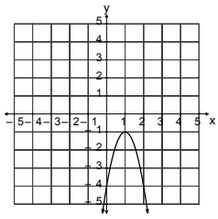
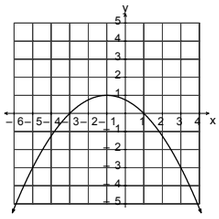
PART I
Total Value: 50%

Answer all items. Shade the letter of the correct answer on the computer scorable answer sheet. All items on Part I have a value of one mark.

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


A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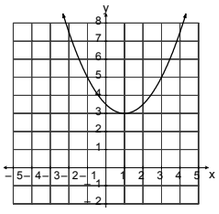
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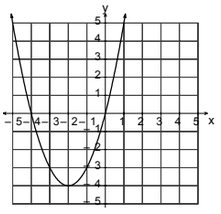
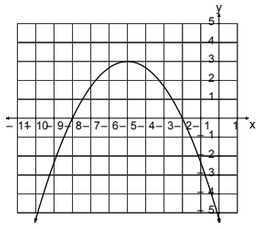

D

(A) A
(B) B
(C) C
(D) D

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

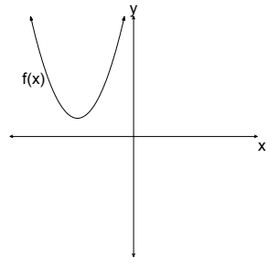
(A) vertex $(-3, 4)$ and vertical stretch factor $\frac{1}{2}$
(B) vertex $(-3, 4)$ and vertical stretch factor 2
(C) vertex $(3, -4)$ and vertical stretch factor $\frac{1}{2}$
(D) vertex $(3, -4)$ and vertical stretch factor 2

3. Which mapping rule applied to $y = x^2$ would generate the graph shown?



(A) $(x, y) \to (x-5, -3y+3)$
(B) $(x, y) \to (x-5, -\frac{1}{3}y+3)$
(C) $(x, y) \to (x-5, \frac{1}{3}y+3)$
(D) $(x, y) \to (x-5, 3y+3)$

4. If the graph of a quadratic function $f(x)$ is as shown, which is a possible value of the discriminant for the equation $f(x) = 0$?



(A) $-5i$
(B) -5
(C) 5
(D) $5i$

5. Which function has a graph with no x-intercepts?

(A) $-3y = (x-1)^2$
(B) $-2(y+3) = (x-1)^2$
(C) $2(y+3) = (x-1)^2$
(D) $3y = (x-1)^2$

6. What is the range of $y = 3x^2 + 6x + 7$?

(A) $\{y \mid y \geq -2, y \in \mathrm{R}\}$
(B) $\{y \mid y \geq -1, y \in \mathrm{R}\}$
(C) $\{y \mid y \geq 4, y \in \mathrm{R}\}$
(D) $\{y \mid y \geq 7, y \in \mathrm{R}\}$

7. What are the possible values of 'b' that would make $x^2 + \mathrm{b}x + \frac{81}{25}$ a perfect square?

(A) $\pm\frac{9}{10}$
(B) $\pm\frac{81}{50}$
(C) $\pm\frac{9}{5}$
(D) $\pm\frac{18}{5}$

8. Which represents the zero(s) of the quadratic function $y = -3x^2 - 150$?

(A) $5i\sqrt{2}$
(B) $\pm 5i\sqrt{2}$
(C) $5\sqrt{2}$
(D) $\pm 5\sqrt{2}$

9. What is the standard form of $y = 3x^2 - 12x + 17$?

(A) $y = 3(x-2)^2 + 5$
(B) $y = 3(x-2)^2 + 13$
(C) $y = 3(x-2)^2 + 21$
(D) $y = 3(x-2)^2 + 29$

10. What are the roots of $4(3x+2) = x(3x+2)$?

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

11. The path of a model rocket launched into the air is modeled by the function $h = -4.9t^2 + 196t$, where h is height in metres and t is elapsed time in seconds. What is the maximum height in metres reached by the rocket?

(A) 1960
(B) 3724
(C) 3822
(D) 5880

12. Which rule describes the sequence $\{-4, -9, -14, -19, -24, \ldots\}$?

(A) $t_n = -5n - 9$
(B) $t_n = -5n - 1$
(C) $t_n = -5n + 1$
(D) $t_n = -5n + 9$

13. What is the value of D_3 for the sequence generated by $t_n = 12n^3 - 3n^2 + 15n + 4$?

(A) 2
(B) 12
(C) 36
(D) 72

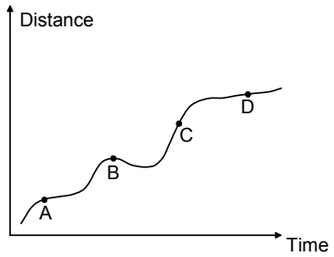
14. Which quadratic equation has $4 + 2\sqrt{3}$ as a root?

(A) $x^2 - 8x + 4 = 0$
(B) $x^2 - 8x + 10 = 0$
(C) $x^2 + 8x - 10 = 0$
(D) $x^2 + 8x - 4 = 0$

15. For what values of 'k' does the equation $x^2 + 2kx + 8k - 15 = 0$ have real and equal roots?

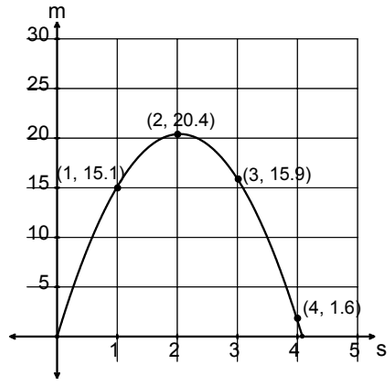
(A) $\{-5, -3\}$
(B) $\{-5, 3\}$
(C) $\{-3, 5\}$
(D) $\{3, 5\}$

16. At which point is the instantaneous rate of change greatest?



(A) A
(B) B
(C) C
(D) D

17. The path of a golf ball after a person hits it is shown in the graph below. What is the average rate of change in the height of the golf ball, in metres per second, from second 3 to second 4?



(A) −14.3
(B) −0.07
(C) 0.07
(D) 14.3

18. A piece of string is repeatedly cut in two and measured with the length recorded in a table. If this cutting pattern is continued, what type of sequence will the values in the table create?

(A) arithmetic
(B) cubic
(C) geometric
(D) quadratic

19. What type of sequence is $\{-5, 1, 25, 79, 175, 325, \ldots\}$?

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

20. Which represents a geometric sequence?

(A) $\left\{\frac{1}{2}+1\cdot 2,\ \frac{1}{2}+2\cdot 2,\ \frac{1}{2}+3\cdot 2,\ \frac{1}{2}+4\cdot 2, \ldots\right\}$

(B) $\left\{\frac{1}{2}\times 1\cdot 2,\ \frac{1}{2}\times 2\cdot 2,\ \frac{1}{2}\times 3\cdot 2,\ \frac{1}{2}\times 4\cdot 2, \ldots\right\}$

(C) $\left\{\frac{1}{2}+2^1,\ \frac{1}{2}+2^2,\ \frac{1}{2}+2^3,\ \frac{1}{2}+2^4, \ldots\right\}$

(D) $\left\{\frac{1}{2}\times 2^1,\ \frac{1}{2}\times 2^2,\ \frac{1}{2}\times 2^3,\ \frac{1}{2}\times 2^4, \ldots\right\}$

21. What is the logarithmic form of $3^{-2}=\frac{1}{9}$?

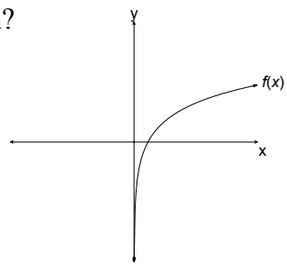
(A) $\log_3\left(\frac{1}{9}\right)=-2$

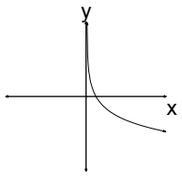
(B) $\log_{\frac{1}{9}}(3)=-2$

(C) $\log_3(-2)=\frac{1}{9}$

(D) $\log_{\frac{1}{9}}(-2)=3$

22. Which best represents the inverse of the graph of $f(x)$ shown?



(A)


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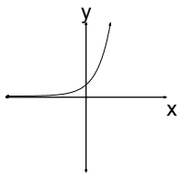
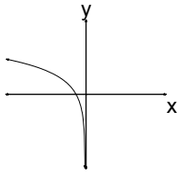


(C)


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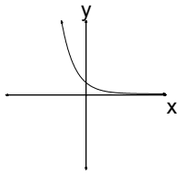
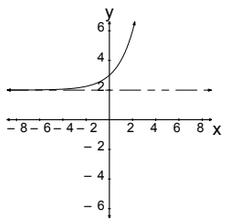
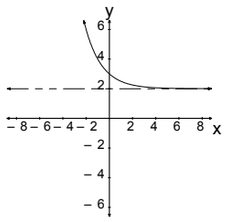


23. Which graph represents an exponential function of the form $y+2=b^{-x}$, where $b>1$?

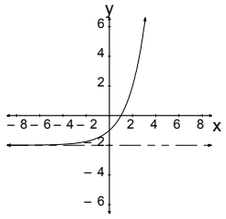
(A)



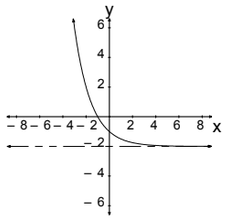
(B)



(C)



(D)



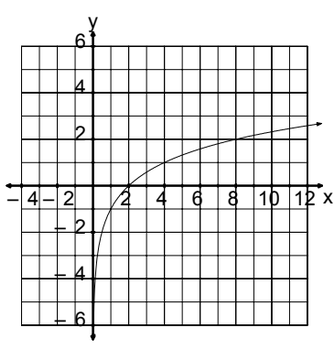
24. What is the range of $\frac{1}{2}(y+4)=3^{x}$?

(A) $\{y \mid y>-4, y\in \mathrm{R}\}$
(B) $\{y \mid y\geq -4, y\in \mathrm{R}\}$
(C) $\{y \mid y>-2, y\in \mathrm{R}\}$
(D) $\{y \mid y\geq -2, y\in \mathrm{R}\}$

25. What mapping rule applied to $y=4^{x}$ results in its graph being reflected in the *x*-axis, vertically stretched by a factor of $\frac{1}{2}$, and translated horizontally 3 units to the right?

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

26. Which equation represents the graph shown?



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

27. Which expression is equivalent to $8\left(\frac{1}{2}\right)^{x-3}$?

(A) 2^{-3x+9}
(B) 2^{-x+6}
(C) 2^{-x}
(D) 2^{x}

28. Solve: $2\cdot 3^{x+2}=8$?

(A) $\frac{\log 3}{\log 4}+2$
(B) $\frac{\log 4}{\log 3}-2$
(C) $\frac{\log 6}{\log 8}+2$
(D) $\frac{\log 8}{\log 6}-2$

29. Given $8^{x}=15$, which best approximates *x?*

(A) 0.27
(B) 0.77
(C) 1.22
(D) 1.30

30. Which represents an exponential relationship?

(A)

x	1	2	3	4
y	1	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$

(B)

x	1	2	3	4
y	$\frac{1}{3}$	$\frac{1}{9}$	$\frac{1}{27}$	$\frac{1}{81}$

(C)

x	1	2	3	4
y	3	5	7	9

(D)

x	1	2	3	4
y	2	−4	4	−2

31. Simplify: $\left(a^{-1}+b\right)^{-1}$.

(A) $\frac{a}{1+ab}$

(B) $\frac{1+ab}{b}$

(C) $\frac{a}{1+b}$

(D) $\frac{a+1}{b}$

32. Which is equivalent to: $\log\sqrt{\frac{y}{x^3}}$?

(A) $\frac{1}{2}\log y - 3\log x$

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

(C) $2\log y - 3\log x$

(D) $2(\log y - 3\log x)$

33. Solve: $\left(\frac{1}{3}\right)^x = \sqrt{27^8}$.

(A) –24

(B) –12

(C) –7

(D) –4

34. Which mapping rule transforms $y = (3)^x$ to $-\frac{1}{2}(y-1) = (3)^{2x+4}$?

(A) $(x, y) \to \left(\frac{1}{2}x - 2, -2y + 1\right)$

(B) $(x, y) \to \left(\frac{1}{2}x - 4, -2y + 1\right)$

(C) $(x, y) \to \left(\frac{1}{2}x - 4, 2y + 1\right)$

(D) $(x, y) \to \left(\frac{1}{2}x + 2, 2y + 1\right)$

35. What is the domain of $(y+2) = \log_2(2x-1)$?

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

(B) $\{x \mid x \geq 0, x \in \mathrm{R}\}$

(C) $\{x \mid x > \frac{1}{2}, x \in \mathrm{R}\}$

(D) $\{x \mid x \geq \frac{1}{2}, x \in \mathrm{R}\}$

36. What is the focal point of the graph of $-\frac{1}{2}(y-3) = 3^{x-4}$?

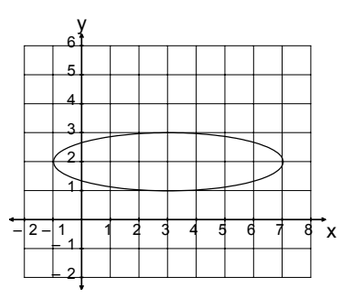
(A) $(0, 1)$

(B) $(4, 1)$

(C) $(4, 3)$

(D) $(5, 3)$

37. What is the equation representing the graph shown?



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

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

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

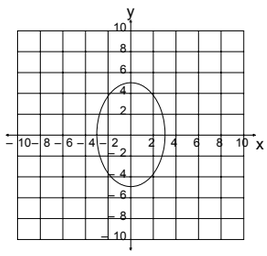
(D) $(x+3)^2 + \left[\frac{1}{4}(y+2)\right]^2 = 1$

38. Which is the converse of: “If a quadrilateral is inscribed in a circle, then opposite angles are supplementary.”?

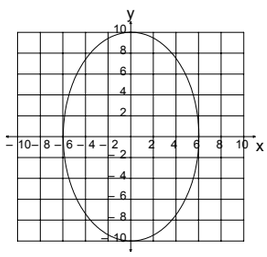
(A) If opposite angles in a quadrilateral are not supplementary, then the quadrilateral is inscribed in a circle.
(B) If opposite angles in a quadrilateral are not supplementary, then the quadrilateral is not inscribed in a circle.
(C) If opposite angles in a quadrilateral are supplementary, then the quadrilateral is inscribed in a circle.
(D) If opposite angles in a quadrilateral are supplementary, then the quadrilateral is not inscribed in a circle.

39. The graph of $x^2 + y^2 = 1$ is stretched horizontally by a factor of 3 and stretched vertically by a factor of 5. Which is the resulting graph?

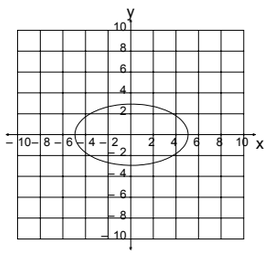
(A)



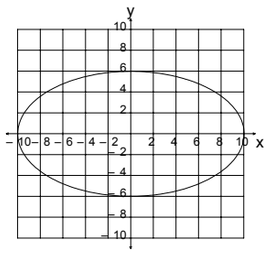
(B)



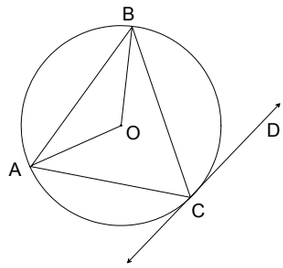
(C)



(D)



40. In the circle with centre O shown, $\overline{CD}$ is tangent at C such that $m\angle BCD = 62°$. If $m\angle ABC = 55°$, what is $m\angle AOB$ in degrees?

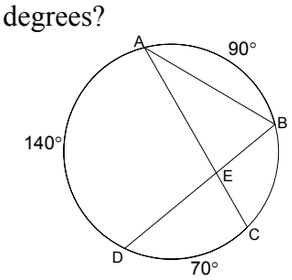


(A) 63
(B) 110
(C) 117
(D) 126

41. What is the exact value of $\cos^2 330° + \tan 60°$?

(A) $\frac{3\sqrt{3}}{2}$
(B) $\frac{1+4\sqrt{3}}{4}$
(C) $\frac{3+2\sqrt{3}}{2}$
(D) $\frac{3+4\sqrt{3}}{4}$

42. Given the diagram shown, what is the measure of $\angle AEB$ in degrees?



(A) 35
(B) 45
(C) 80
(D) 90

43. If a point $P(1, 0)$ is rotated $210°$ 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) $\left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$

44. The circle represented by $x^2 + y^2 - 4x + 6y + 4 = 0$ has its radius changed by a factor of $\frac{2}{3}$. What is the new equation?

(A) $(x-2)^2 + (y+3)^2 = 2$
(B) $(x-2)^2 + (y+3)^2 = 4$
(C) $(x-2)^2 + (y+3)^2 = 6$
(D) $(x-2)^2 + (y+3)^2 = 36$

45. The graph of $x^2 + y^2 = 1$ is transformed according to the mapping rule $(x, y) \to (2x+3, 5y+1)$. Which statement about the image is correct?

(A) It has a horizontal major axis of 5 units, and a vertical minor axis of 2 units.
(B) It has a horizontal major axis of 10 units, and a vertical minor axis of 4 units.
(C) It has a vertical major axis of 5 units, and a horizontal minor axis of 2 units.
(D) It has a vertical major axis of 10 units, and a horizontal minor axis of 4 units.

46. Given the endpoints of a diameter of a circle are $A(2a, 2b)$ and $B(4a, 6b)$, what is the length of the radius?

(A) $a + 2b$
(B) $2a + 4b$
(C) $\sqrt{a^2 + 4b^2}$
(D) $2\sqrt{a^2 + 4b^2}$

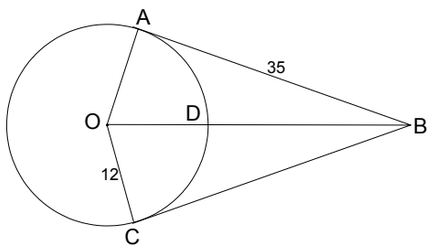
47. The line containing the points $A(-8, m)$ and $B(2, 1)$ is parallel to the line containing points $C(11, -1)$ and $D(7, m+1)$. What is the value of 'm'?

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

48. Which is the equation of the ellipse having centre $(3, 2)$ and tangent to both the x and y axes?

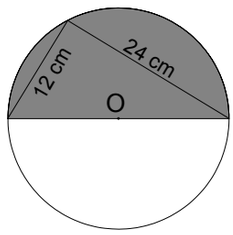
(A) $\left[\frac{1}{3}(x-3)\right]^2 + \left[\frac{1}{2}(y-2)\right]^2 = 1$
(B) $\left[\frac{1}{3}(x+3)\right]^2 + \left[\frac{1}{2}(y+2)\right]^2 = 1$
(C) $\left[\frac{1}{6}(x-3)\right]^2 + \left[\frac{1}{4}(y-2)\right]^2 = 1$
(D) $\left[\frac{1}{6}(x+3)\right]^2 + \left[\frac{1}{4}(y+2)\right]^2 = 1$

49. $\overline{BA}$ and $\overline{BC}$ are tangent to the circle with centre O as shown. If $\overline{AB} = 35$ and $\overline{OC} = 12$, what is the length of $\overline{DB}$?



(A) 23
(B) 25
(C) 35
(D) 37

50. Given O is the centre of the circle shown, what would be the approximate area of the shaded region in cm^2?



(A) 84.2
(B) 282.1
(C) 564.1
(D) 1128.2

PART II
Total Value: 50%

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

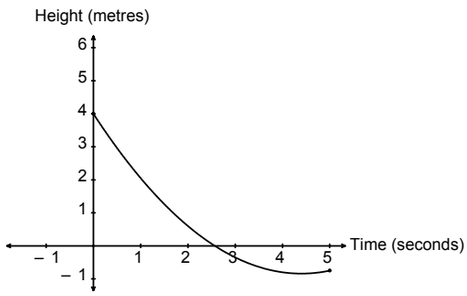
Value

4 51. Algebraically determine the **EXACT** roots in simplest form for

$$\frac{5x+2}{x+3} = \frac{2x}{x+3} - \frac{x}{x-3}.$$

4 52. Two numbers have a difference of 24. Set up a quadratic function and use it to find the numbers if the result of adding the sum of the two numbers and the product of the two numbers is a minimum.

4 53. A seagull dives from a cliff to retrieve a fish which is just below the surface of the ocean. The graph and table show the height in metres of the seagull above sea level over a 5 second period. Algebraically determine the quadratic function that defines the height of the seagull above sea level t seconds after leaving the cliff.



T	0	1	2	3	4	5
H	4	2.05	0.6	–0.35	–0.8	–0.75

2 54(a). The height of a golf ball, h, in metres, t seconds after being struck, is given by the function $h(t) = 28t - 4.9t^2$. What is the instantaneous rate of change in the height of the golf ball at $t = 2$ seconds?

2 (b). A balloon with a diameter of 10 cm is deflating such that the radius is decreasing at a rate of 5 mm/sec. Determine the function that represents the volume of the balloon at any given instant. Note: $V_{\text{sphere}} = \frac{4}{3}\pi r^3$.

3 55. Algebraically solve: $2 \cdot 2^{2x} - 11 \cdot 2^{x} + 5 = 0$.

4 56. Algebraically solve: $\log_3\left(2x^2 - x\right) - \log_3\left(x + 2\right) = 1$.

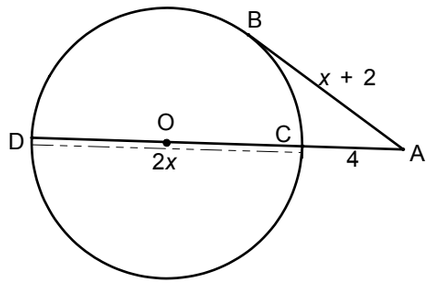
4 57. A radioactive element with an initial mass of 100 g decays to 70.7 g in 25 years. Write a function to model this situation and use it to determine the half-life of the element.

4 58. On a television show, a homicide victim was found in a warehouse where the room temperature was a constant $20°C$. Based on the table below, write a function to show the relationship between body temperature and time, and use it to find the time, to the nearest hour, at which the body temperature would have been $22°C$ had the victim remained in the warehouse.

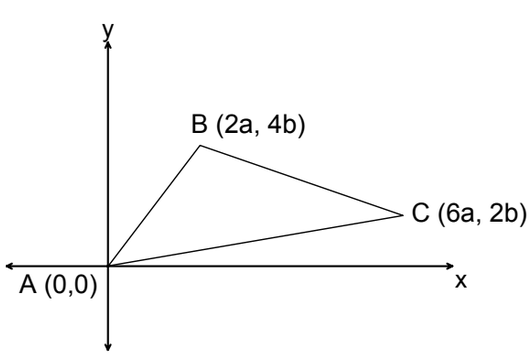
Time (hours)	*Body Temp* (°C)
1	33.6
2	30.88
3	28.704
4	26.9632

3 59. Algebraically show that the line $x-2y-4=0$ passes through the centre of the ellipse $25x^2+4y^2-100x+8y+4=0$.

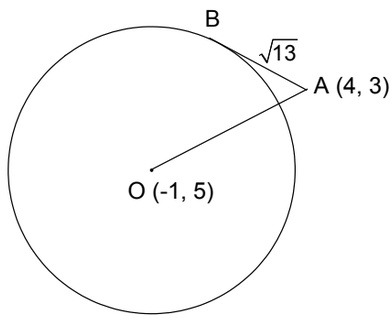
4 60. Given $\overline{AB}$ is tangent to the circle with centre O as shown, determine the value of x.



4 61. Using coordinate geometry, prove that the line segment joining the midpoints of $\overline{AB}$ and $\overline{BC}$ is equal to half the length of $\overline{AC}$.



4 62. In the circle with centre O, $\overline{AB}$ is tangent to the circle at B. Determine the equation of the circle in general form.



4 63. Given two circles with centres A and D as shown, determine the area of the shaded region to the nearest tenth of a cm^2.