PART I
Total Value: 50%

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

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

(A) $\{y \mid y \leq -5, y \in R\}$

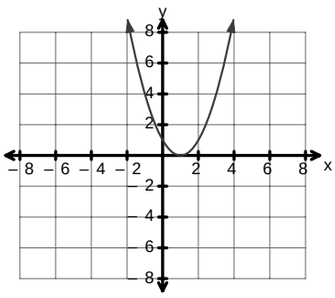
(B) $\{y \mid y \geq -5, y \in R\}$

(C) $\{y \mid y \leq 5, y \in R\}$

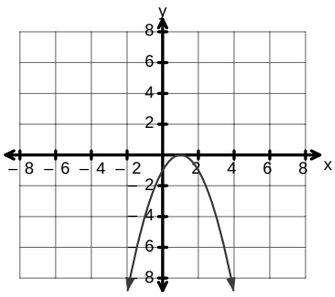
(D) $\{y \mid y \geq 5, y \in R\}$

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

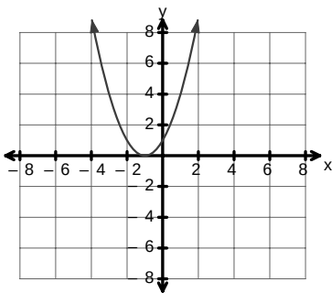
(A)



(B)



(C)



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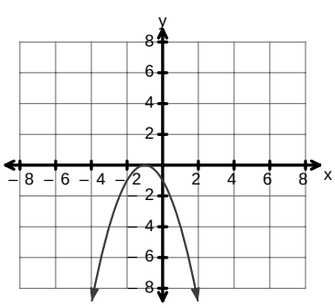


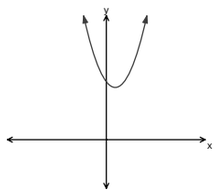
3. The graph of $y = x^2$ has been reflected in the *x*-axis, translated 3 units to the right, and translated 2 units up, resulting in the graph of $g(x)$. What is the nature of the roots of $g(x) = 0$?

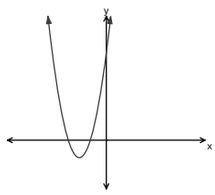
(A) imaginary and equal
(B) imaginary and unequal
(C) real and equal
(D) real and unequal

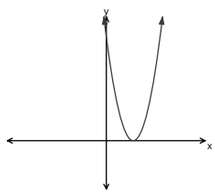
4. Which sequence below is arithmetic?

(A) {3−2(1), 3−2(2), 3−2(3), 3−2(4),…}
(B) {3−1, 3+1, 3−2, 3+2,…}
(C) $\{3^1, 3^2, 3^3, 3^4, \ldots\}$
(D) $\{3+2, 3+2^2, 3+2^3, 3+2^4, \ldots\}$

5. A quadratic function $f(x)$ has $1 \pm 3i$ as its zeros. Which is the graph of $f(x)$?

(A)


(B)


(C)


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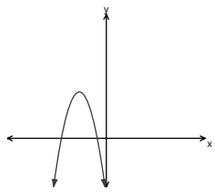


6. What mapping rule was applied to $y = x^2$ to result in the quadratic function $3(y+1) = (x-2)^2$?

(A) $(x, y) \rightarrow (x-2, \frac{1}{3}y+1)$
(B) $(x, y) \rightarrow (x-2, 3y+1)$
(C) $(x, y) \rightarrow (x+2, \frac{1}{3}y-1)$
(D) $(x, y) \rightarrow (x+2, 3y-1)$

7. What is the second level difference for the sequence $\{-1,-2,-7,-16,-29,...\}$?

(A) -4
(B) -1
(C) 1
(D) 4

8. What is the transformational form of $y=3(x-2)^2+5$?

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

9. If $f(x)=2x^2-5x-12$, what are the roots of $f(x)=0$?

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

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. 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) $y=2x^2+12x+20$

12. Which quadratic equation has imaginary roots?

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

13. Which quadratic function has zeros of $\frac{1}{2}$ and -3?

(A) $y = 2x^2 - 7x + 3$
(B) $y = 2x^2 - 5x - 3$
(C) $y = 2x^2 + 5x - 3$
(D) $y = 2x^2 + 7x + 3$

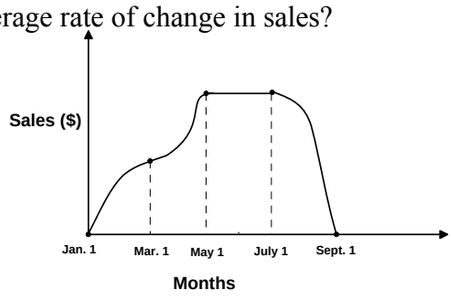
14. What is the discriminant of the quadratic equation $3x^2 - 5x - 1 = 0$?

(A) $\sqrt{13}$
(B) $\sqrt{37}$
(C) 13
(D) 37

15. Given $t_n = \frac{1}{3}n - \frac{1}{6}$, what is t_3?

(A) $\frac{5}{6}$
(B) $\frac{17}{6}$
(C) $\frac{19}{6}$
(D) $\frac{17}{2}$

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?



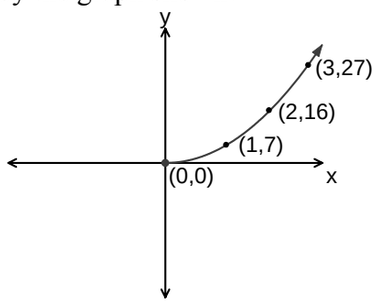
(A) Jan. 1 $\rightarrow$ Mar. 1
(B) Mar. 1 $\rightarrow$ May 1
(C) May 1 $\rightarrow$ July 1
(D) July 1 $\rightarrow$ Sept. 1

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

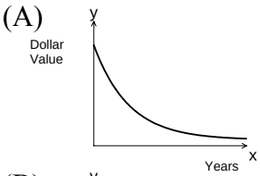
18. What type of function is illustrated by the graph shown?



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

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

(A)



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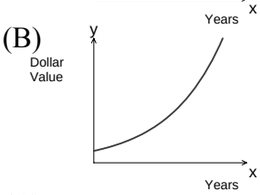
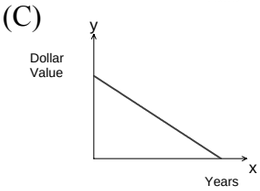


(C)



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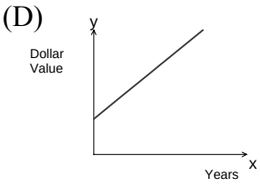


20. Which represents a geometric sequence?

(A) $\left\{\frac{1}{3}, 1, \frac{5}{3}, \frac{7}{3}, \ldots\right\}$

(B) $\left\{8, \frac{16}{3}, \frac{32}{9}, \frac{64}{27}, \ldots\right\}$

(C) $\left\{\frac{2}{3}, \frac{8}{3}, 6, \frac{32}{3}, \ldots\right\}$

(D) $\left\{\frac{2}{3}, \frac{16}{3}, 18, \frac{128}{3}, \ldots\right\}$

21. Solve: $\log_5 6 - \log_5 x = \log_5 2$.

(A) $\frac{1}{12}$

(B) $\frac{1}{3}$

(C) 3

(D) 4

22. What is the inverse of $y = \log_9 x$?

(A) $x = y^9$

(B) $x = 9^y$

(C) $y = x^9$

(D) $y = 9^x$

23. Which describes the function $y = 3(2)^x + 4$?

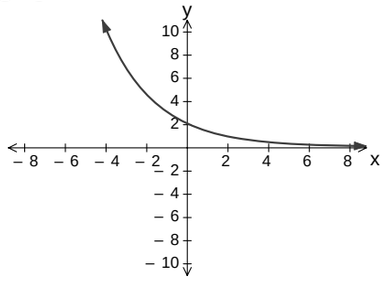
(A) exponential decay, asymptote $y = 4$

(B) exponential decay, asymptote $y = -4$

(C) exponential growth, asymptote $y = 4$

(D) exponential growth, asymptote $y = -4$

24. Which equation best represents the graph shown?



(A) $y = \left(\frac{2}{3}\right)^x$

(B) $y = \left(\frac{3}{2}\right)^x$

(C) $y = 2\left(\frac{2}{3}\right)^x$

(D) $y = 2\left(\frac{3}{2}\right)^x$

25. What is the y-intercept of $y = 2(3)^x + 1$?

(A) (0, 2)
(B) (0, 3)
(C) (0, 4)
(D) (0, 7)

26. Which function describes the data shown?

x	-2	0	2	4	6
y	24	6	$\frac{3}{2}$	$\frac{3}{8}$	$\frac{3}{32}$

(A) $y = 6\left(\frac{1}{4}\right)^{\frac{x}{2}}$

(B) $y = 6\left(\frac{1}{4}\right)^x$

(C) $y = 24\left(\frac{1}{4}\right)^x$

(D) $y = 24\left(\frac{1}{4}\right)^{\frac{x}{2}}$

27. Which is equivalent to $\frac{9^x}{\left(27^{2x}\right)(3)}$?

(A) 3^{-4x-1}
(B) 3^{4x+1}
(C) 3^{-3x-1}
(D) 3^{3x+1}

28. Solve: $\sqrt[3]{7} = 49^x$.

(A) $\frac{1}{6}$
(B) $\frac{2}{3}$
(C) $\frac{3}{2}$
(D) 6

29. Given $2(5)^x = 30$, what is the approximate value of x?

(A) 0.5
(B) 1.5
(C) 1.7
(D) 3.0

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. Evaluate: $\left[\left(\frac{3}{4}\right)^{-1} - 6^{0}\right]^{-1}$.

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

32. Solve: $\log_2 8 + \log_2 4 - \log_2 2 = x$.

(A) 3
(B) 4
(C) 5
(D) 6

33. Solve: $3^{x+1} = 5$.

(A) $\frac{\log 3}{\log 5} - 1$
(B) $\frac{\log 3}{\log 5} + 1$
(C) $\frac{\log 5}{\log 3} - 1$
(D) $\frac{\log 5}{\log 3} + 1$

34. A baseball card valued at $100 appreciates 8% every 3 years. If this appreciation rate continues, which function represents the value of the card, *V*, after t years?

(A) $V = 100(1.08)^{\frac{t}{3}}$
(B) $V = 100(1.08)^{3t}$
(C) $V = 100(1.8)^{\frac{t}{3}}$
(D) $V = 100(1.8)^{3t}$

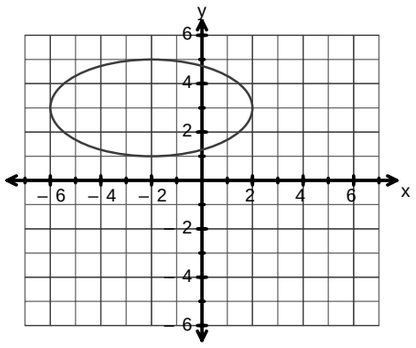
35. Evaluate: $(9)^{\frac{-5}{2}}$.

(A) $\frac{1}{243}$
(B) $\frac{1}{15}$
(C) 15
(D) 243

36. Which situation can be modeled by $y = 11(0.5)^{\frac{x}{4}}$?

(A) 4 g of a radioactive substance has a half-life of 11 years.
(B) 4 g of a radioactive substance increases by 50% every 11 years.
(C) 11 g of a radioactive substance has a half-life of 4 years.
(D) 11 g of a radioactive substance increases by 50% every 4 years.

37. 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) $\left[4(x+2)\right]^2+\left[2(y-3)\right]^2=1$

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. Which equation represents a circle?

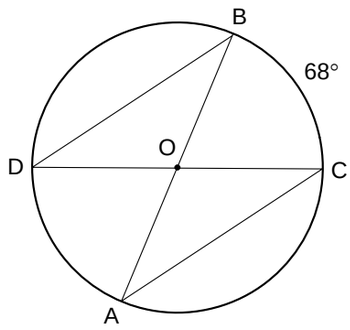
(A) $9x^2-4y^2-9x-4y-25=0$

(B) $9x^2+4y^2+9x+4y-36=0$

(C) $10x^2-10y^2-x+8y-121=0$

(D) $10x^2+10y^2-3x+y-64=0$

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



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

41. If a point $P(1,0)$ is rotated 120° from standard position on a unit circle, what are the new coordinates of P?

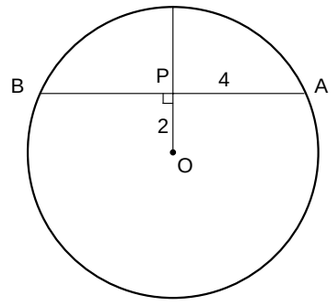
(A) $\left(-\frac{\sqrt{3}}{2},-\frac{1}{2}\right)$

(B) $\left(-\frac{\sqrt{3}}{2},\frac{1}{2}\right)$

(C) $\left(-\frac{1}{2},-\frac{\sqrt{3}}{2}\right)$

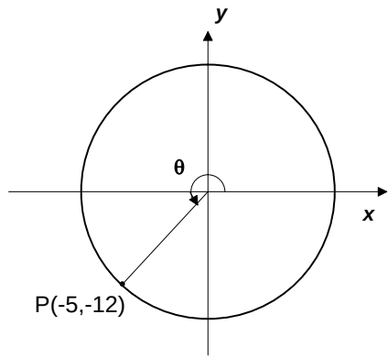
(D) $\left(-\frac{1}{2},\frac{\sqrt{3}}{2}\right)$

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



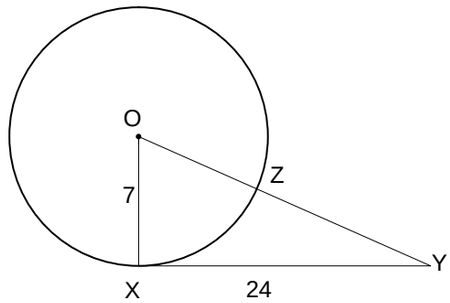
(A) $\sqrt{13}$
(B) $2\sqrt{5}$
(C) $2\sqrt{13}$
(D) $4\sqrt{5}$

43. 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) $\cos\theta = -\frac{5}{12}$

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

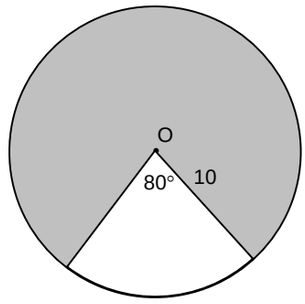
45. What is the length of the minor axis of the ellipse given by $9(x-3)^2 + 16(y-2)^2 = 144$?

(A) 3
(B) 4
(C) 6
(D) 8

46. A circle with centre C (1, 6) has a diameter with endpoint (3, 9). What are the coordinates of the other endpoint of this diameter?

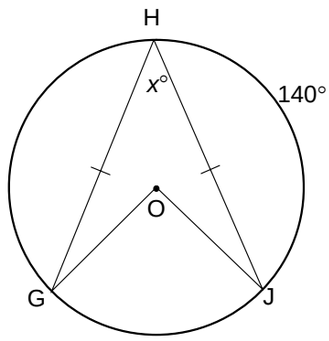
(A) (–1, 3)
(B) (2, 7.5)
(C) (5, 12)
(D) (9, –7)

47. What is the approximate area, in square units, of the shaded region in the circle with centre O shown?



(A) 48.87
(B) 69.81
(C) 244.35
(D) 314.16

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

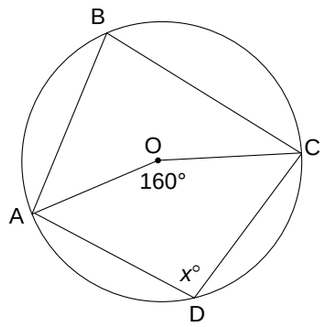


(A) 35
(B) 40
(C) 70
(D) 80

49. 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) $(x, y) \rightarrow (9x+4, 25y+2)$

50. In the circle with centre O shown, what is the value of x, in degrees?



(A) 80
(B) 90
(C) 100
(D) 120

PART II
Total Value: 50%

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

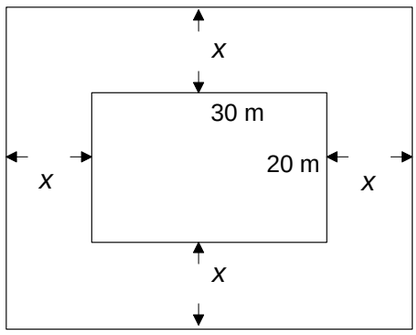
Value

4 51. Algebraically determine the **exact** roots in simplest form for $(3x-2)(x+4)=-13$.

4 52. A baseball is hit and follows a parabolic path described by the function $h(t)=-3t^2+12t+1$, where t is time in seconds after the ball is hit and $h(t)$ is the height of the ball above the ground in metres. Algebraically determine the maximum height reached by the ball and the time it takes the ball to reach its maximum height.

Value

4 53. A rectangular swimming pool has length 30 m and width 20 m. There is a deck of uniform width surrounding the pool. The area of the pool is the same as the area of the deck. Write a quadratic equation to model this situation and use it to determine the width of the deck.



4 54. 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.

Value

3 55. Solve for x: $\left(\sqrt[3]{16^{2x}}\right) = 64^{\frac{1}{2}}$.

4 56. Solve for x: $\log_2(x-6) + \log_2(x) = 4$.

4 57. Tom bought a car for \$14 000. The value of the car depreciates at a rate of 21% every two years. Write an equation that models the value of the car over time and use it to determine the approximate value of the car after five years.

Value

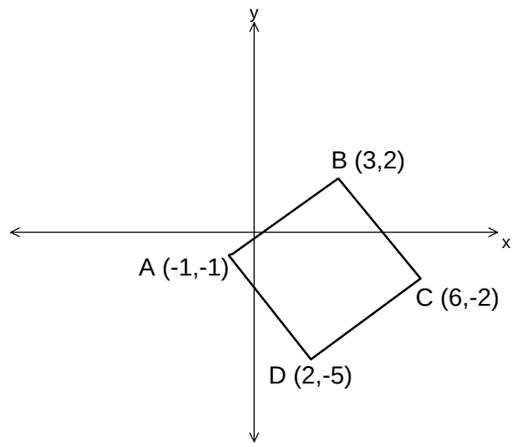
4 58. A laboratory assistant decided to observe the reproductive properties of a new strain of bacteria. The assistant started observing a population of 300 bacteria and noted that the bacteria population doubled every 5 minutes. Write a function to model this situation and use it to determine the time it will take for the population to reach 18 000 bacteria.

4 59. Find the centre of the circle defined by $x^2 + y^2 + 10x - 16y - 11 = 0$ and prove that it lies on the line $3x - 4y + 47 = 0$.

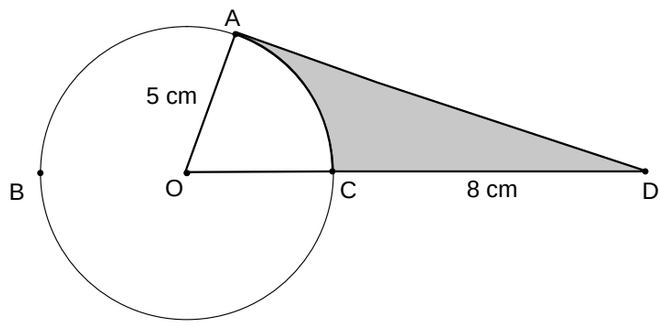
3 60. Write $4x^2 + y^2 - 8x + 4y - 8 = 0$ in transformational form and state the coordinates of the centre.

Value

4 61. Given the square ABCD with vertices $A(-1,-1)$, $B(3,2)$, $C(6,-2)$ and $D(2,-5)$, prove that the diagonals are congruent.



4 62. The circle shown has centre O and radius 5 cm. If $\overline{AD}$ is tangent to the circle, $\overset{\frown}{ABC} = 293°$, and $\overline{CD}$ = 8 cm, determine the area of the shaded region.



Value

4 63. $\overline{AB}$ is a chord with midpoint M (6, 5) in the circle having centre O (5, 8) as shown. Determine the equation of the line containing chord $\overline{AB}$.