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January 2002

Applied Mathematics 30

Grade 12 Diploma Examination

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 ____, ____, ____, and ____.

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

Use the following information to answer the first question.

A box contains 6 blue balls and 4 red balls. Two balls are drawn from the box, one after the other, without replacement.

1. The actions described above will result in events that are
 - A. dependent
 - B. independent
 - C. complementary
 - D. mutually exclusive
-

Use the following information to answer the next question.

The numbers 1 through 5 are each written on a separate slip of paper, and the papers are placed in a box. The letters A, B, C, and D are each written on a separate slip of paper, and the papers are placed into a **different** box. Jodi draws one slip of paper from each box.

2. The number of elements in the sample space for this trial is
 - A. 51
 - B. 20
 - C. 9
 - D. 2

Use the following information to answer the next question.

A particular traffic light at the outskirts of a town is red for 30 s, green for 25 s, and yellow for 5 s in every minute.

3. The probability that the traffic light will **not** be green when a motorist first sees it is
- A. $\frac{1}{2}$
 - B. $\frac{1}{12}$
 - C. $\frac{5}{12}$
 - D. $\frac{7}{12}$

Use the following information to answer the next question.

Given their previous performance, the probability of a particular baseball team winning any given game is $\frac{4}{5}$.

4. The probability that the team will win their next 2 games is
- A. $\frac{8}{5}$
 - B. $\frac{16}{25}$
 - C. $\frac{2}{5}$
 - D. $\frac{1}{25}$

Use the following information to answer the next question.

The average individual score per round for each of several golfers on the 2000 PGA tour is recorded in the table below.

Name	Average	Name	Average
Mike Weir	70.4	Joe Durrant	70.9
Greg Chalmers	70.5	Tiger Woods	67.8
David Duval	69.4	Scott Dunlop	70.4

Numerical Response

1. The standard deviation, σ , of the golfers' average scores, to the nearest hundredth, is _____.

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

Use the following information to answer the next question.

A medical researcher measured the body temperature of 700 people and found that the temperatures were normally distributed with a mean of 36.8°C and a standard deviation of 0.35°C .

5. The number of people expected to have a body temperature of 37.5°C or lower is
- A. 16
 - B. 68
 - C. 490
 - D. 684

Use the following information to answer the next question.

A potato chip manufacturing company has found that the mean mass of potato chips in its bags is 65 g and the standard deviation is 7 g.

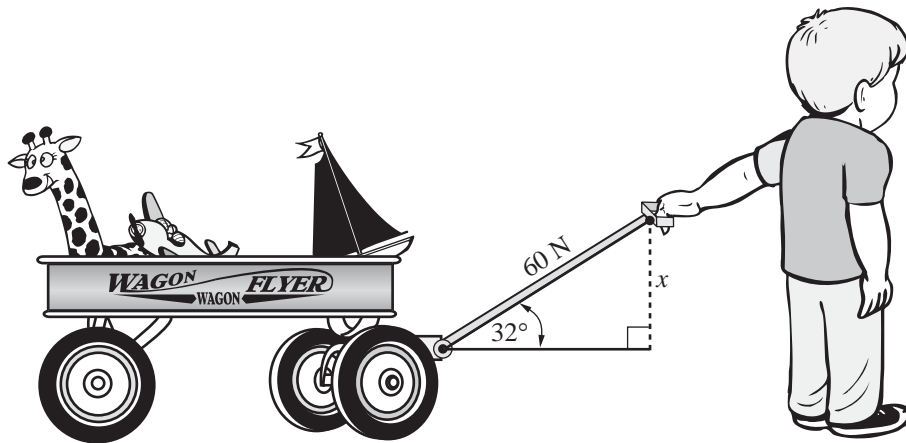
Numerical Response

2. The symmetric 95% confidence interval for the mass of potato chips in a bag, to the nearest whole number, is between 51 g and _____ g.

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

Use the following information to answer the next question.

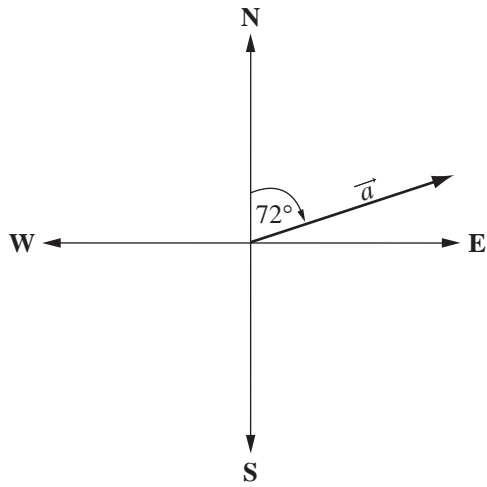
A boy pulls a wagon along level ground by exerting a force of 60 N at an angle of 32° to the horizontal, as shown in the diagram below.



6. The magnitude of the vertical force, x , to the nearest tenth of a newton, is
- A. 60.0 N
 - B. 50.9 N
 - C. 32.0 N
 - D. 31.8 N

Use the following information to answer the next question.

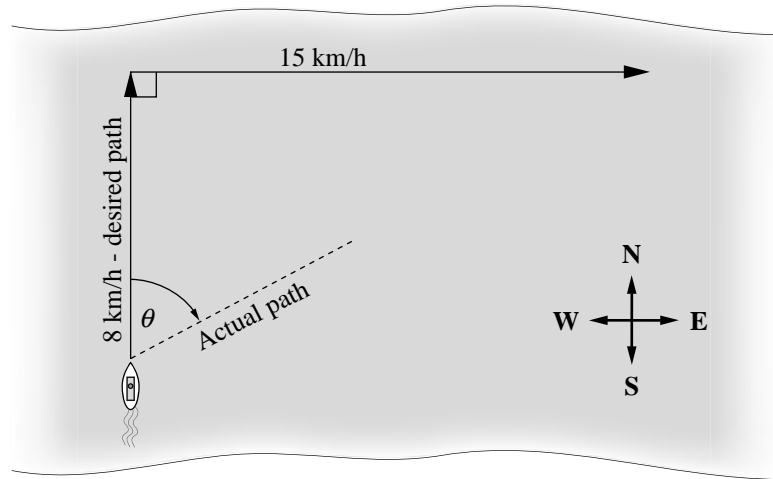
Vector \vec{a} has a bearing of 72° , as shown in the diagram below.



7. If vector \vec{a} is multiplied by a negative scalar, then the new vector will have a bearing of
- A. 108°
 - B. 144°
 - C. 252°
 - D. 288°

Use the following information to answer the next question.

A person is trying to sail a boat north across a river, but the boat is being pushed off-course by a 15 km/h current flowing toward the east, as shown below.



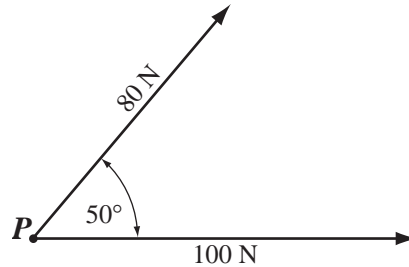
8. Relative to the shore, the actual speed of the boat is *i* km/h, and relative to the desired path, the boat is travelling off-course by an angle, θ , of *ii* .

The statement above is completed by the information in row

	<i>i</i>	<i>ii</i>
A.	17	62°
B.	17	28°
C.	13	62°
D.	13	28°

Use the following information to answer the next question.

Two forces act on a point P . The first force has a magnitude of 100 N. The second force has a magnitude of 80 N and is at an angle of 50° to the first force, as shown below.

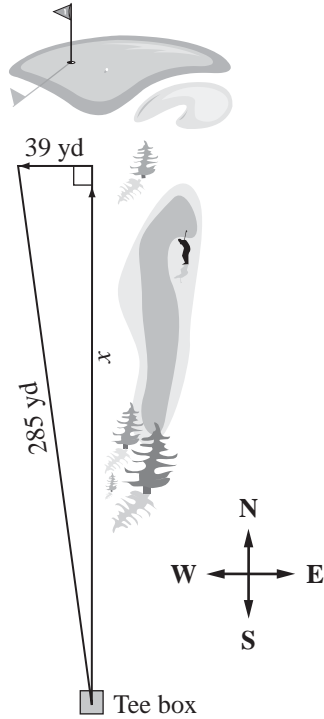


9. The magnitude of the resultant force, to the nearest newton, is
- A. 31 N
 - B. 128 N
 - C. 163 N
 - D. 180 N
-

10. Which of the following statements describes a vector quantity?
- A. A car travelled north.
 - B. A car travelled at 100 km/h.
 - C. A car travelled north at 100 km/h.
 - D. A car travelled 200 km at 100 km/h.

Use the following information to answer the next question.

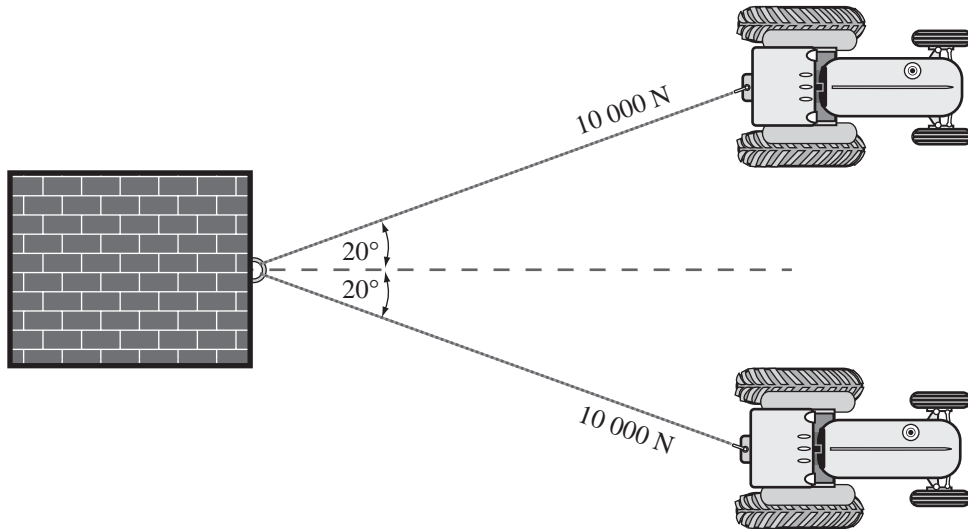
A golfer tees off and hits a drive. The 285 yd drive is affected by a westerly wind that pushes the ball 39 yd off-line, as shown in the diagram below.



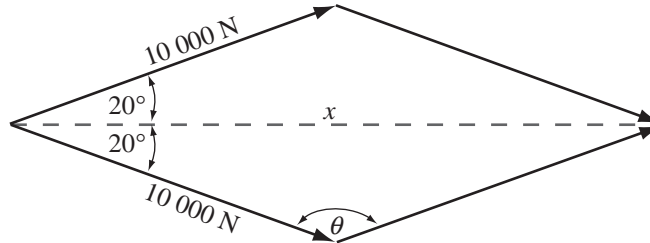
11. If there had been no wind, then the distance, x , that the ball would have travelled is
- A. 246 yd
 - B. 282 yd
 - C. 288 yd
 - D. 324 yd

Use the following information to answer the next question.

Two tractors pull on a large block with a force of 10 000 N each. Each of the tractors pulls at an angle 20° from the direction that the block is to move in, as shown below.



The force exerted by the tractors can be modelled by the vector diagram shown below.

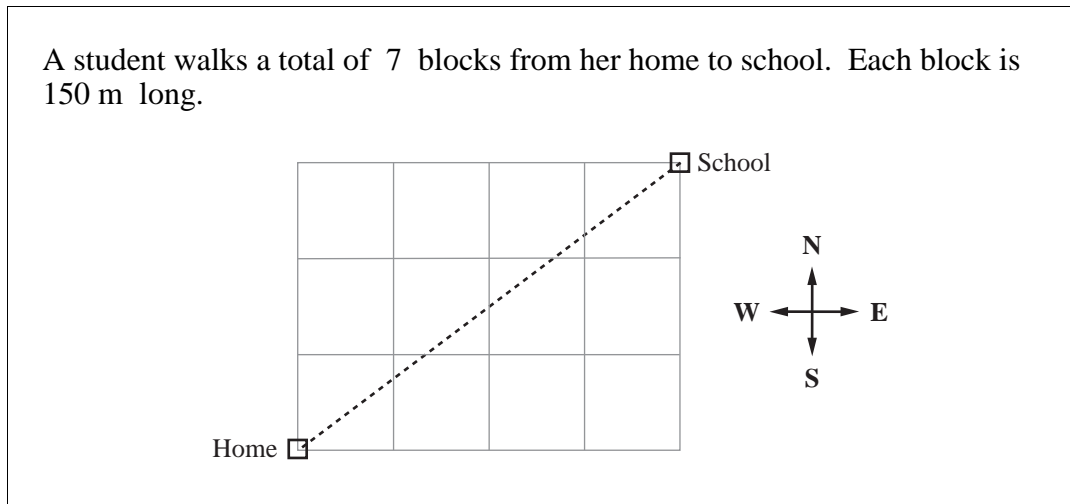


Written Response—10%

- 1.** a. Determine the measure of angle θ in the vector diagram.

- b.** Calculate the magnitude, x , of the resultant force that the tractors exert on the block.
- c.** If a force of 18 000 N is required to move the block, will the tractors be able to do so? Explain and justify your answer mathematically.

Use the following information to answer the next two questions.



12. The direction and straight-line distance from the student's home to her school are, respectively,
- A. E37°N and 750 m
 - B. E53°N and 750 m
 - C. E37°N and 1 050 m
 - D. E53°N and 1 050 m
13. The number of different paths that the student could choose to travel from home to school, if she travels only directly north and east, is
- A. 6
 - B. 7
 - C. 12
 - D. 35

Use the following information to answer the next question.

The graduation council has been given the task of determining the menu for the graduation banquet. They have to select one salad, one main course, one side dish, one vegetable dish, and one dessert from the following choices.

Salad: caesar, garden, tomato-herb, pasta
Main course: chicken, beef, fish
Side dish: rice, baked potato, mashed potato, French fries, pasta
Vegetable: peas, corn, carrots, mixed vegetables, broccoli
Dessert: cheesecake, pudding, ice cream, pie

Numerical Response

- 3.** The number of possible menu combinations is _____.

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

Use the following information to answer the next question.

The table below shows the number of vehicles parked in a downtown parking lot over a three-day period.

	Cars	Buses	Bicycles
Thursday	72	6	7
Friday	81	2	2
Saturday	94	3	12

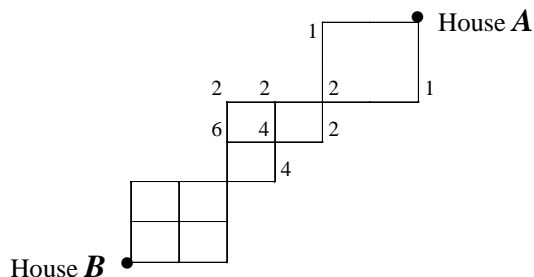
The charge for cars is \$6, the charge for buses is \$15, and there is no charge for bicycles. The total revenue for each of the three days can be determined from the product of the two matrices below.

$$\begin{bmatrix} 72 & 6 & 7 \\ 81 & 2 & 2 \\ 94 & 3 & 12 \end{bmatrix} \times \begin{bmatrix} 6 \\ 15 \\ 0 \end{bmatrix}$$

14. From this matrix operation, it can be determined that the revenue from
- A. cars on Thursday was \$522
 - B. all vehicles on Saturday was \$609
 - C. all vehicles on Thursday was \$516
 - D. buses over the three days was \$516

Use the following information to answer the next question.

A paperboy who delivers papers on his bike can travel only on the trails represented in the diagram below.



The number beside a vertex indicates the number of trails that lead to that vertex.

15. The number of different trails that the paperboy can take to get from house *A* to house *B* without backtracking is
- A. 36
 - B. 60
 - C. 72
 - D. 120

Use the following information to answer the next question.

A Matrix Equation

$$\begin{bmatrix} -3 & 11 \\ 2 & 8 \end{bmatrix} + 3 \begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} 0 & 26 \\ 35 & 14 \end{bmatrix}$$

Numerical Response

4. In this equation, the value of *c* is _____.

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

16. On which of the following matrices can addition be performed?

A. $\begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}$ and $\begin{bmatrix} g \\ h \end{bmatrix}$

B. $\begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}$ and $\begin{bmatrix} g & h \\ i & j \\ k & l \end{bmatrix}$

C. $\begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}$ and $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$

D. $\begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}$ and $\begin{bmatrix} g & h & i \\ j & k & l \end{bmatrix}$

Use the following information to answer the next question.

A researcher discovered mould growing in a petri dish in her laboratory. When first observed, the mould covered only 12.5% of the dish's surface. After 24 hours, the surface area of the mould doubled in size, as shown in the table below.

Time (h)	Area covered (%)
0	12.5
24	25

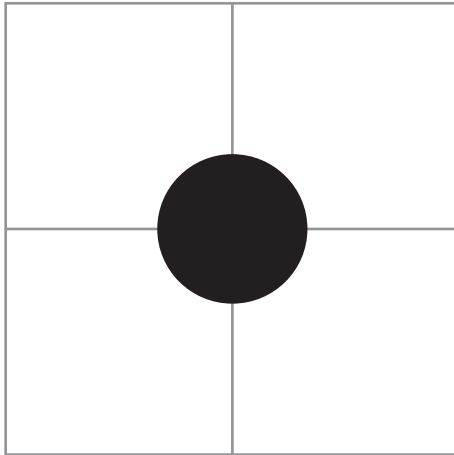
Numerical Response

- 5.** If the mould continues to grow at the same rate, the petri dish will be covered with mould after _____ hours.

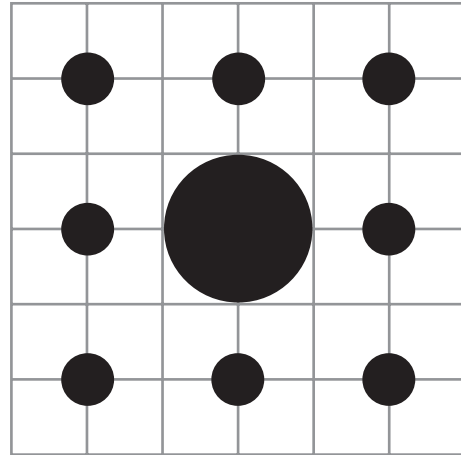
(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next two questions.

The diagrams below show the first two iterations of a fractal pattern. In each consecutive iteration, 8 new circles are drawn around the circles created in the previous iteration.



Iteration 1



Iteration 2

17. The total number of **new** circles created in iteration 3 will be
- A. 17
 - B. 64
 - C. 72
 - D. 81

Use the following additional information to answer the next question.

The diameter of the new circle created by each of the first four iterations is shown in the table below.

Iteration	1	2	3	4
Diameter in units	2	0.667	0.222	0.074

This data can be modelled by an exponential regression equation in the form $y = a \cdot b^x$.

18. The diameter, to the nearest thousandth of a unit, of each new circle created by iteration 7 would be
- A. 0.003 units
 - B. 0.008 units
 - C. 0.025 units
 - D. 0.518 units

Use the following information to answer the next question.

A group of biologists studied the population of wolves in an area in northern Canada. The biologists found that the number of wolves was directly related to the number of caribou found in the study area. The wolf population for the period of the study is shown in the table below.

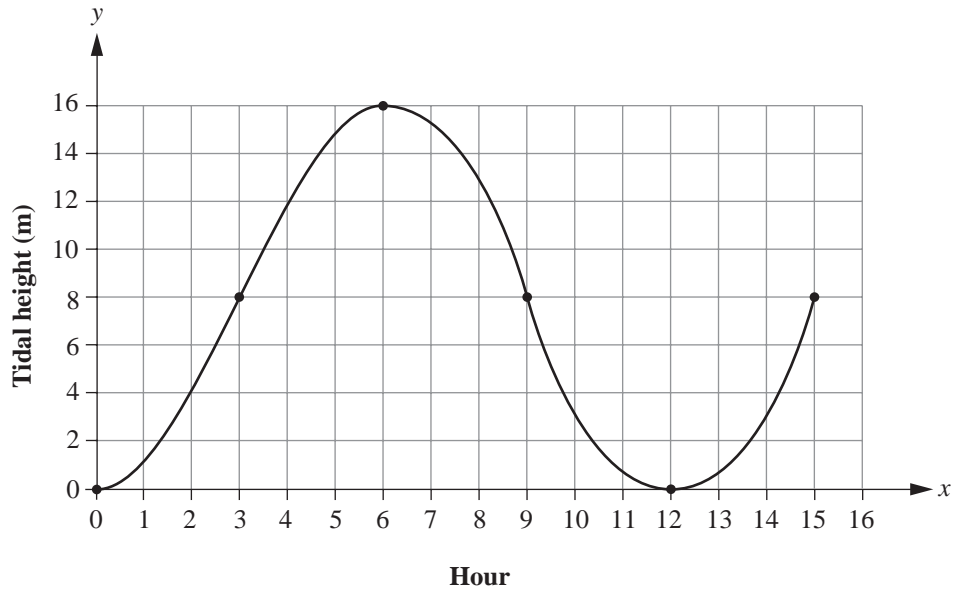
Year	Wolf Population
Base year (0)	400
1	548
2	800
3	1 168

Written Response—10%

- 2.** a. State the exponential regression equation for this data in the form $y = ab^x$. Round the value of a to the nearest whole number and the value of b to the nearest hundredth.
- b. The biologists found that a herd of approximately 17 800 caribou was needed to sustain 650 wolves. If the wolf population continued increasing at the same rate as it did in years 0 to 3 of the study, how many caribou would be required to sustain the wolf population in year 4?

Use the following information to answer the next question.

The highest tides on Earth occur in the Minas Basin in the Bay of Fundy, Nova Scotia, where tides can reach a maximum height of 16 m. The tidal heights over a particular period are graphed below.



This graph can be represented by the sinusoidal function

$$y = a \cdot \sin(0.52x - 1.57) + d$$

19. The value of d in the sinusoidal function is
- A. 0
 - B. 8
 - C. 12
 - D. 16

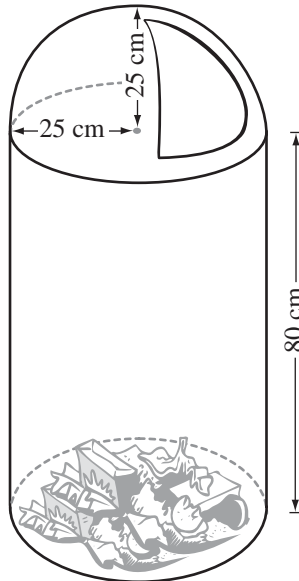
Use the following information to answer the next three questions.

The function $y = 17.14 \sin(0.48x - 1.75) + 7.11$, where x represents the number of the month, models the average monthly temperature, in degrees Celsius, for Edmonton.

20. The amplitude of this function is
- A. 0.48°C
 - B. 1.75°C
 - C. 7.11°C
 - D. 17.14°C
21. The maximum average temperature in Edmonton can be found by adding 17.14°C and
- A. 7.11°C
 - B. 0.48°C
 - C. 1.75°C
 - D. -1.75°C
22. Using her calculator set in radian mode, a tourist is able to determine that the average monthly temperature in Edmonton for month 8 (August) is
- A. 1.8°C
 - B. 7.11°C
 - C. 22.0°C
 - D. 25.1°C

Use the following information to answer the next question.

A manufacturer wishes to determine the cost of producing a plastic garbage container. The lid of the container is in the shape of a hemisphere, and it is attached to a closed-bottom cylinder, as shown in the diagram below. The opening for the garbage swings shut when not in use.



The surface area of the container can be determined by using the formula

$$SA = \pi r^2 + 2\pi rh + 2\pi r^2$$

The plastic required to produce the container costs \$0.0006/cm².

23. The cost of the plastic required to produce one garbage container is
- A. \$7.68
 - B. \$11.07
 - C. \$15.36
 - D. \$29.22

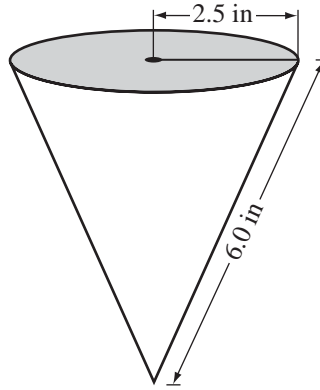
Use the following information to answer the next question.

The surface area to be repainted on an older model car is 17 m^2 . The paint costs \$42.50 per can, including tax, and each can will cover 2.75 m^2 . Paint must be purchased in whole cans.

24. The total cost to purchase the number of cans of paint required is
- A. \$297.50
 - B. \$263.50
 - C. \$262.73
 - D. \$240.83

Use the following information to answer the next question.

The manufacturer of hollow plastic cones wishes to calculate the profit on the sale of a cone with the dimensions shown below. It costs $\$0.08/\text{in}^2$ to produce this cone. The cone will be sold for $\$5.99$.



The surface area of this cone can be calculated using the formula

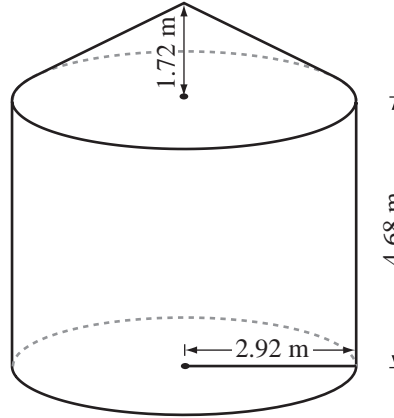
$$SA = \pi rs$$

where r is the radius and s is the slant height.

25. The profit made on the sale of one cone will be
- A. \$0.48
 - B. \$1.55
 - C. \$2.22
 - D. \$5.91

Use the following information to answer the next question.

The Duffys have a grain bin on their farm. The bin, which is made in the shape of a cylinder and a cone, has the dimensions shown below.

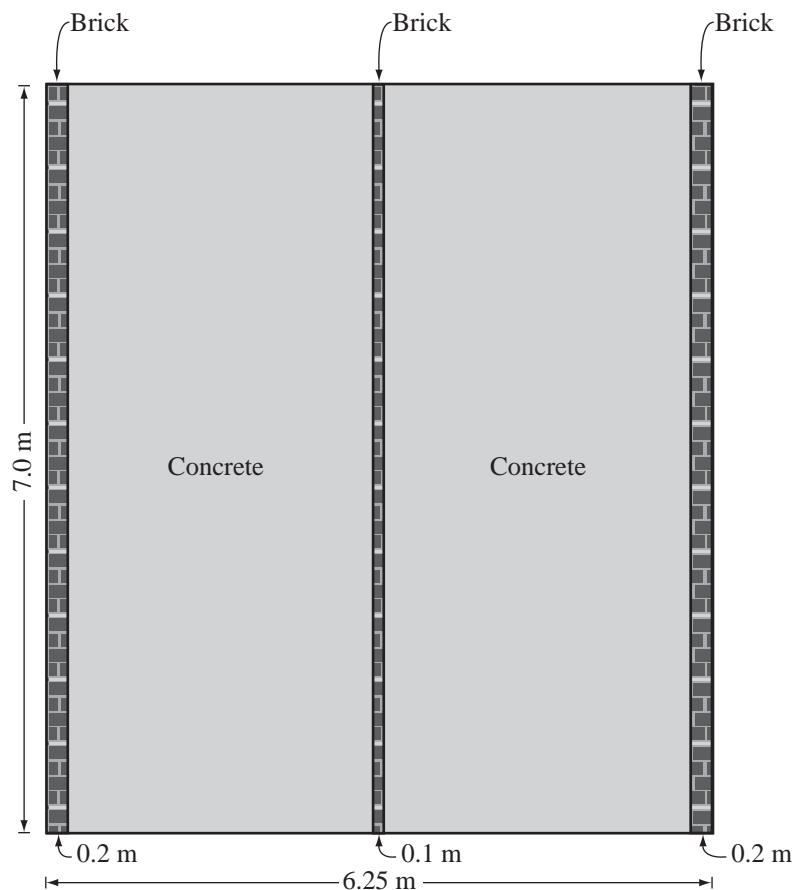


26. The maximum volume of this bin is

- A. 57.14 m^3
- B. 125.36 m^3
- C. 140.72 m^3
- D. 171.43 m^3

Use the following information to answer the next question.

The Hacketts are planning to pour a concrete driveway. The driveway will be 6.25 m by 7.0 m by 0.10 m deep, and the concrete pads will be bordered with brick, as shown in the diagram below.



To determine the cost of the concrete, the Hackett's must first calculate its **volume**.

27. If concrete costs $\$142.25/\text{m}^3$, the total cost of the concrete portion of the driveway will be
- A. $\$572.56$
 - B. $\$531.66$
 - C. $\$286.28$
 - D. $\$124.77$

Use the following information to answer the next question.

The Jones bought a new house for \$149 700. As a result of economic growth in the area, the value of their house increased at an average rate of 8%/a for 5 years.

28. The value of their house after the 5 years, to the nearest dollar, was
- A. \$219 958
 - B. \$209 580
 - C. \$198 754
 - D. \$161 676

Use the following information to answer the next question.

A student entered the data for a \$17 000 loan, compounded monthly at 6%/a, on the computer spreadsheet shown below.

	A	B	C	D	E
1	Loan Amortization Table				
2					
3	Interest Rate =	0.06	Year =	5	
4	Number of payments =	60	Compound =	12	
5	Principal =	17 000			
6	Payment =	327			
7					
8	Payment	Outstanding Balance	Payment to Interest	Payment to Principal	Principal Owed
9	1	=B\$5	=B9*(B\$3/D\$4)	=B\$6-C9	=B9-D9
10	2	=E9	=B10*(B\$3/D\$4)	=B\$6-C10	=B10+D10

Numerical Response

6. The value of cell C9, to the nearest dollar, is \$ _____.

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

Use the following information to answer the next two questions.

Owen invested \$2 000 three years ago. During this time, he has been tracking the investment by recording its value at the end of each year.

Year	Value
0	\$2 000.00
1	\$2 160.00
2	\$2 309.04
3	\$2 477.98

29. The average annual rate of return on this investment, to the nearest tenth of a percentage, is
- A. 0.7%/a
 - B. 1.1%/a
 - C. 1.2%/a
 - D. 7.4%/a
30. The total **return** on this investment after year 3 is
- A. \$168.94
 - B. \$477.98
 - C. \$6 947.02
 - D. \$8 947.02

Use the following information to answer the next question.

A person purchases a new car for \$21 500.00. He takes out a four-year loan at 7%/a, compounded monthly. The following spreadsheet shows the entries for the first two monthly payments.

	A	B	C	D	E	F
1	Month	Current Balance	Interest Charged	Balance with Interest	Payment	New Balance
2	1	\$21 500.00	\$125.42	\$21 625.42	\$514.84	\$21 110.58
3	2	\$21 110.58	\$123.15	\$21 233.73	\$514.84	\$20 718.89

31. Which of the following formulas would have been used to calculate the new balance at the end of month 2?
- A. =D3 – C3
 - B. =B3 + E3
 - C. =D3 – E3
 - D. =D3 + E3

Use the following information to answer the next question.

Mike is planning to purchase a sofa and chair set for his new apartment. He is considering the following two options.

Option One: “rent-to-own” with a down payment of \$179.99 and 24 monthly payments of \$58.50

Option Two: purchase the set outright for \$1099.00 (including taxes)

- 32.** The difference in total cost between the two options, to the nearest dollar, is
- A.** \$125
 - B.** \$193
 - C.** \$305
 - D.** \$485

Use the following information to answer the next question.

A couple plans to purchase a home. They will take out a 25-year mortgage for \$146 000 at 7.0%/a, compounded semi-annually. The monthly payments on this mortgage will be \$1 022.61.

33. The total amount of **interest**, to the nearest dollar, that the couple will pay on this mortgage is
- A. \$306 783
 - B. \$160 783
 - C. \$25 565
 - D. \$12 271

Use the following information to answer the next question.

In 1998, a truck dealership sold 300 blue trucks, 100 green trucks, and 200 red trucks. In 1999, sales of blue trucks decreased by 10%, sales of green trucks increased by 20%, and sales of red trucks increased by 30%. This situation can be modelled by the matrix operation shown below.

$$\begin{bmatrix} 0.9 & 0 & 0 \\ 0 & 1.2 & 0 \\ 0 & 0 & 1.3 \end{bmatrix} \times \begin{bmatrix} 300 \\ 100 \\ 200 \end{bmatrix} = \begin{bmatrix} \\ \\ \end{bmatrix}$$

Written Response—15%

3. a. Calculate the product of the matrices above.

b. How many green trucks were sold in 1999?

c. Assume that the pattern continues. Use matrix multiplication to determine the sales for each colour of truck in the year 2000.

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

In 1998, of all vehicles sold at a different vehicle dealership, 800 were trucks and 600 were sport utility vehicles (SUVs).

In 1999, 8% of the truck owners traded in their trucks for new SUVs, and 22% of the SUV owners traded in their SUVs for new trucks.

No SUV or truck owner switched to a different type of vehicle and no owner of other types of vehicles switched to an SUV or a truck.

- d. • Represent this information by completing the 2×2 matrix below, and then perform the matrix multiplication.

$$\begin{bmatrix} 800 & 600 \end{bmatrix} \times \begin{bmatrix} \underline{\hspace{1cm}} & 0.08 \\ 0.22 & \underline{\hspace{1cm}} \end{bmatrix}$$

- Explain what the product of the matrix multiplication in the bullet above means in this context.

***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**Area**

Circle $A = \pi r^2$

Triangle $A = \frac{b \times h}{2}$

Parallelogram $A = b \times h$

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

Surface Area

Sphere $SA = 4\pi r^2$

Cylinder $SA = 2\pi r^2 + 2\pi rh$

Cone $SA = \pi r^2 + \pi rs$

Volume

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

Cylinder $V = \pi r^2 h$

Prism $V = B \cdot h$, where B is the area of the base

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

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

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

$$\mu = np$$

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

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

Conf. int: $\mu \pm z (\sigma)$

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

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

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

Regression Models

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

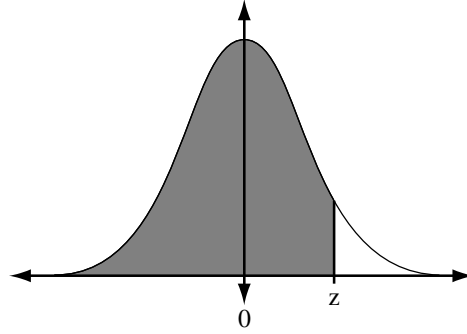
$$\text{period} = \frac{2\pi}{b}$$

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

$$y = ax + b$$

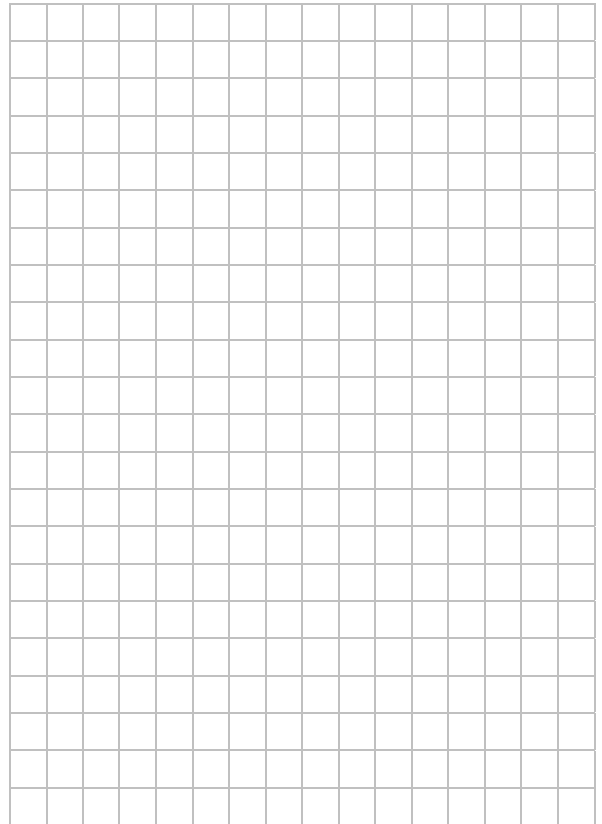
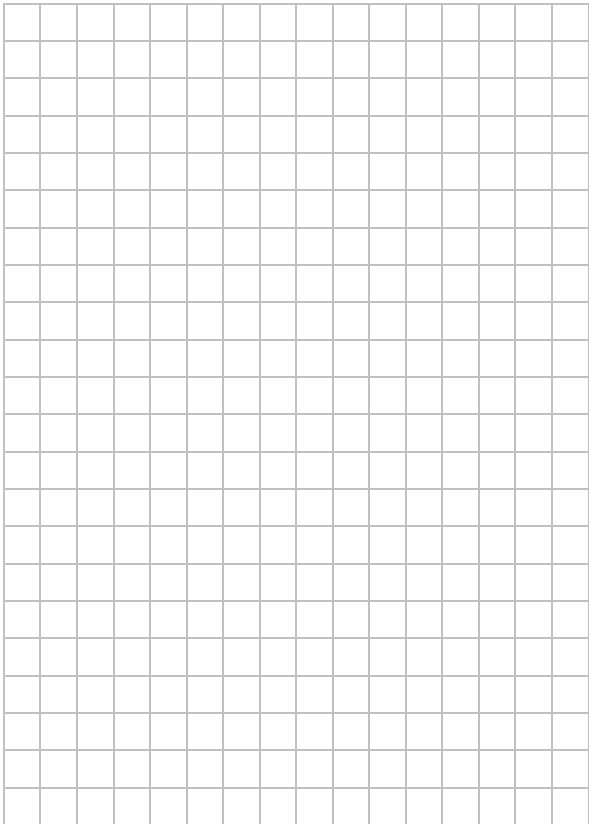
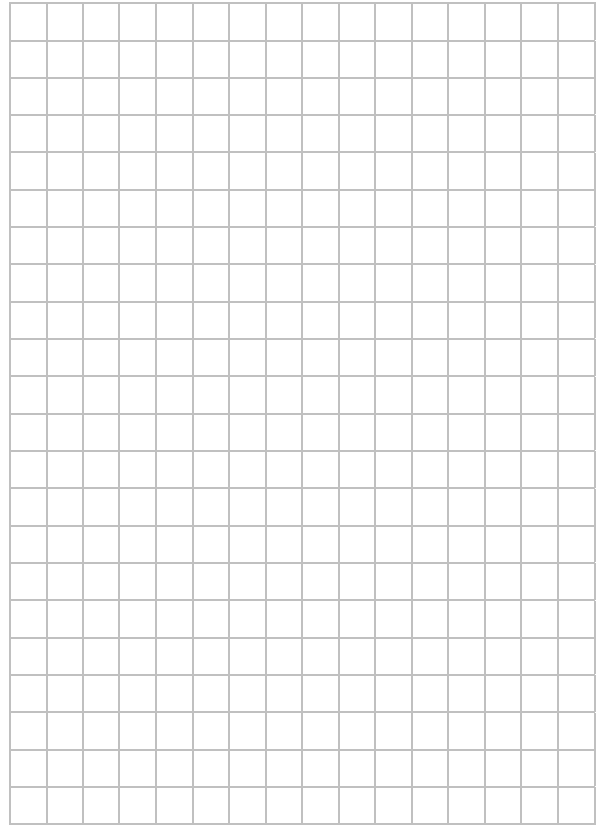
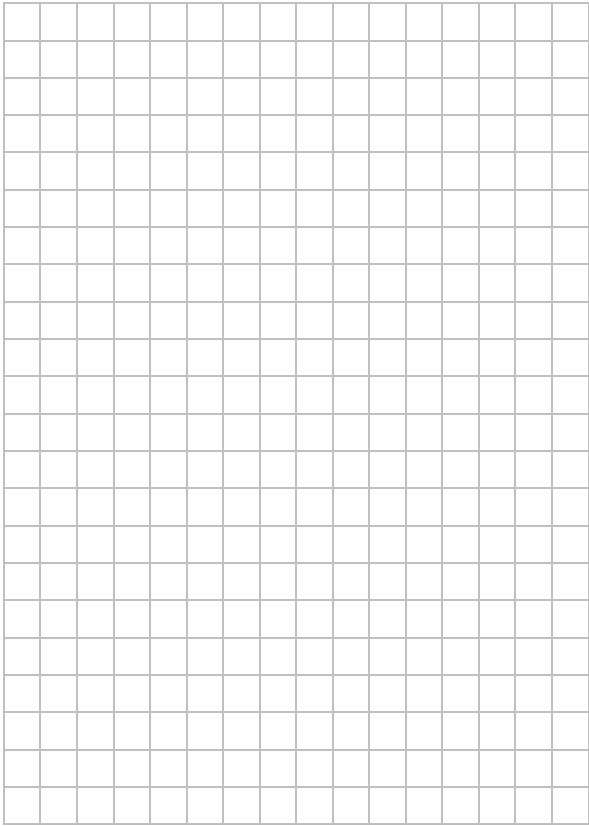
$$y = a \cdot b^x$$

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



Areas under the Standard Normal Curve

<i>z</i>	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



No marks will be given for work done on this page.

Fold and tear along perforation.

No marks will be given for work done on this page.

Fold and tear along perforation.

Applied Mathematics 30

January 2002

Name

Apply Label With Student's Name

Applied Mathematics 30

(Last Name)

(Legal First Name)

Y M D

Date of Birth:

Sex:

Permanent Mailing Address:

(Apt./Street/Ave./P.O. Box)

(Village/Town/City)

(Postal Code)

School Code:

School:

Signature:

For Department Use Only

M1

M2

M3

C1

C2

C3

No Name

Apply Label Without Student's Name

Applied Mathematics 30



JANUARY 2002

**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 2002 Diploma Examination
Multiple-Choice and Numerical-Response Keys**

Multiple Choice

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

Numerical Response

- | | |
|-----------|------|
| 1. | 1.04 |
| 2. | 79 |
| 3. | 1200 |
| 4. | 11 |
| 5. | 72 |
| 6. | 85 |

This scoring guide reflects a mark based on four criteria:

- mathematical understanding
- application of processes
- clarity of communication
- 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

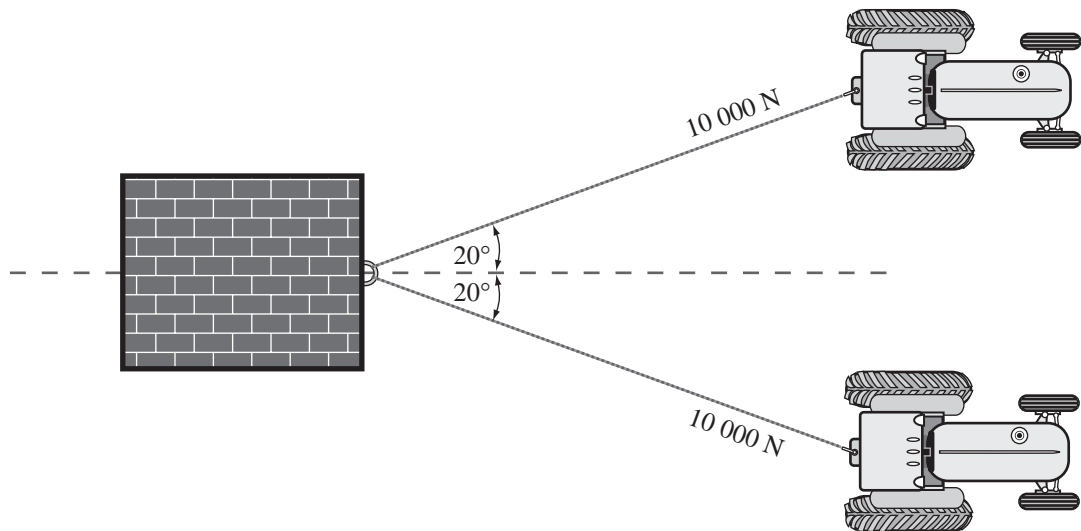
Written Response

Note: The responses that follow represent **ONE** approach to each of the problems. During the diploma examination marking session, provision is made for considering the various approaches students may have used.

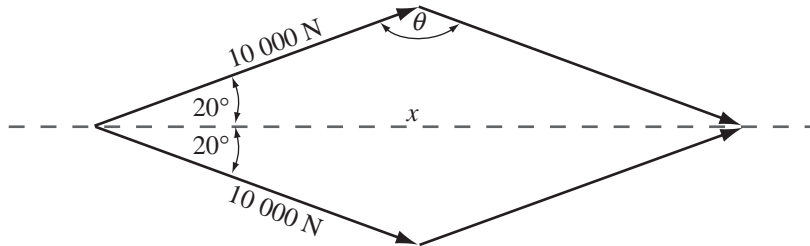
Written-Response Question 1

Use the following information to answer the next question.

Two tractors pull on a large block with a force of 10 000 N each. Both of the tractors pull at a 20° angle from the direction the block is to move in, as shown below.



The force exerted by the tractors can be modelled by the vector diagram shown below.



Written Response—5 marks

1. a. Determine the measure of angle θ in the vector diagram.

A POSSIBLE SOLUTION to part a.

$$\theta = 180 - 40$$

$$\theta = 140^\circ$$

- b. Calculate the magnitude, x , of the resultant force that the tractors exert on the block.

A POSSIBLE SOLUTION to part b.

$$x = \sqrt{10\,000^2 + 10\,000^2 - 2(10\,000)^2 \cos 140^\circ}$$

$$x = 18\,793.85$$

The tractors exert a force of 18 794 N.

- c. If a force of 18 000 N is required to move the block, will the tractors be able to do so?
Explain and justify your answer mathematically.

A POSSIBLE SOLUTION to part c.

Yes, the tractors exceed the required force by 794 N.

Written-Response Question 2

Use the following information to answer the next question.

A group of biologists studied the population of wolves in an area in northern Canada. The biologists found that the number of wolves was directly related to the number of caribou found in the study area. The wolf population for the period of the study is shown in the table below.

Year	Wolf Population
Base year (0)	500
1	548
2	800
3	1 168

Written Response—5 marks

1. a. State the exponential regression equation for this data in the form $y = ab^x$. Round the value of a to the nearest whole number and the value of b to the nearest hundredth.

A POSSIBLE SOLUTION to part a.

$$y = 392 (1.43)^x$$

- b. The biologists found that a herd of approximately 17 800 caribou was needed to sustain 650 wolves. If the wolf population continued increasing at the same rate as it did in years 0 to 3 of the study, how many caribou would be required to sustain the wolf population in 4?

A POSSIBLE SOLUTION to part b.	
<p>Using Rounded Values:</p> $y = 392 (1.43)^4$ $y = 1639.193476$ $\frac{17\,800}{650} = \frac{\text{caribou}}{1639.193476}$ <p>Caribou = 44 888.68288</p> <p>The caribou should number 44 889.</p>	<p>Using Calculated Values:</p> <p>Graph the exponential regression and use the CALC function to determine the value of y when x = 4.</p> $y = 1651.8014$ $\frac{17\,800}{650} = \frac{\text{caribou}}{1651.8014}$ <p>Caribou = 45 233.94603</p> <p>The caribou should number 45 234</p>

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

The area the biologists studied was approximately 14 500 km², and they found the maximum population density of wolves to be 18 wolves/100 km².

- c. • What is the maximum number of wolves that this area can sustain?

A POSSIBLE SOLUTION to part c.
$\frac{14\,500}{100} \times 18 = 2\,610$ <p>The area can sustain 2 610 wolves.</p>

- If the wolf population continued increasing at the same rate as it did in years 0 to 3 of the study, how much time will have elapsed when this maximum number of wolves is reached?

A POSSIBLE SOLUTION to part c.(Bullet 1)

1. Graph $y = 392.44\dots (1.43\dots)^x$
2. Graph $y = 2610$
3. Use INTERSECT function on calculator
when $y = 2610, x = 5.273\dots$

The wolf population will reach the maximum sustainable population during year 5.

Written-Response Question 3

Use the following information to answer the next question.

In 1998, a truck dealership sold 300 blue trucks, 100 green trucks, and 200 red trucks. In 1999, sales of blue trucks decreased by 10%, sales of green trucks increased by 20%, and sales of red trucks increased by 30%. This situation can be modelled by the matrix operation shown below.

$$\begin{bmatrix} 0.9 & 0 & 0 \\ 0 & 1.2 & 0 \\ 0 & 0 & 1.3 \end{bmatrix} \times \begin{bmatrix} 300 \\ 100 \\ 200 \end{bmatrix} = \begin{bmatrix} \\ \\ \end{bmatrix}$$

Written Response—15%

3. a. Calculate the product of the matrices above.

A POSSIBLE SOLUTION to part a.

$$\begin{bmatrix} 0.9 & 0 & 0 \\ 0 & 1.2 & 0 \\ 0 & 0 & 1.3 \end{bmatrix} \times \begin{bmatrix} 300 \\ 100 \\ 200 \end{bmatrix} = \begin{bmatrix} 270 \\ 120 \\ 260 \end{bmatrix}$$

- b. How many green trucks were sold in 1999?

A POSSIBLE SOLUTION to part b.

$100 \times 1.2 = 120$ green trucks sold.

- c. Assume that the pattern continues. Use matrix multiplication to determine the sales for each colour of truck in the year 2000.

A POSSIBLE SOLUTION to part c.

$$\begin{bmatrix} 0.9 & 0 & 0 \\ 0 & 1.2 & 0 \\ 0 & 0 & 1.3 \end{bmatrix} \times \begin{bmatrix} 270 \\ 120 \\ 260 \end{bmatrix} = \begin{bmatrix} 243 \\ 144 \\ 338 \end{bmatrix}$$

Sales of blue trucks will be 243, green trucks will be 144, and red trucks will be 338.

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

In 1998, of all vehicles sold at a different vehicle dealership, 800 were trucks and 600 were sport utility vehicles (SUVs).

In 1999, 8% of the truck owners traded in their trucks for new SUVs, and 22% of the SUV owners traded in their SUVs for new trucks.

No SUV or truck owner switched to a different type of vehicle and no owner of other types of vehicles switched to an SUV or a truck.

- d. Represent this information by completing the 2×2 matrix below, and perform the matrix multiplication.

$$\begin{bmatrix} 800 & 600 \end{bmatrix} \times \begin{bmatrix} \underline{\quad} & 0.08 \\ 0.22 & \underline{\quad} \end{bmatrix}$$

A POSSIBLE SOLUTION to part d.

$$\begin{bmatrix} 800 & 600 \end{bmatrix} \times \begin{bmatrix} \underline{0.92} & \underline{0.08} \\ 0.22 & \underline{0.78} \end{bmatrix} = \begin{bmatrix} 868 & 532 \end{bmatrix}$$

- Explain what the product of the matrix multiplication in the bullet above means in this context.

A POSSIBLE SOLUTION to part d (Bullet 1).

In 1999, 868 people owned trucks bought from the dealership, and 532 owned SUVs bought from the dealership.