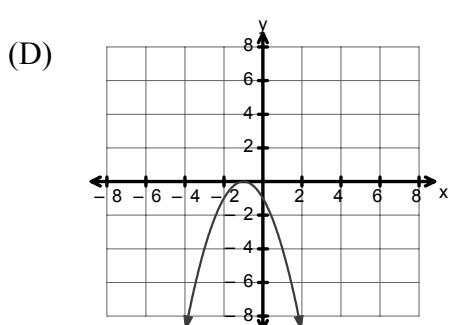
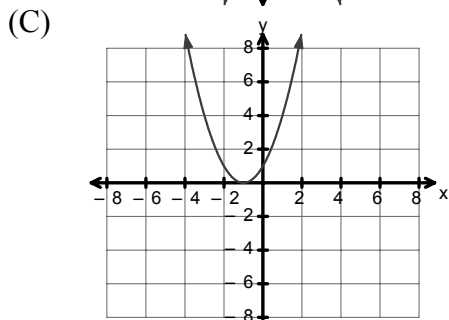
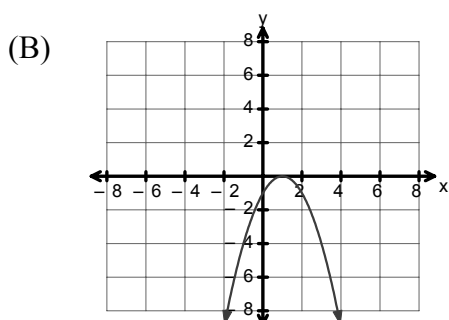
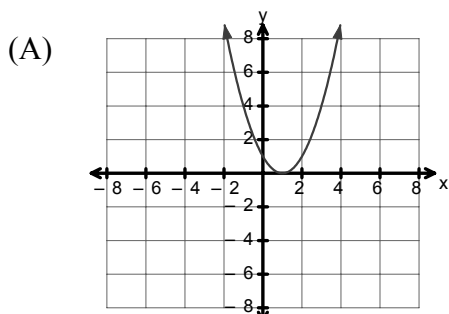


PART I
Total Value: 50%

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

1. Which graph represents the transformation of $y = x^2$ under the mapping rule $(x, y) \rightarrow (x+1, -y)$?



2. Which sequence below is arithmetic?

- (A) $\{3-2(1), 3-2(2), 3-2(3), 3-2(4), \dots\}$
 (B) $\{3-1, 3+1, 3-2, 3+2, \dots\}$
 (C) $\{3^1, 3^2, 3^3, 3^4, \dots\}$
 (D) $\{3+2, 3+2^2, 3+2^3, 3+2^4, \dots\}$

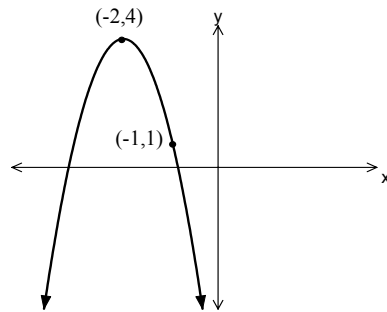
3. Which quadratic equation has roots $3 \pm 2i\sqrt{2}$?

- (A) $x^2 - 6x + 1 = 0$
 (B) $x^2 - 6x - 1 = 0$
 (C) $x^2 - 6x + 17 = 0$
 (D) $x^2 - 6x - 17 = 0$

4. What is the range of the quadratic function $y - 5 = (x + 3)^2$?

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

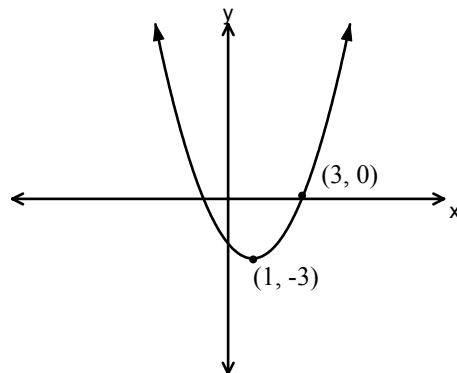
5. Which describes the graph shown when it is compared to the graph of $y = x^2$?



- (A) reflected in the x-axis, horizontal translation of -2 , vertical translation of 4 , vertical stretch factor of $\frac{1}{3}$
 - (B) reflected in the x-axis, horizontal translation of -2 , vertical translation of 4 , vertical stretch factor of 3
 - (C) reflected in the x-axis, horizontal translation of 2 , vertical translation of -4 , vertical stretch factor of $\frac{1}{3}$
 - (D) reflected in the x-axis, horizontal translation of 2 , vertical translation of -4 , vertical stretch factor of 3
6. Given the function $g(x) = -4(x - 1)^2 + 8$, what is the nature of the roots of $g(x) = 0$?
- (A) imaginary and equal
 - (B) imaginary and unequal
 - (C) real and equal
 - (D) real and unequal

7. Which function represents the graph shown?

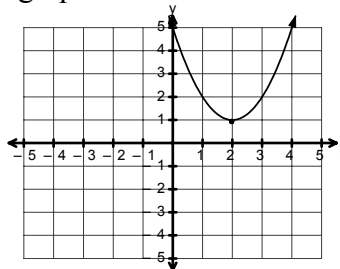
- (A) $y = \frac{2}{3}(x - 1)^2 - 3$
- (B) $y = \frac{3}{2}(x - 1)^2 - 3$
- (C) $y = \frac{3}{4}(x - 1)^2 - 3$
- (D) $y = \frac{4}{3}(x - 1)^2 - 3$



8. What is the general form of $y = 2(x + 3)^2 + 1$?

- (A) $y = 2x^2 + 19$
- (B) $y = 2x^2 + 20$
- (C) $y = 2x^2 + 12x + 19$
- (D) $y = 2x^2 + 12x + 20$

9. What are the zeros of the quadratic function graphed below?



- (A) $\{2 \pm i\}$
 (B) $\{4 \pm i\}$
 (C) $\{5, -1\}$
 (D) $\{8, -4\}$
10. Which table of values shows a quadratic relationship?

(A)

n	1	2	3	4	5
t_n	7	11	15	19	23

(B)

n	1	2	3	4	5
t_n	2	5	10	17	26

(C)

n	1	2	3	4	5
t_n	1	3	9	27	81

(D)

n	1	2	3	4	5
t_n	1	1	2	3	5

11. The roots of $ax^2 + 8x + 16 = 0$ are real and equal. What is(are) the possible value(s) of “ a ”?

- (A) -1
 (B) 1
 (C) $a \geq 1$
 (D) $a \leq 1$

12. What is the sum and product of the roots of $2(x^2 + 3) - 3x = 4$?

- (A) Sum $\frac{3}{4}$, Product -1
 (B) Sum $\frac{3}{4}$, Product 1
 (C) Sum $\frac{3}{2}$, Product -1
 (D) Sum $\frac{3}{2}$, Product 1

13. Which is the axis of symmetry for the graph of the function $y = -\frac{1}{2}x^2 + \frac{3}{2}x + 7$?

- (A) $x = -3$
 (B) $x = -\frac{3}{2}$
 (C) $x = \frac{3}{2}$
 (D) $x = 3$

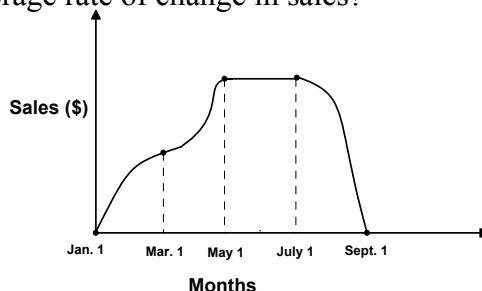
14. Solve: $-2\sqrt{7}k(\sqrt{7} - \sqrt{7}k) = 28k$.

- (A) $\{1\}$
 (B) $\{3\}$
 (C) $\{0, 0.09\}$
 (D) $\{0, 3\}$

15. Which quadratic equation has imaginary roots?

- (A) $x^2 - 9 = 0$
- (B) $x^2 + 4x + 3 = 0$
- (C) $x^2 - 3 = 0$
- (D) $x^2 + 4 = 0$

16. The graph below shows the sales of a company over an eight month period. Between what dates was there a negative average rate of change in sales?



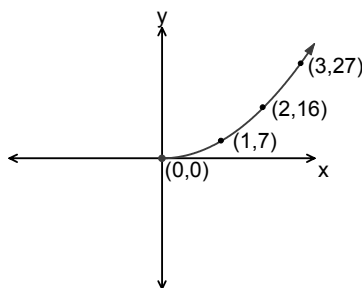
- (A) Jan. 1 → Mar. 1
- (B) Mar. 1 → May 1
- (C) May 1 → July 1
- (D) July 1 → Sept. 1

17. The table below shows the height, in meters, of a dropped ball over time, in seconds. Based on this data, what is the best approximation for the instantaneous rate of change, in m/s, at 4 seconds?

t	3.98	3.99	4.00	4.01	4.02
$h(t)$	22.382	21.992	21.6	21.208	20.814

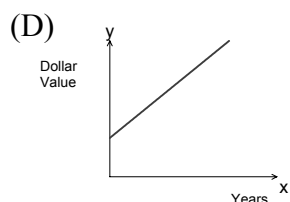
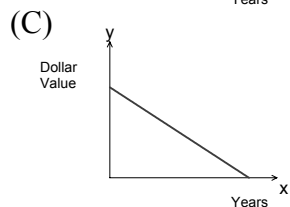
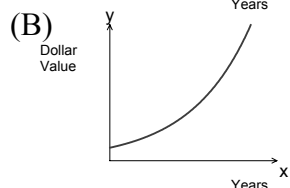
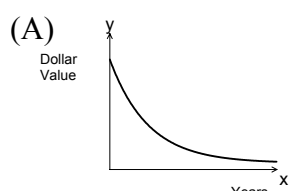
- (A) -39.2
- (B) -0.026
- (C) 0
- (D) 21.6

18. What type of function is illustrated by the graph shown?



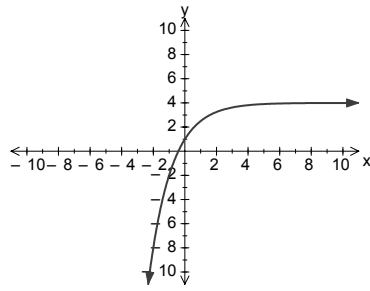
- (A) cubic
- (B) exponential
- (C) linear
- (D) quadratic

19. Which graph represents the value of a car depreciating by 18% annually?



20. What is the domain of the function $y = \log(x + 7)$?
- (A) $\{x|x > -7, x \in R\}$
 (B) $\{x|x \geq -7, x \in R\}$
 (C) $\{x|x > 7, x \in R\}$
 (D) $\{x|x \geq 7, x \in R\}$
21. What is the inverse of $y = \log_9 x$?
- (A) $x = y^9$
 (B) $x = 9^y$
 (C) $y = x^9$
 (D) $y = 9^x$
22. Solve: $\log_5 6 - \log_5 x = \log_5 2$.
- (A) $\frac{1}{12}$
 (B) $\frac{1}{3}$
 (C) 3
 (D) 4
23. What is the equivalent logarithmic form of $3^y = x + 1$?
- (A) $y = \log_3(x - 1)$
 (B) $y = \log_3(x + 1)$
 (C) $y = \log(3x + 1)$
 (D) $y = \log(3x - 1)$
24. Which represents a geometric sequence?
- (A) $\left\{\frac{1}{3}, 1, \frac{5}{3}, \frac{7}{3}, \dots\right\}$
 (B) $\left\{8, \frac{16}{3}, \frac{32}{9}, \frac{64}{27}, \dots\right\}$
 (C) $\left\{\frac{2}{3}, \frac{8}{3}, 6, \frac{32}{3}, \dots\right\}$
 (D) $\left\{\frac{2}{3}, \frac{16}{3}, 18, \frac{128}{3}, \dots\right\}$
25. What is the equation of the image of $y = 5^x$ under the mapping rule $(x, y) \rightarrow \left(\frac{1}{3}x + 2, -\frac{1}{2}y - 1\right)$?
- (A) $-2(y + 1) = 5^{3x-6}$
 (B) $-2(y + 1) = 5^{3x-2}$
 (C) $-\frac{1}{2}(y - 1) = 5^{3x-6}$
 (D) $-\frac{1}{2}(y - 1) = 5^{3x-2}$

26. Given the equation $A(y - C) = \left(\frac{1}{2}\right)^{B(x-D)}$, which conditions could result in the graph shown?



- (A) $A < 0, B = 1, C < 0, D = 0$
 (B) $A < 0, B = 1, C > 0, D = 0$
 (C) $A > 0, B = 1, C < 0, D = 0$
 (D) $A > 0, B = 1, C > 0, D = 0$
27. Given $2(5)^x = 30$, what is the approximate value of x ?
- (A) 0.5
 (B) 1.5
 (C) 1.7
 (D) 3.0
28. Which is equivalent to $3\left[\frac{1}{2}\log_4 A + \log_4 B - \log_4 C\right]$?

- (A) $\log_4 \frac{(B\sqrt{A})^3}{C}$
 (B) $\frac{3}{2}\log_4 \frac{AB}{C}$
 (C) $\log_4 \left(\sqrt{\frac{AB}{C}}\right)^3$
 (D) $\log_4 \left(\frac{B\sqrt{A}}{C}\right)^3$

29. What is the simplified form of $\frac{5(16^a)(125^{3a})}{8^a}$?

- (A) $5^{9a} \cdot 10$
 (B) $5^{10a} \cdot 2^a$
 (C) $5^{9a+1} \cdot 2^a$
 (D) $5^{9a+1} \cdot 2^{7a}$
30. The temperature, T , in degrees Celsius, inside a house at the time of a power failure, cools exponentially according to the function $T = 15\left(\frac{1}{2}\right)^{\frac{t}{30}} + 5$, where t is time in minutes. What is the temperature inside the house, in degrees Celsius, at the instant of the power failure?
- (A) 5
 (B) 10
 (C) 15
 (D) 20
31. Solve: $\frac{1}{9} = \left(\sqrt[3]{3}\right)^{x-1}$.
- (A) -5
 (B) $-\frac{1}{3}$
 (C) $\frac{1}{3}$
 (D) 5

32. Solve: $2 \cdot 6^{x+1} = 18$.

(A) $\frac{\log 9 - 1}{\log 6}$

(B) $\frac{\log 9}{\log 6} - 1$

(C) $\frac{\log 18}{\log 12} - 1$

(D) $\frac{\log 18 - 1}{\log 12}$

33. Simplify: $(3^0 + a^{-1})^{-2}$.

(A) $\frac{a^2}{a^2 + 2a + 1}$

(B) $\frac{1}{2a + 1}$

(C) a^2

(D) $1 + a^2$

34. Which represents the transformation of $y = 5^x$ if the original y-intercept is translated to $(-3, 3)$?

(A) $y - 2 = (5)^{x-3}$

(B) $y - 2 = (5)^{x+3}$

(C) $y + 2 = (5)^{x-3}$

(D) $y + 2 = (5)^{x+3}$

35. If $y = 3^x$ is transformed to $\frac{1}{2}(y+1) = 3^{-\frac{1}{3}(x-4)}$, what are the coordinates of the mapped focal point?

(A) $(1, -1)$

(B) $(1, 1)$

(C) $(4, -1)$

(D) $(4, 1)$

36. What horizontal translation was applied to $y = \left(\frac{1}{2}\right)^x$ to result in $-2(y-1) = \left(\frac{1}{2}\right)^{\frac{3}{2}x+6}$?

(A) 4 left

(B) 4 right

(C) 6 left

(D) 6 right

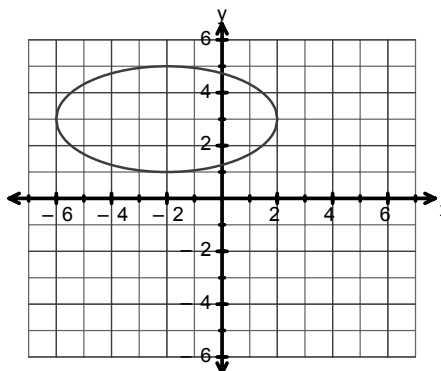
37. Which equation represents a circle?

- (A) $9x^2 - 4y^2 - 9x - 4y - 25 = 0$
- (B) $9x^2 + 4y^2 + 9x + 4y - 36 = 0$
- (C) $10x^2 - 10y^2 - x + 8y - 121 = 0$
- (D) $10x^2 + 10y^2 - 3x + y - 64 = 0$

38. Which is the converse of, "If the vertices of a quadrilateral lie on a circle, then that quadrilateral is cyclic."?

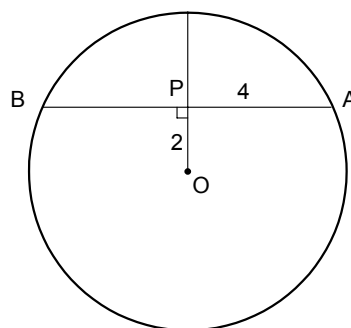
- (A) If a quadrilateral is cyclic, then the vertices of that quadrilateral lie on a circle.
- (B) If a quadrilateral is not cyclic, then the vertices of that quadrilateral do not lie on a circle.
- (C) If the vertices of a quadrilateral do not lie on a circle, then that quadrilateral is not cyclic.
- (D) If the vertices of a quadrilateral lie on a circle, then that quadrilateral is not cyclic.

39. What is the equation of the graph shown?



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

40. In the circle with centre O shown, $\overline{PA} = 4$ and $\overline{PO} = 2$. What is the length of the diameter of the circle?

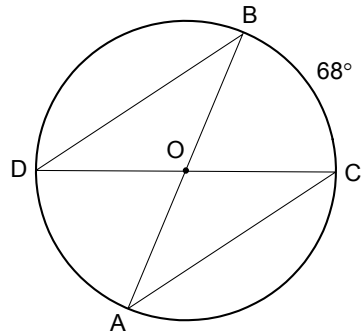


- (A) $\sqrt{13}$
- (B) $2\sqrt{5}$
- (C) $2\sqrt{13}$
- (D) $4\sqrt{5}$

41. If a point P (0, 4) is rotated 150° counterclockwise on a circle of radius 4, what are the new coordinates of P?

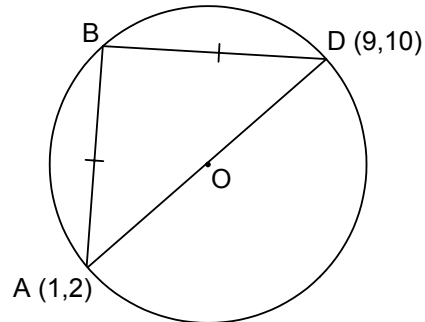
- (A) $(-2, -2\sqrt{3})$
- (B) $(-2, 2\sqrt{3})$
- (C) $(-\frac{1}{2}, -\frac{\sqrt{3}}{2})$
- (D) $(-\frac{1}{2}, \frac{\sqrt{3}}{2})$

42. In the circle with centre O shown, the measure of minor arc \widehat{BC} is 68° . What is the measure, in degrees, of $\angle BOD$?



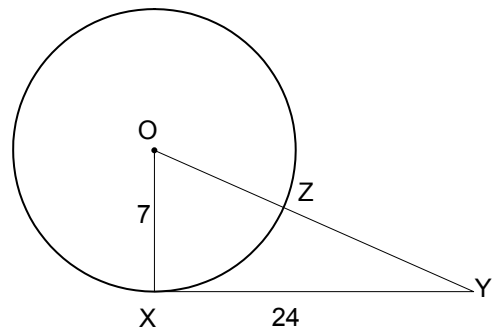
- (A) 102
 (B) 112
 (C) 136
 (D) 146

43. What is the length of chord \overline{BD} in the circle with centre O shown?



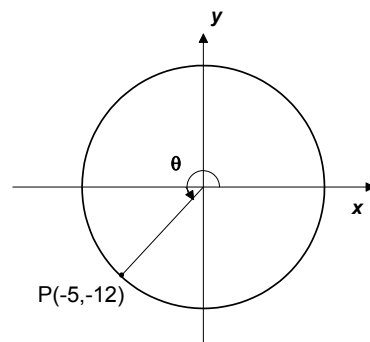
- (A) $2\sqrt{2}$
 (B) $4\sqrt{2}$
 (C) 8
 (D) 16

44. In the circle with centre O shown, what is the length of \overline{YZ} if \overline{YX} is tangent to the circle at X?



- (A) 16
 (B) 18
 (C) 23
 (D) 25

45. Given point P rotated through an angle θ from standard position as shown, which equation is true?

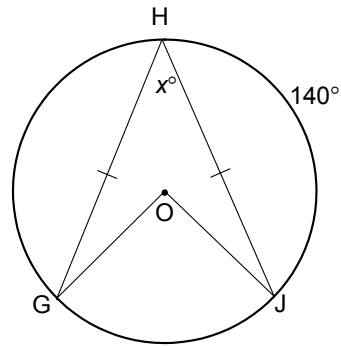


- (A) $\sin \theta = -\frac{5}{13}$
 (B) $\sin \theta = -\frac{5}{12}$
 (C) $\cos \theta = -\frac{5}{13}$
 (D) $\cos \theta = -\frac{5}{12}$

46. What mapping rule was applied to $x^2 + y^2 = 1$ to result in $\frac{1}{9}(x-4)^2 + \frac{1}{25}(y+2)^2 = 1$?

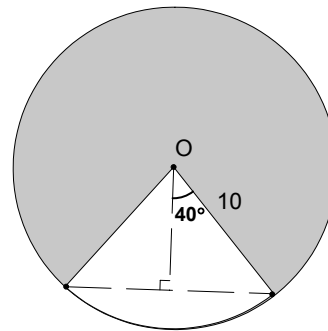
- (A) $(x, y) \rightarrow (3x-4, 5y+2)$
 (B) $(x, y) \rightarrow (3x+4, 5y-2)$
 (C) $(x, y) \rightarrow (9x-4, 25y-2)$
 (D) $(x, y) \rightarrow (9x+4, 25y+2)$

47. In the circle with centre O shown, the measure of minor arc \widehat{HJ} is 140° . What is the measure, in degrees, of $\angle GHJ$?



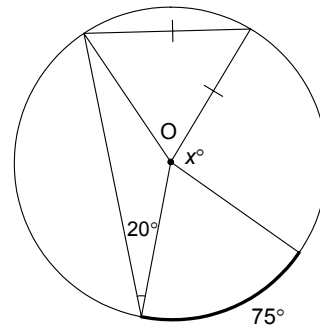
- (A) 35
 (B) 40
 (C) 70
 (D) 80

48. What is the area of the shaded region in the circle with centre O shown?



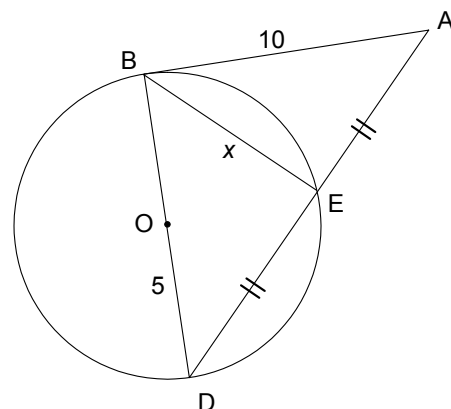
- (A) $\frac{200\pi}{9}$
 (B) $\frac{700\pi}{9}$
 (C) $\frac{1600\pi}{9}$
 (D) 100π

49. What is the measure, in degrees, of angle x for the circle with centre O shown?



- (A) 70
 (B) 85
 (C) 95
 (D) 100

50. In the circle with centre O shown, \overline{AB} is tangent to the circle at B, $\overline{OD} = 5$ and $\overline{AB} = 10$. What is the exact length of \overline{BE} ?



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

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 $\frac{3}{x-5} = 4 - \frac{x}{x+3}$.

- 4 52. An orange grower has 400 crates of oranges ready for market and will have 20 more crates each day that shipment is delayed. The present price is \$60 per crate; however, for each day shipment is delayed, the price per crate decreases by \$2. Write a quadratic function to model the grower's revenue and use it to determine how many days the grower should delay shipment in order to maximize revenue. What is the maximum revenue?

Value

- 4 53. A soccer player kicks a ball from the ground towards a wall that is 28 m away. The ball reaches a maximum height of 9 m when it is a horizontal distance of 15 m away from the player. At what height from the floor will the ball hit the wall?
- 2 54.(a) The height of a pebble fired by a sling shot is given by $h(t) = 25t - 4.9t^2$, where $h(t)$ is height in metres and t is time in seconds after the pebble leaves the sling shot. Determine an approximation for the instantaneous rate of change in the height of the pebble at 3 seconds and describe how the height of the pebble is changing at that instant.
- 2 54.(b) A spherical snowball with a diameter of 8 cm is cut in half, and one of the pieces is discarded. Write an expression for the volume of the half snowball remaining if the radius decreases at a uniform rate of 1 mm/min. $(V_{\text{sphere}} = \frac{4}{3}\pi r^3)$

Value

3 55. Algebraically solve the system of equations: $(2)^{3x-2y} = 64$
 $(\sqrt{6})^{2x+2y} = 36$

4 56. Algebraically solve: $\log_2(x+2) + \frac{1}{3}\log_2(8x^3) = 16^{\frac{1}{2}}$.

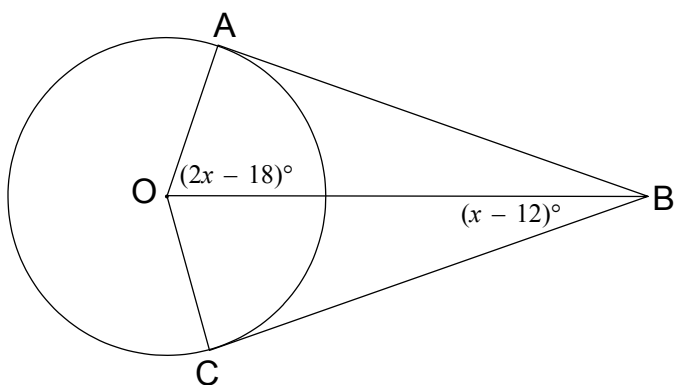
4 57. A truck is purchased for \$51 000 and depreciates by 23% annually. At the same time a minivan is purchased for \$38 000 and depreciates by 17% annually. Write an equation to model this situation and use it to determine when the two vehicles will be of equal value.

Value

- 4 58. A teacher walks into a classroom of temperature 23°C with a cup of coffee. The temperature of the coffee is recorded in the table shown. Determine the equation of the exponential function that models the cooling behaviour of the coffee, and use it to determine the temperature of the coffee at the end of a 56 minute class period.

Time (minutes)	0	15	30	45
Temperature ($^{\circ}\text{C}$)	93	65	48	38

- 3 59. \overline{BA} and \overline{BC} are tangents to the circle with centre O shown. If $\angle AOB = (2x - 18)^{\circ}$ and $\angle CBO = (x - 12)^{\circ}$, what is the numerical measure of angle $\angle ABO$?



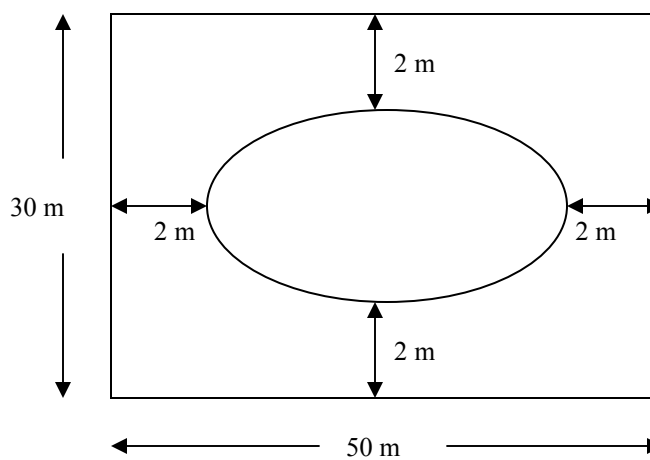
Value

4

60. Determine the equation of the line joining the centres of the ellipses $x^2 + 25y^2 - 6x - 100y + 84 = 0$ and $9(x+1)^2 + (y-3)^2 = 9$.

4

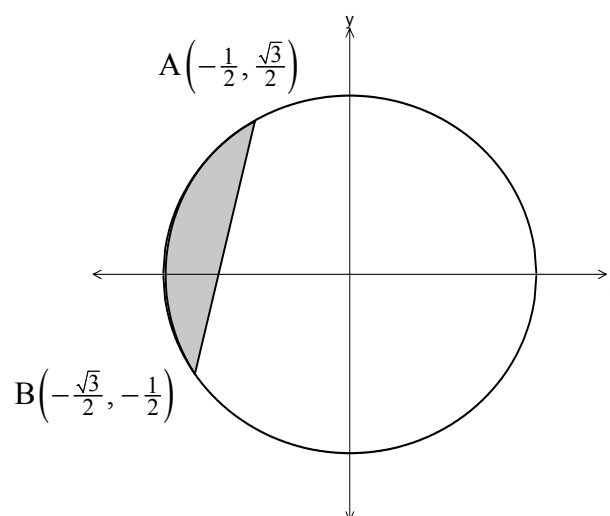
61. A university plans to construct an elliptical indoor running track inside a gym with dimensions 30 m by 50 m. The track requires a minimum of 2 m clearance from each wall. If the equation for the track is $x^2 + 4y^2 - 50x - 120y = -1125$, calculate whether or not the track will fit inside the gym.



Value

4

62. Determine the area of the shaded region in the unit circle shown.



4

63. Using coordinate geometry, prove that the midpoint of \overline{AC} is equidistant from all three vertices.

