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 common difference between successive terms generated by the sequence $t_n = \frac{2}{3}n + 4$?

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

2. Which represents a quadratic relationship?

(A)

x	0	1	2	3	4
y	–3	1	5	9	13

(B)

x	0	1	2	3	4
y	0	4	16	64	256

✓ (C)

x	0	1	2	3	4
y	3	4	7	12	19

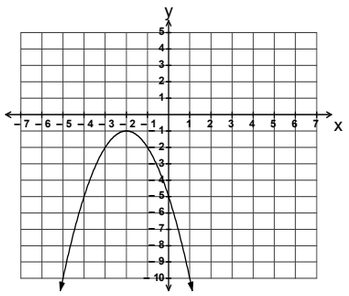
(D)

x	0	1	2	3	4
y	–2	–1	6	25	62

3. Which generates the sequence $\{4, 1, -2, -5, -8, ...\}$?

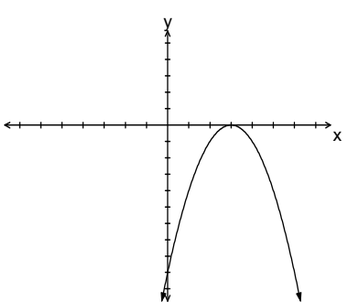
(A) $t_n = -3n + 1$
✓ (B) $t_n = -3n + 7$
(C) $t_n = 3n + 1$
(D) $t_n = 3n + 7$

4. What is the range of the function provided?



(A) $\{y \mid y \le -2, y \in R\}$
(B) $\{y \mid y \ge -2, y \in R\}$
✓ (C) $\{y \mid y \le -1, y \in R\}$
(D) $\{y \mid y \ge -1, y \in R\}$

5. What is the value of the discriminant for $f(x) = 0$ in the graph provided?



(A) –9
(B) –3
✓ (C) 0
(D) 3

6. What is the axis of symmetry for $y = 3x^2 - 12x + 11$?

(A) $x = -2$
(B) $x = -1$
✓ (C) $x = 2$
(D) $x = 4$

7. Which has the smallest vertical stretch factor when compared to $y = x^2$?

(A) $-2(y+1) = (x-3)^2$
(B) $-\frac{3}{4}(y+1) = (x-3)^2$
(C) $\frac{2}{7}(y+1) = (x-3)^2$
✓ (D) $3(y+1) = (x-3)^2$

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

(A) reflected across the *x*-axis, vertical stretch factor of -2, translated 3 units down and 1 unit right
(B) reflected across the *x*-axis, vertical stretch factor of $-\frac{1}{2}$, translated 3 units up and 1 unit left
✓ (C) reflected across the *x*-axis, vertical stretch factor of $\frac{1}{2}$, translated 3 units down and 1 unit right
(D) reflected across the *x*-axis, vertical stretch factor of 2, translated 3 units up and 1 unit left

9. What mapping rule transforms $y = x^2$ into $2(y-3) = (x+4)^2$?

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

10. What is the *y*-intercept of the function $-\frac{1}{2}(y-1) = (x+3)^2$?

(A) -20
✓ (B) -17
(C) -11
(D) -5

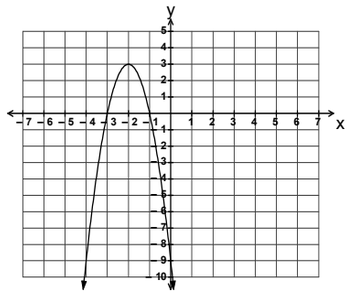
11. What is the general form of $2(y+1) = (x-4)^2$?

(A) $y = -2x^2 + 16x - 33$
(B) $y = \frac{1}{2}x^2 + 7$
✓ (C) $y = \frac{1}{2}x^2 - 4x + 7$
(D) $y = \frac{1}{2}x^2 - 4x + \frac{15}{2}$

12. What is the value of k if $kx^2 + 5x - 6 = 0$ has a root of -2?

(A) -4
(B) -1
(C) 1
✓ (D) 4

13. What is the quadratic function for the graph provided?



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

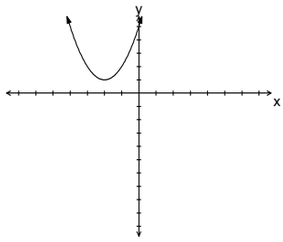
(B) $-3(y+3)=(x-2)^2$

✓ (C) $-\frac{1}{3}(y-3)=(x+2)^2$

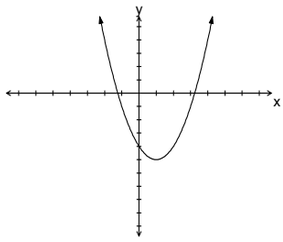
(D) $-\frac{1}{3}(y+3)=(x-2)^2$

14. Which graph represents a quadratic function with zeros $1\pm\sqrt{5}$?

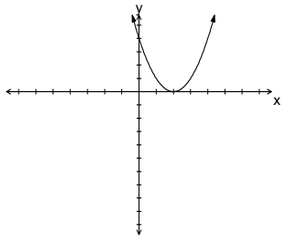
(A)



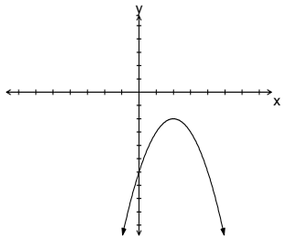
✓ (B)



(C)



(D)



15. What are the zeros of the function $y=(2x-1)(x+4)$?

✓ (A) $\left\{-4,\frac{1}{2}\right\}$

(B) $\{-4,2\}$

(C) $\{4,-2\}$

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

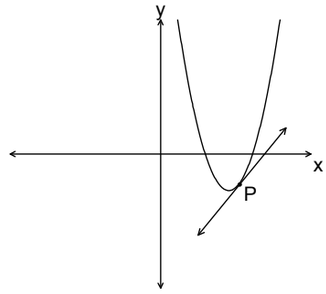
16. Solve: $-2x^2 - 36 = 0$.

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

17. A rectangular garden, measuring 15 m by 20 m, has a uniform strip removed from the edge of one length and the edge of one width to make a concrete walkway. If the area of the remaining garden is 200 m^2, which equation represents the relationship between the width, the length, and the area of the new garden?

(A) $(15-2x)(20-2x) = 200$
✓ (B) $(15-x)(20-x) = 200$
(C) $(15+x)(20+x) = 200$
(D) $(15+2x)(20+2x) = 200$

18. What rate of change is represented by the graph provided?



(A) negative average
(B) negative instantaneous
(C) positive average
✓ (D) positive instantaneous

19. The table below shows the height, in metres, of a tree as it grows over time, in months. What is the average rate of change, in metres per month, between months 1 and 3?

month	0	1	2	3	4
height *(h)*	0	0.22	1	1.54	1.78

✓ (A) 0.66
(B) 0.88
(C) 1.32
(D) 1.52

20. Which sequence is geometric?

✓ (A) $\frac{1}{6}, \frac{1}{2}, \frac{3}{2}, \frac{9}{2}$
(B) $\frac{9}{2}, \frac{15}{2}, \frac{21}{2}, \frac{27}{2}$
(C) 5, 5.5, 6, 6.5
(D) 1, 1, 2, 3

21. What is the value of $\left[\left(\frac{2}{3}\right)^{-1} - 3^0\right]^2$?

✓ (A) $\frac{1}{4}$
(B) $\frac{5}{4}$
(C) $\frac{9}{4}$
(D) $\frac{25}{9}$

22. What is the simplified form of $\frac{4^{3x}}{\left(32^{5x}\right)(2)}$?

✓ (A) 2^{-19x-1}
(B) 2^{-19x}
(C) 2^{-5x-1}
(D) 2^{-5x}

23. Which equation represents the data in the table provided?

x	–3	0	3	6	9
y	$\frac{5}{4}$	5	20	80	320

(A) $y=\frac{5}{4}(3)^{\frac{x}{4}}$
(B) $y=\frac{5}{4}(4)^{\frac{x}{3}}$
(C) $y=5(3)^{\frac{x}{4}}$
✓ (D) $y=5(4)^{\frac{x}{3}}$

24. Solve: $3x^{-3}=81$.

(A) –9
(B) $\frac{1}{9}$
✓ (C) $\frac{1}{3}$
(D) 3

25. What is the range of the function $y=20(1.8)^x+3.4$?

✓ (A) $\{y|y>3.4, y\in R\}$
(B) $\{y|y\geq 3.4, y\in R\}$
(C) $\{y|y>23.4, y\in R\}$
(D) $\{y|y\geq 23.4, y\in R\}$

26. Solve: $4^{-2x+1}=\sqrt{8}$.

(A) $-\frac{1}{4}$
(B) $-\frac{1}{2}$
✓ (C) $\frac{1}{8}$
(D) $\frac{1}{2}$

27. What is the value of x if $f(x)=32$ for the function $f(x)=2^{-2(x-4)}$?

(A) $-\frac{13}{2}$
(B) $-\frac{9}{2}$
✓ (C) $\frac{3}{2}$
(D) $\frac{13}{2}$

28. A big screen TV is purchased for $2000 and depreciates by 2.5 % per year. What is the value, in dollars, of the TV after 3 years?

(A) 843.75
✓ (B) 1853.72
(C) 1950.00
(D) 1983.19

29. Which represents a decay curve with a *y*-intercept of 4?

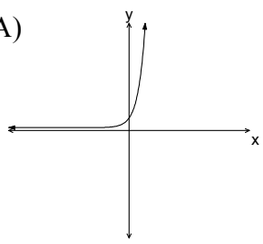
(A) $y = \left(\frac{1}{2}\right)^x - 3$
✓ (B) $y = \left(\frac{1}{2}\right)^x + 3$
(C) $y = (2)^x - 3$
(D) $y = (2)^x + 3$

30. The domain for an exponential function is $\{x \in R\}$ and the range is $\{y | y > 1, y \in R\}$. What is the equation of the horizontal asymptote for the graph of this function?

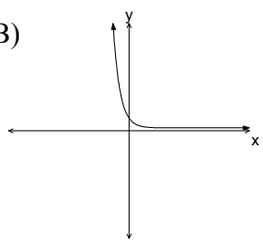
(A) $y = -1$
✓ (B) $y = 1$
(C) $x = -1$
(D) $x = 1$

31. Which is the graph of $y = \log_5 x$?

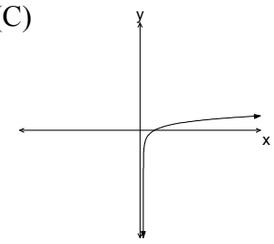
(A)



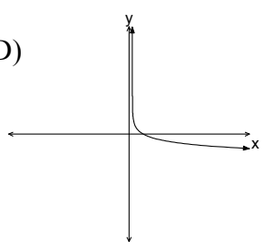
(B)



✓ (C)



(D)



32. What is the logarithmic form of $81^{\frac{3}{4}} = 27$?

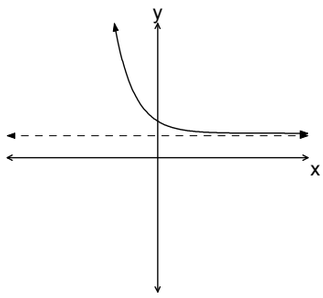
(A) $\log_{\frac{3}{4}}(27) = 81$

(B) $\log_{27}\left(\frac{3}{4}\right) = 81$

(C) $\log_{27}(81) = \frac{3}{4}$

✓ (D) $\log_{81}(27) = \frac{3}{4}$

33. Which equation describes the graph provided?



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

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

(C) $y = 2^x - 3$

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

34. What is the simplified form of $2\log_a 5 + \log_a 6 - \frac{1}{3}\log_a 8$?

(A) $\log_a 29$

(B) $\log_a 30$

✓ (C) $\log_a 75$

(D) $2\log_a 15$

35. What is the exact value of x for $(1.3)^x = 28$?

(A) $\frac{\log 1.3}{\log 28}$

(B) $\log\left(\frac{1.3}{28}\right)$

✓ (C) $\frac{\log 28}{\log 1.3}$

(D) $\log\left(\frac{28}{1.3}\right)$

36. What is the value of x for $\log_2 5 + \log_2 x = 3$?

(A) 1

(B) $\frac{6}{5}$

✓ (C) $\frac{8}{5}$

(D) 3

37. What transformation of $(x-4)^2 + (y-3)^2 = 1$ produces $\left[\frac{1}{2}(x-4)\right]^2 + \left[\frac{1}{5}(y-3)\right]^2 = 1$?

(A) horizontal stretch of $\frac{1}{2}$, vertical stretch of $\frac{1}{5}$

(B) horizontal stretch of $\sqrt{2}$, vertical stretch of $\sqrt{5}$

✓ (C) horizontal stretch of 2, vertical stretch of 5

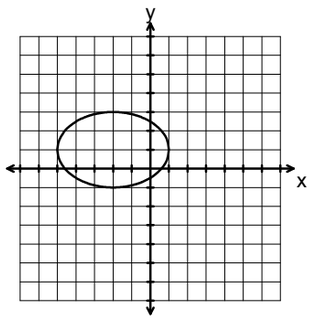
(D) horizontal stretch of 4, vertical stretch of 25

38. What is the length of the major axis of the ellipse given by the equation $\left[\frac{1}{3}(x-1)\right]^2+\left[\frac{1}{5}(y-3)\right]^2=1$?

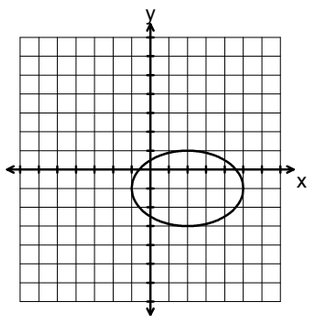
(A) 3
(B) 5
(C) 6
✓ (D) 10

39. Which is the graph of $\frac{1}{9}(x-2)^2+\frac{1}{4}(y+1)^2=1$?

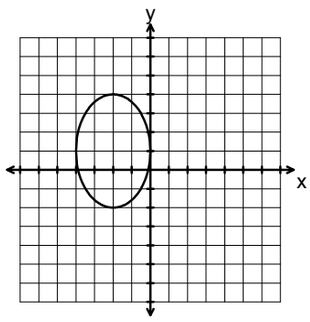
(A)



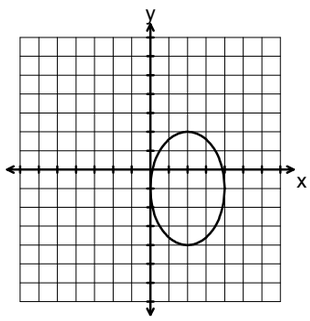
✓ (B)



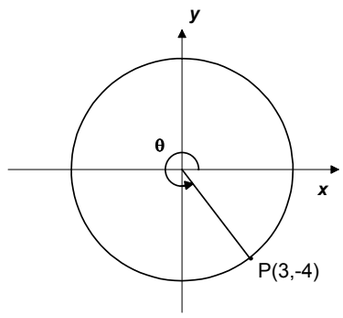
(C)



(D)



40. Which is true if point P is rotated through an angle θ from standard position as shown?

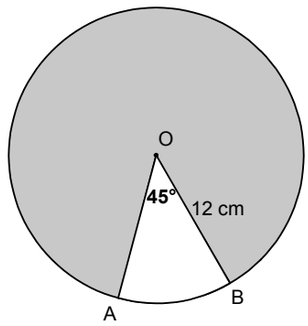


(A) $\cos\theta = -\frac{3}{5}$
✓ (B) $\cos\theta = \frac{3}{5}$
(C) $\sin\theta = -\frac{3}{4}$
(D) $\sin\theta = \frac{4}{5}$

41. Chords $\overline{AB}$ and $\overline{CD}$ are equidistant from the centre of a circle. What is the length of $\overline{CD}$ if $\overline{AB}$ has endpoints $A(-4,3)$ and $B(2,-5)$?

(A) $2\sqrt{17}$
(B) $4\sqrt{17}$
✓ (C) 10
(D) 100

42. The circle with centre O shown, has a radius of 12 cm. What is the area of the shaded region if $\angle AOB = 45°$?



(A) 32.99
(B) 56.55
✓ (C) 395.84
(D) 508.94

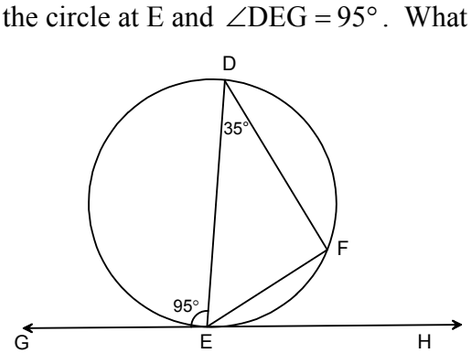
43. What is the radius of the circle given by $16x^2 + 16y^2 = 64$?

✓ (A) 2
(B) 4
(C) 8
(D) 64

44. Which angle of rotation, in degrees, on the unit circle will map $(1,0)$ to $\left(\frac{\sqrt{3}}{2}, -\frac{1}{2}\right)$?

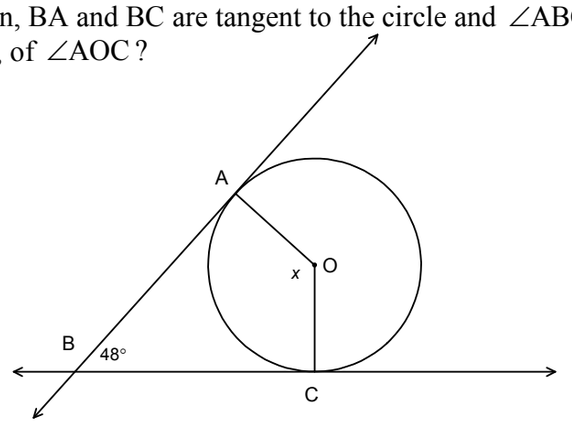
(A) 210
(B) 240
(C) 300
✓ (D) 330

45. In the circle shown, GH is tangent to the circle at E and $\angle DEG = 95°$. What is the measure, in degrees, of $\angle DEF$?



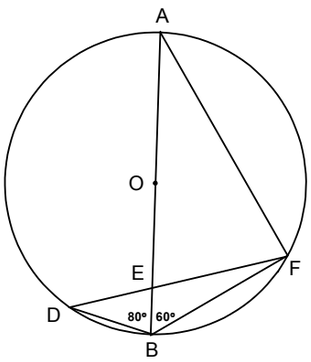
(A) 42.5
✓ (B) 50
(C) 55
(D) 72.5

46. In the circle with centre O shown, BA and BC are tangent to the circle and $\angle ABC = 48°$. What is the measure, in degrees, of $\angle AOC$?



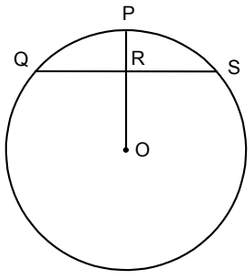
(A) 48
(B) 96
✓ (C) 132
(D) 138

47. In the circle with centre O shown, $\angle DBE = 80°$ and $\angle FBE = 60°$. What is the measure, in degrees, of $\angle BEF$?



(A) 70
(B) 90
✓ (C) 110
(D) 160

48. In the circle with centre O shown, $\overline{QR} = \overline{RS} = 4$ and $\overline{OP} = 8$. What is the exact value of $\overline{PR}$?

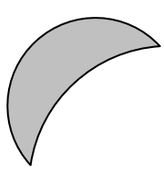


(A) $8 - 4\sqrt{5}$
✓ (B) $8 - 4\sqrt{3}$
(C) $4\sqrt{3}$
(D) $4\sqrt{5}$

49. A circle with centre $(2, -1)$ has a diameter AB. If one endpoint of the diameter is $B(6, 3)$, what are the coordinates of the other endpoint?

(A) $(-8, 1)$
✓ (B) $(-2, -5)$
(C) $(4, 1)$
(D) $(10, 7)$

50. A math student finds a broken piece of a circular CD. Which process could be used to determine the radius of the CD before it was broken?



(A) constructing the perpendicular bisector of a chord
✓ (B) constructing the perpendicular bisectors of two chords
(C) drawing a tangent to the circle
(D) drawing two tangents to the circle

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

Answer:

$4(x-3) = 3x^2$ **1 mark**

$4x - 12 = 3x^2$

$3x^2 - 4x + 12 = 0$ **1 mark**

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$= \frac{4 \pm \sqrt{16 - 4(3)(12)}}{2(3)}$ **0.5 marks**

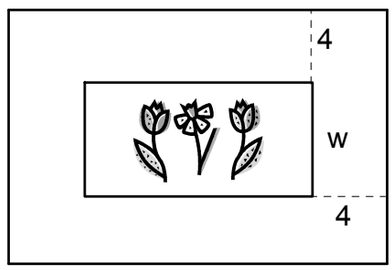
$= \frac{4 \pm \sqrt{-128}}{6}$ **0.5 marks**

$= \frac{4 \pm 8i\sqrt{2}}{6}$

$= \frac{2 \pm 4i\sqrt{2}}{3}$ **1 mark**

4 52. A flower bed is in the shape of a rectangle and its length is twice its width. The bed is surrounded by a 4 m wide walkway. If the total area of the bed and walkway is 504 m^2, algebraically determine the width of the flower bed.

Use $l = 2w$ **0.5 marks**



$504 = (2w+8)(w+8)$ **1 mark**

$504 = 2w^2 + 16w + 8w + 64$

$504 = 2w^2 + 24w + 64$

$0 = 2w^2 + 24w - 440$ **1 mark**

$0 = w^2 + 12w - 220$

$0 = (w-22)(w+10)$ **0.5 marks**

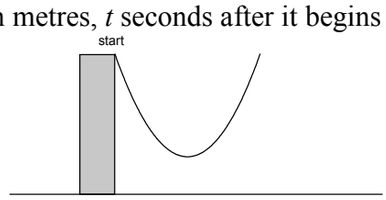
~~$w = -22$~~ $w = 10$ m

reject $w = -22$ **0.5 marks**

The width of the flower bed is 10 m. **0.5 marks**

Value

4 53. The flight path of an owl as it dives from a tree is shown below. The height of the owl above the ground, in metres, t seconds after it begins its dive is approximated by $h(t) = 25 - 20t + 5t^2$.



a) What is the height of the owl at the start of the dive? 25 m **1 mark**

b) Algebraically determine the minimum height of the owl.

Answer:

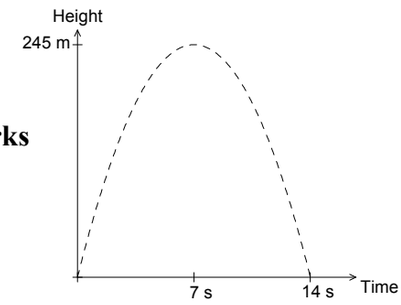
t-coordinate of the vertex:

$$t = -\frac{b}{2a}$$
$$= -\frac{(-20)}{2(5)}$$
$$= 2 \text{ sec} \qquad \textbf{1.5 marks}$$

$$h(t) = 25 - 20t + 5t^2$$
$$h(2) = 25 - 20(2) + 5(2)^2$$
$$h(2) = 5 \text{ m} \qquad \textbf{1 mark}$$

The minimum height of the owl above the ground is 5 m. **0.5 marks**

4 54. A signal flare is fired from ground level and reaches a maximum height of 245 m at a time of 7 s. After travelling for 14 s, the flare hits the ground. Algebraically determine the quadratic function representing the path of the flare, and use it to determine the approximate height of the flare at 9 s.



Answer:

vertex = $(7, 245)$ **0.5 marks**

Use the vertex and one other point to determine a.

$$\frac{1}{a}(y-k) = (x-h)^2$$
$$\frac{1}{a}(y-245) = (x-7)^2 \qquad \textbf{0.5 marks}$$
$$\frac{1}{a}(0-245) = (0-7)^2$$
$$\frac{-245}{a} = 49$$
$$a = \frac{-245}{49} = -5 \qquad \textbf{1 mark}$$
$$-\frac{1}{5}(y-245) = (x-7)^2 \qquad \textbf{1 mark}$$

At $t = 9$ sec: $-\frac{1}{5}(y-245) = (9-7)^2$ **0.5 marks**

$$y - 245 = -5(2)^2$$
$$y = 245 - 20$$
$$y = 225 \text{ m} \qquad \textbf{0.5 marks}$$

Value

4 55. The power, P, in Watts, supplied to a circuit by a 9 volt battery is given by the formula $P = 9I - 0.5I^2$, where I is the current in amperes. Calculate the approximate instantaneous rate of change in the power with a current of 5 amperes.

Answer:

$P(5.01) = 32.53995$ **1 mark**

$P(5.00) = 32.5$ **1 mark**

$$IRoC = \frac{P(5.01) - P(5)}{5.01 - 5}$$
$$= \frac{32.53995 - 32.5}{0.01}$$ **1 mark**
$$= \frac{0.03995}{0.01}$$
$= 4$ Watts/amp **1 mark**

4 56. Algebraically solve for x: $\sqrt{125^x} = (25)\left(5^{-2x}\right)$.

Answer:

$125^{\frac{x}{2}} = \left(5^2\right)\left(5^{-2x}\right)$ **1 mark**

$5^{\frac{3x}{2}} = 5^{-2x+2}$ **1 mark**

$\frac{3x}{2} = -2x + 2$ **1 mark**

$3x = -4x + 4$

$7x = 4$

$x = \frac{4}{7}$ **1 mark**

4 57. Algebraically solve for x: $\log(3 - x) = \frac{1}{2}\log 4 - \log x$.

Answer:

$\log(3 - x) = \log 4^{\frac{1}{2}} - \log x$ **0.5 marks**

$\log(3 - x) = \log\left(\frac{2}{x}\right)$ **1 mark**

$(3 - x) = \left(\frac{2}{x}\right)$ **0.5 marks**

$x(3 - x) = 2$ **0.5 marks**

$3x - x^2 = 2$

$x^2 - 3x + 2 = 0$ **0.5 marks**

$(x - 1)(x - 2) = 0$ **0.5 marks**

$x = 1 \quad x = 2$ **0.5 marks**

Value

4 58. A father invested \$500 for his son, who was born in 1990, in an account that paid 8% every 2 years. Another father bought his son a hockey card in 1990 for \$250 that appreciated at a rate of 10% per year. Write a function to model each situation and use the functions to determine which is worth more in 2008.

Answer:

Investment		Hockey Card	
$A(t) = 500(1.08)^{\frac{t}{2}}$	**1 mark**	$A(t) = 250(1.10)^{t}$	**1 mark**
$A(18) = 500(1.08)^{\frac{18}{2}}$		$A(18) = 250(1.10)^{18}$	
$= 500(1.08)^{9}$		$= \$1389.98$	
$= \$999.50$	**1 mark**	(worth more)	**1 mark**

4 59. A medication has a half-life of 7.5 days. If 30 mg of the medication is administered initially, determine the equation of the function and use it to calculate how long it will take, to the nearest day, for the amount of medication in the bloodstream to reduce to 6 mg.

Answer:

$A = 30\left(\frac{1}{2}\right)^{\frac{t}{7.5}}$	**1.5 marks**
$6 = 30\left(\frac{1}{2}\right)^{\frac{t}{7.5}}$	**0.5 marks**
$\frac{6}{30} = \left(\frac{1}{2}\right)^{\frac{t}{7.5}}$	**0.5 marks**
$\frac{1}{5} = \left(\frac{1}{2}\right)^{\frac{t}{7.5}}$	
$\log\left(\frac{1}{5}\right) = \frac{t}{7.5}\log\left(\frac{1}{2}\right)$	**0.5 marks**
$-0.699 = \frac{-0.301t}{7.5}$	
$t = \frac{-5.243}{-0.301}$	**0.5 marks**
$t = 17$ days	**0.5 marks**

Value

3 60. Write the equation $4x^2+9y^2-8x+72y+112=0$ in transformational form.

Answer:

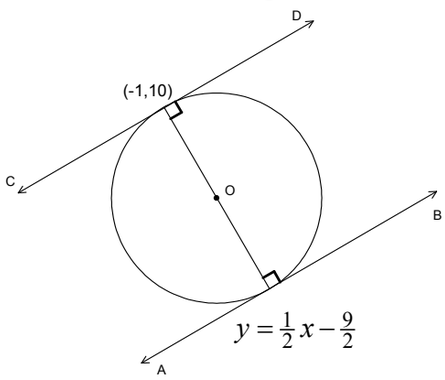
$4\left(x^2-2x+1\right)+9\left(y^2+8y+16\right)=-112+4+144$ **1 mark**

$\frac{4}{36}(x-1)^2+\frac{9}{36}(y+4)^2=\frac{36}{36}$ **1 mark**

$\frac{1}{9}(x-1)^2+\frac{1}{4}(y+4)^2=1$ **0.5 marks**

$\left[\frac{1}{3}(x-1)\right]^2+\left[\frac{1}{2}(y+4)\right]^2=1$ **0.5 marks**

3 61. In the circle with centre O shown, the equation of tangent line AB is given by $y=\frac{1}{2}x-\frac{9}{2}$. Algebraically determine the equation of line CD if it is tangent to the circle at $(-1,10)$.



Answer:

Since $AB \parallel CD$, $m_{AB}=m_{CD}=\frac{1}{2}$. **1 mark**

$y=\frac{1}{2}x+b$

$10=\frac{1}{2}(-1)+b$ **0.5 marks**

$10=-\frac{1}{2}+b$

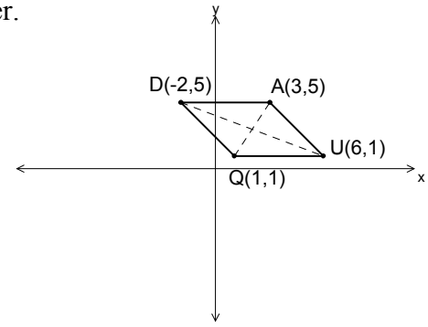
$b=\frac{21}{2}$ **0.5 marks**

The equation of line CD is:

$y=\frac{1}{2}x+\frac{21}{2}$ **1 mark**

Value

4 62. Using coordinate geometry, prove that the diagonals of the rhombus QUAD shown are perpendicular bisectors of one another.



Answer:

slope

$$m_{AQ} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-1}{3-1} = \frac{4}{2} = 2$$

$$m_{DU} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5-1}{-2-6} = \frac{4}{-8} = -\frac{1}{2}$$ **1.5 marks**

Since the slopes are negative reciprocals, $AQ \perp DU$. **0.5 marks**

mid-points

$$\text{midpoint of AQ} = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$
$$= \left(\frac{3+1}{2}, \frac{5+1}{2}\right)$$
$$= (2,3)$$

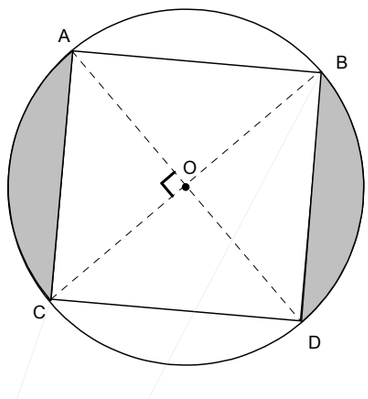
$$\text{midpoint of DU} = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$
$$= \left(\frac{-2+6}{2}, \frac{5+1}{2}\right)$$
$$= (2,3)$$ **1.5 marks**

midpoint of AQ = midpoint of DU

$\therefore$ AQ and DU bisect each other. **0.5 marks**

The diagonals are perpendicular bisects.

4 63. Square ABDC is inscribed in the circle with centre O shown. Calculate the total area of the shaded regions if the diameter of the circle is 10.



Answer:

$$A_{segment} = A_{sector} - A_{triangle}$$
$$= \frac{\theta}{360}\pi r^2 - \frac{1}{2}r^2 \sin\theta$$
$$= \frac{1}{4}\pi(5)^2 - \frac{1}{2}(5)^2 \sin 90°$$ **2 marks**
$$= \frac{25\pi}{4} - \frac{25}{2}$$
$$= 7.13 \text{ units}^2 \text{ per segment}$$ **1 mark**

$$\text{Total } A_{shaded} = 2A_{segment}$$
$$= 2 \times 7.13 \text{ units}^2$$
$$= 14.3 \text{ units}^2$$ **1 mark**