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 quadratic equation represents the transformation of $y = x^2$ under the mapping $(x, y) \to (x - 3, -\frac{1}{2}y + 1)$?

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

2. What is the range of $-\frac{1}{5}(y+1) = (x-4)^2$?

   (A) $\{y \mid y \le -1, y \in \mathrm{R}\}$
   (B) $\{y \mid y \ge -1, y \in \mathrm{R}\}$
   (C) $\{y \mid y < -1, y \in \mathrm{R}\}$
   (D) $\{y \mid y > -1, y \in \mathrm{R}\}$

3. The graph of a quadratic function $f(x)$ intersects the *x*-axis at only one point. Which is a possible value of the discriminant for the equation $f(x) = 0$?

   (A) –5
   (B) $-\frac{1}{2}$
   (C) 0
   (D) 3

4. Compared to the graph of $y = x^2$, which quadratic has a graph with a vertical stretch factor of $\frac{1}{3}$?

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

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

   (A) HT 3 units left, VT 2 units up, VS factor $\frac{1}{4}$
   (B) HT 3 units right, VT 2 units down, VS factor $\frac{1}{4}$
   (C) HT 3 units left, VT 2 units up, VS factor 4
   (D) HT 3 units right, VT 2 units down, VS factor 4

6. Which quadratic function has vertex $(1, 3)$ and two unequal x-intercepts?

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

7. What is the transformational form of $y = -\frac{1}{3}x^2 + 3x - 1$?

(A) $-3(y - \frac{23}{4}) = (x - \frac{9}{2})^2$
(B) $-3(y + \frac{23}{4}) = (x - \frac{9}{2})^2$
(C) $-3(y - \frac{23}{4}) = (x + \frac{9}{2})^2$
(D) $-3(y + \frac{23}{4}) = (x + \frac{9}{2})^2$

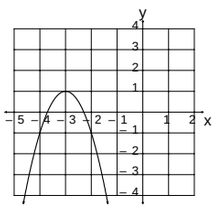
8. What is the product of the roots of $\mathrm{k}\sqrt{2}\,x^2 + 6x + \mathrm{k} = 0$?

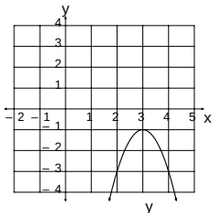
(A) $\frac{-\sqrt{2}}{2}$
(B) $\frac{-3\sqrt{2}}{\mathrm{k}}$
(C) $\frac{\sqrt{2}}{2}$
(D) $\frac{3\sqrt{2}}{\mathrm{k}}$

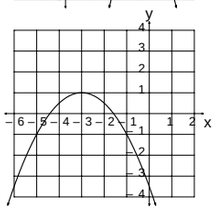
9. If $f(x) = -4x^2 - 72$, what are the roots of $f(x) = 0$?

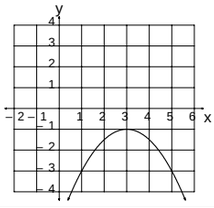
(A) $\pm 2\sqrt{3}$
(B) $\pm 2i\sqrt{3}$
(C) $\pm 3\sqrt{2}$
(D) $\pm 3i\sqrt{2}$

10. Which graph represents $-2(y+1) = (x-3)^2$?

(A)


(B)


(C)


(D)


11. Which represents a quadratic relationship?

(A)

x	0	1	2	3	4
y	6	7	8	9	10

(B)

x	0	2	4	6	8
y	2	5	14	29	50

(C)

x	0	1	2	3	4
y	1	3	9	27	81

(D)

x	0	2	4	6	8
y	0	2	16	54	128

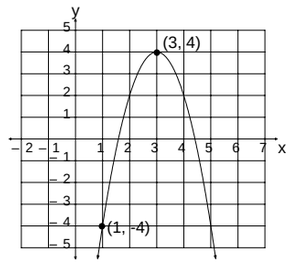
12. The graph of which function has x-intercepts of $\left(\sqrt{5}, 0\right)$ and $\left(-\sqrt{5}, 0\right)$?

(A) $y = -2x^2 - 10$
(B) $y = -2x^2 + 10$
(C) $y = -2x^2 - 5$
(D) $y = -2x^2 + 5$

13. Solve: $\sqrt{3}x\left(\sqrt{3}x - 3\sqrt{3}\right) = -6$.

(A) $\left\{\frac{9 \pm \sqrt{57}}{6}\right\}$
(B) $\left\{\frac{9 \pm \sqrt{105}}{6}\right\}$
(C) $\{1, 2\}$
(D) $\{-2, -1\}$

14. Which quadratic function represents the graph shown?



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

15. For what values of 'k' will the quadratic function $y = 3x^2 + (2k + 2)x + 3$ have two equal real roots?

(A) $1 \pm 3i$
(B) $-1 \pm 3i$
(C) $2, -4$
(D) $-2, 4$

16. Which best describes instantaneous rate of change?

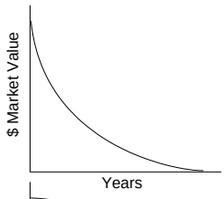
(A) slope of an asymptote to a curve
(B) slope of a perpendicular to a curve
(C) slope of a secant to a curve
(D) slope of a tangent to a curve

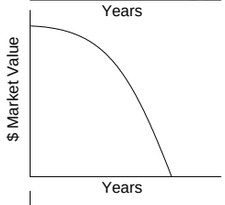
17. The Department of Fisheries and Oceans recorded the temperature on the Torrent River over 5 days as illustrated in the table below. Which represents the average rate of change in temperature between days 1 and 5 in °C per day ?

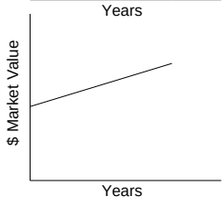
Day	Temperature in °C
1	14
2	15
3	17
4	20
5	22

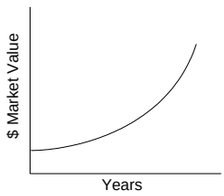
(A) -2
(B) $-\frac{1}{2}$
(C) $\frac{1}{2}$
(D) 2

18. Which models a situation where the market value of a house appreciates by 3% annually?

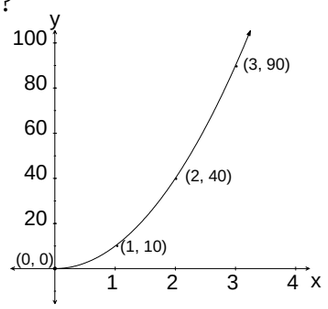
(A)


(B)


(C)


(D)


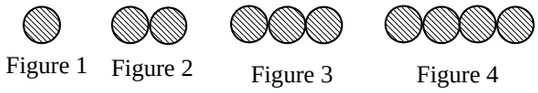
19. What type of function is illustrated by the graph shown?



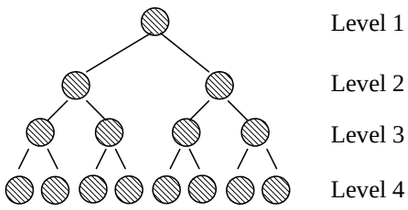
(A) cubic
(B) exponential
(C) linear
(D) quadratic

20. Which pattern represents an exponential sequence?

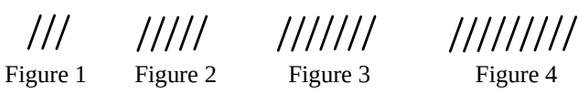
(A)



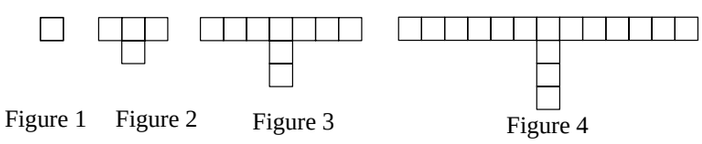
(B)



(C)



(D)



21. Solve: $\log_2 8 - \log_2 4 = x$.

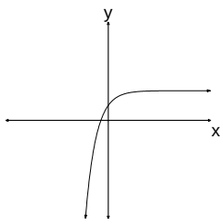
(A) 1
(B) 2
(C) 3
(D) 5

22. Which is the inverse of $y = 5^x$?

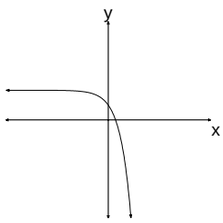
(A) $y = \log_5 x$
(B) $y = \log_x 5$
(C) $\log_5 y = x$
(D) $\log_y 5 = x$

23. Given $A = B = -1,\ C > 0,$ and $D = 0$, which graph best represents the equation $A(y - C) = 3^{B(x-D)}$?

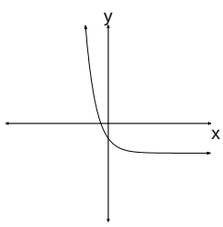
(A)



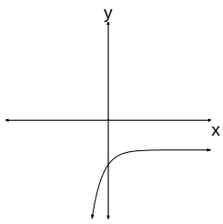
(B)



(C)



(D)



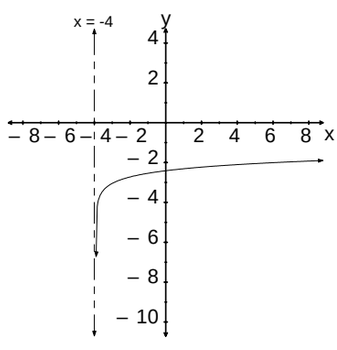
24. Which function has a range of $\{y \mid y > -3, y \in R\}$?

(A) $y = 10^x + 3$
(B) $y = 10^x - 3$
(C) $y = \log(x + 3)$
(D) $y = \log(x - 3)$

25. What is the mapping rule which produces $-3(y - 2) = 2^{2x+4}$ from $y = 2^x$?

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

26. Which function represents the graph shown?



(A) $y + 3 = \log(x + 4)$
(B) $y - 3 = \log(x + 4)$
(C) $y + 3 = \log(x - 4)$
(D) $y - 3 = \log(x - 4)$

27. What is the simplified form of $\frac{\left(9^{2a}\right)\left(4^{a}\right)(27)}{2^{a}}$?

(A) $3^{4a+3} \cdot 2^{a}$
(B) $3^{6a+3} \cdot 2^{a}$
(C) 6^{5a+3}
(D) 6^{7a+3}

28. Solve: $\frac{1}{3} \cdot 7^{2x+1} = 2$.

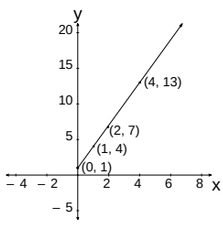
(A) –0.53
(B) –0.04
(C) 0.04
(D) 0.53

29. Given $7^{x} = 14$, which best approximates *x*?

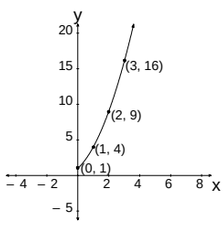
(A) 1.15
(B) 1.36
(C) 2
(D) 7

30. Which best represents an exponential relationship?

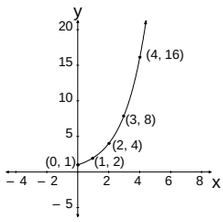
(A)



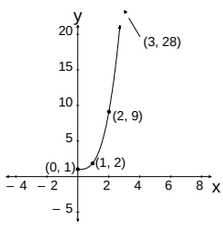
(B)



(C)



(D)



31. Simplify: $3\left(4^0 - a^{-1}\right)^{-1}$.

(A) $\dfrac{a-1}{3a}$

(B) $\dfrac{3a}{a-1}$

(C) $\dfrac{1-a}{3}$

(D) $\dfrac{3a-3}{a}$

32. Which is equivalent to $\frac{1}{4}\left[\log_3 \mathrm{P} + \log_3 \mathrm{Q} - 5\log_3 \mathrm{W}\right]$?

(A) $\log_3 \sqrt[4]{\left(\mathrm{P}+\mathrm{Q}-5\mathrm{W}\right)}$

(B) $\sqrt[4]{\log_3 \left(\frac{\mathrm{PQ}}{\mathrm{W}}\right)^5}$

(C) $\sqrt[4]{\log_3 \frac{\mathrm{PQ}}{\mathrm{W}^5}}$

(D) $\log_3 \sqrt[4]{\frac{\mathrm{PQ}}{\mathrm{W}^5}}$

33. Solve: $\frac{1}{8}\left(\sqrt{2}^{\,x+2}\right) = \frac{1}{2}$.

(A) –12
(B) –6
(C) 0
(D) 2

34. What is the horizontal stretch factor which transforms $y = \left(\frac{2}{3}\right)^x$ to $-\frac{1}{2}(y+3) = \left(\frac{2}{3}\right)^{5x+10}$?

(A) $\frac{1}{5}$

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

(C) 2

(D) 5

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

(A) $(-3, -3)$

(B) $(-1, 1)$

(C) $\left(\frac{3}{2}, 0\right)$

(D) $\left(2, \frac{1}{4}\right)$

36. Which represents the transformation of $y = 3^x$ if the original focal point is translated to $(4, -4)$ and there is a vertical stretch factor of 1?

(A) $y = (3)^{x-4} - 5$

(B) $y = (3)^{x-4} + 5$

(C) $y = (3)^{x+4} - 5$

(D) $y = (3)^{x+4} + 5$

37. What transformations of $x^2 + y^2 = 1$ result in the equation $\left[\frac{1}{2}(x+2)\right]^2 + \left[\frac{1}{3}(y-1)\right]^2 = 1$?

(A) HS factor 2, VS factor 3, HT 2 units left, VT 1 unit up
(B) HS factor $\frac{1}{2}$, VS factor $\frac{1}{3}$, HT 2 units left, VT 1 unit up
(C) HS factor 2, VS factor 3, HT 2 units right, VT 1 unit down
(D) HS factor $\frac{1}{2}$, VS factor $\frac{1}{3}$, HT 2 units right, VT 1 unit down

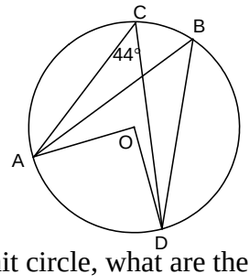
38. Which is the converse of: "Two minor arcs are congruent if their central angles are congruent."?

(A) Two minor arcs are not congruent *iff* their central angles are congruent.
(B) Two central angles are congruent if their minor arcs are congruent.
(C) Two central angles are not congruent if their minor arcs are congruent.
(D) Two minor arcs are congruent *iff* their central angles are congruent.

39. Which equation represents an ellipse?

(A) $4x^2 + 4y^2 - 9y = 225$
(B) $10x^2 + 10y^2 + 4x + 2y - 144 = 0$
(C) $12x^2 + 20y^2 + 12x + 20y = 256$
(D) $2x^2 + 2y = 36$

40. In the circle with centre O shown, $\angle C = 44°$. What is the measure of minor arc $\overset{\frown}{AD}$ in degrees?

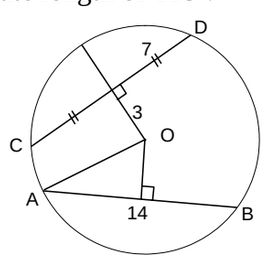


(A) 22
(B) 44
(C) 88
(D) 272

41. If the point $P\left(-\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$ is rotated counter-clockwise $90°$ on a unit circle, what are the new coordinates of P?

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

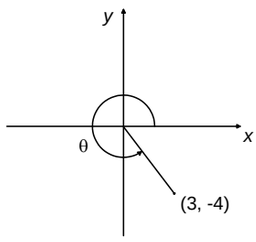
42. Given the circle with centre O shown, what is the approximate length of $\overline{AO}$?



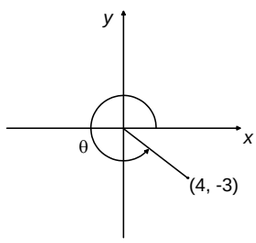
(A) 6.3
(B) 7.6
(C) 12.1
(D) 13.7

43. Which point, rotated through an angle θ from standard position, produces $\sin\theta = \frac{-3}{5}$ when $0° \le \theta \le 360°$?

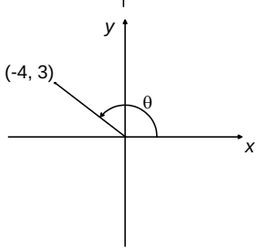
(A)



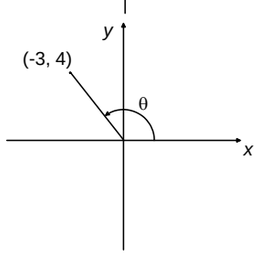
(B)



(C)

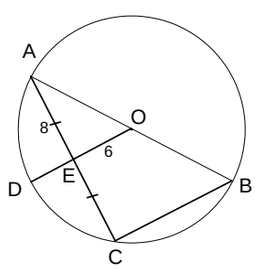


(D)



44. In the circle with centre O shown, AE = 8, OE = 6, and $\overline{AE}$ = $\overline{CE}$. What is the length of $\overline{CB}$?

(A) 8
(B) 8.5
(C) 12
(D) 25.6

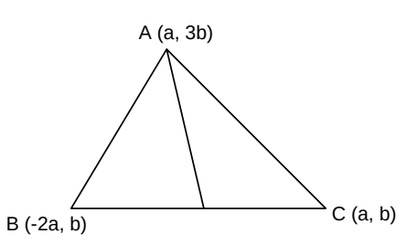


45. What is the length of the major axis of the ellipse having equation $4x^2 + 5y^2 - 20 = 0$?

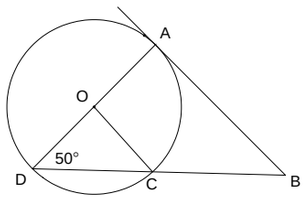
(A) 2
(B) $\sqrt{5}$
(C) 4
(D) $2\sqrt{5}$

46. Given the diagram shown, what is the length of the median from A to $\overline{BC}$?

(A) $\sqrt{\frac{9a^2}{4} + 4b^2}$
(B) $\sqrt{a^2 + 4b^2}$
(C) $\sqrt{4a^2 + 4b^2}$
(D) $\sqrt{\frac{a^2}{4} + 4b^2}$



47. Given A, C, and D are points on the circle with centre O as shown, and $\overline{AB}$ is tangent to the circle at A, what is $m\angle ABC$ in degrees?

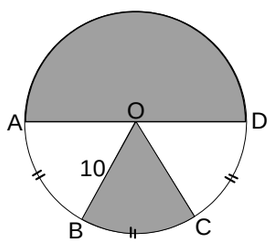


(A) 30
(B) 40
(C) 50
(D) 80

48. Which represents the circle $x^2 + y^2 = 1$ after it is transformed according to the mapping rule $(x, y) \rightarrow (4x - 2, \frac{1}{2}y + 3)$?

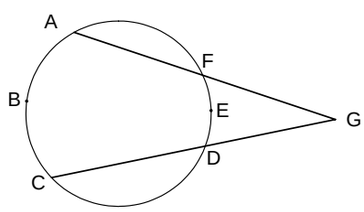
(A) $\left[4(x-2)\right]^2 + \left[\frac{1}{2}(y+3)\right]^2 = 1$
(B) $\left[\frac{1}{4}(x+2)\right]^2 + \left[2(y-3)\right]^2 = 1$
(C) $\left[4(x+2)\right]^2 + \left[\frac{1}{2}(y-3)\right]^2 = 1$
(D) $\left[\frac{1}{4}(x-2)\right]^2 + \left[2(y+3)\right]^2 = 1$

49. Given the circle with centre O shown, and $\overset{\frown}{AB} = \overset{\frown}{BC} = \overset{\frown}{CD}$, what is the approximate total area, in square units, of the shaded regions?



(A) 41.9
(B) 52.4
(C) 209.4
(D) 261.8

50. In the diagram shown, if $\overset{\frown}{ABC} = 105°$ and $\angle FGD = 29°$, what is the measure of $\overset{\frown}{FED}$ in degrees?



(A) 38
(B) 47
(C) 67
(D) 163

PART II
Total Value: 50%

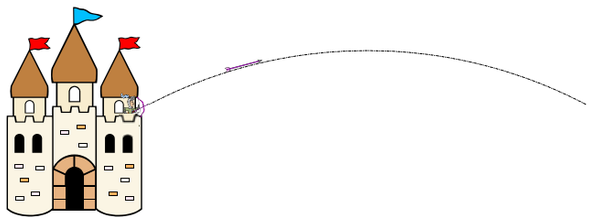
Answer **ALL** items in the space provided. Show **ALL** workings.

Value

4 51. Algebraically determine the **EXACT** roots in simplest form for $\frac{\sqrt{6}-x}{\sqrt{6x}} = \frac{\sqrt{6x}}{\sqrt{6}+x}$.

4 52. Chris purchased a motorboat and used it to travel 6 km upstream and then 6 km back downstream in a total of 4 hours. If the river's current is constant at 2 km/h, algebraically determine an equation which models this situation and use it to find the speed of the boat in still water.

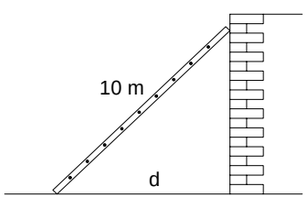
4 53. An archer atop a turret 30 m above the ground shoots an arrow as shown. The height of the arrow, *h*, in metres above the ground, *t* seconds after shooting, is shown in the table below. Algebraically determine the function that defines the height *h* of the arrow above the ground *t* seconds after shooting.



t	0	1	2	3
h	30	45.1	50.4	45.9

2 54(a). The volume of water at a given time in a 2000 L tank is represented by the formula $V = 2000\left(1-\frac{t}{45}\right)^2$, where *t* is time in minutes. Determine the average rate of change in the volume of water in the tank from minute 0 to minute 10, and use it to describe how the volume of water in the tank is changing during that time.

2 (b). A 10 m long ladder is leaning against the top of an 8 m high wall. The ladder is slipping down the wall at a rate of 0.5 m/s. Algebraically determine the function that represents the distance, *d*, between the base of the ladder and the wall at any given instant.

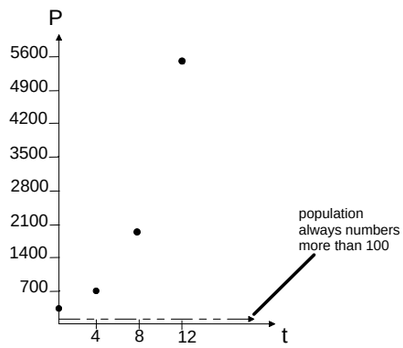


4 55. Algebraically solve: $\log_4(x+7)-\log_4(x^2+3x)=\frac{1}{2}$.

3 56. Algebraically solve: $2^{4x}-6(2)^{2x}-16=0$.

4 57. A bacteria population is well cared for so it always numbers more than 100. An experiment was begun to study how a particular type of light affected the number of bacteria. Upon starting the experiment, the population, *P*, at time, *t*, in hours, was recorded in the table and on the graph shown. Algebraically determine the exponential function that models this population, and use it to determine the time it will take for the bacteria to number 48 700.

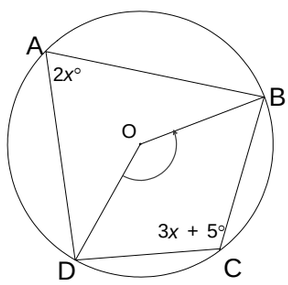
t	0	4	8	12
P	300	700	1900	5500



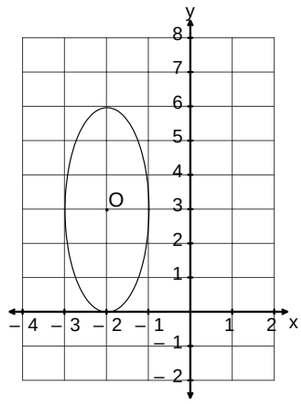
4 58. A rich relative gave Pat a gift of $100 000 as a college fund. Pat can withdraw half of the money that remains in the fund once every 5 months. Set up an equation that models the money remaining in the fund and use it to determine, to the nearest 5 months, when the amount remaining first drops below $500.

4 59. Algebraically show that the centre of the ellipse defined by $9x^2 + 4y^2 - 90x - 16y + 205 = 0$ lies on the parabola defined by $y = 2x^2 - 16x + 32$.

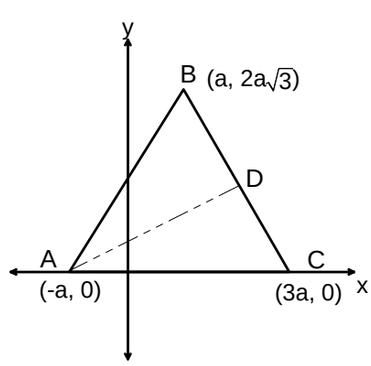
3 60. The points A, B, C, and D are on the circumference of the circle with centre O shown. Determine the measure of $\angle DOB$ in degrees.



4 61. Determine the equation of the ellipse, in general form, having centre O as shown.



4 62. Using coordinate geometry, prove the median from A to $\overline{BC}$ is perpendicular to $\overline{BC}$.



4 63. Square ABCD is inscribed in the circle with centre O as shown. If the diameter of the circle is 20 cm, determine the approximate area of the shaded region.