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BRITISH
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Principles of Mathematics 12

August 2003

Course Code = MA

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. .

(2)

Question 5b:

8. .

(2)

Question 1b:

2. .

(2)

Question 6a:

9. .

(2)

Question 2:

3. .

(4)

Question 6b:

10. .

(2)

Question 3:

4. .

(5)

Question 7a:

11. .

(3)

Question 4a:

5. .

(2)

Question 7b:

12. .

(1)

Question 4b:

6. .

(2)

Question 8:

13. .

(5)

Question 5a:

7. .

(2)

PRINCIPLES OF MATHEMATICS 12

August 2003

COURSE CODE = MA

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.*

PRINCIPLES OF MATHEMATICS 12 PROVINCIAL EXAMINATION

- | | Value | Suggested Time |
|---|------------------|--------------------|
| 1. This examination consists of two parts: | | |
| PART A: 44 multiple-choice questions | 66 | 75 |
| PART B: 8 written-response questions | 34 | 45 |
| Total: | 100 marks | 120 minutes |
2. The last **four** pages inside the back cover contain **A Summary of Basic Identities and 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 Principles 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, of which one may be a scientific calculator. 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 graphing 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 values. If the statistical features of the calculator are used, it is important to show the function with the substitution of the relevant numbers. For example: in part of the solution it is acceptable to show $\text{normalcdf}(10, 40, 50, 20)$ or the equivalent syntax for the calculator used.
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: 66 marks

Suggested Time: 75 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. Convert 100° to radians.

- A. 0.18
- B. 0.57
- C. 1.75
- D. 5.66

2. Give the period of $y = 2 \sec x$.

- A. $\frac{1}{2\pi}$
- B. $\frac{\pi}{2}$
- C. π
- D. 2π

3. Determine the exact value of $\tan \frac{2\pi}{3}$.

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

4. Give the range of $y = 5 \sin \frac{1}{2}x + 8$.

- A. $3 \leq y \leq 8$
- B. $3 \leq y \leq 13$
- C. $-13 \leq y \leq -3$
- D. $-13 \leq y \leq 13$

5. Simplify: $4 - 8 \sin^2 6x$

- A. $\cos 12x$
- B. $2 \cos 6x$
- C. $4 \cos 6x$
- D. $4 \cos 12x$

6. Determine an equation of an asymptote of $y = 2 \tan x$.

- A. $x = \frac{\pi}{4}$
- B. $x = \frac{\pi}{2}$
- C. $x = \pi$
- D. $x = 2\pi$

7. Solve: $\sin x = \frac{1}{x}$, $0 \leq x < 2\pi$

- A. 0, 1.56
- B. 1.11, 2.77
- C. 3.44, 6.11
- D. 0, 3.14, 6.28

8. At a seaport, the water has a maximum depth of 18 m at 3:00 am. After this maximum depth, the first minimum depth of 4 m occurs at 9:30 am. Assume that the relation between the depth, h metres, and the time, t hours, is a sinusoidal function. Determine an equation for h at any time t .

A. $h = 7 \cos 2\pi \frac{(t-3)}{6.5} + 11$

B. $h = 7 \cos 2\pi \frac{(t-3)}{13} + 11$

C. $h = 11 \cos 2\pi \frac{(t-3)}{6.5} + 7$

D. $h = 11 \cos 2\pi \frac{(t-3)}{13} + 7$

9. Point P is the intersection of the terminal arm of angle θ in standard position and the unit circle with centre $(0, 0)$. If P is in quadrant 3 and $\cos \theta = m$, determine the coordinates of P in terms of m .

A. $(-m, \sqrt{1-m^2})$

B. $(-m, -\sqrt{1-m^2})$

C. $(m, \sqrt{1-m^2})$

D. $(m, -\sqrt{1-m^2})$

10. Determine the number of solutions in the interval $0 \leq x < 2\pi$ for:

$$\sin ax = 0.5, \quad a \text{ is an integer, where } a \geq 1$$

A. 2

B. $\frac{a}{2}$

C. a

D. $2a$

OVER

11. Determine the number of terms in the series defined by $\sum_{k=12}^{38} 3(2)^{k-1}$.
- A. 26
B. 27
C. 37
D. 38
12. Determine the 11th term of the geometric sequence: $-2, 6, -18, \dots$
- A. $-354\,294$
B. $-118\,098$
C. $118\,098$
D. $354\,294$
13. The general term of a geometric sequence is $t_n = 5(2)^{n-1}$. Determine the sum of the first 15 terms.
- A. 81 915
B. 81 920
C. 163 835
D. 163 840
14. The sum of an infinite geometric series is 9. If the common ratio is $-\frac{1}{3}$, determine the first term.
- A. 6
B. 12
C. $\frac{27}{4}$
D. $\frac{27}{2}$
15. Determine the common ratio of the geometric sequence $\log x, \log x^2, \log x^4, \log x^8$, where $x > 0$.
- A. 2
B. x
C. $\log x$
D. $\log x^2$

16. Change $1000 = 7^x$ to logarithmic form.

- A. $\log_7 x = 1000$
- B. $\log_x 7 = 1000$
- C. $\log_x 1000 = 7$
- D. $\log_7 1000 = x$

17. Give the domain of $y = \log_3(x + 7) - 5$.

- A. $x > -7$
- B. $x > -5$
- C. $x > 0$
- D. $x > 7$

18. Which expression is equivalent to $\log\left(\frac{x}{100y}\right)$?

- A. $\log x - 2 - \log y$
- B. $\log x - 2 + \log y$
- C. $\log x - 4 + 2 \log y$
- D. $\log x - 4 - 2 \log y$

19. Solve: $\left(\frac{1}{6}\right)^{3x-2} = 36^{x+4}$

- A. -2
- B. $-\frac{6}{5}$
- C. $-\frac{2}{5}$
- D. 10

OVER

20. Solve: $\log(3x - 1) + \log 4 = \log(4x + 5)$

A. -2

B. $-\frac{21}{13}$

C. $\frac{3}{4}$

D. $\frac{9}{8}$

21. If \$5000 is invested at 7.2% per annum compounded monthly, which equation can be used to determine the number of years, t , for the investment to increase to \$8000?

A. $8000 = 5000(1.072)^t$

B. $8000 = 5000(1.006)^t$

C. $8000 = 5000(1.072)^{12t}$

D. $8000 = 5000(1.006)^{12t}$

22. Determine the magnitude of an earthquake that is 200 times as intense as an earthquake of magnitude 3.7 on the Richter scale.

A. 5.4

B. 6.0

C. 6.5

D. 7.5

23. Solve for x : $a^{x-2} = b^x$

A. $\frac{-2 \log a}{\log a - \log b}$

B. $\frac{2 \log a}{\log a - \log b}$

C. $\frac{-2 \log a}{\log a + \log b}$

D. $\frac{2 \log a}{\log a + \log b}$

24. Determine an equation of the circle with centre $(7, -4)$ and radius 8.

A. $(x + 7)^2 + (y - 4)^2 = 16$

B. $(x + 7)^2 + (y - 4)^2 = 64$

C. $(x - 7)^2 + (y + 4)^2 = 16$

D. $(x - 7)^2 + (y + 4)^2 = 64$

25. Determine the length of the major axis of the ellipse $5x^2 + 7y^2 - 35 = 0$.

A. 7

B. 14

C. $\sqrt{7}$

D. $2\sqrt{7}$

26. Change to general form: $x = -2(y + 3)^2 - 5$

A. $2y^2 + x + 23 = 0$

B. $4y^2 - x + 31 = 0$

C. $2y^2 + x + 12y + 23 = 0$

D. $4y^2 - x + 24y + 31 = 0$

OVER

27. Give the vertices of $y^2 - (x - 2)^2 = 16$.

- A. $(2, 4)$, $(2, -4)$
- B. $(-2, 0)$, $(6, 0)$
- C. $(-2, 4)$, $(-2, -4)$
- D. $(-6, 0)$, $(2, 0)$

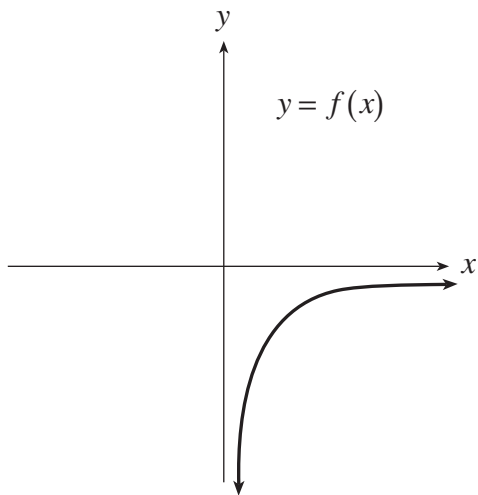
28. If the graph of $2x + 3y = 5$ is translated 4 units up, determine the equation of the new graph.

- A. $2x + 3y = 1$
- B. $2x + 3y = 9$
- C. $2x + 3(y + 4) = 5$
- D. $2x + 3(y - 4) = 5$

29. How is the graph of $y = 7^{3x}$ related to the graph of $y = 7^x$?

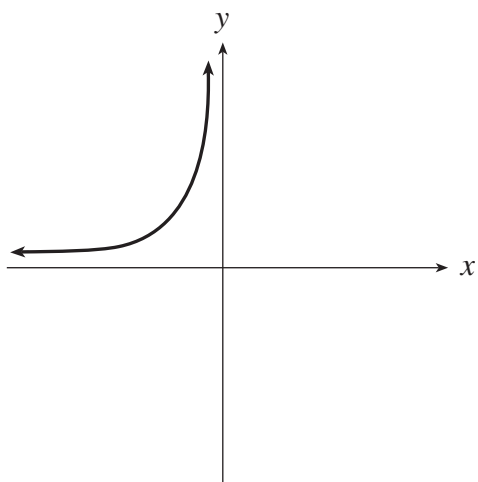
- A. The graph of $y = 7^x$ has been expanded vertically by a factor of 3.
- B. The graph of $y = 7^x$ has been compressed vertically by a factor of $\frac{1}{3}$.
- C. The graph of $y = 7^x$ has been expanded horizontally by a factor of 3.
- D. The graph of $y = 7^x$ has been compressed horizontally by a factor of $\frac{1}{3}$.

30. The graph of the function $y = f(x)$ is shown below.

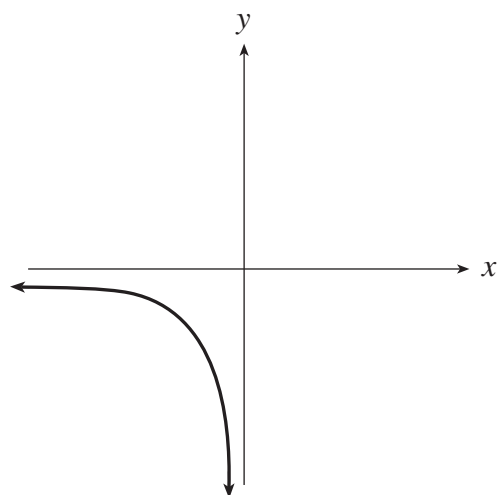


Which of the following is the graph of $y = f^{-1}(x)$?

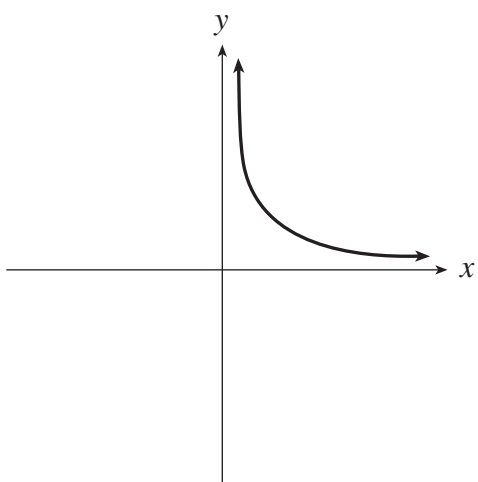
A.



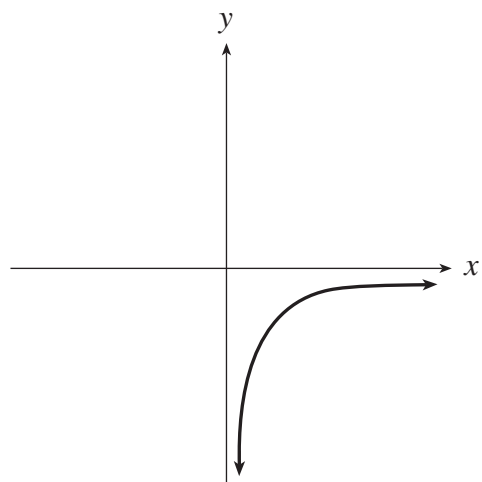
B.



C.

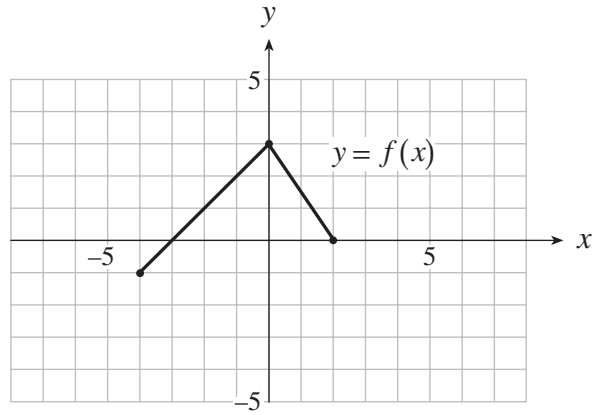


D.

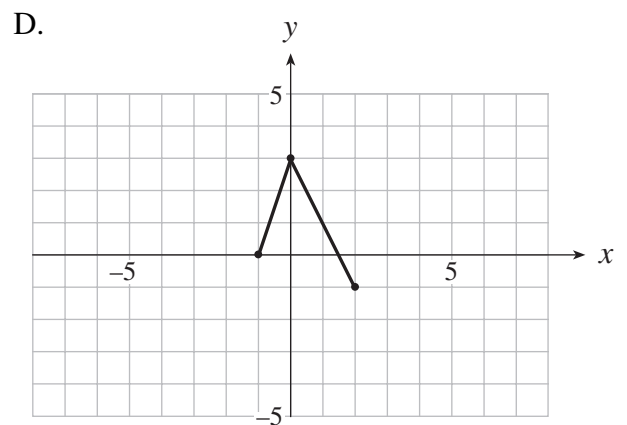
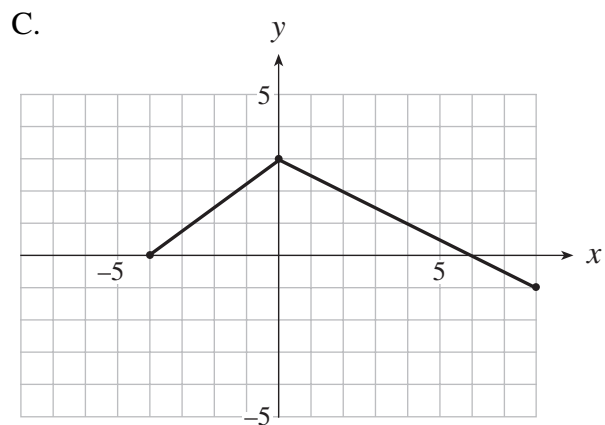
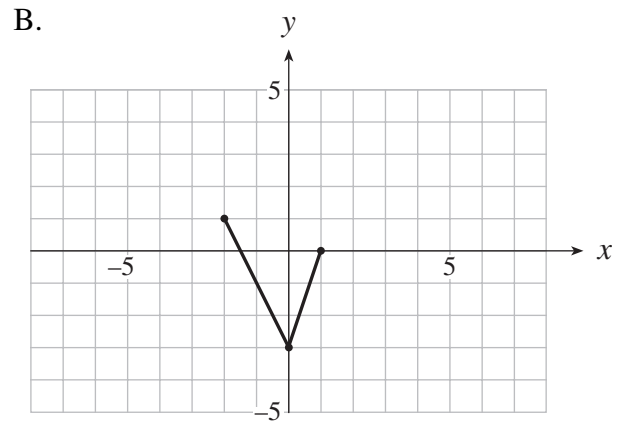
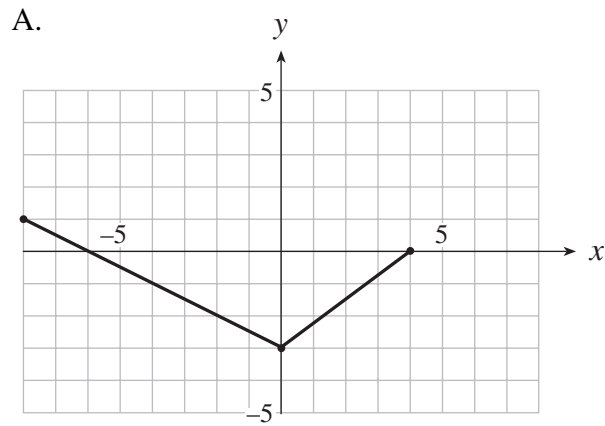


OVER

31. The graph of the function $y = f(x)$ is shown below.



Which of the following is the graph of $y = -f\left(\frac{x}{2}\right)$?



32. Determine an equation that will cause the graph of $y = f(x)$ to expand vertically by a factor of 4 and reflect in the y -axis.
- A. $y = -4f(x)$
 - B. $y = -\frac{1}{4}f(x)$
 - C. $y = \frac{1}{4}f(-x)$
 - D. $y = 4f(-x)$
33. If $(6, -10)$ is a point on the graph of $y = f(x)$, what must be a point on the graph of $y = f(2x + 8) - 5$?
- A. $(-5, -15)$
 - B. $(-1, -15)$
 - C. $(-1, -5)$
 - D. $(8, -5)$
34. Car license plates consist of 6 characters. Each of the first 3 characters can be any letter from A to Z inclusive except I or O. Each of the last 3 characters can be any digit from 2 to 9 inclusive. If repetitions of letters and digits are not allowed, how many different license plates are possible? An example of this format is G R T 4 9 2.
- A. 4 080 384
 - B. 5 241 600
 - C. 7 077 888
 - D. 11 232 000
35. Determine the first three terms in the expansion of $(x + 2y)^{10}$.
- A. $x^{10} + 10x^9y + 90x^8y^2$
 - B. $x^{10} + 20x^9y + 180x^8y^2$
 - C. $x^{10} + 10x^9y + 45x^8y^2$
 - D. $x^{10} + 20x^9y + 45x^8y^2$

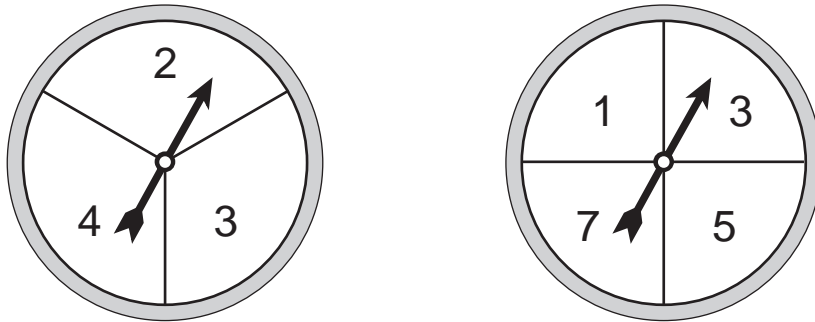
OVER

36. From a class of 12 boys and 10 girls a committee of 3 people is selected. How many different committees have at least 1 boy?
- A. 120
 - B. 540
 - C. 1 420
 - D. 1 540
37. A bag contains 4 white balls and 6 black balls. Two balls are drawn one at a time without replacement. What is the probability that both balls are the same colour?
- A. $\frac{2}{15}$
 - B. $\frac{1}{3}$
 - C. $\frac{7}{15}$
 - D. $\frac{8}{15}$
38. A survey of people that live within 40 km of a ski resort found that 22% go snowboarding, 48% go skiing and 6% do both sports. Determine the probability that a randomly selected person does neither sport.
- A. 24%
 - B. 30%
 - C. 36%
 - D. 42%


39. Two fair coins are tossed. What is the probability that both coins are heads, given that at least one of them is a head?

- A. $\frac{1}{4}$
- B. $\frac{1}{3}$
- C. $\frac{1}{2}$
- D. $\frac{3}{4}$

40. In the diagram below, each spinner is spun once and the resulting numbers are added. What is the probability that the sum is an odd number?



- A. $\frac{5}{12}$
- B. $\frac{1}{2}$
- C. $\frac{2}{3}$
- D. $\frac{5}{7}$

41. If a fair die is rolled 8 times, what is the probability of obtaining exactly two 's (5's)?

- A. 0.11
- B. 0.25
- C. 0.26
- D. 0.29

42. The weights of a population are normally distributed. Approximately what percent of the population has a weight that is within 2 standard deviations of the mean?
- A. 48%
 - B. 68%
 - C. 95%
 - D. 99.7%
43. The hours of sleep for a population are normally distributed with a mean of 7.5 h and a standard deviation of 1.25 h. What proportion of the population sleeps between 7 and 9 h?
- A. 0.07
 - B. 0.54
 - C. 0.67
 - D. 0.73
44. In a population of men, their heights are normally distributed with a mean of 178 cm. If a man with a height of 184 cm is shorter than 20% of the population, determine the standard deviation of the population.
- A. 5.9 cm
 - B. 6.5 cm
 - C. 7.1 cm
 - D. 8.3 cm

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

PART B: WRITTEN RESPONSE

Value: 34 marks

Suggested Time: 45 minutes

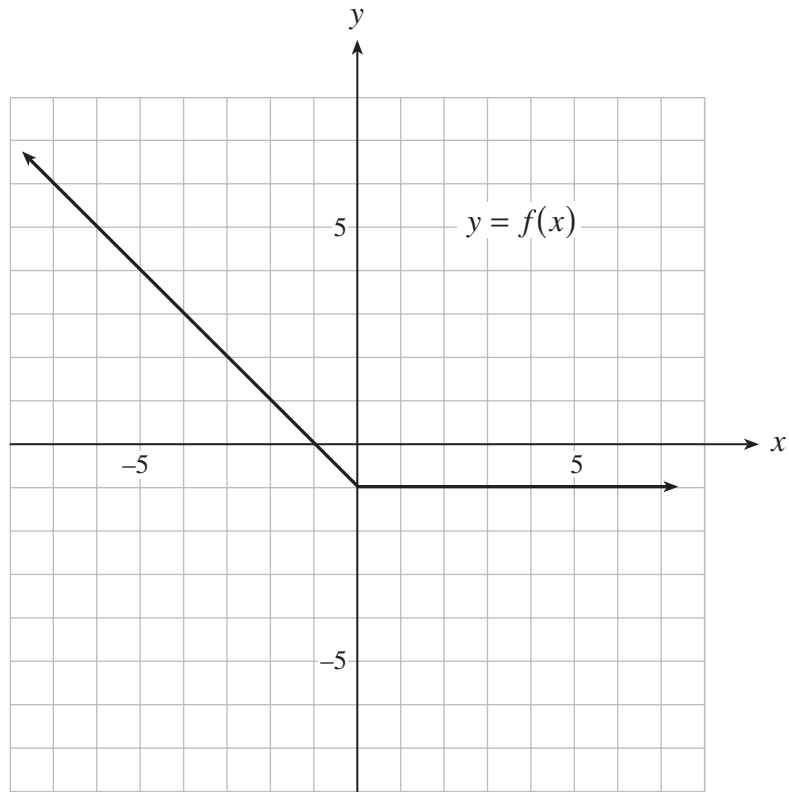
INSTRUCTIONS: Rough-work space has been incorporated into the space allowed for answering each question. You may not need all the space provided to answer each question. Where required, place the final answer for each question in the space provided.

If, in a justification, you refer to information produced by the graphing 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 values. If the statistical features of the calculator are used, it is important to show the function with the substitution of the relevant numbers. For example: in part of the solution it is acceptable to show $\text{normalcdf}(10, 40, 50, 20)$ or the equivalent syntax for the calculator used.

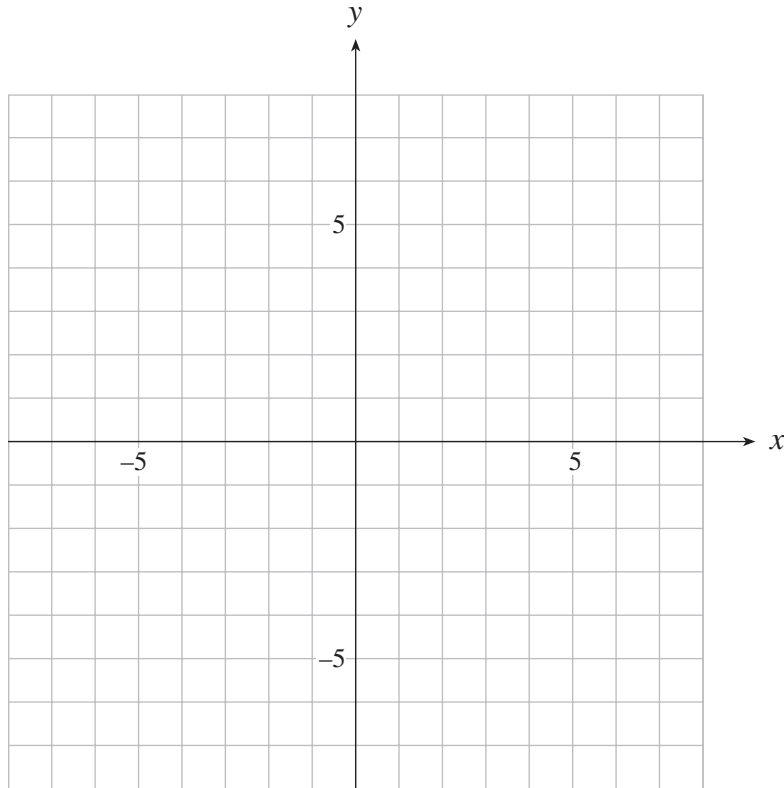
When using the calculator, you should provide a decimal answer that is correct to **at least two decimal places** (unless otherwise indicated). Such rounding should occur **only** in the final step of the solution.

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

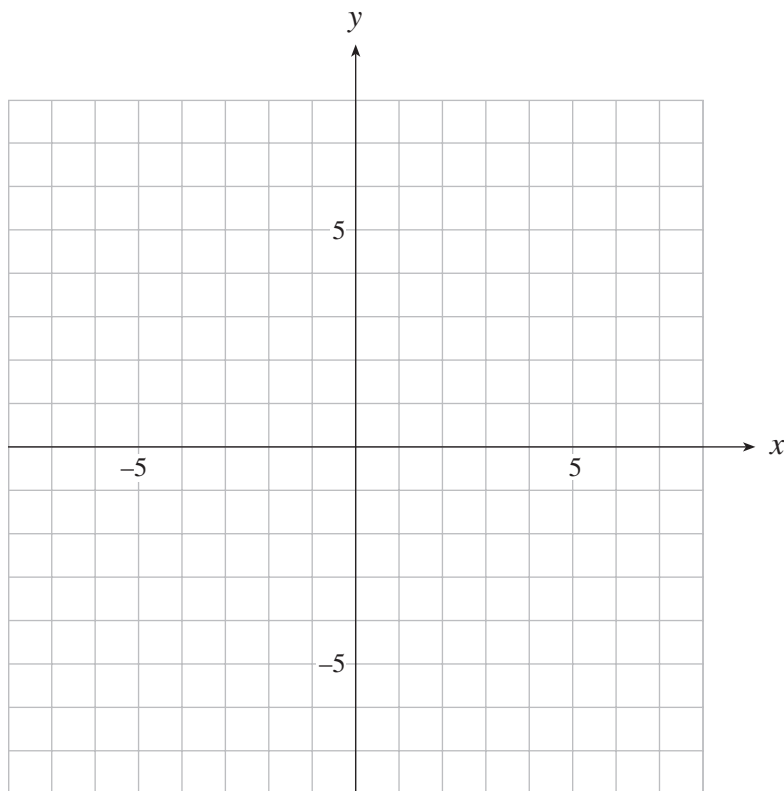
1. The graph of $y = f(x)$ is shown below.



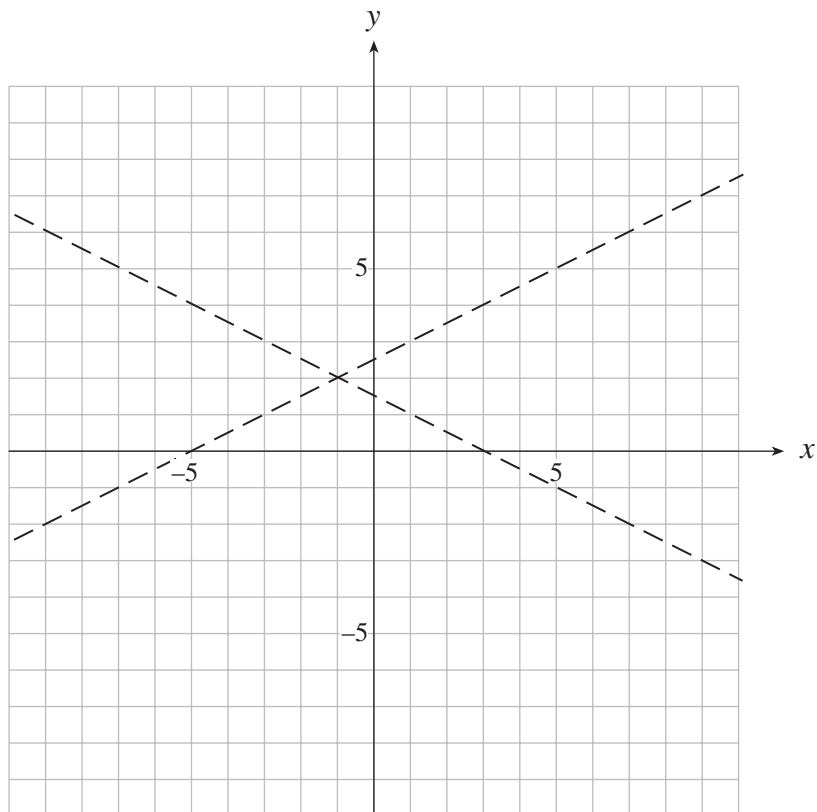
- a) On the grid provided, sketch the graph of $y = \frac{1}{f(x)}$. **(2 marks)**



- b) On the grid provided, sketch the graph of $y = 2|f(x)|$. **(2 marks)**



2. The asymptotes of a hyperbola are shown below. Determine an equation of the hyperbola if the transverse axis is horizontal and has a length of 8. **(4 marks)**
- (Note:** The grid is provided for rough work only.)



ANSWER:

3. Malcolm bought a new car for \$24 000. Every year it will depreciate in value by 8%. How long will it take for the car to be worth \$16 000? **(5 marks)**
(Solve algebraically using logarithms. Answer accurate to at least 2 decimal places.)

ANSWER:

4. a) How many groups of 3 chairs can be chosen from 7 chairs if the chairs are all different colours?
(2 marks)

ANSWER:

- b) How many different ways can 7 chairs be arranged in a row if 2 of the chairs are blue, 3 are yellow, 1 is red and 1 is green? (Assume that all of the chairs are identical except for colour.)
(2 marks)

ANSWER:

OVER

5. A hand of five cards is dealt from a standard deck of 52 cards.

a) What is the probability that the hand contains exactly 1 club?

(2 marks)

ANSWER:

b) What is the probability that the hand contains at most 1 club?

(2 marks)

ANSWER:

OVER

6. In a large city in BC the probability that a car has air conditioning is 0.72. If 200 cars are randomly selected, determine the probability that between 130 and 132 cars inclusive have air conditioning by using the following methods.

- a) Use the binomial distribution to obtain this probability.
(Answer accurate to at least 4 decimal places.)

(2 marks)

ANSWER:

- b) Use the normal approximation to the binomial distribution to obtain an estimate of this probability. (Answer accurate to at least 4 decimal places.) **(2 marks)**

ANSWER:

OVER

7. a) Solve algebraically, giving exact values for x , where $0 \leq x < 2\pi$.

(3 marks)

$$2 \cos^2 x - \cos x - 1 = 0$$

ANSWER:

- b) Give the general solution for this equation.
(Solve over the set of real numbers, giving exact value solutions.)

(1 mark)

ANSWER:

OVER

8. Prove the identity:

(5 marks)

$$\frac{\cos \theta + \cot \theta}{1 + \sin \theta} = \cot \theta$$

LEFT SIDE

RIGHT SIDE

END OF EXAMINATION

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A SUMMARY OF BASIC IDENTITIES AND FORMULAE

Pythagorean Identities:

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$1 + \tan^2 \theta = \sec^2 \theta$$

$$1 + \cot^2 \theta = \csc^2 \theta$$

Reciprocal and Quotient Identities:

$$\sec \theta = \frac{1}{\cos \theta}$$

$$\csc \theta = \frac{1}{\sin \theta}$$

$$\cot \theta = \frac{1}{\tan \theta}$$

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

$$\cot \theta = \frac{\cos \theta}{\sin \theta}$$

Addition Identities:

$$\cos(\alpha + \beta) = \cos \alpha \cos \beta - \sin \alpha \sin \beta$$

$$\sin(\alpha + \beta) = \sin \alpha \cos \beta + \cos \alpha \sin \beta$$

$$\cos(\alpha - \beta) = \cos \alpha \cos \beta + \sin \alpha \sin \beta$$

$$\sin(\alpha - \beta) = \sin \alpha \cos \beta - \cos \alpha \sin \beta$$

Double-Angle Identities:

$$\cos 2\theta = \cos^2 \theta - \sin^2 \theta$$

$$\sin 2\theta = 2 \sin \theta \cos \theta$$

$$= 2 \cos^2 \theta - 1$$

$$= 1 - 2 \sin^2 \theta$$

Formulae:

$$t_n = ar^{n-1}$$

$$S_n = \frac{a(1-r^n)}{1-r}$$

$$S_n = \frac{a-r\ell}{1-r}$$

$$S = \frac{a}{1-r}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Probability and Statistics:

$${}_n P_r = \frac{n!}{(n-r)!}$$

$${}_n C_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}$$

$$t_{k+1} = {}_n C_k a^{n-k} b^k$$

$$P(\bar{A}) = 1 - P(A)$$

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

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

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

$$P(x) = {}_n C_x p^x q^{n-x} \quad (q = 1 - p)$$

$$\mu = \frac{\sum x_i}{n}$$

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

$$\mu = np$$

$$\sigma = \sqrt{npq}$$

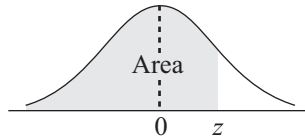
$$z = \frac{x - \mu}{\sigma}$$

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 |

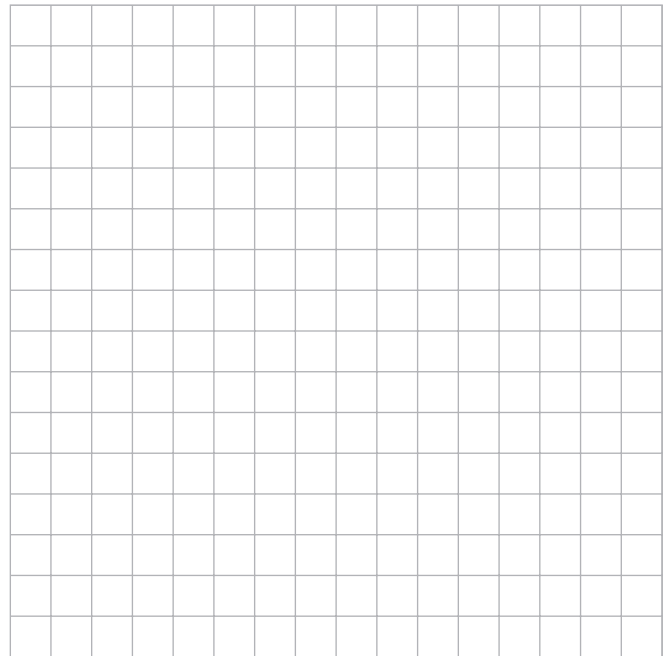
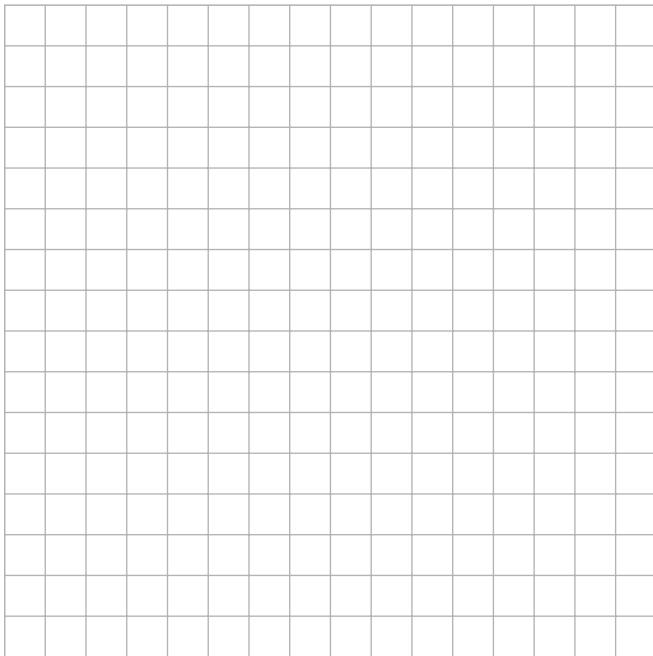
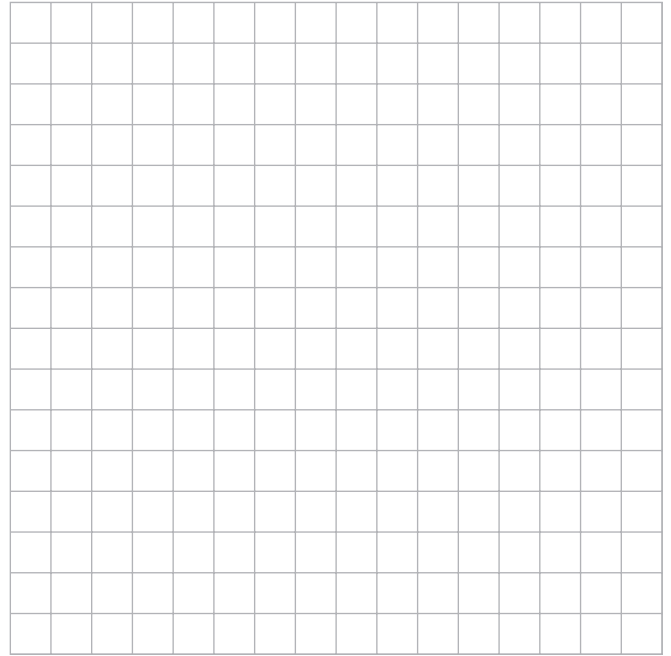
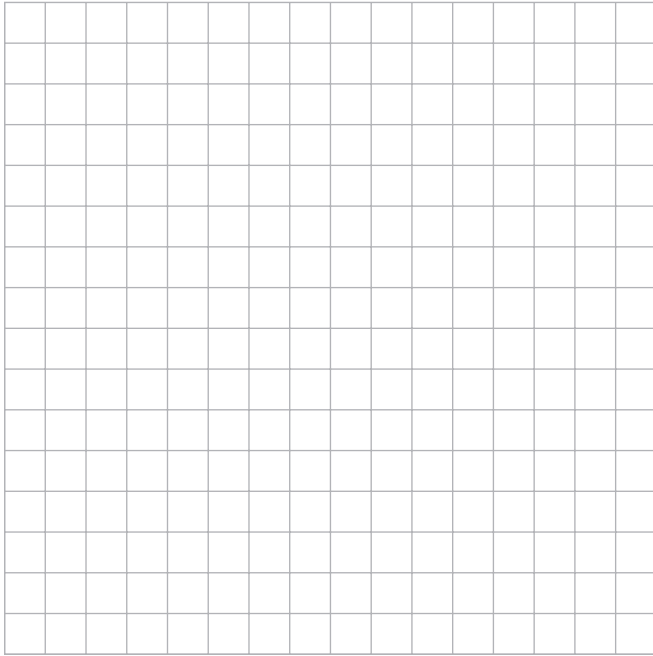
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$$F_z(z) = P[Z \leq z]$$

| 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

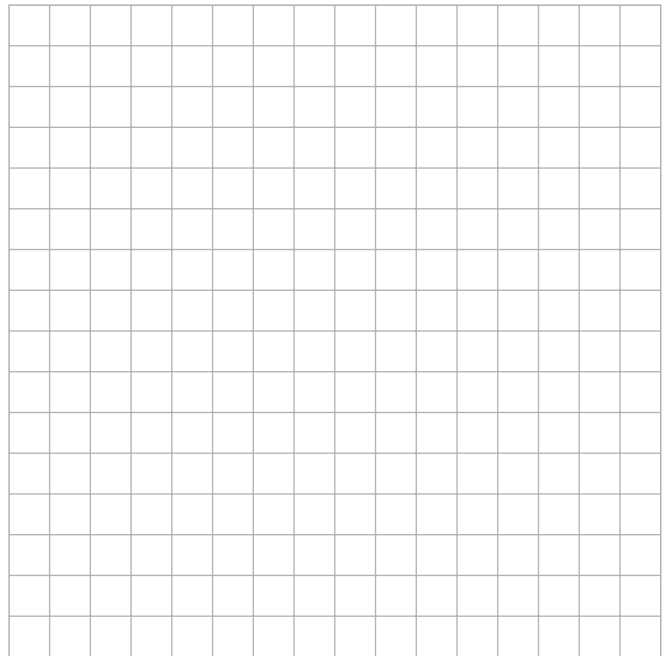
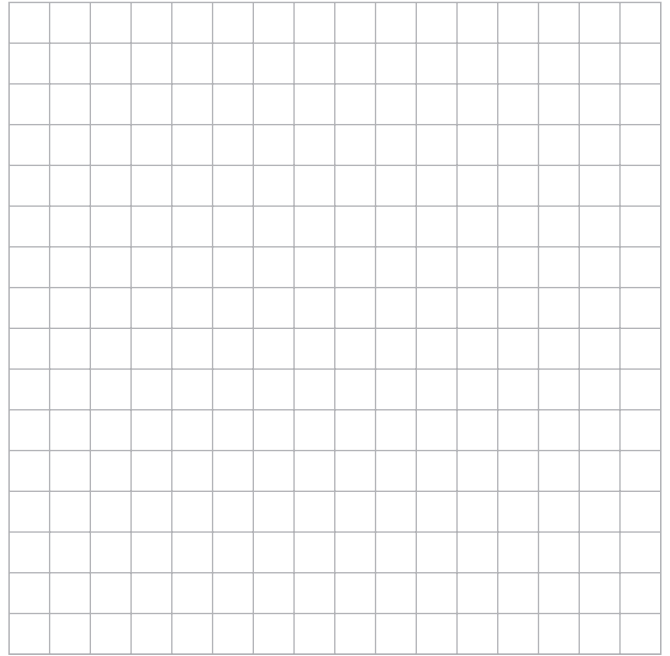
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ROUGH WORK FOR GRAPHING

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