

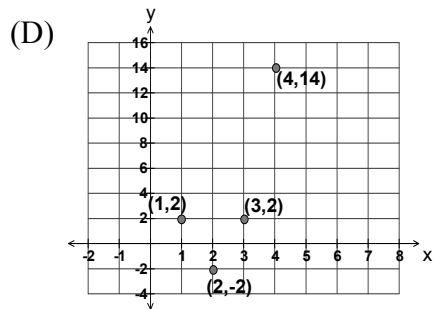
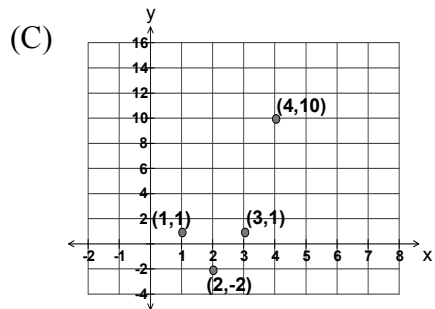
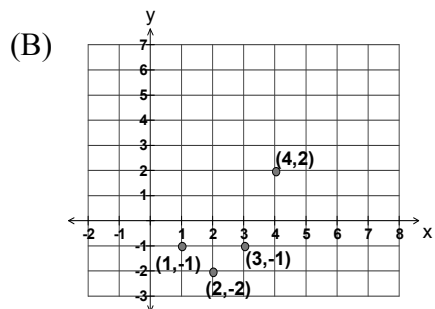
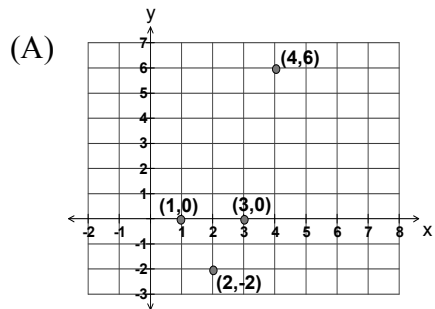
PART I
Total Value: 50%

Answer all items. Shade the letter of the correct answer on the computer scorable answer sheet.

1. What is t_n for the sequence $\left\{\frac{14}{3}, \frac{16}{3}, 6, \frac{20}{3}, \frac{22}{3}\right\}$?

- (A) $t_n = \frac{2}{3}n + \frac{11}{3}$
- (B) $t_n = \frac{2}{3}n + 4$
- (C) $t_n = \frac{2}{3}n + \frac{14}{3}$
- (D) $t_n = \frac{2}{3}n + 6$

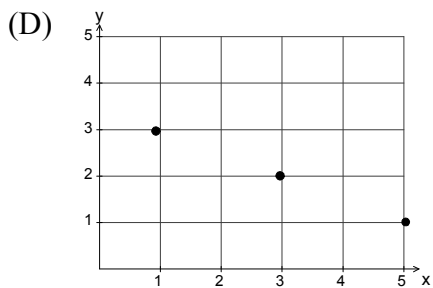
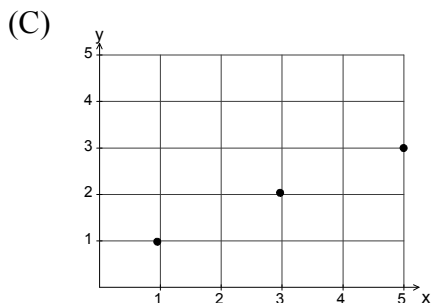
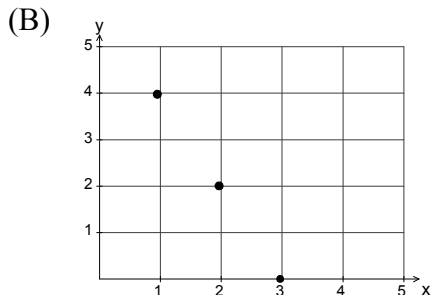
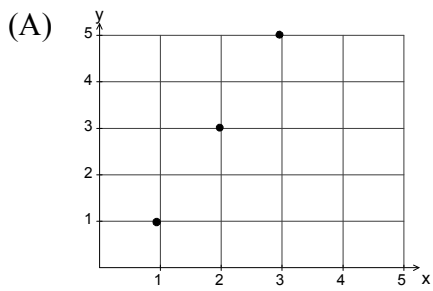
2. Which represents a quadratic sequence with a second level difference of 2?



3. Which will produce the same graph as $-2(y-3) = (x+5)^2$?

- (A) $y = -2(x+5)^2 - 3$
- (B) $y = -2(x+5)^2 + 3$
- (C) $y = -\frac{1}{2}(x+5)^2 - 3$
- (D) $y = -\frac{1}{2}(x+5)^2 + 3$

4. Which represents a sequence with a first level difference of $-\frac{1}{2}$?



5. Which function represents the transformation of $y = x^2$ under the mapping rule $(x, y) \rightarrow (x - 3, -\frac{1}{3}y + 4)$?

- (A) $y = -3(x + 3)^2 + 4$
- (B) $y = -\frac{1}{3}(x + 3)^2 + 4$
- (C) $y = \frac{1}{3}(x + 3)^2 - 4$
- (D) $y = 3(x + 3)^2 - 4$

6. Which has the greatest vertical stretch when compared to $y = x^2$?

- (A) $-4y = (x - 2)^2$
- (B) $-2y = (x - 2)^2$
- (C) $-\frac{1}{2}y = (x - 2)^2$
- (D) $-\frac{1}{4}y = (x - 2)^2$

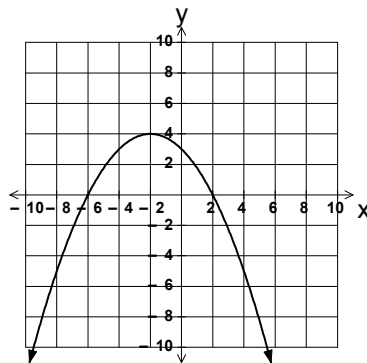
7. The graph of the function $y = a(x - h)^2 + k$ opens downward. If it is translated 5 units upward, what is the range of the new function?

- (A) $\{y \mid y \leq k - 5, y \in R\}$
- (B) $\{y \mid y \leq k + 5, y \in R\}$
- (C) $\{y \mid y \geq k - 5, y \in R\}$
- (D) $\{y \mid y \geq k + 5, y \in R\}$

8. What is the transformational form of $y = 4x^2 + 8x$?

- (A) $-\frac{1}{4}y = (x + 1)^2$
- (B) $-\frac{1}{4}(y + 4) = (x + 1)^2$
- (C) $\frac{1}{4}y = (x + 1)^2$
- (D) $\frac{1}{4}(y + 4) = (x + 1)^2$

9. Which equation describes the graph provided?



- (A) $y = -x^2 - 4x$
- (B) $y = -\frac{1}{2}x^2 - 2x + 2$
- (C) $y = -\frac{1}{4}x^2 - x + 3$
- (D) $y = -\frac{1}{4}x^2 - x + 5$

10. Which describes the y-coordinate of the vertex of $y + \frac{1}{8} = -\frac{1}{4}x + x^2$?

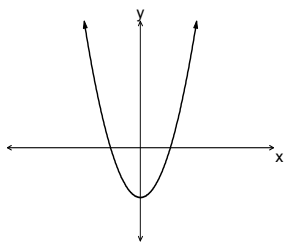
- (A) $-\frac{9}{64}$, minimum value
- (B) $-\frac{1}{32}$, minimum value
- (C) $\frac{9}{64}$, maximum value
- (D) $\frac{1}{32}$, maximum value

11. Which is true of the roots of a quadratic function $ax^2 + bx + c = 0$ if $b^2 < 4ac$?

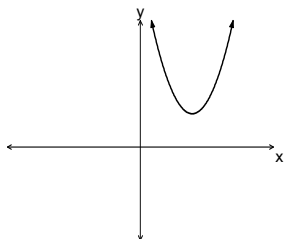
- (A) imaginary and equal
- (B) imaginary and unequal
- (C) real and equal
- (D) real and unequal

12. Which is the graph of a quadratic function with a negative leading coefficient and a negative discriminant?

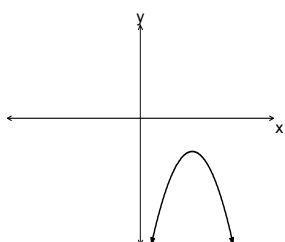
(A)



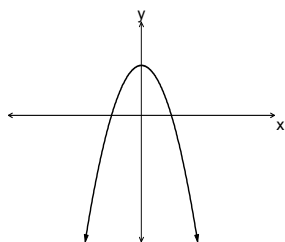
(B)



(C)



(D)



13. What is a possible discriminant for a quadratic function whose roots are real, unequal and irrational?

- (A) -2
- (B) 0
- (C) 5
- (D) 9

14. What is the simplest form of $\frac{3 \pm \sqrt{-54}}{3}$?

- (A) $\pm i\sqrt{6}$
- (B) $\pm 3i\sqrt{6}$
- (C) $1 \pm i\sqrt{6}$
- (D) $1 \pm 3i\sqrt{6}$

15. What is the value of c if $3 + \sqrt{2}$ and $3 - \sqrt{2}$ are roots of $x^2 - 6x + c = 0$?

- (A) -11
- (B) -7
- (C) 7
- (D) 11

16. What are the roots of the equation $\sqrt{3}x(\sqrt{3}x + 3\sqrt{3}) = -6$?

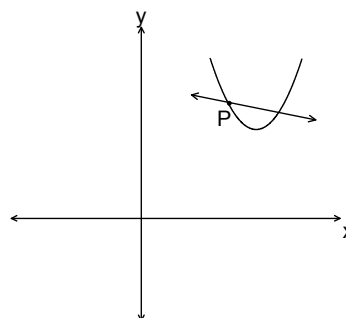
- (A) $-2, -1$
- (B) $2, 1$
- (C) $\frac{-9 \pm \sqrt{57}}{6}$
- (D) $\frac{-9 \pm \sqrt{73}}{2}$

17. The total flying time from St. John's to Toronto and back again is 8 hours. The speed of the plane on the trip to Toronto is 50 km/h slower than on the return trip and the distance one way is 2112 km. Which represents this situation?

- (A) $\frac{2112}{x} + \frac{2112}{x+50} = 8$
- (B) $\frac{2112}{x-50} + \frac{2112}{x+50} = 8$
- (C) $\frac{2112}{x} + \frac{2112}{50x} = 8$
- (D) $\frac{2112}{x} + \frac{2112}{50-x} = 8$

18. What rate of change is represented by the graph provided?

- (A) negative average
- (B) negative instantaneous
- (C) positive average
- (D) positive instantaneous



19. An ice cube with side lengths of 10 cm is melting such that the length is decreasing at a rate of 4 mm/second. Which represents the instantaneous rate of change in the volume of the ice cube over time?

- (A) $V = (10 - 4t)^3$
- (B) $V = (10 - 0.4t)^3$
- (C) $V = 1000 - 0.64t^3$
- (D) $V = 1000 - 64t^3$

20. Which represents an exponential relationship?

- (A)

x	1	2	3	4
y	3	-1	$-\frac{1}{3}$	$\frac{1}{9}$
- (B)

x	1	2	3	4
y	3	0	-3	-6
- (C)

x	1	2	3	4
y	3	1	$\frac{1}{3}$	$\frac{1}{9}$
- (D)

x	1	2	3	4
y	3	12	27	48

21. What is the y -intercept of $-\frac{1}{4}(y+3) = 2^x$?

- (A) $(0, -7)$
- (B) $(0, -3)$
- (C) $(0, -1)$
- (D) $(0, 1)$

22. What is the range of $(y+3) = \left(\frac{1}{5}\right)^x$?

- (A) $\{y \mid y > -3, y \in R\}$
- (B) $\{y \mid y \geq -3, y \in R\}$
- (C) $\{y \mid y > 3, y \in R\}$
- (D) $\{y \mid y \geq 3, y \in R\}$

23. The temperature, T , of a cup of hot chocolate with respect to time, m , in minutes is given by the equation below. What is the initial temperature, in degrees Celsius, of the hot chocolate?

$$T = 73(0.90)^m + 22$$

- (A) 22
- (B) 73
- (C) 90
- (D) 95

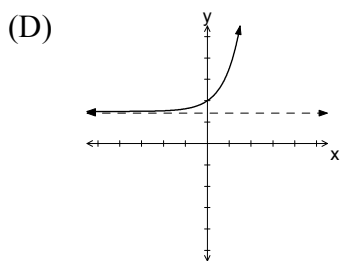
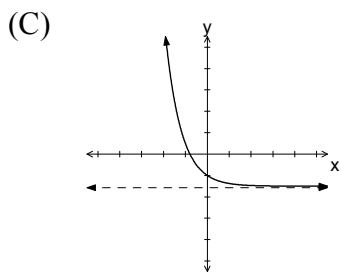
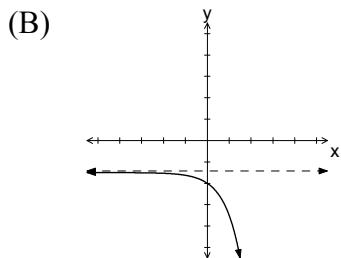
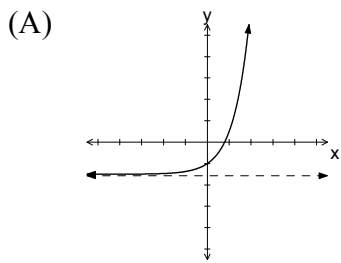
24. What mapping rule applied to $y = \left(\frac{1}{3}\right)^x$ results in its graph being reflected in the y -axis, stretched horizontally by a factor of 2, and translated vertically 5 units down?

- (A) $(x, y) \rightarrow (-2x, y - 5)$
- (B) $(x, y) \rightarrow \left(-\frac{1}{2}x, y - 5\right)$
- (C) $(x, y) \rightarrow \left(\frac{1}{2}x, -y - 5\right)$
- (D) $(x, y) \rightarrow (2x, -y - 5)$

25. What are the coordinates of the focal point if $y = 4^x$ is transformed to $\frac{1}{3}(y-1) = 4^{-\frac{1}{2}x+4}$?

- (A) $(-6, 1)$
- (B) $(-4, 4)$
- (C) $(6, 1)$
- (D) $(8, 4)$

26. Which represents an exponential function given by the equation $A(y - C) = 2^{B(x-D)}$, where $A > 0$, $B = 1$, $C < 0$, and $D = 0$?



27. What is the simplified form of $\frac{3^{a+2} \cdot 36^a \cdot 9^{2a}}{6^{-a+1}}$?

- (A) $3^{5a+2} \cdot 6^{a+1}$
 (B) $3^{5a+2} \cdot 6^{3a-1}$
 (C) 18^{6a+3}
 (D) 18^{8a+1}

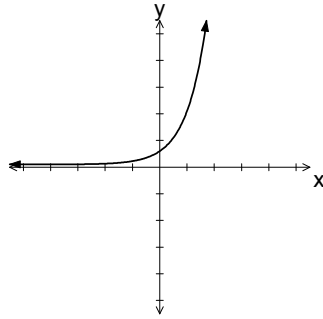
28. What is the simplest form of $(3 + b^{-1})^2$?

- (A) $9 - b^2$
 (B) $9 - 6b + b^2$
 (C) $9 + \frac{1}{b^2}$
 (D) $9 + \frac{6}{b} + \frac{1}{b^2}$

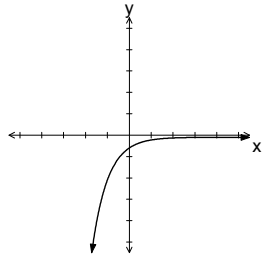
29. Solve: $\left(\frac{1}{3}\right)^x = \sqrt{27^6}$.

- (A) -27
 (B) -18
 (C) -9
 (D) -6

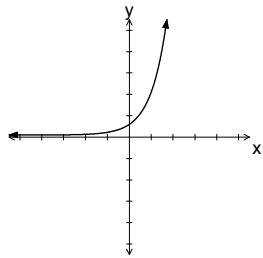
30. Which represents the inverse of the graph of $f(x)$ shown below?



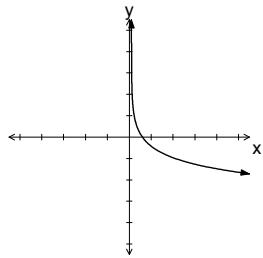
(A)



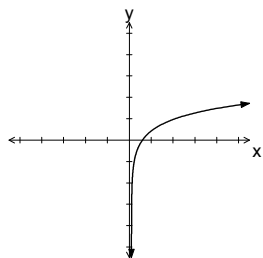
(B)



(C)



(D)



31. What is the domain of $-(y+1) = \log_4(3x+2)$?

(A) $\{x \mid x < -\frac{2}{3}, x \in R\}$

(B) $\{x \mid x > -\frac{2}{3}, x \in R\}$

(C) $\{x \mid x < 0, x \in R\}$

(D) $\{x \mid x > 0, x \in R\}$

32. Evaluate: $\frac{1}{2} \log_9 36 - \log_9 2$.

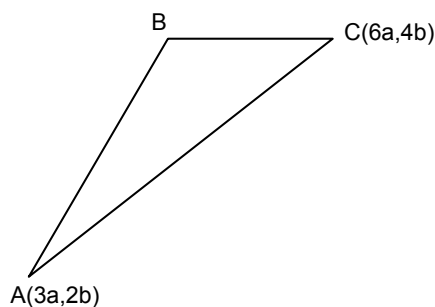
(A) $\frac{1}{2}$

(B) 1

(C) $\log_9 12$

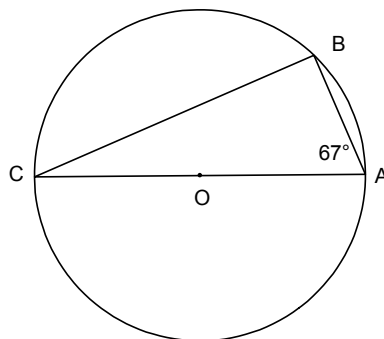
(D) $\log_9 36$

33. Which is equivalent to $\log_5(x+2) - 2\log_5 x = y$?
- (A) $5^y = \frac{x+2}{2x}$
 (B) $5^y = \frac{x+2}{x^2}$
 (C) $5^y = x+2-x^2$
 (D) $5^y = 2-x$
34. What is the exact value of x for $3^{x+1} = 15$?
- (A) $\frac{\log 3}{\log 15} - 1$
 (B) $\frac{\log 3}{\log 15} + 1$
 (C) $\frac{\log 15}{\log 3} - 1$
 (D) $\frac{\log 15}{\log 3} + 1$
35. Solve for x : $2\log_2 x + \log_2 4 = \log_2 64$.
- (A) 4
 (B) ± 4
 (C) 16
 (D) ± 16
36. What is (are) the exact value(s) of x for $\log_x(2x+8) = \log_3 9$?
- (A) $-4, 2$
 (B) $-2, 4$
 (C) 2
 (D) 4
37. What is the converse of the statement, "If a triangle is isosceles then the base angles are congruent"?
- (A) A triangle is isosceles *iff* the two base angles are congruent.
 (B) If a triangle is not isosceles then the base angles are not congruent.
 (C) If the base angles of a triangle are congruent then the triangle is isosceles.
 (D) The two base angles of a triangle are congruent *iff* the triangle is isosceles.
38. What is the slope of the altitude from B to \overline{AC} in the diagram below?



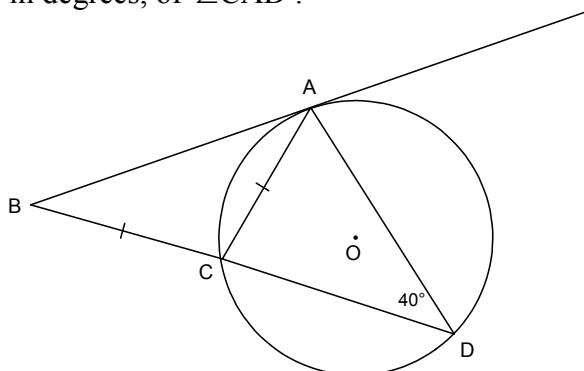
- (A) $-\frac{3a}{2b}$
 (B) $-\frac{2b}{3a}$
 (C) $\frac{2b}{3a}$
 (D) $\frac{3a}{2b}$

39. In the circle with centre O shown, the diameter is 13 cm and $\angle BAC = 67^\circ$. What is the length, in cm, of minor \widehat{AB} ?



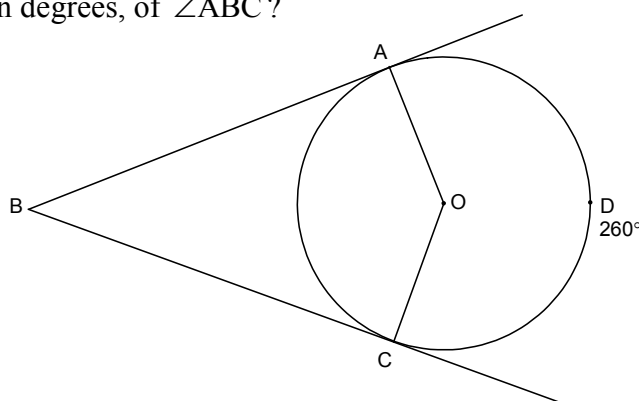
- (A) 2.6
(B) 5.2
(C) 10.4
(D) 17.0

40. In the circle with centre O shown, $\widehat{AC} = \widehat{BC}$, $\angle ADC = 40^\circ$, and \overline{AB} is tangent to the circle. What is the measure, in degrees, of $\angle CAD$?



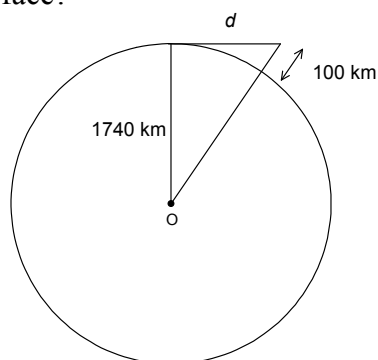
- (A) 40
(B) 50
(C) 60
(D) 100

41. In the circle with centre O shown, $\widehat{ADC} = 260^\circ$ and \overline{BA} and \overline{BC} are tangent to the circle. What is the measure, in degrees, of $\angle ABC$?



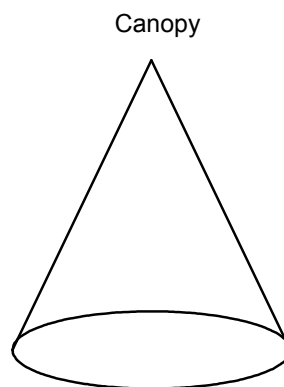
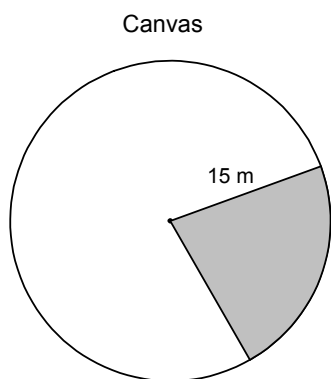
- (A) 50
(B) 80
(C) 100
(D) 130

42. The radius of the moon is approximately 1740 km. If a spacecraft is 100 km above the surface of the moon, what is the distance, d , in kilometres, from the spacecraft to the furthest visible point on the moon's surface?

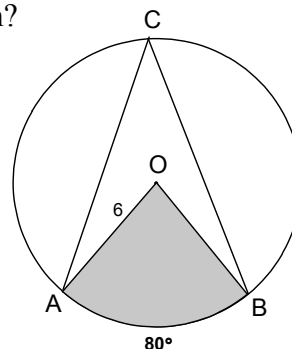


- (A) 598.33
(B) 1737.12
(C) 1742.87
(D) 2532.43

43. A cone-shaped canopy is to be constructed for a merry-go-round by removing a sector from a circular piece of canvas with a radius of 15 m. What is the radius of the canopy if its height is 9 m?



- (A) 2.4
 (B) 6
 (C) 12
 (D) 17.5
44. In the circle with centre O shown, the radius is 6 units and minor $\widehat{AB} = 80^\circ$. What is the approximate area, in square units, of the shaded region?



- (A) 4.19
 (B) 8.38
 (C) 12.57
 (D) 25.13
45. The equation of a circle is $(x+1)^2 + (y-2)^2 = 25$. If the circle is translated 4 units down, 3 units right, and its radius is changed by a factor of $\frac{1}{4}$, what is the new equation of the circle?

- (A) $\left[\frac{4}{5}(x-2)\right]^2 + \left[\frac{4}{5}(y+2)\right]^2 = 1$
 (B) $\left[\frac{4}{5}(x+5)\right]^2 + \left[\frac{4}{5}(y+5)\right]^2 = 1$
 (C) $\left[\frac{5}{4}(x-2)\right]^2 + \left[\frac{5}{4}(y+2)\right]^2 = 1$
 (D) $\left[\frac{5}{4}(x+5)\right]^2 + \left[\frac{5}{4}(y+5)\right]^2 = 1$

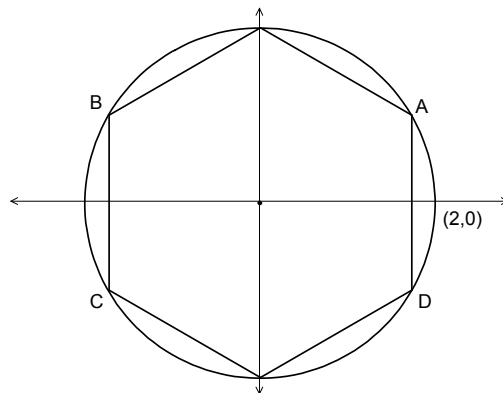
46. What is the length of the minor axis of the ellipse having equation $10x^2 + 20y^2 - 100 = 0$?

- (A) $\sqrt{5}$
 (B) $\sqrt{10}$
 (C) $2\sqrt{5}$
 (D) $2\sqrt{10}$

47. Which equation represents a circle?

- (A) $4x^2 - 4y^2 = 0$
 (B) $4x^2 + 10y^2 - 8x + 20y - 70 = 0$
 (C) $12x^2 - 20y^2 - 2x - 4y - 6 = 0$
 (D) $16x^2 + 16y^2 - 12x + 2y - 18 = 0$

48. The endpoints of the major vertical axis of an ellipse are $(0, -5)$ and $(0, 5)$. What is the vertical stretch factor of the ellipse as compared to the unit circle?
- (A) $\frac{1}{5}$
 (B) $\frac{1}{\sqrt{5}}$
 (C) $\sqrt{5}$
 (D) 5
49. What is the approximate measure of θ , in degrees, if the point $P(8, -6)$ is on the terminal arm of θ in standard position?
- (A) 306.9
 (B) 311.4
 (C) 318.6
 (D) 323.1
50. A rectangular hexagon is inscribed in a circle as shown. What are the exact coordinates of point B?



- (A) $(-\sqrt{3}, 1)$
 (B) $(-1, \sqrt{3})$
 (C) $(-\frac{\sqrt{3}}{2}, \frac{1}{2})$
 (D) $(-\frac{1}{2}, \frac{\sqrt{3}}{2})$

PART II
Total Value: 50%

Answer **ALL** items in the space provided. Show **ALL** workings.

Value

4 51. Algebraically determine the **exact** roots in simplest form for $\frac{x}{x+2} - \frac{2}{x-4} = -\frac{1}{2}$.

- 4 52. A local restaurant averages 200 customers per day who spend \$30 per meal. The manager estimates a loss of 10 customers per day for each \$1 increase in meal price. If the average cost to prepare each meal is \$12, write a quadratic function to model the daily profit and use it to determine the meal price that will maximize the profit.

Value

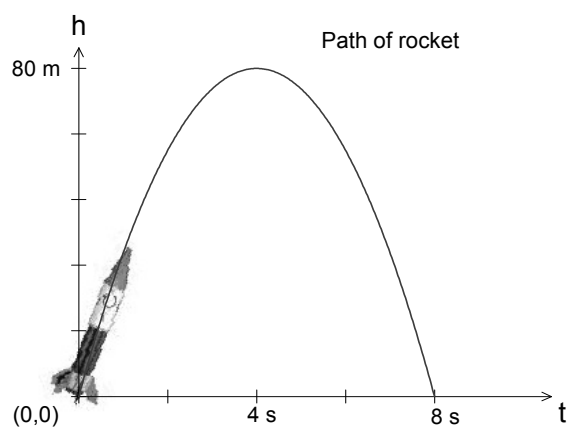
4

53. A person standing on the surface of Mars throws a ball from a height of 1 m and the data below is collected on the ball's height over time. Algebraically determine the function, $h(t)$, that defines the height of the ball above the ground, in metres, t seconds after leaving the person's hand.

$t(\text{s})$	1	2	3	4
$h(\text{m})$	12	19	22	21

4

54. A toy rocket is launched into the air and reaches a maximum height of 80 m after a time of 4 seconds. If the rocket lands after 8 seconds, determine the quadratic function that describes the flight path of the rocket. Use the function to determine the height of the rocket at 6.5 seconds.



Value

- 4 55. A ball is thrown vertically upward with an initial speed of 30 m/s. Its height, in metres, t seconds after release is given by $h(t) = 1 + 30t - 5t^2$. Calculate the instantaneous rate of change at 2.5 seconds and describe how the height of the ball is changing at that instant.

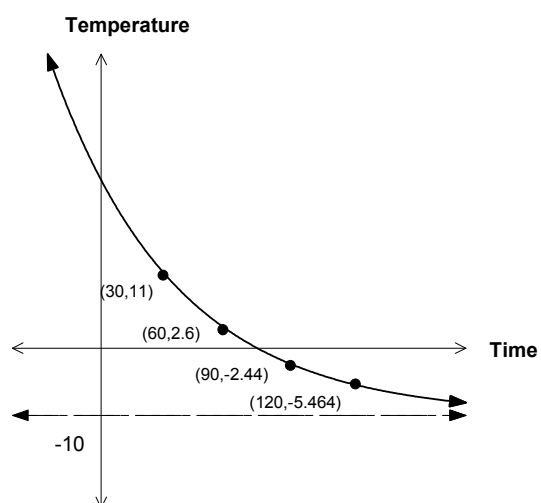
- 4 56. Algebraically solve for x : $\frac{1}{3}\log_2 125 + \log_2(x + 2) = 4$.

- 4 57. Algebraically solve for x : $3^{2x} - 5 \cdot 3^x = -4$.

Value

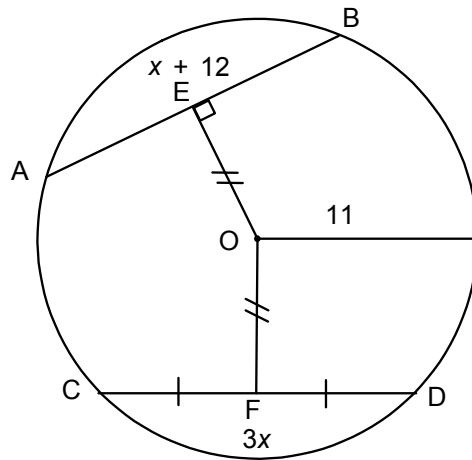
- 4 58. The amount of a certain antibiotic drug remaining in a person's body decreases by 15% each hour. If the initial dose was 250 mg, algebraically determine an exponential equation to model this situation and use it to determine how long it will take for the amount of drug in the person's body to reduce to 55 mg.

- 4 59. During a power failure caused by a winter storm, the temperature inside a house, with respect to time, in minutes, is shown in the graph below. Based on an outside temperature of -10°C , create a function to model this situation.

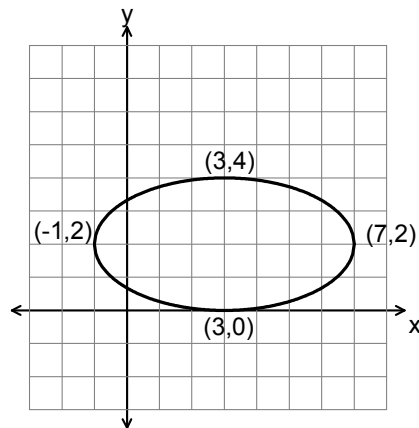


Value

- 3 60. In the circle with centre O shown, the radius is 11 cm and $\overline{OE} \cong \overline{OF}$. If $\overline{AB} = x + 12$ and $\overline{CD} = 3x$, determine the length of \overline{OF} .



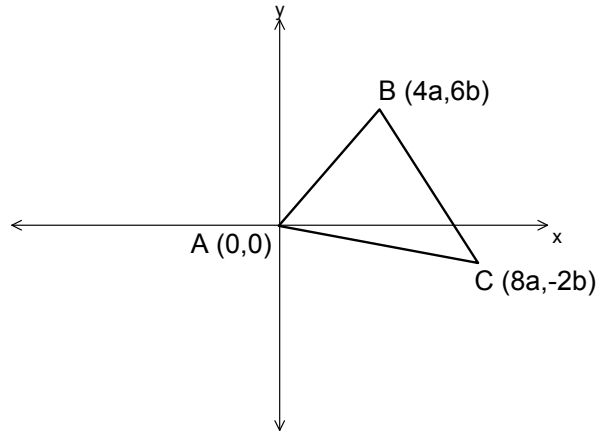
- 3 61. Write, in transformational form, the equation for the ellipse shown.



Value

4

62. In $\triangle ABC$, the coordinates of the vertices are $A(0,0)$, $B(4a, 6b)$, and $C(8a, -2b)$. Prove that the segment joining the midpoints of \overline{AB} and \overline{CB} is one half the length of \overline{AC} .



4

63. In the circle with centre O shown, calculate the area of the shaded region if $\angle AOB = 100^\circ$.

