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Applications of
Mathematics 12

JUNE 2002

Course Code = AMA

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by **END OF EXAMINATION**.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

Question 1a:

1. .

(3)

Question 5b:

9. .

(2)

Question 1b:

2. .

(2)

Question 5c:

10. .

(4)

Question 2a:

3. .

(2)

Question 5d:

11. .

(2)

Question 2b:

4. .

(3)

Question 6a:

12. .

(2)

Question 3a:

5. .

(4)

Question 6b:

13. .

(3)

Question 3b:

6. .

(1)

Question 6c:

14. .

(3)

Question 4:

7. .

(6)

Question 6d:

15. .

(3)

Question 5a:

8. .

(4)

Question 6e:

16. .

(2)

APPLICATIONS OF MATHEMATICS 12

JUNE 2002

COURSE CODE = AMA

GENERAL INSTRUCTIONS

1. Aside from an approved calculator, electronic devices, including dictionaries and pagers, are **not** permitted in the examination room.
2. All multiple-choice answers must be entered on the Response Form using an **HB pencil**. Multiple-choice answers entered in this examination booklet will **not** be marked.
3. For each of the written-response questions, write your answer in the space provided in this booklet.

You will not be provided with any additional paper since rough-work space for the written-response questions has been incorporated into the space allowed for answering each question. You may not need all of the space provided to answer each question.

4. Ensure that you use language and content appropriate to the purpose and audience of this examination. Failure to comply may result in your paper being awarded a zero.
5. This examination is designed to be completed in **two hours**. *Students may, however, take up to 30 minutes of additional time to finish.*

APPLICATIONS OF MATHEMATICS 12 PROVINCIAL EXAMINATION

- | | Value | Suggested Time |
|---|------------------|--------------------|
| 1. This examination consists of three parts: | | |
| PART A: 36 multiple-choice questions | 54 | 60 |
| PART B: 4 written-response questions | 21 | 30 |
| PART C: 2 Case Study questions | 25 | 30 |
| Total: | 100 marks | 120 minutes |
2. The last **four** pages inside the back cover contain **Formulae, The Standard Normal Distribution Table, Rough Work for Graphing, and Rough Work for Multiple-Choice**. These pages may be detached for convenient reference prior to writing this examination.
3. **A graphing calculator is essential for the Applications of Mathematics 12 Provincial Examination.** The calculator must be a hand-held device designed primarily for mathematical computations involving logarithmic and trigonometric functions, for graphing functions and for performing statistical tests. Computers, calculators with a QWERTY keyboard or symbolic manipulation abilities, such as the Computer Algebraic System (CAS) and electronic writing pads will not be allowed. Students must not bring any external devices (peripherals) to support calculators such as manuals, printed or electronic cards, printers, memory expansion chips or cards, CD-ROMs, libraries or external keyboards. Students may have more than one calculator available during the examination. Calculators may not be shared and must not have the ability to either transmit or receive electronic signals. In addition to an approved calculator, students will be allowed to use rulers, compasses, and protractors during the examination.
- Calculators must not have any information programmed into the memory which would not be acceptable in paper form.* Specifically, calculators must not have any built-in notes, definitions, or libraries. There is no requirement to clear memories at the beginning of the examination but the use of calculators with built-in notes is equivalent to the use of notes in paper form. Any student deemed to have cheated on a provincial examination will receive a “0” on that examination and will be permanently disqualified from the Provincial Examination Scholarship Program.
4. If, in a justification, you refer to information produced by the calculator, this information must be presented clearly in the response. For example, if a graph is used in the solution of the problem, it is important to sketch the graph, showing its general shape and indicating the appropriate window dimensions.
5. When using the calculator, you should provide a decimal answer that is correct to **at least two decimal places** (unless otherwise indicated). Such rounding should occur **only** in the final step of the solution.

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PART A: MULTIPLE CHOICE

Value: 54 marks

Suggested Time: 60 minutes

INSTRUCTIONS: For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

1. Given $P = \begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$ and $Q = \begin{bmatrix} 5 \\ 3 \end{bmatrix}$, which of the following matrix operations is possible?

- A. PQ
- B. QP
- C. $P+Q$
- D. $Q+P$

2. A sports store had the following sales of hockey equipment for the months shown.

	Shoulder Pads	Shin Pads
September	18	16
October	12	10
November	8	12

If the profit on shoulder pads is \$48 and on shin pads is \$36, which of the following column matrices represents the profits for these months?

- A. Sept $\begin{bmatrix} 1440 \\ 936 \\ 816 \end{bmatrix}$
- B. Sept $\begin{bmatrix} 1416 \\ 912 \\ 864 \end{bmatrix}$
- C. Sept $\begin{bmatrix} 816 \\ 936 \\ 1440 \end{bmatrix}$
- D. Sept $\begin{bmatrix} 864 \\ 912 \\ 1416 \end{bmatrix}$

3. Three stores, A, B and C, were surveyed to determine costs of the same weight and brand of bread, flour and sugar. The amounts to be purchased and the prices charged are shown in the matrices below. If all three items are purchased at the same store, what is the **lowest** total price?

Amounts		
Bread	Flour	Sugar
[3	1	2]

Price (\$)			
	A	B	C
Bread	1.09	1.15	1.03
Flour	6.15	5.95	6.45
Sugar	4.35	4.30	4.10

- A. \$11.40
- B. \$11.58
- C. \$17.74
- D. \$18.00

4. Solve for y:

$$[2x \quad 3y] \begin{bmatrix} 5 \\ -1 \end{bmatrix} = [10x \quad 1] \begin{bmatrix} 1 \\ -12 \end{bmatrix}$$

- A. -4
- B. -1
- C. $\frac{1}{3}$
- D. 4

5. An airline offers flights between Vancouver, Calgary, Edmonton and Regina. The flight matrix below shows the connections between the cities. How many ways can a person travel from Vancouver to Regina with either one or two stopovers?

		To			
		V	C	E	R
From	Vancouver	0	1	1	0
	Calgary	1	0	1	1
	Edmonton	1	1	0	1
	Regina	0	1	1	0

- A. 2
 B. 4
 C. 5
 D. 6
6. Solve for x :

$$[x \quad 6] \begin{bmatrix} 1 & 0 \\ 0 & 3 \end{bmatrix} \begin{bmatrix} x \\ -2 \end{bmatrix} = 0$$

- A. -6
 B. 6
 C. ± 6
 D. ± 18

Use the following spreadsheet for Acme Auto Parts to answer question 7.

	A	B	C	D	E	F
1	Qty	Auto parts	Unit Price	Total Price		
2	2	Brake pads	\$26.00	\$52.00		
3	2	Wheel seals	5.00	10.00		
4	1	Rotor	30.25	30.25		
5						
6	Hrs	Labour				
7	0.8	Overhaul front brakes	60.00	48.00		
8						
9					Total parts	\$92.25
10					Total labour	48.00
11					PST (7%)–parts	
12					GST (7%)–parts & labour	
13					Total	

7. Which formula could be used to calculate the amount in cell F11?

- A. $0.07 * F9$
- B. $1.07 * F9$
- C. $0.07 * (F9 + F10)$
- D. $1.07 * (F9 + F10)$

8. What is the rate of **depreciation** for a sports car in the first year?

Residual Values of Vehicles as Percent of Original Price

Type of vehicle	Length of lease (months)		
	12	24	36
Luxury car	65%	55%	50%
Sports car	55%	50%	42%
Economy car	57%	48%	42%

- A. 40%
- B. 45%
- C. 50%
- D. 55%

9. To apply for a mortgage, a couple must calculate their combined annual income. Details of their earnings are summarized below.

Person 1: (systems analyst)	Person 2: (commission salesperson)
earns: \$24.50 per hour works: 37.5 hours per week	base salary: \$1 500 per month commission: 2.5% of sales average monthly sales: \$60 000

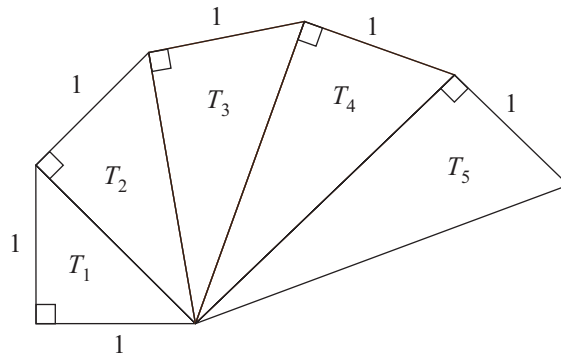
What is their combined annual income?

- A. \$47 025
B. \$50 775
C. \$67 275
D. \$83 775
10. Finance companies offer discount loans where part of the loan is used to pay the total interest before the funds are advanced. James obtains a discount loan for three years at a rate of 10.25% compounded quarterly. At the end of the three-year period, he must pay back \$25 000, which includes both the principal and interest. How much does James actually receive at the start of the three-year period?
- A. \$1 692.10
B. \$18 453.42
C. \$22 437.50
D. \$23 172.57
11. A couple arranges a \$100 000 mortgage at 8% per annum compounded semi-annually. What is the total amount paid if the mortgage is amortized, with monthly payments, over 20 years? (Answer to the nearest one hundred dollars.)
- A. \$107 000
B. \$196 600
C. \$198 800
D. \$200 000

12. What is the amplitude for the function $y = -2 \sin 3x$?
- A. -2
 - B. 2
 - C. $\frac{2\pi}{3}$
 - D. 2π
13. A hive contains 300 bees. If the population of bees in the hive doubles every week, and no bees die, how many bees are in the hive after five weeks?
- A. 1 500
 - B. 3 000
 - C. 4 800
 - D. 9 600
14. The volume, in litres, of air in the lungs at time t seconds can be approximated by the function $V(t) = -0.37 \sin\left(\frac{\pi t}{2}\right) + 0.45$. Determine the number of litres of air in the lungs at time 2.5 seconds.
- A. 0.20
 - B. 0.45
 - C. 0.64
 - D. 0.71
15. A set of four nested cube-shaped boxes is to be constructed. The boxes are open at one end so that a smaller box fits inside a larger box. The largest box has a side of length 10 cm. Each successive box has a side of length 85% of the previous one. What is the volume of the smallest box? (Accurate to the nearest cm^3 .)
- A. 232
 - B. 377
 - C. 550
 - D. 614

16. The Wheel of Theodorus is constructed as follows:

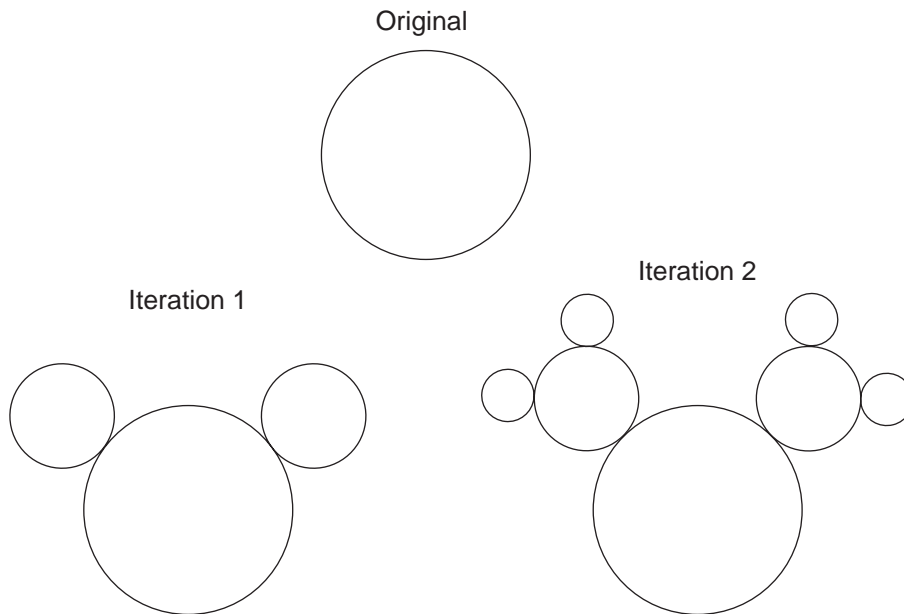
- T_1 is an isosceles right triangle with legs of length one unit
- T_2 is a right triangle constructed with one leg the hypotenuse of T_1 , and the other leg of length one unit
- The process is continued as shown in the diagram



What is the length of the hypotenuse of T_5 ?

- A. 2
- B. 3.24
- C. $\sqrt{5}$
- D. $\sqrt{6}$

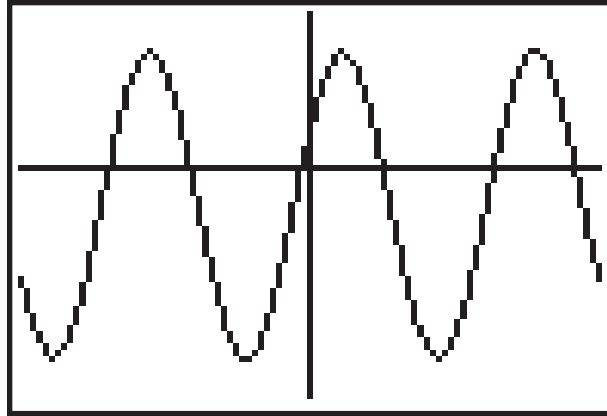
17. The diagram below shows the first two iterations in the generation of a fractal. Two circles are added to the original circle and then two circles are added to these new circles and so on. The radius of the first circle is 8 cm. Each successive circle has a radius that is one-half the radius of the previous circle.



What is the area, in cm^2 , enclosed by all circles in Iteration 3?

- A. 112π
- B. 120π
- C. 124π
- D. 126π

18. Using the graph of $y = a \sin(bx + c) + d$ from the graphing calculator, determine b .



$[-2\pi, 2\pi]$

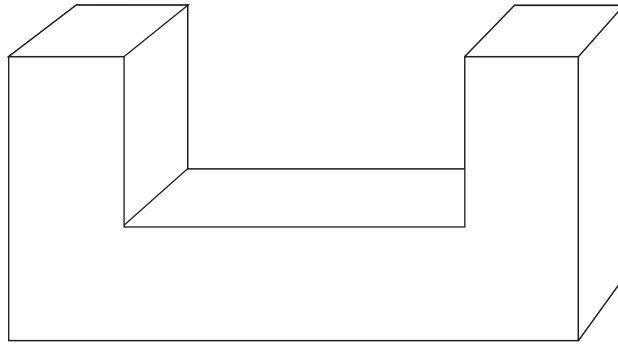
$[-6, 4]$

x x
min max

y y
min max

- A. 1
 B. 1.5
 C. 2
 D. π
19. A rubber ball is dropped on a hard surface from a height of 6 m. It makes a sequence of bounces, each one 75% as high as the preceding one. After how many bounces does the ball rebound to a height of less than 0.5 m?
- A. 6
 B. 7
 C. 8
 D. 9

20. Each face of this three-dimensional piece is to be painted a different colour.
How many colours are required?

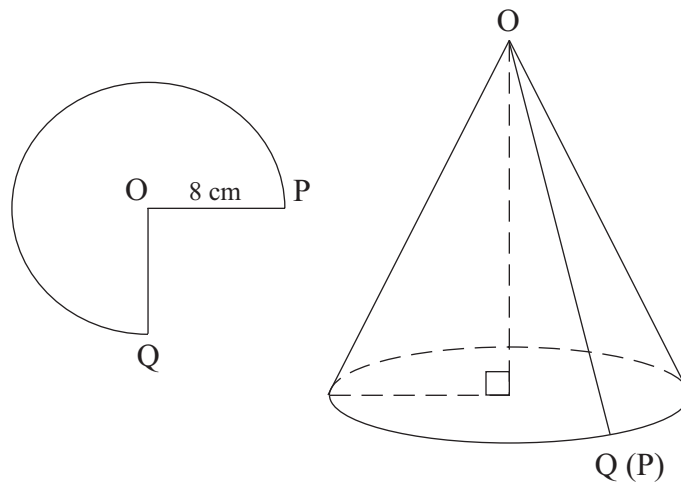


- A. 6
- B. 8
- C. 10
- D. 12

21. A cylindrical section of concrete drainage pipe, 15.5 m long, has an inside diameter of 0.55 cm and an outside diameter of 0.80 cm. If concrete costs \$90 per cubic metre, determine the cost of the concrete needed to make the pipe, to the nearest \$10. **QUESTION DELETED**

- ~~— A. \$270~~
- ~~— B. \$370~~
- ~~— C. \$490~~
- ~~— D. \$610~~

22. A 90° sector is removed from a circular sheet of metal with radius 8 cm. A cone is formed from the remaining sector by joining edges OP and OQ, as shown in the diagram.



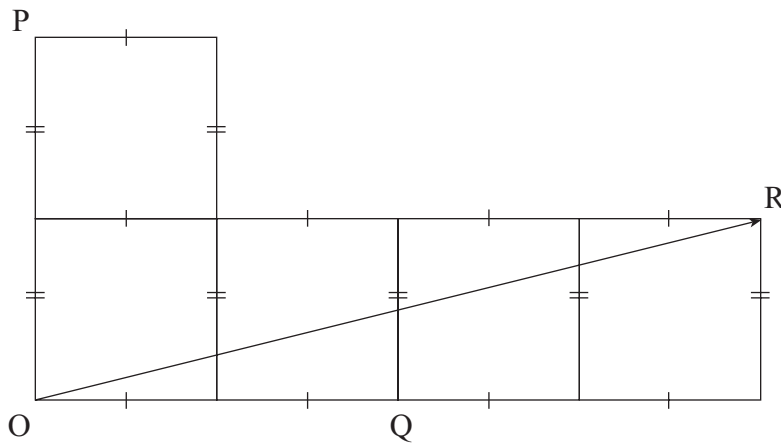
Determine the height, in cm, of this cone.

- A. $\sqrt{28}$
 - B. $\sqrt{48}$
 - C. 8
 - D. 10
23. Which of the following is a vector quantity?
- A. time
 - B. mass
 - C. force
 - D. volume

24. If a vector, \vec{v} , is multiplied by a scalar, k , what must be true about k if $k\vec{v}$ is shorter than \vec{v} , but in the same direction?

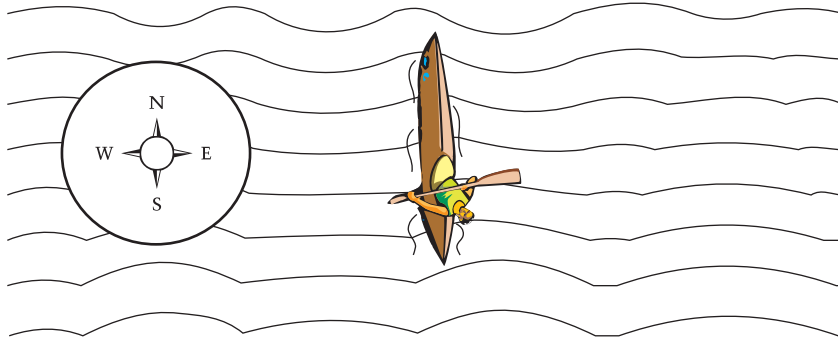
- A. k is positive and less than 1
- B. k is positive and greater than 1
- C. k is negative and less than -1
- D. k is negative and greater than -1

25. By using the diagram below, express \vec{OR} in terms of scalar multiples of \vec{OP} and \vec{OQ} .

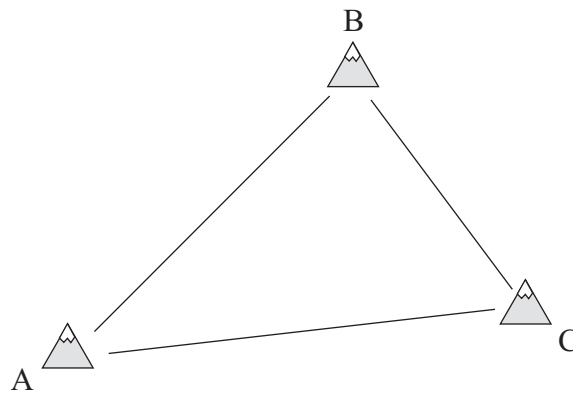


- A. $\vec{OP} + 2\vec{OQ}$
- B. $2\vec{OP} + 2\vec{OQ}$
- C. $\frac{1}{2}\vec{OP} + \vec{OQ}$
- D. $\frac{1}{2}\vec{OP} + 2\vec{OQ}$

26. A river flows from west to east at a rate of 4.75 km/h. A kayaker who can paddle at a rate of 8.25 km/h in still water heads due north across the current. Determine her rate and bearing.



- A. 7.48 km/h, 29.9°
 B. 7.48 km/h, 60.1°
 C. 9.52 km/h, 29.9°
 D. 9.52 km/h, 60.1°
27. A helicopter company offers transportation for skiers to three mountain glaciers.
- From Glacier A, the flight is 43 km to reach Glacier B.
 - From Glacier B, the flight is 28 km to reach Glacier C.
 - $\angle ABC$ is 80° .



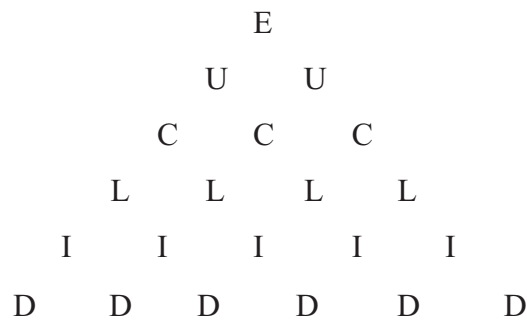
How far is it directly from Glacier C to Glacier A? (Give your answer to the nearest km.)

- A. 33
 B. 47
 C. 51
 D. 55

28. Three vectors when added have a sum of zero ($\vec{v}_1 + \vec{v}_2 + \vec{v}_3 = 0$). If \vec{v}_1 is 5 km at 40° and \vec{v}_2 is also 5 km at 40° , what is \vec{v}_3 ?
- A. 5 km at 40°
B. 5 km at 220°
C. 10 km at 40°
D. 10 km at 220°
29. If the probability that an event will occur is p , what is the probability that p will not occur?
- A. $-p$
B. $1 - p$
C. $p - 1$
D. $-(p + 1)$
30. Licence plates are formed using 6 characters. Letters are used for the first 3 characters except for I, L, O, Q and Z, while the other 3 characters are numbers. How many different licence plates are possible?
- A. 6 751 269
B. 8 000 000
C. 9 261 000
D. 14 196 000
31. A survey of 200 male students between the ages of 10 and 15 determined that
- 65 played soccer
 - 42 played baseball
 - 26 played both soccer and baseball
- How many played neither soccer nor baseball?
- A. 67
B. 93
C. 119
D. 135

32. The lengths of the nails in a manufacturing process are normally distributed with a mean of 45 mm and a standard deviation of 1.5 mm. What is the probability that a nail, selected at random, will be longer than 47 mm?
- A. 0.09
 B. 0.16
 C. 0.84
 D. 0.91

33. For the triangular letter arrangement given below, start at the top and work diagonally left or right towards the bottom. How many different paths will spell EUCLID?



- A. 31
 B. 32
 C. 63
 D. 64
34. A young boy and his mom are playing a game, each taking turns tossing a tetrahedral (4-sided) die with sides numbered 1, 2, 3 and 4. The boy wins if he tosses a 1, 2 or 3. The mom wins if she tosses a 4. The boy tosses first, and they keep tossing until one of them wins. What is the probability that the mom will win on her second turn?
- A. $\frac{1}{4}$
 B. $\frac{1}{16}$
 C. $\frac{3}{16}$
 D. $\frac{3}{256}$

OVER

35. A delivery truck driver has six stops to make on his route before returning to his starting point. The order of his deliveries is randomly selected. What is the probability that the route selected will be the shortest possible route?
- A. $\frac{1}{360}$
 - B. $\frac{1}{180}$
 - C. $\frac{1}{36}$
 - D. $\frac{1}{18}$
36. A theatre company knows that on average 5% of the people who buy tickets do not show up. Consequently, it regularly oversells tickets to its 200-seat theatre by six seats. What is the probability that more ticket holders show up than there are seats available?
- A. less than 5%
 - B. 5% to 7%
 - C. 7% to 9%
 - D. greater than 9%

**This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.**

PART B: WRITTEN RESPONSE

Value: 21 marks

Suggested Time: 30 minutes

INSTRUCTIONS: Rough-work space has been incorporated into the space allowed for answering each question. You may not need all the space provided to answer each question. Where required, place the final answer for each question in the space provided.

If, in a justification, you refer to information produced by the calculator, this information must be presented clearly in the response. For example, if a graph is used in the solution of the problem, it is important to sketch the graph, showing its general shape and indicating the appropriate window dimensions.

When using the calculator, you should provide a decimal answer that is correct to **at least two decimal places** (unless otherwise indicated). Such rounding should occur **only** in the final step of the solution.

Full marks will NOT be given for the final answer only.

1. Commuters to a certain city either drive to work or use public transit. At present, two-thirds of commuters drive, while one-third use public transit. City planners have determined that 85% of commuters who use public transit will continue to use transit the following year, while 75% of car drivers will continue to drive.

a) After three years, what percent of commuters will be using public transit? **(3 marks)**

ANSWER:

b) If the trend continues, what percent of commuters will eventually be using public transit?
(2 marks)

ANSWER:

OVER

2. The tides on the Pacific coast of BC follow a sinusoidal pattern. The depth of the water at a BC coast resort was measured eight times during one day by using times for a 24-hour clock. Data for these measurements is as follows.

Time (hours)	Depth (metres)
1:00	4.38
3:00	7.63
5:00	8.40
7:00	5.98
9:00	2.64
11:00	1.51
13:00	3.67
15:00	7.07

- a) Determine the sine regression equation for this data.

(2 marks)

b) For how long was the depth of the water less than 4 m during the first 12 hours? (3 marks)

If providing a graphical solution, state the function(s) used, sketch the graph, indicate appropriate window dimensions and clearly explain how your solution is derived from the graph.



$Y_1 =$

$Y_2 =$

$Y_3 =$

$Y_4 =$

[,] [,]

x x
min max

y y
min max

OVER

3. An investment portfolio of \$50 000 was held from Dec. 31, 1997 to Dec. 31, 2000. One-fourth of the portfolio was invested in guaranteed investment certificates (GICs) that paid 6.5% compounded annually. The remaining part of the portfolio was in Canadian stocks that traced the Toronto Stock Exchange (TSE) index. On Dec. 31, 1997, the TSE index was at 6 486. On Dec. 31, 2000, the TSE index was at 10 500.

a) What was the value of the total portfolio on Dec. 31, 2000?

(4 marks)

ANSWER:

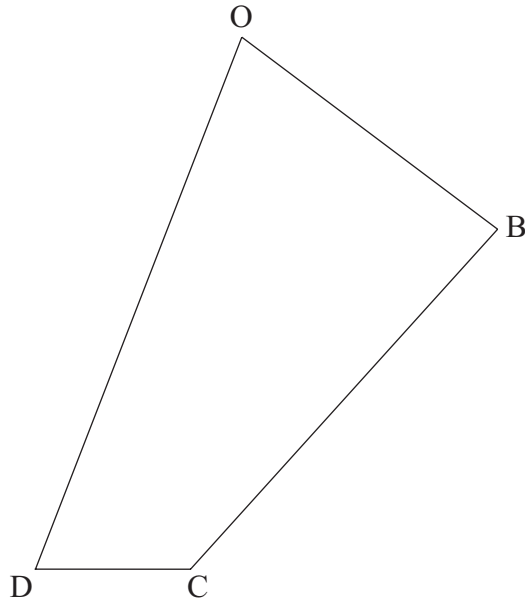
b) What is the percentage increase in the value of the portfolio after three years?
(Give your answer as a percentage accurate to one decimal place.)

(1 mark)

ANSWER:

OVER

4. A ship leaves Ocean Harbour on a practice mission. It has orders to first go 30 km on a bearing of 135° to Birch Island, then 40 km on a bearing of 225° to Port Cod and finally 20 km on a bearing of 270° to Destination. What is the distance and bearing of Destination from Ocean Harbour? (Give distance to the nearest tenth and bearing to the nearest degree.) **(6 marks)**



ANSWER:

OVER

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PART C: CASE STUDIES

Value: 25 marks

Suggested Time: 30 minutes

INSTRUCTIONS: Rough-work space has been incorporated into the space allowed for answering each question. You may not need all the space provided to answer each question. Where required, place the final answer for each question in the space provided.

If, in a justification, you refer to information produced by the calculator, this information must be presented clearly in the response. For example, if a graph is used in the solution of the problem, it is important to sketch the graph, showing its general shape and indicating the appropriate window dimensions.

When using the calculator, you should provide a decimal answer that is correct to **at least two decimal places** (unless otherwise indicated). Such rounding should occur **only** in the final step of the solution.

Full marks will NOT be given for the final answer only.

5. As part of its yearly plan, a recreation centre surveyed its community and gathered the following data. A frequency distribution of the number of children under 18 years of age from 100 families selected at random is shown below.

x	f
0	6
1	13
2	20
3	23
4	19
5	12
6	7

- a) Calculate the mean and standard deviation for the number of children in each family. **(4 marks)**

ANSWER:

mean:

standard deviation:

- b) What is the probability of a family having from 2 to 4 children under 18 years of age? **(2 marks)**

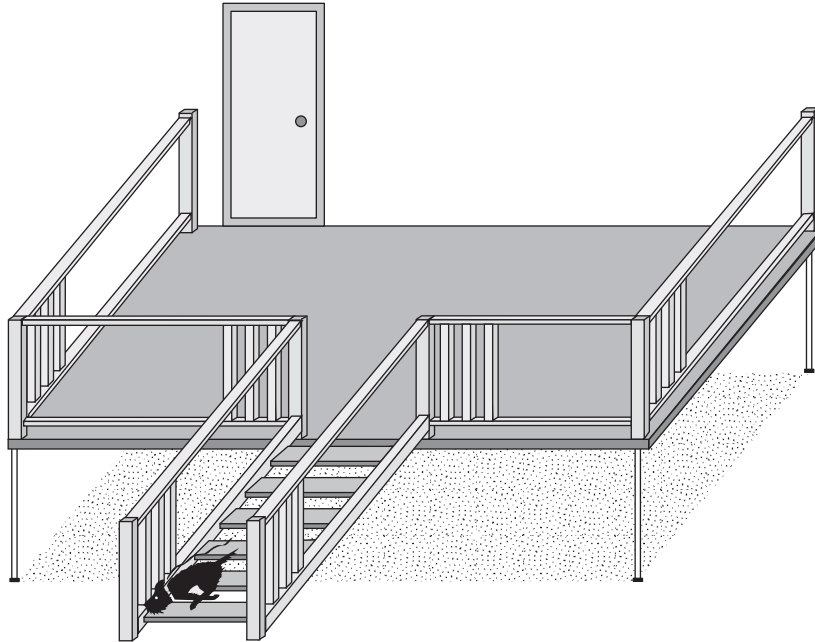
ANSWER:

- c) Recalculate the answer to part b) using the normal approximation to the binomial. **(4 marks)**

ANSWER:

- d) Why are the answers to part b) and part c) slightly different? **(2 marks)**

6. A patio attached to the back of a house is going to be rebuilt by replacing the deck of the patio, putting up new railings and replacing the stairs leading to the deck of the patio.



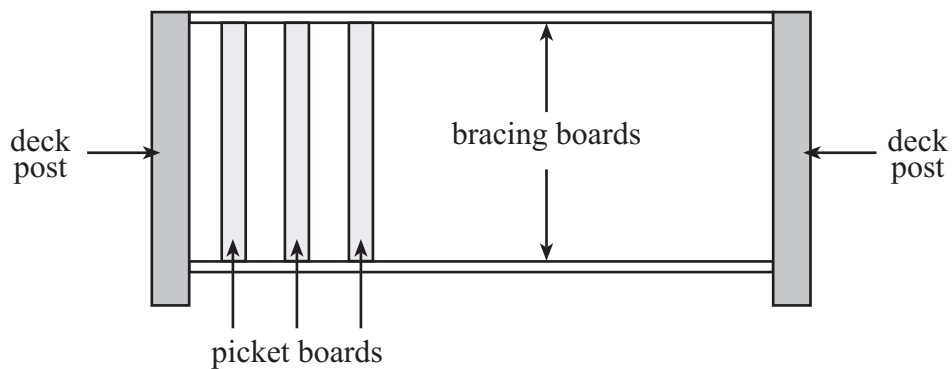
- a) The deck of the patio is 24 feet by 8 feet. Sheets of plywood are used to form the deck of the patio. Each 8 foot by 4 foot sheet of plywood costs \$23.95. Determine the cost of plywood for the deck. Do not include taxes in your calculations. **(2 marks)**

ANSWER:

- b) The deck of the patio needs a waterproof coating. The coating will cost \$9.75 for each 12 square feet of deck to be covered. Determine the cost of waterproofing the surface of the deck. Do not include taxes in your calculations. **(3 marks)**

ANSWER:

- c) Sections of the deck railings are built as shown below.



The total amount of deck railing, excluding the stairs, is 36 feet. There are three picket boards for every foot. The costs of the materials are as follows.

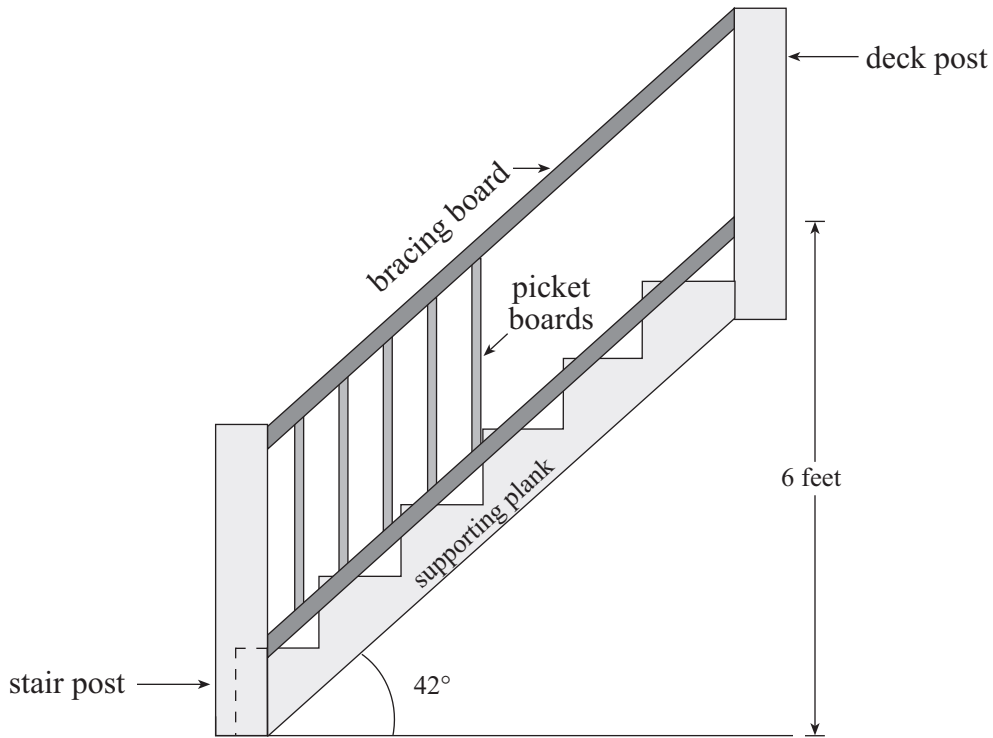
- cost of each deck post is \$5.95
- cost of each bracing board is \$6.50
- cost of each picket board is \$2.10

Determine the cost of the materials needed to rebuild the deck railings. Do not include taxes in your calculations. **(3 marks)**

ANSWER:

OVER

- d) A side view of the stairs leading up to the deck of the patio is shown below. There are six steps each measuring four feet in length.



The costs of the materials are as follows.

- a supporting plank is needed on each side; these are sold in 8 ft., 10 ft., 12 ft., etc. lengths and cost \$1.45 a linear foot
- bracing boards to hold picket boards on each side of the stairs cost \$6.50 for each board
- two stair posts at the bottom of the stairs cost \$5.95 each
- picket boards are \$2.10 each with 27 picket boards required for each stair railing
- planks for the steps can be purchased for \$1.45 a linear foot

Determine the cost of the materials needed to build the stairs. Do not include taxes in your calculations.

(3 marks)

ANSWER:

e) What other expenses might a homeowner have if he or she rebuilds this patio? **(2 marks)**

END OF EXAMINATION

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FORMULAE

Geometry:

$$\begin{aligned}\text{Triangle: Area} &= \frac{1}{2}bh \\ &= \frac{1}{2}ab \sin C \\ &= \sqrt{s(s-a)(s-b)(s-c)} \\ \text{where } s &= \frac{a+b+c}{2}\end{aligned}$$

$$\text{Trapezoid: } A = \frac{1}{2}(b_1 + b_2) \cdot h$$

$$\text{Circle: } A = \pi r^2, C = 2\pi r = \pi d$$

$$\text{Sphere: } A = 4\pi r^2, V = \frac{4}{3}\pi r^3$$

$$\text{Cylinder: } A = 2\pi r^2 + 2\pi rh, V = \pi r^2 h$$

$$\text{Cone: } A = \pi rs + \pi r^2, V = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of pyramid: } V = \frac{1}{3}A_b h$$

$$\text{Volume of prism: } V = A_b h$$

Interest:

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

$$I = Prt$$

Miscellaneous:

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

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

$$S_\infty = \frac{a}{1-r}$$

Probability and Statistics:

$$\mu = \frac{1}{n} \sum (f_i)(x_i)$$

$$\sigma = \sqrt{\frac{1}{n} \sum (x_i - \mu)^2} = \sqrt{\frac{1}{n} \sum x_i^2 - \mu^2}$$

$$\mu = np$$

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

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

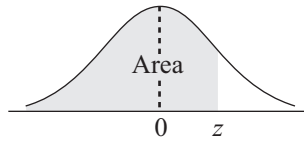
$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

Note: Graphing calculators will contain many of these formulae as pre-programmed functions.

**You may detach this page for convenient reference.
Exercise care when tearing along perforations.**

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THE STANDARD NORMAL DISTRIBUTION TABLE



$$F_z(z) = P[Z \leq z]$$

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0017	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0352	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0722	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

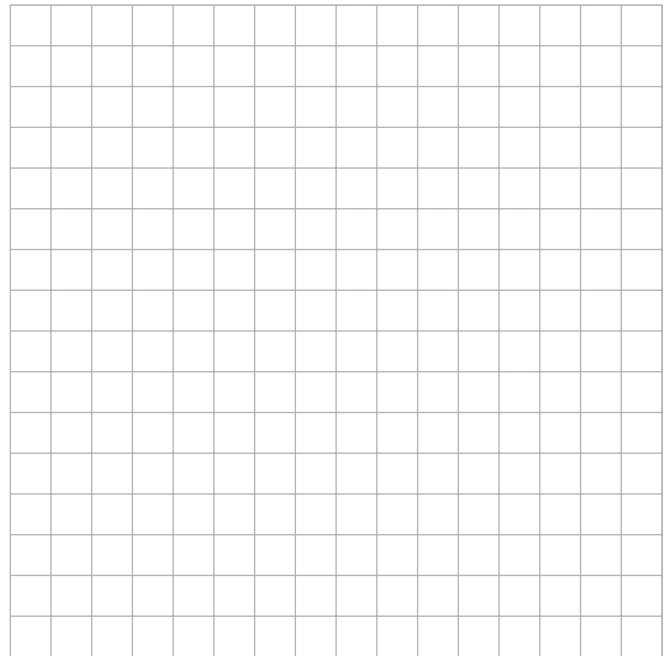
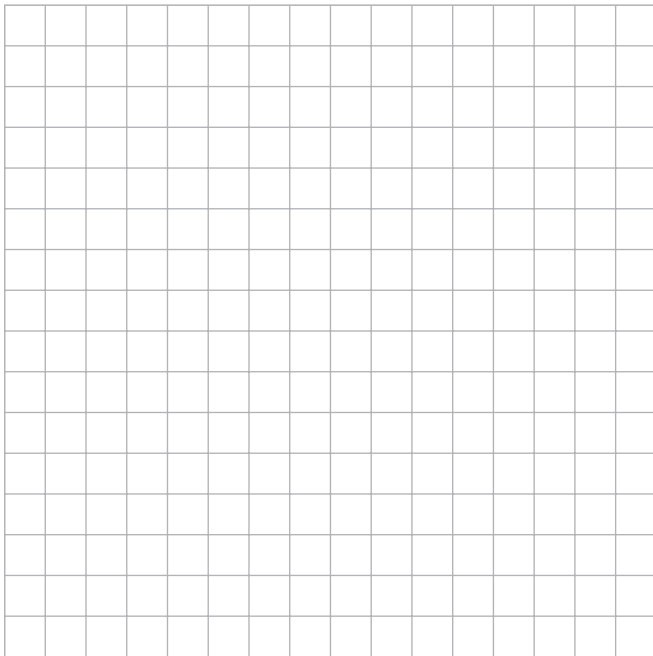
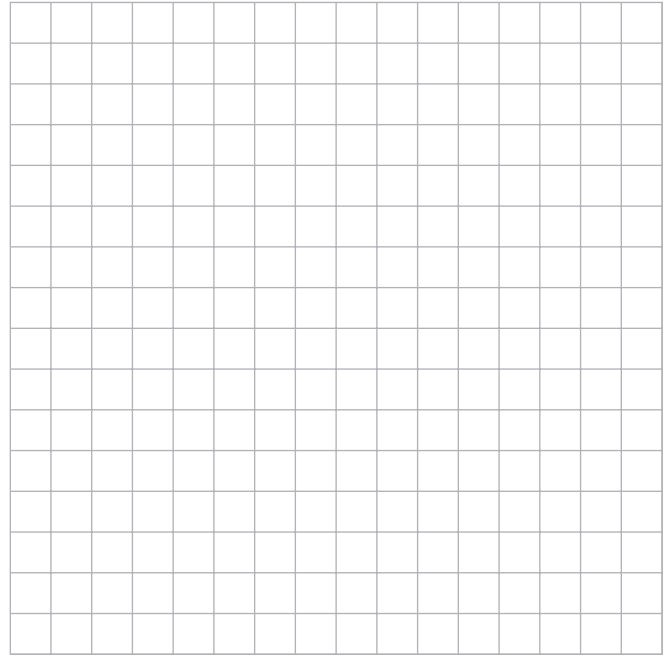
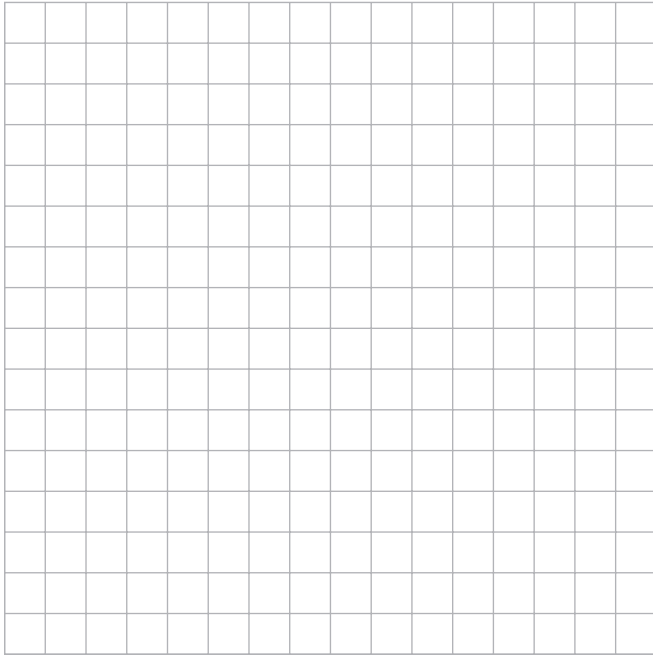
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$$F_z(z) = P[Z \leq z]$$

z	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	0.8438	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	0.9278	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

ROUGH WORK FOR GRAPHING

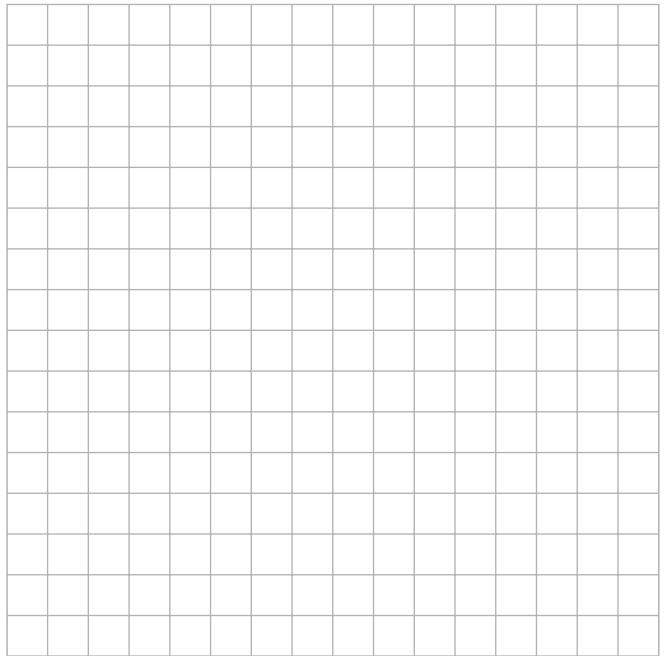
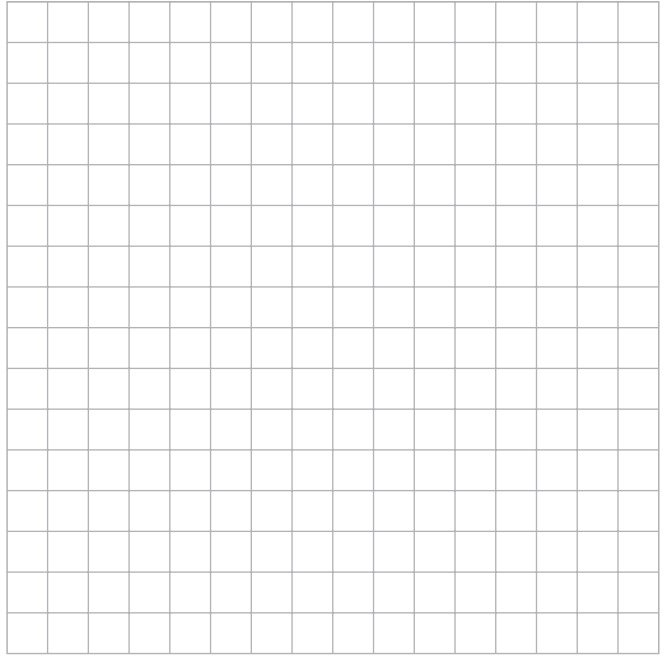
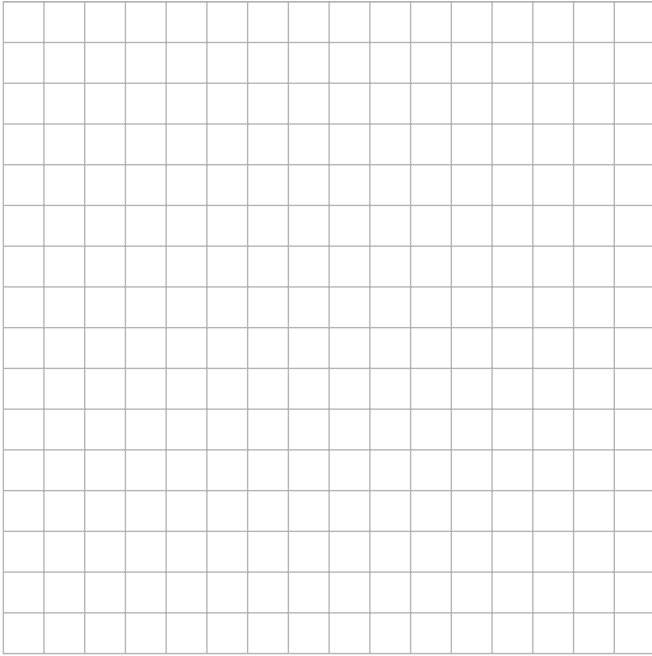
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ROUGH WORK FOR GRAPHING

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ROUGH WORK FOR MULTIPLE-CHOICE

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