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Fold and tear along perforation.



Fold and tear along perforation.

*Tear-out
Page*

JANUARY 2001

**APPLIED MATHEMATICS 30
DIPLOMA EXAMINATION**

**Multiple-Choice Key,
Numerical-Response Key
and
Sample Answers to
Written-Response Questions**



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**Applied Mathematics 30 January 2001 Diploma Examination
Multiple-Choice and Numerical-Response Keys**

Multiple Choice

- | | | | |
|-----|---|-----|---|
| 1. | D | 18. | B |
| 2. | D | 19. | B |
| 3. | B | 20. | C |
| 4. | A | 21. | C |
| 5. | A | 22. | C |
| 6. | B | 23. | B |
| 7. | B | 24. | C |
| 8. | D | 25. | A |
| 9. | C | 26. | C |
| 10. | B | 27. | C |
| 11. | A | 28. | A |
| 12. | B | 29. | A |
| 13. | C | 30. | A |
| 14. | C | 31. | D |
| 15. | B | 32. | A |
| 16. | D | 33. | C |
| 17. | C | | |

Numerical Response

- | | |
|-----------|------|
| 1. | 40 |
| 2. | 2.5 |
| 3. | 192 |
| 4. | 1120 |
| 5. | 58 |
| 6. | 8149 |

This scoring guide reflects a mark based on four criteria:

- **mathematical understanding**
- **clarity of communication**
- **application of processes**
- **use of technology**

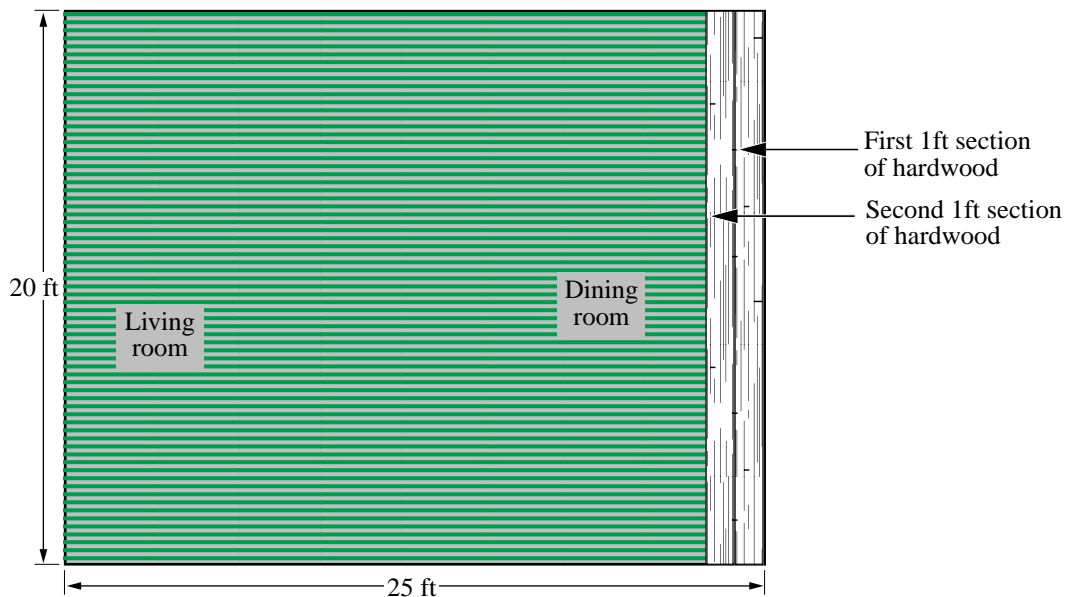
GENERAL SCORING GUIDE	
1 mark	<p>In the response, the student</p> <ul style="list-style-type: none"> • applies some relevant mathematical knowledge to explore the initial stages of the problem; however, the response reflects a misunderstanding of the problem • uses a relevant strategy, mathematical process, or problem-solving technique to explore the initial stages of the problem • communicates very little relevant information and the response lacks clarity • uses technology inappropriately or the use of technology is not evident
2 marks	<p>In the response, the student</p> <ul style="list-style-type: none"> • applies some relevant mathematical knowledge to find partial solutions to the problem; however, the response reflects a minimal understanding of the problem • uses relevant strategies, mathematical processes, or problem-solving techniques to find a partial solution • communicates strategies in a manner that lacks clarity or is incomplete • uses technology where appropriate; however, errors are evident
3 marks	<p>In the response, the student</p> <ul style="list-style-type: none"> • applies mathematical knowledge to find partial solutions to the problem and reflects a basic understanding of the problem • uses appropriate strategies, mathematical processes, and problem-solving techniques to find partial solutions to the problem • communicates strategies and solutions in an organized manner; however, errors, inconsistencies, and omissions affect clarity • uses technology appropriately; however, there are inconsistencies in their application
4 marks	<p>In the response, the student</p> <ul style="list-style-type: none"> • applies appropriate mathematical knowledge to find a complete solution to the problem and reflects a good understanding of the problem • uses appropriate strategies, mathematical processes, and problem-solving techniques to find a complete solution to the problem; however, the solution contains an error that hinders understanding of the response • communicates strategies and solutions in an organized manner; however, errors or omissions may affect clarity • uses technology appropriately
5 marks	<p>In the response, the student</p> <ul style="list-style-type: none"> • applies appropriate mathematical knowledge to find a complete and correct solution to the problem and reflects an excellent understanding of the problem • uses appropriate strategies, mathematical processes, and problem-solving techniques to find a complete, correct solution; the solution may have a minor error but it does not hinder the understanding of the response • communicates strategies and solutions in a clear, complete, and organized manner that reflects a thorough understanding of the problem • uses technology effectively

Written-Response Question 1

Use the following information to answer the next question.

A family is planning to cover their $20\text{ ft} \times 25\text{ ft}$ living room/dining room with carpet and hardwood. Their budget for this project is \$5 000. The cost of carpet is $\$7.25/\text{ft}^2$, and the cost of hardwood is $\$12.50/\text{ft}^2$.

The family would like to cover the total area with hardwood, but they know that it would cost more than the budgeted amount. In order to determine the maximum area of hardwood they can afford, they calculated the total cost of the flooring each time a 1 ft wide section of hardwood was added to the room, as shown below.



The following spreadsheet was used to calculate costs and to determine the maximum area of hardwood.

	A	B	C	D	E
1	Area of floor with hardwood (ft²)	Area of floor with carpet (ft²)	Cost of hardwood @ \$12.50/ft²	Cost of carpet @ \$7.25/ft²	Total cost of flooring
2	500	0	\$6 250	\$0	\$6 250
3	480	20	\$6 000	\$145	\$6 145
4	460	40	\$5 750	\$290	\$6 040
5	440	60	\$5 500	\$435	\$5 935
6	420	80	\$5 250	\$580	\$5 830
7	400	100	\$5 000	\$725	\$5 725
8	380	120	\$4 750	\$870	\$5 620
9	360	140	\$4 500	\$1 015	\$5 515
10	340	160	\$4 250	\$1 160	\$5 410
11	320	180	\$4 000	\$1 305	\$5 305
12	300	200	\$3 750	\$1 450	\$5 200
13	280	220	\$3 500	\$1 595	\$5 095
14	260	240	\$3 250	\$1 740	\$4 990
15	240	260	\$3 000	\$1 885	\$4 885
16	220	280	\$2 750	\$2 030	\$4 780
17	200	300	\$2 500	\$2 175	\$4 675
18	180	320	\$2 250	\$2 320	\$4 570
19	160	340	\$2 000	\$2 465	\$4 465
20	140	360	\$1 750	\$2 610	\$4 360
21	120	380	\$1 500	\$2 755	\$4 255
22	100	400	\$1 250	\$2 900	\$4 150
23	80	420	\$1 000	\$3 045	\$4 045
24	60	440	\$750	\$3 190	\$3 940
25	40	460	\$500	\$3 335	\$3 835
26	20	480	\$250	\$3 480	\$3 730
27	0	500	0	\$3 625	\$3 625

Written Response—5 marks

1. a. Explain the relationship between the values in columns A and B.

A POSSIBLE SOLUTION to part a.

The sum of each row of columns A and B yields 500 ft^2 (the total floor of the living room and dining room).

- b. Show, by writing a statement or a formula, how the value in cell E9 (\$5 515) was calculated. Make reference to other cells in row 9.

A POSSIBLE SOLUTION to part b.

Cell C9 is calculated by multiplying A9, the total area of hardwood, by \$12.50. Cell D9 is calculated by multiplying B9, the total area of carpet, by \$7.25. Cell E9 is then calculated by adding cells C9 and D9 to find the total cost of flooring for the given areas of carpet and hardwood.

or

$$E9 = A9 * 12.50 + B9 * 7.25$$

or

$$C9 = A9 * 12.50$$

$$D9 = B9 * 7.25$$

$$C9 + D9 = E9$$

or

$$C9 + D9 = E9$$

- c. If the family is to remain within their budget, what is the maximum area of hardwood that they can place into this living room/dining room area?

A POSSIBLE SOLUTION to part c.

To remain within budget, the maximum area of hardwood is a $13' \times 20'$ piece or 260 ft^2 .

Use the following additional information to answer the next part of the question.

The family decided that they would finish one half of the floor in carpet and one half in hardwood.

- d. What is the total cost for this plan?

A POSSIBLE SOLUTION to part d., bullet one

Option 1:

the family could have 250 ft² of each carpet and hardwood for a total cost of \$4 937.50.

Option 2: reference row 14

260 ft² of hardwood and 240 ft² of carpet for a total cost of \$4 990.00

Option 3: reference row 15

240 ft² of hardwood and 260 ft² of carpet for a total cost of \$4 885.00

Will the family remain within their budget? Explain.

A POSSIBLE SOLUTION to part d., bullet two

The total cost is less than \$5 000.00, so the family will remain within their budget.

Written-Response Question 2

Use the following information to answer the next question.

The owner of a small amusement park represents the number and type of vehicles that are in his parking lot on a particular Thursday, Friday, and Saturday using the matrix below.

		Type of Vehicle	
		Car	Bus
Matrix A: Day of Week	T	85	12
	F	43	17
	S	102	33

He makes a second matrix to indicate the parking cost of \$8 per car and \$22 per bus.

		Parking Cost	
		Car	Bus
Matrix A: Type of Vehicle	Car	8	
	Bus		22

Written Response—5 marks

2. a. What does the value 33 in matrix A represent?

A POSSIBLE SOLUTION to part a.

There are 33 buses in the parking lot on Saturday.

- b. Use matrix multiplication to calculate the revenue for each of the three days. Write a statement that describes the result of this multiplication.

A POSSIBLE SOLUTION to part b.

$$\begin{bmatrix} 85 & 12 \\ 43 & 17 \\ 102 & 33 \end{bmatrix} \times \begin{bmatrix} 8 \\ 22 \end{bmatrix} = \begin{bmatrix} 944 \\ 718 \\ 1542 \end{bmatrix}$$

The revenue for each day is \$944, \$718 and \$1 542 for Thursday, Friday and Saturday respectively.

- c. Use matrix operations to calculate an increase of 10% in the daily parking price. Show all calculation.

A POSSIBLE SOLUTION to part c.

$$1.10 \times \begin{bmatrix} 8 \\ 22 \end{bmatrix} = \begin{bmatrix} 8.8 \\ 24.2 \end{bmatrix}$$

The new parking price is \$8.80 for cars and \$24.20 for buses.

or

$$0.1 \times \begin{bmatrix} 8 \\ 22 \end{bmatrix} = \begin{bmatrix} 0.8 \\ 2.2 \end{bmatrix}$$

The parking prices will increase by \$0.80 for cars and \$2.20 for buses.

- d. How much more money would the owner have made on Saturday as a result of a 10% price increase?

A POSSIBLE SOLUTION to part d.

$$\begin{bmatrix} 85 & 12 \\ 43 & 17 \\ 102 & 33 \end{bmatrix} \times \begin{bmatrix} 8 \\ 22 \end{bmatrix} \times 1.10 = \begin{bmatrix} 85 & 12 \\ 43 & 17 \\ 102 & 33 \end{bmatrix} \times \begin{bmatrix} 8.8 \\ 24.2 \end{bmatrix}$$
$$= \begin{bmatrix} 1038.4 \\ 789.8 \\ 1696.2 \end{bmatrix}$$

or

$$1.1 \times \begin{bmatrix} 944 \\ 718 \\ 1542 \end{bmatrix} = \begin{bmatrix} 1038.4 \\ 789.8 \\ 1696.2 \end{bmatrix}$$

New revenue = \$1 696.20

Orig. revenue = \$1 542.00

$$\$1\,696.20 - \$1\,542 = \$154.20$$

The increase in revenue on Saturday is \$154.20.

Written-Response Question 3

Use the following information to answer the next question.

The diameter of wire, in millimetres, is described by a gauge number. The following table relates selected gauge numbers and the corresponding wire diameter.

Wire gauge	Diameter (in mm)
0	8.25
5	4.62
10	2.59
15	1.45
20	0.81

Written Response—15 %

3. a. • Input the data above into two of your calculator lists, and graph the data with the window settings

$$x: [0, 30, 5]$$

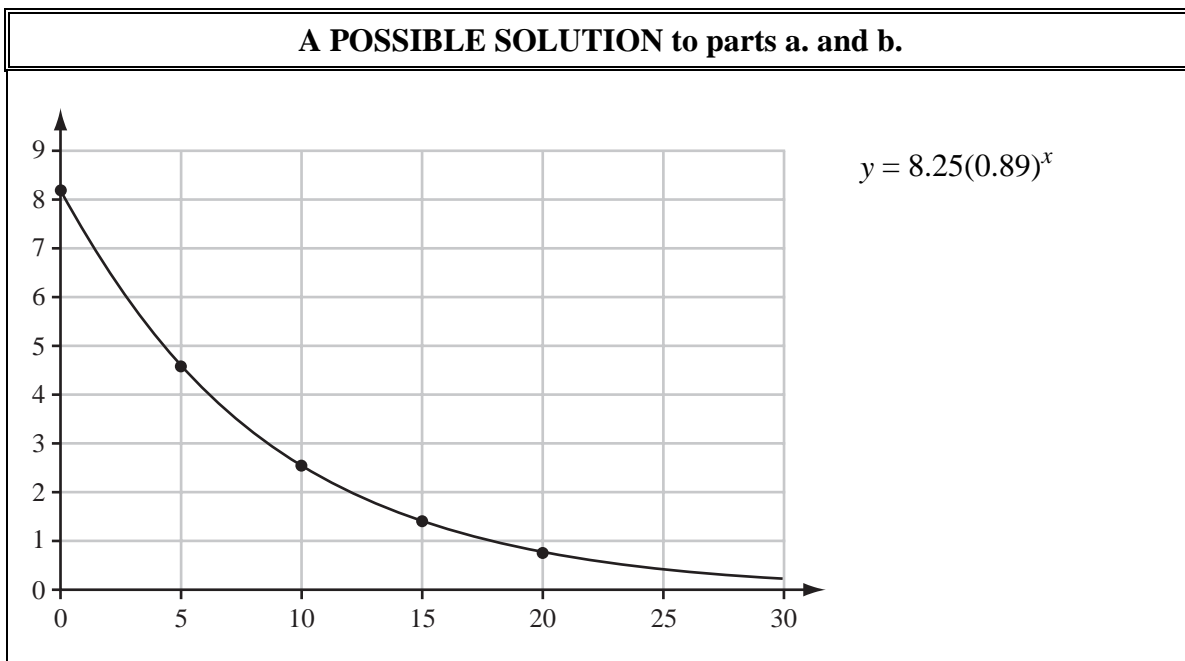
$$y: [0, 9, 1]$$

- Plot the information from your graphing calculator on the coordinate plane below.



b. • Perform an exponential regression on the data and sketch this regression model on the coordinate plane on the previous page.

• State the exponential regression equation in the form $y = ab^x$. Round the values of a and b to the nearest hundredth.



c. What do the variables x and y represent in the context of this question?

A POSSIBLE SOLUTION to part d.

x represents the wire gauge
 y represents the diameter of the wire (in mm).

d. Determine the diameter of wire for a 40 gauge wire, to the nearest hundredth of a millimetre.

A POSSIBLE SOLUTION to part c.

The diameter of wire for a 40 gauge wire is 0.08 mm.

Use the following information to answer the next question.

The forces of a drag on a car are measured by how much the speed drops during a 10-second interval of coasting without power. The results of some time trials are shown below.

<u>Speed (km/h)</u>	<u>Drag force (N)</u>
20	290
30	300
40	340
50	380
60	430

- e. Use your graphing calculator to perform an exponential regression on this data. Compare the graph of this relationship with the graph relating wire gauge and diameter.

A POSSIBLE SOLUTION to part e.

Both are exponential functions.

The first function falls to the right, while the second function rises to the right.

The y-intercept of the first function is 8.25, and y-intercept of the second function is 228.5.