PART I
Total Value: 50%

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

1. Which describes the graph of $3(y-1)=(x+4)^2$ compared to the graph of $y=x^2$?

   * (A) vertex $(-4,1)$ and vertical stretch factor of $\frac{1}{3}$
   (B) vertex $(-4,1)$ and vertical stretch factor of 3
   (C) vertex $(4,-1)$ and vertical stretch factor of $\frac{1}{3}$
   (D) vertex $(4,-1)$ and vertical stretch factor of 3

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

   (A) $\{y \mid y \le -4, y \in R\}$
   (B) $\{y \mid y \ge -4, y \in R\}$
   * (C) $\{y \mid y \le 4, y \in R\}$
   (D) $\{y \mid y \ge 4, y \in R\}$

3. A quadratic function $f(x)$ has a negative discriminant when $f(x)=0$. If its graph opens downward, which is a possible vertex for $f(x)$?

   (A) $(-5,0)$
   * (B) $(0,-5)$
   (C) $(0,5)$
   (D) $(5,0)$

4. Which quadratic function is represented by the mapping rule $(x,y)\rightarrow\left(x-6,\frac{1}{5}y+1\right)$?

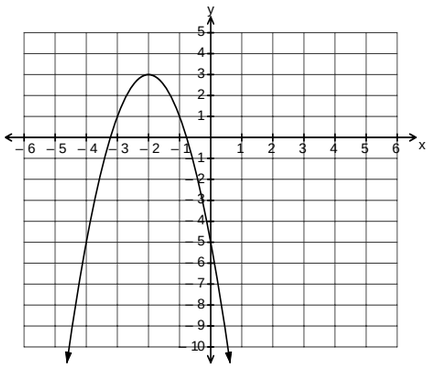
   (A) $\frac{1}{5}(y-1)=(x+6)^2$
   (B) $\frac{1}{5}(y+1)=(x-6)^2$
   * (C) $5(y-1)=(x+6)^2$
   (D) $5(y+1)=(x-6)^2$

5. Which quadratic function has the greatest vertical stretch factor when compared to $y=x^2$?

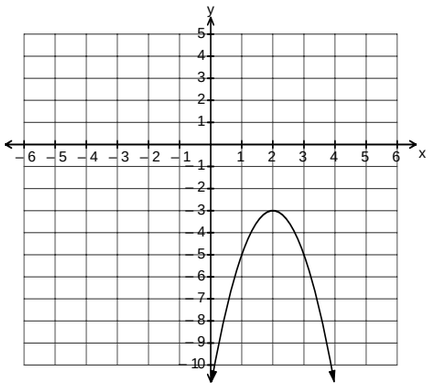
   * (A) $\frac{3}{4}(y+2)=(x-5)^2$
   (B) $2(y+2)=(x-5)^2$
   (C) $\frac{7}{2}(y+2)=(x-5)^2$
   (D) $5(y+2)=(x-5)^2$

6. Which graph represents $-\frac{1}{2}(y+3)=(x-2)^2$?

(A)



* (B)



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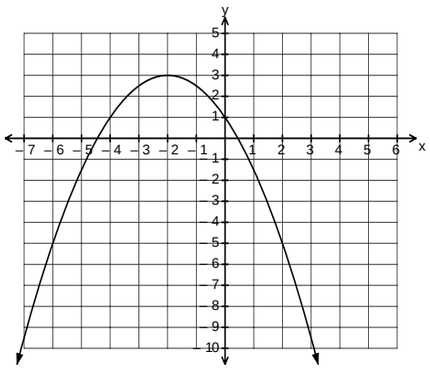
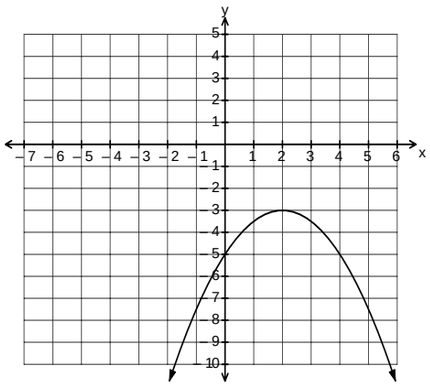


(D)



7. Which function has axis of symmetry $x=2$?

(A) $y=3x^2-6x+4$

(B) $y=3x^2+6x+4$

* (C) $y=3x^2-12x+4$

(D) $y=3x^2+12x+4$

8. The graph of which function has x-intercepts $\left(\sqrt{2},0\right)$ and $\left(-\sqrt{2},0\right)$?

(A) $y=-2x^2-2$
(B) $y=-2x^2+2$
* (C) $y=2x^2-4$
(D) $y=2x^2+4$

9. Which value of c makes x^2-7x+c a perfect square?

(A) $\frac{7}{2}$
* (B) $\frac{49}{4}$
(C) 7
(D) 49

10. What is the standard form of $2\left(y+3\right)=\left(x-4\right)^2$?

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

11. What is the function rule for the sequence $\{7,3,-1,-5,-9,...\}$?

(A) $t_n=-4n+3$
(B) $t_n=4n+3$
* (C) $t_n=-4n+11$
(D) $t_n=4n+11$

12. What is the transformational form of $y=3x^2-12x+1$?

(A) $\frac{1}{3}(y-13)=(x-2)^2$
* (B) $\frac{1}{3}(y+11)=(x-2)^2$
(C) $3(y-13)=(x+2)^2$
(D) $3(y+11)=(x+2)^2$

13. What are the roots of $2x^2-5x-3=0$?

(A) $\{6,-1\}$
(B) $\{-6,1\}$
* (C) $\left\{-\frac{1}{2},3\right\}$
(D) $\left\{\frac{1}{2},-3\right\}$

14. The roots of $x^2+kx+9=0$ are real and equal. What are the possible values of k?

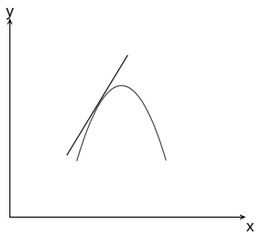
(A) ±3
* (B) ±6
(C) $-6<k<6$
(D) $k<-6$ or $k>6$

15. What is t_6 for the sequence generated by $t_n = -2n^2 + 3n + 8$?

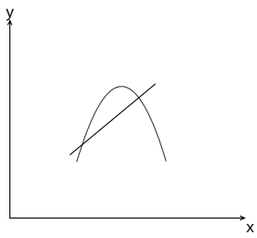
(A) -118
* (B) -46
(C) 2
(D) 14

16. Which line illustrates a negative instantaneous rate of change?

(A)



(B)



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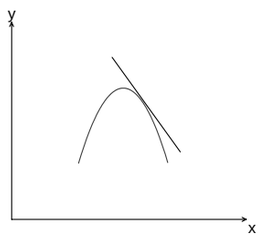

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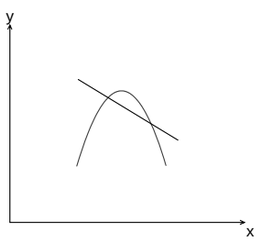


17. The table shown illustrates gas prices over a five-week period. What is the average rate of change, in cents/week, of the price of gas from week 3 to week 5?

Week	Price per Litre (cents)
1	103.5
2	102
3	99.1
4	98.7
5	97.9

(A) -1.2
* (B) -0.6
(C) 0.6
(D) 1.2

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

x	2	3	4	5
y	-4	-1	2	5

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

19. Which has a *y*-intercept of (0,5)?

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

20. Which function models a situation where the market value of an investment depreciates by 5% annually?

(A) $y = 1000(0.05)^x$
* (B) $y = 1000(0.95)^x$
(C) $y = 1000(1.05)^x$
(D) $y = 1000(1.5)^x$

21. Which represents an exponential sequence?

(A) $\{2,\ 2+3,\ 2+6,\ 2+9,\ 2+12,...\}$
(B) $\{2, 2\cdot 3, 2\cdot 6, 2\cdot 9, 2\cdot 12,...\}$
* (C) $\{2, 2\cdot 3, 2\cdot 3^2, 2\cdot 3^3, 2\cdot 3^4,...\}$
(D) $\{2, 2+3, 2+3^2, 2+3^3, 2+3^4,...\}$

22. Solve: $\log_3 x + \log_3 2 = 2\log_3 4$.

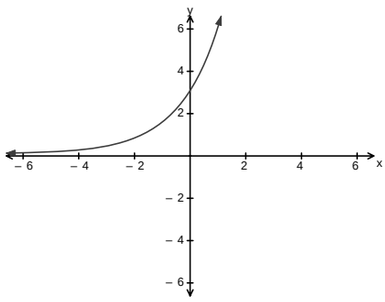
(A) 4
* (B) 8
(C) 14
(D) 32

23. What is the inverse of $y = 3^x$?

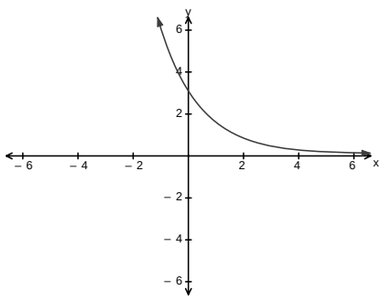
(A) $x = \log_3 y$
(B) $x = 3\log y$
* (C) $y = \log_3 x$
(D) $y = x\log 3$

24. Which graph represents the equation $y = 2(3)^x$?

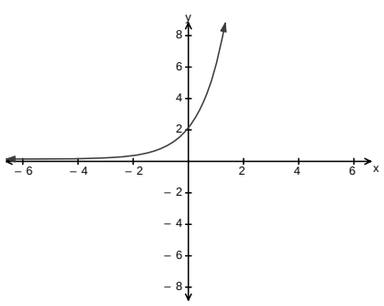
(A)



(B)



*(C)



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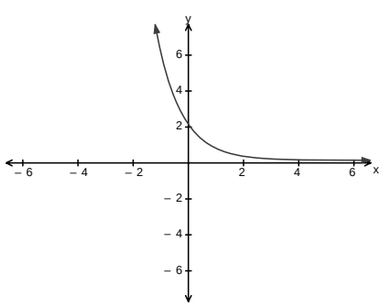


25. What is the equation of the asymptote of $y = 2\left(\frac{1}{2}\right)^x - 5$?

* (A) $y = -5$
(B) $y = -3$
(C) $y = 3$
(D) $y = 5$

26. Which function describes the data shown?

x	–3	0	3	6	9
y	8	12	18	27	40.5

(A) $y = 8\left(\frac{3}{2}\right)^{\frac{x}{3}}$

(B) $y = 8\left(\frac{3}{2}\right)^{3x}$

* (C) $y = 12\left(\frac{3}{2}\right)^{\frac{x}{3}}$

(D) $y = 12\left(\frac{3}{2}\right)^{3x}$

27. Which is equivalent to $\frac{25^x}{\left(125^{x+1}\right)(5)}$?

(A) 5^{-x-2}

(B) 5^{-x+2}

* (C) 5^{-x-4}

(D) 5^{-x+4}

28. Solve: $\sqrt[4]{5} = 125^{x+1}$.

* (A) $-\frac{11}{12}$

(B) $-\frac{1}{4}$

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

(D) $\frac{13}{12}$

29. Given $7^x + 5 = 25$, what is the approximate value of x?

(A) 0.83

(B) 1.30

* (C) 1.54

(D) 1.75

30. The population, P, of a bacteria culture is described by the function $P = 400(2)^{\frac{t}{20}}$, where t is time in minutes. How long, in minutes, will it take the population to reach 1600?

(A) 20

* (B) 40

(C) 200

(D) 400

31. Evaluate: $\left[\left(\frac{3}{5}\right)^{-1} - 4^0\right]^{-2}$.

(A) $\frac{9}{25}$

(B) $\frac{4}{9}$

* (C) $\frac{9}{4}$

(D) $\frac{25}{9}$

32. Solve: $\log_2 8 + \log_2 (x-1) = 4$.

(A) $\frac{2}{3}$

(B) $\frac{3}{2}$

(C) 2

* (D) 3

33. Solve: $4^{x+1} = 11$.

(A) –0.56
(B) –0.42
* (C) 0.73
(D) 1.75

34. Which is equivalent to $\log_4\left(\frac{AB^3}{C}\right)$?

(A) $\log_4(A + B^3 - C)$
* (B) $\log_4 A + 3\log_4 B - \log_4 C$
(C) $3(\log_4 A + \log_4 B) - \log_4 C$
(D) $3(\log_4 A + \log_4 B - \log_4 C)$

35. Evaluate: $\left(\frac{8}{27}\right)^{-\frac{4}{3}}$.

(A) $\frac{16}{81}$
(B) $\frac{2}{3}$
(C) $\frac{3}{2}$
* (D) $\frac{81}{16}$

36. Given $f(x) = 2^{-x+1} + 3$, what is the value of $f(2)$?

(A) 1
(B) $\frac{5}{2}$
* (C) $\frac{7}{2}$
(D) 11

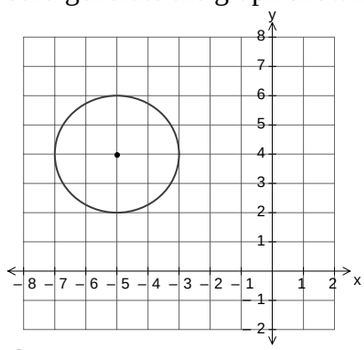
37. The circle $(x-1)^2 + (y+2)^2 = 1$ has been stretched vertically by a factor of 3 and horizontally by a factor of 4. What is the equation of the ellipse formed?

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

38. "If a point lies on the bisector of an angle, then that point is equidistant from the sides of the angle." What is the converse of this statement?

(A) If a point does not lie on the bisector of an angle, then that point is equidistant from the sides of the angle.
(B) If a point does not lie on the bisector of an angle, then that point is not equidistant from the sides of the angle.
(C) If a point is equidistant from the sides of an angle, then that point does not lie on the bisector of the angle.
* (D) If a point is equidistant from the sides of an angle, then that point lies on the bisector of the angle.

39. Which mapping rule when applied to $x^2 + y^2 = 1$ would generate the graph shown?



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

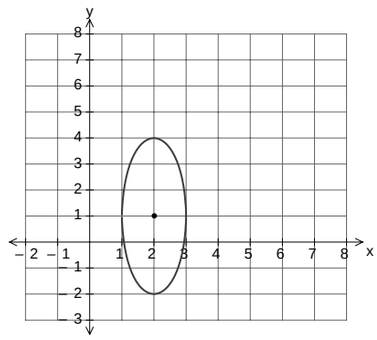
40. What is the radius of the circle with equation $x^2 + y^2 - 10x + 12y + 36 = 0$?

* (A) 5
(B) 6
(C) 10
(D) 12

41. If point P is in standard position on the unit circle, which angle of rotation, in degrees, places P at $\left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$?

(A) 30
(B) 60
* (C) 120
(D) 150

42. What is the equation of the graph shown?

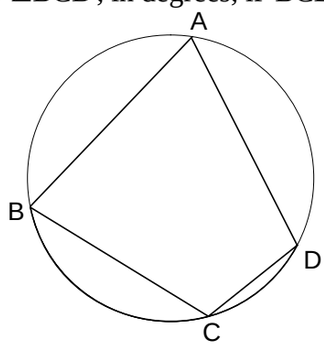


* (A) $\left[(x-2)\right]^2 + \left[\frac{1}{3}(y-1)\right]^2 = 1$
(B) $\left[(x-2)\right]^2 + \left[3(y-1)\right]^2 = 1$
(C) $\left[(x+2)\right]^2 + \left[\frac{1}{3}(y+1)\right]^2 = 1$
(D) $\left[(x+2)\right]^2 + \left[3(y+1)\right]^2 = 1$

43. What is the exact value of $2\sin 150° + \cos 30°$?

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

44. Given the circle shown, what is the measure of $\angle BCD$, in degrees, if $\overset{\frown}{BCD} = 110°$?



(A) 70
(B) 110
* (C) 125
(D) 220

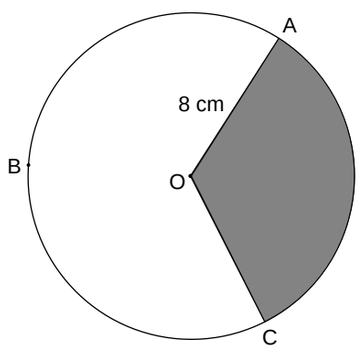
45. What is the length of the major axis of the ellipse with equation $16(x-3)^2 + 9(y+2)^2 = 144$?

(A) 6
* (B) 8
(C) 18
(D) 32

46. If the diameter of a circle has endpoints of (4, 5) and $(-2, 3)$, what is the exact length of the radius?

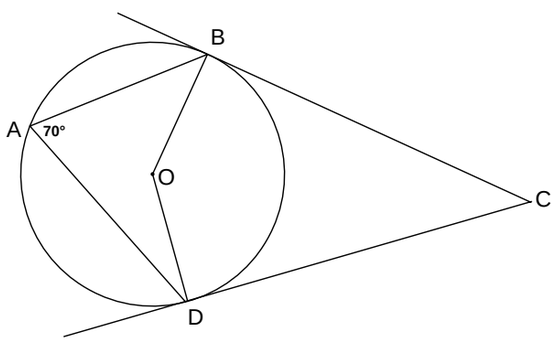
* (A) $\sqrt{10}$
(B) $2\sqrt{10}$
(C) $\sqrt{17}$
(D) $2\sqrt{17}$

47. In the circle with centre O shown, $\overset{\frown}{ABC} = 240°$. What is the area, in square cm, of the shaded region?



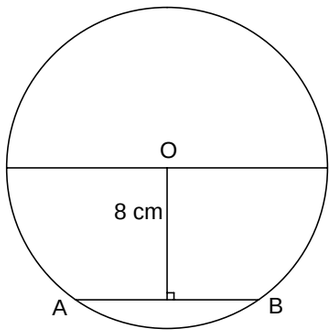
(A) 16.8
(B) 33.5
* (C) 67.0
(D) 134.0

48. In the circle with centre O shown, $\overline{BC}$ and $\overline{DC}$ are tangent to the circle at points B and D respectively. What is the measure, in degrees, of $\angle BCD$?



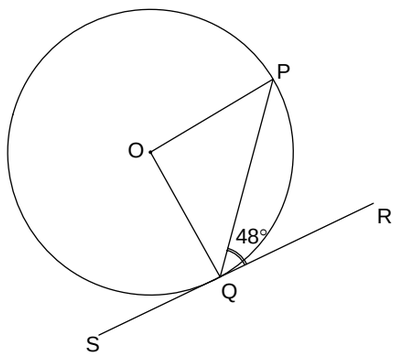
(A) 20
(B) 35
* (C) 40
(D) 70

49. The circle shown with centre O has a diameter of 20 cm. If chord $\overline{AB}$ is 8 cm from the centre, find the length, in centimeters, of $\overline{AB}$.



(A) 6.0
* (B) 12.0
(C) 12.8
(D) 25.6

50. In the circle with centre O shown, $\overline{RS}$ is tangent to the circle at Q. What is the measure, in degrees, of $\angle POQ$?



(A) 42
(B) 48
(C) 90
* (D) 96

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 $2x(x+1) = -3$.

$2x^2 + 2x + 3 = 0$ 0.5 pt.

$x = \dfrac{-2 \pm \sqrt{2^2 - 4(2)(3)}}{2(2)}$ 1 pt.

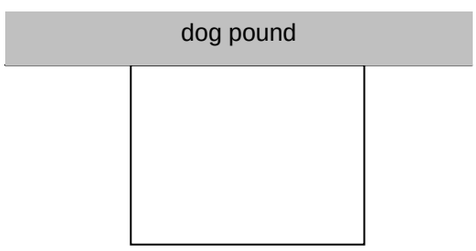
$x = \dfrac{-2 \pm \sqrt{4 - 24}}{4}$ 0.5 pt.

$x = \dfrac{-2 \pm \sqrt{-20}}{4}$ 0.5 pt.

$x = \dfrac{-2 \pm 2i\sqrt{5}}{4}$ 1 pt.

$x = \dfrac{-1 \pm i\sqrt{5}}{2}$ 0.5 pt.

4 52. A rectangular enclosure is made using the wall of a city dog pound as one side, and 80 m of fencing in total, for the other three sides. Algebraically determine the maximum area of the enclosure and the dimensions that produce the maximum area.



$A = x(80 - 2x)$ 1 pt

$A = 80x - 2x^2$ 0.5 pt.

$x = \dfrac{-80}{2(-2)}$ 0.5 pt.

$x = 20$ 0.5 pt.

$\therefore$ width = 20m 0.5 pt.

length $= 80 - 2(20) = 40$m 0.5 pt.

Area $= 20 \times 40 = 800\text{m}^2$ 0.5 pt.

4 53. A toy rocket is launched in the air from a launcher located 6 m above the ground. The rocket's path is described by $h(t) = -5t^2 + 13t + 6$ where $h(t)$ is the height of the rocket above the ground t seconds after launch. How long is the rocket in the air?

$-5t^2 + 13t + 6 = 0$ 0.5 pt.

$t = \dfrac{-13 \pm \sqrt{(13)^2 - 4(-5)(6)}}{2(-5)}$ 1 pt.

$t = \dfrac{-13 \pm \sqrt{169 + 120}}{-10}$ 0.5 pt.

$t = \dfrac{-13 \pm \sqrt{289}}{-10}$ 0.5 pt.

$t = \dfrac{-13 \pm 17}{-10}$

$t = 3$ or $t \neq -0.4$ 1.5 pts (0.5 for each value of t and 0.5 pt. for rejecting -0.4)

Value

4 54. A rectangular picture is reduced in size using a photocopier. The area of the picture is given by $A = -2w^2 + 60w$ where A is the area of the picture in cm^2, and w is the width of the picture in cm. Algebraically determine the approximate instantaneous rate of change of area of the picture when the width is 3 cm.

$\text{Instantaneous Rate of Change} = \dfrac{A(3.1) - A(2.9)}{3.1 - 2.9}$ 2 pts.

$\text{Instantaneous Rate of Change} = \dfrac{166.78 - 157.18}{0.2}$ 1 pt.

Instantaneous Rate of Change=48 cm/s 1 pt.

3 55. Solve for x: $4^{2x+3} = \sqrt{8}$.

$2^{2(2x+3)} = \left(2^3\right)^{\frac{1}{2}}$ 1 pt.

$2^{4x+6} = 2^{\frac{3}{2}}$ 0.5 pt.

$4x + 6 = \dfrac{3}{2}$ 0.5 pt.

$2(4x + 6) = 3$

$8x + 12 = 3$ 0.5 pt.

$8x = -9$

$x = \dfrac{-9}{8}$ 0.5 pt.

4 56. Solve for x: $\log_4(2x+1) - \log_4(x-2) = 1$.

$\log_4\left(\dfrac{2x+1}{x-2}\right) = 1$ 1 pt.

$4^1 = \dfrac{2x+1}{x-2}$ 1 pt.

$4(x-2) = 2x+1$ 0.5 pt.

$4x - 8 = 2x + 1$ 0.5 pt.

$2x = 9$ 0.5 pt.

$x = \dfrac{9}{2}$ 0.5 pt.

4 57. A radioactive isotope has a half-life of 125 years. How long does it take for an initial amount of 200 mg to decay to 120 mg?

$120 = 200\left(\dfrac{1}{2}\right)^{\frac{t}{125}}$ 2 pts.

$\dfrac{120}{200} = \left(\dfrac{1}{2}\right)^{\frac{t}{125}}$ 0.5 pt.

$\log(0.6) = \dfrac{t}{125}\log(.5)$ 0.5 pt.

$\dfrac{\log(0.6)}{\log(.5)} = \dfrac{t}{125}$ 0.5 pt.

$t = 92$ years 0.5 pt.

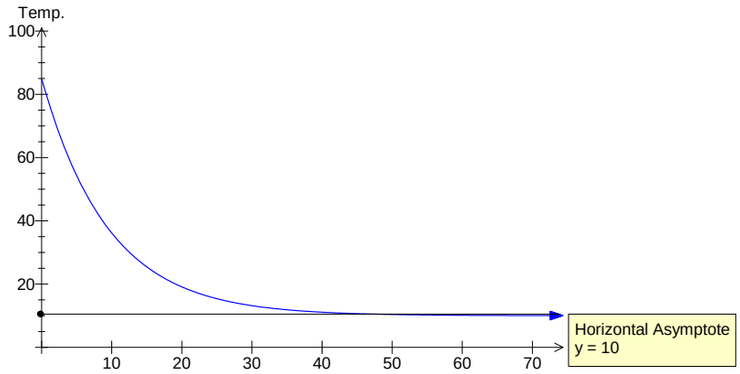
Value

4 58. A cup of coffee cools exponentially over time after it is brought into a car. The cooling is described by the function shown where T is the temperature of the coffee in degrees Celsius with respect to time, m, in minutes.

$$T = 75(0.90)^m + 10$$

Sketch a labeled graph of the temperature of the coffee for the first 70 minutes it is cooling while in the car, and state the initial temperature of the coffee and the air temperature in the car.

time	0	10	20	30	40	50	60	70
Temp	85	36	19	13	11	10.4	10.1	10.046



Coffee Temp = 85 1 pt.
Air Temp. in car = 10 1 pt.

Graph

Shape 0.5 pt.
Axis Labeled 0.5 pt.
Asymptote 0.5 pt.
Accuracy of points 0.5 pt.

3 59. Write the equation, in transformational form, of the ellipse having centre $(2,1)$, horizontal axis of length 6, and vertical axis of length 4.

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

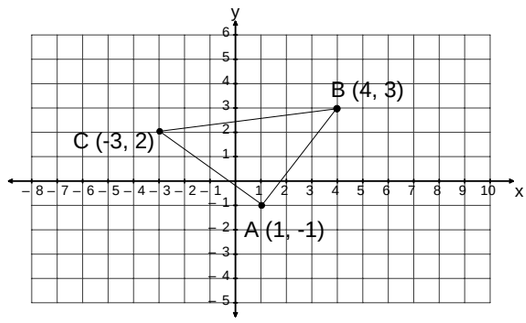
$\frac{1}{3}$ 0.5 pt.
$\frac{1}{2}$ 0.5 pt.
$(x-2)$ 0.5 pt.
$(y-1)$ 0.5 pt.
Both parts squared 0.5 pt.
+ and $=1$ 0.5 pt.

4 60. Write $3x^2 + 3y^2 + 30x - 18y + 54 = 0$ in transformational form, and state the coordinates of the centre.

$3(x^2 + 10x) + 3(y^2 - 6y) = -54$ 0.5 pt.
$3(x^2 + 10x + 25) + 3(y^2 - 6y + 9) = -54 + 75 + 27$ 1 pt.
$3(x+5)^2 + 3(y-3)^2 = 48$ 0.5 pt.
$(x+5)^2 + (y-3)^2 = 16$ 0.5 pt.
$\frac{1}{16}(x+5)^2 + \frac{1}{16}(y-3)^2 = 1$ 0.5 pt.
$\left[\frac{1}{4}(x+5)\right]^2 + \left[\frac{1}{4}(y-3)\right]^2 = 1$ 0.5 pt.
Centre $(-5,3)$ 0.5 pt.

Value

4 61. If the points $A(1,-1)$, $B(4,3)$, and $C(-3,2)$ are the vertices of a triangle, prove that the triangle is isosceles.



$d_{AB} = \sqrt{(4-1)^2 + (3+1)^2}$ 0.5 pt.

$d_{AB} = 5$ 0.5 pt.

$d_{AC} = \sqrt{(-3-1)^2 + (2+1)^2}$ 0.5 pt.

$d_{AC} = 5$ 0.5 pt.

$d_{BC} = \sqrt{(-3-4)^2 + (2-3)^2}$ 0.5 pt.

$d_{BC} = \sqrt{50}$ 0.5 pt.

Since $\overline{AB} = \overline{AC} \neq \overline{BC}$, ΔABC is isosceles. 1 pt.

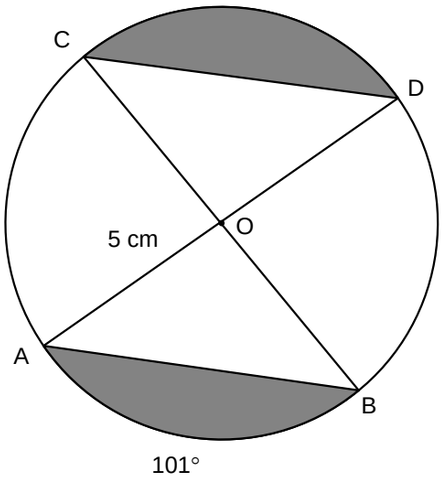
4 62. If O is the centre of the circle shown, $\overset{\frown}{AB} = 101°$ and the radius is 5 cm, determine the area of the shaded region.

Area Segment $= \frac{101}{360}\pi(5)^2 - \frac{1}{2}(5)(5)\sin(101)$ 1 pt. for each part.

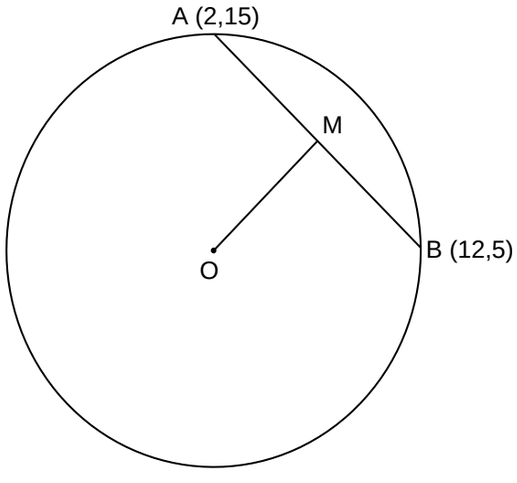
Area Segment $= 22.03 - 12.27$ 0.5 pt.

Area Segment $= 9.765$ 0.5 pt.

Area Shaded $= 2(9.765) = 19.53$ cm.^{2} 1 pt.



4 63. A circle with centre $O(2,5)$ contains a chord with endpoints $A(2,15)$ and $B(12,5)$ as shown. Determine the equation of the perpendicular bisector of chord $\overline{AB}$.



Slope AB $= \frac{5-15}{12-2} = \frac{-10}{10} = -1$ 1 pt.

Slope of $\perp$ bisector is 1. 1 pt.

$y = mx + b$

$5 = 1(2) + b$ 0.5 pt.

$3 = b$ 0.5 pt.

$\therefore y = 1x + 3$ 1 pt.