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 first level difference between successive terms in the sequence generated by $t_n = \frac{4}{3} - \frac{2}{5}n$?

   (A) $-\frac{4}{3}$

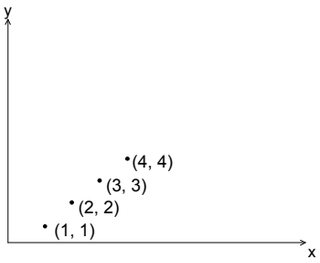
   * (B) $-\frac{2}{5}$

   (C) $\frac{2}{5}$

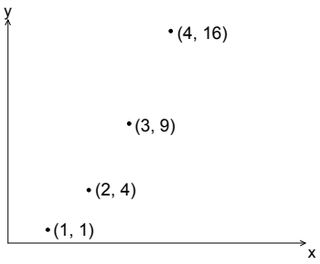
   (D) $\frac{4}{3}$

2. Which represents a quadratic sequence?

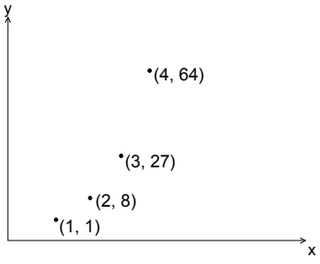
   (A)



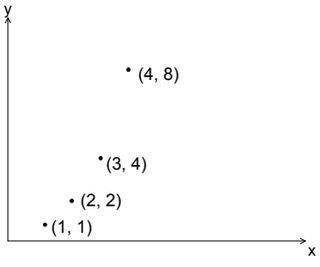
   * (B)



   (C)

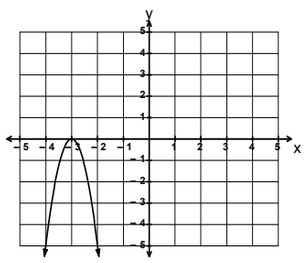


   (D)

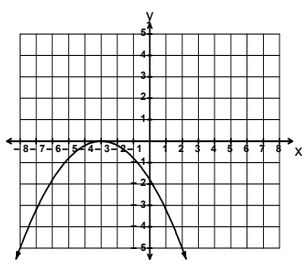


3. Which graph has a vertical stretch of 5 and is reflected in the *x*-axis when compared to the graph of $y = x^2$?

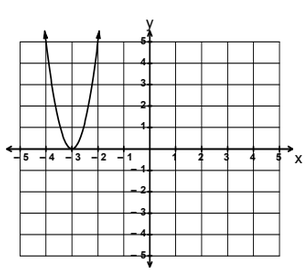
* (A)



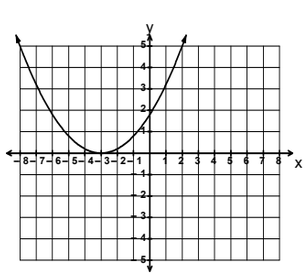
(B)



(C)



(D)



4. Which equation represents the image of $y = x^2$ under the mapping rule $(x, y) \rightarrow \left(x + 1, -\frac{1}{3}y\right)$?

* (A) $-3y = (x-1)^2$

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

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

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

5. What value of c will make $x^2 - 7x + c$ a perfect square trinomial?

(A) $-\frac{49}{4}$

(B) $-\frac{7}{2}$

(C) $\frac{7}{2}$

* (D) $\frac{49}{4}$

6. Which represents the transformation of the data below, under the mapping rule $(x, y) \rightarrow (x+1, 3y)$?

x	-2	-1	0	1	2
y	4	2	1	2	4

(A)

x	-2	-1	0	1	2
y	12	6	3	6	12

(B)

x	-3	-2	-1	0	1
y	12	6	3	6	12

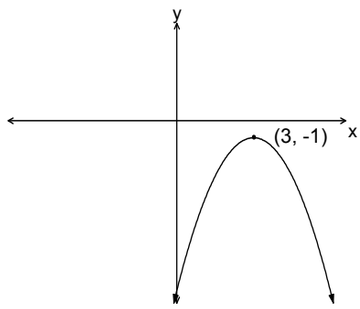
* (C)

x	-1	0	1	2	3
y	12	6	3	6	12

(D)

x	-1	0	1	2	3
y	$\frac{4}{3}$	$\frac{2}{3}$	$\frac{1}{3}$	$\frac{2}{3}$	$\frac{4}{3}$

7. What is the equation of the axis of symmetry for the graph below?



(A) $x = -3$
(B) $x = -1$
(C) $x = 1$
* (D) $x = 3$

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

(A) $-4, -2, \frac{1}{2}$
(B) $0, -2, \frac{1}{2}$
* (C) $-2, \frac{1}{2}$
(D) $2, -\frac{1}{2}$

9. What is the range of the function $-\frac{1}{4}(y+8) = (x-3)^2$?

* (A) $\{y \mid y \leq -8, y \in R\}$
(B) $\{y \mid y \geq -8, y \in R\}$
(C) $\{y \mid y \leq 8, y \in R\}$
(D) $\{y \mid y \geq 8, y \in R\}$

10. Which equation has roots -2 and $\frac{3}{4}$?

(A) $4x^2 - 11x + 6 = 0$
(B) $4x^2 - 5x - 6 = 0$
* (C) $4x^2 + 5x - 6 = 0$
(D) $4x^2 + 11x + 6 = 0$

11. What is the general form of $y = 2(x+3)^2 - 1$?

(A) $y = 2x^2 + 12x + 11$
(B) $y = 2x^2 + 12x + 16$
* (C) $y = 2x^2 + 12x + 17$
(D) $y = 2x^2 + 12x + 18$

12. What is the nature of the roots of $2x^2 - x - 3 = -5$?

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

13. Which equation would be used to determine two consecutive odd integers whose product is 143?

(A) $x(x+1) = 143$
* (B) $x(x+2) = 143$
(C) $x(2x+1) = 143$
(D) $(x+1)(x+2) = 143$

14. What is the value of k if $x = 3$ is a root of $2x^2 - kx - 3 = 0$?

(A) -5
(B) -3
(C) 3
* (D) 5

15. Solve: $(3x-2)^2 = 64$.

(A) $\frac{10}{3}$
* (B) $\frac{10}{3}, -2$
(C) $\pm\frac{2\sqrt{15}}{3}$
(D) $\pm\frac{2\sqrt{17}}{3}$

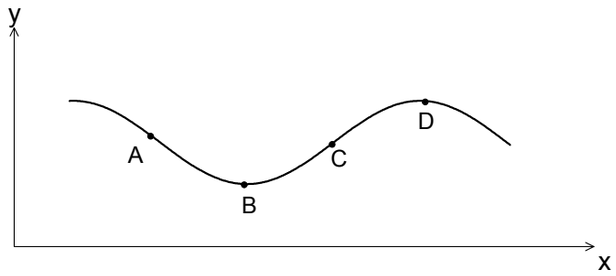
16. Simplify: $\frac{4 \pm \sqrt{-80}}{4}$.

(A) $\pm i\sqrt{5}$
(B) $\pm 4i\sqrt{5}$
* (C) $1 \pm i\sqrt{5}$
(D) $1 \pm 4i\sqrt{5}$

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

* (A) -21
(B) -19
(C) 19
(D) 21

18. At which point would a tangent be drawn to best indicate a positive instantaneous rate of change?



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

19. The table below shows the cost of gasoline, in cents/Litre, over a 4 month period. What is the approximate average rate of change in the price of gas between month 1 and month 4?

month	1	2	3	4
cents/Litre	96.8	97.2	100.4	105.4

(A) –2.9
(B) –0.3
(C) 0.3
* (D) 2.9

20. Which represents a geometric sequence?

(A) $\{2, 2+3, 2+3+3, ...\}$
(B) $\{2, 2\times 2, 2\times 3, 2\times 4, ...\}$
(C) $\{2, 2+3, 2+3^2, 2+3^3, ...\}$
* (D) $\{2, 2\times 3, 2\times 3^2, 2\times 3^3, ...\}$

21. Which is described by $y = 100(0.90)^{\frac{x}{5}}$?

(A) investment of $100 appreciating by 10% every 5 years
(B) investment of $100 appreciating by 90% every 5 years
* (C) investment of $100 depreciating by 10% every 5 years
(D) investment of $100 depreciating by 90% every 5 years

22. Which describes the data in the table below?

x	–3	0	3	6	9
y	2	4	8	16	32

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

23. What is the range of the function given by $y = 2(3)^x - 5$?

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

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

* (C) $\{y \mid y > -5, y \in R\}$

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

24. A motorcycle originally purchased for $15 000 appreciates 9% every 2 years. What is the value, in dollars, of the motorcycle after 6 years?

(A) 15 437.14

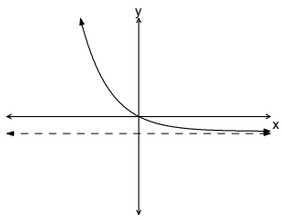
* (B) 19 425.44

(C) 25 156.50

(D) 102 885.00

25. Which graph represents $y + 1 = \left(\frac{1}{2}\right)^x$?

* (A)



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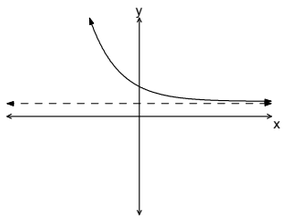

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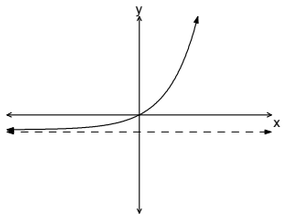
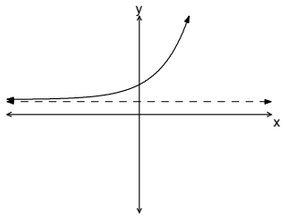


(D)



26. What is the exponential form of $\log_8\left(\frac{1}{4}\right) = x$?

* (A) $8^x = \frac{1}{4}$

(B) $8^{\frac{1}{4}} = x$

(C) $x^{\frac{1}{4}} = 8$

(D) $\frac{1}{4}^x = 8$

27. Which is equivalent to $4\left(\frac{1}{8}\right)^x$?

(A) 2^{-6x}
(B) 2^{-4x+2}
* (C) 2^{-3x+2}
(D) 2^{-x}

28. Simplify: $\left(2^{-1}-3^0\right)^{-1}$.

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

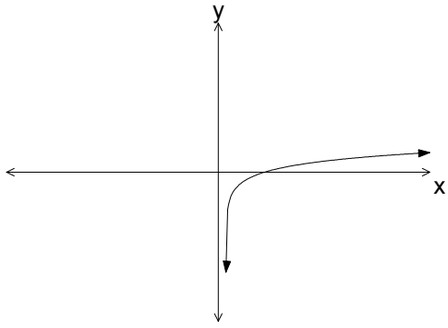
29. Solve: $5^{2x-3}=\left(\frac{1}{125}\right)^x$.

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

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

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

31. What type of function best describes the graph below?



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

32. Solve: $\log_5(2x)=\log_5\left(16^{-\frac{3}{4}}\right)$.

* (A) $\frac{1}{16}$
(B) $\frac{1}{4}$
(C) 4
(D) 16

33. What is the domain of $y = \log_5 (x+3)$?

(A) $\{x | x < -3, x \in R\}$

(B) $\{x | x \leq -3, x \in R\}$

* (C) $\{x | x > -3, x \in R\}$

(D) $\{x | x \geq -3, x \in R\}$

34. What is $2\log A + \log B - \log C$ written as a single logarithm?

(A) $\log \frac{2AB}{C}$

(B) $\log \frac{A^2C}{B}$

(C) $\log \frac{A^2}{BC}$

* (D) $\log \frac{A^2B}{C}$

35. Solve: $\log_2 5 = x$.

(A) $\log \frac{2}{5}$

(B) $\log \frac{5}{2}$

(C) $\frac{\log 2}{\log 5}$

* (D) $\frac{\log 5}{\log 2}$

36. Solve: $\log_3 4x + \log_3 2 = \log_3 24$.

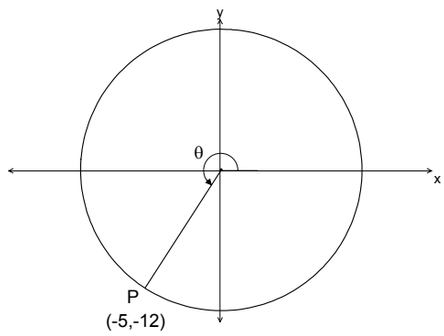
* (A) 3

(B) $\frac{11}{2}$

(C) $\frac{13}{2}$

(D) 12

37. If point P is rotated through an angle θ from standard position as shown, what is cos θ?



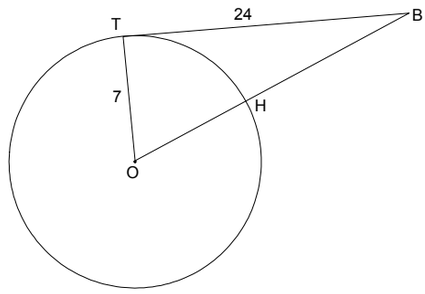
(A) -12

(B) -5

(C) $\frac{-12}{13}$

* (D) $\frac{-5}{13}$

38. In the circle with centre O shown, tangent $\overline{TB} = 24$ and $\overline{OT} = 7$. What is the length of $\overline{BH}$?



(A) 16
* (B) 18
(C) 23
(D) 25

39. What is the length of the major axis of the ellipse with equation $9x^2 + 16y^2 = 144$?

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

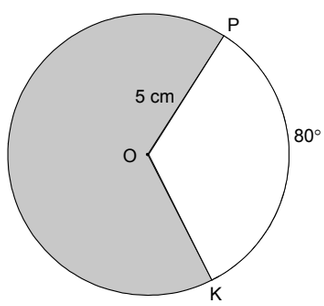
40. What is the transformational form of $x^2 + y^2 - 6x = 0$?

(A) $\left[\frac{1}{9}(x-3)\right]^2 + \left[\frac{1}{9}y\right]^2 = 1$
(B) $\left[\frac{1}{9}(x+3)\right]^2 + \left[\frac{1}{9}y\right]^2 = 1$
* (C) $\left[\frac{1}{3}(x-3)\right]^2 + \left[\frac{1}{3}y\right]^2 = 1$
(D) $\left[\frac{1}{3}(x+3)\right]^2 + \left[\frac{1}{3}y\right]^2 = 1$

41. What is the equation of a circle with centre $(-2,5)$ and diameter of 18?

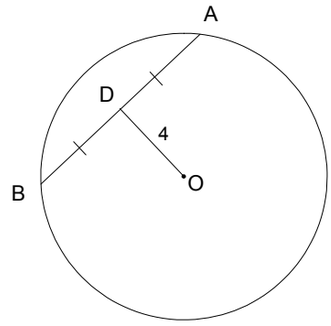
(A) $(x-2)^2 + (y+5)^2 = 9$
(B) $(x-2)^2 + (y+5)^2 = 81$
(C) $(x+2)^2 + (y-5)^2 = 9$
* (D) $(x+2)^2 + (y-5)^2 = 81$

42. In the circle with centre O shown, if minor $\overset{\frown}{PK} = 80°$ and $\overline{OP} = 5$ cm, what is the approximate area, in cm^2, of the shaded region?



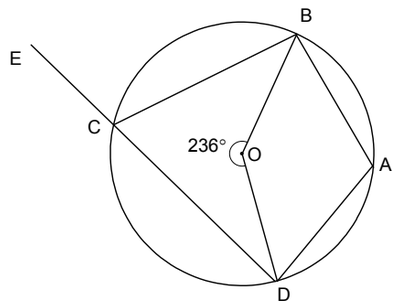
(A) 3.5
(B) 12.2
(C) 17.5
* (D) 61.1

43. In the circle with centre O shown, the radius is 6, $\overline{OD} = 4$ and D is the midpoint of chord $\overline{AB}$. What is the length of $\overline{AB}$?



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

44. In the circle with centre O shown, what is the measure, in degrees, of $\angle BCE$?

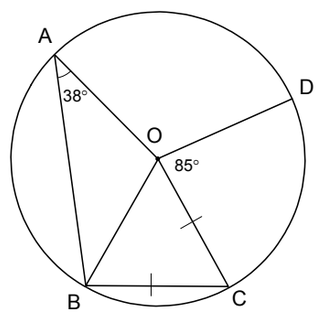


(A) 56
(B) 62
* (C) 118
(D) 124

45. If two sides of a triangle are congruent, then the angles opposite the congruent sides are congruent. What is the converse of this statement?

* (A) If two angles of a triangle are congruent, then the sides opposite the congruent angles are congruent.
(B) It two angles of a triangle are congruent, then the sides opposite the congruent angles are not congruent.
(C) If two sides of a triangle are congruent, then the angles opposite these sides are not congruent.
(D) If two sides of a triangle are not congruent, then the angles opposite these sides are not congruent.

46. In the circle with centre O shown, $\overline{OC} = \overline{BC}$, $\angle BAO = 38°$ and $\angle COD = 85°$. What is the measure, in degrees, of $\angle AOD$?



(A) 95
(B) 103
* (C) 111
(D) 130

47. Which represents an ellipse?

(A) $3x^2 + 3y^2 - 6y = 24$
* (B) $3x^2 + y^2 - 6y = 24$
(C) $3x^2 + y = 24$
(D) $3x^2 + 3y^2 - 6x - 6y = 24$

48. Which mapping rule will transform $x^2 + y^2 = 1$ to $\left[\frac{1}{4}x\right]^2 + \left[y-3\right]^2 = 1$?

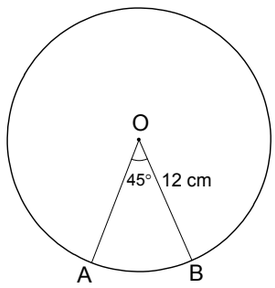
(A) $(x, y) \rightarrow \left(\frac{1}{4}x, y-3\right)$

(B) $(x, y) \rightarrow \left(\frac{1}{4}x, y+3\right)$

(C) $(x, y) \rightarrow (4x, y-3)$

* (D) $(x, y) \rightarrow (4x, y+3)$

49. In the circle with centre O shown, the radius is 12 cm and $\angle AOB = 45°$. What is the length, in cm, of minor $\overset{\frown}{AB}$?



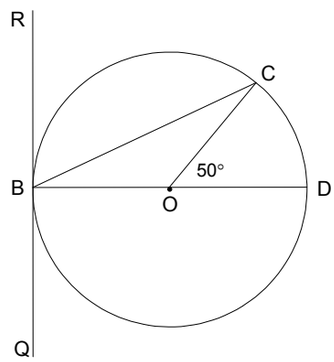
(A) 6.28

* (B) 9.42

(C) 12.57

(D) 18.85

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



(A) 50

* (B) 65

(C) 75

(D) 90

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 $\frac{4x-1}{x} = \frac{2x}{3}$.

$2x^2 = 12x - 3$ **0.5 marks**

$2x^2 - 12x + 3 = 0$ **0.5 marks**

$x = \frac{12 \pm \sqrt{(-12)^2 - 4(2)(3)}}{2(2)}$ **1 mark**

$x = \frac{12 \pm \sqrt{144 - 24}}{4}$ **0.5 marks**

$x = \frac{12 \pm \sqrt{120}}{4}$ **0.5 marks**

$x = \frac{12 \pm 2\sqrt{30}}{4}$ **0.5 marks**

$x = \frac{6 \pm \sqrt{30}}{2}$ **0.5 marks**

4 52. A cannonball follows a parabolic path described by the function $h(t) = -5t^2 + 20t + 2$, 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.

$t = -\frac{b}{2a} = -\frac{20}{2(-5)} = \frac{-20}{-10} = 2\,s$ **2 marks**

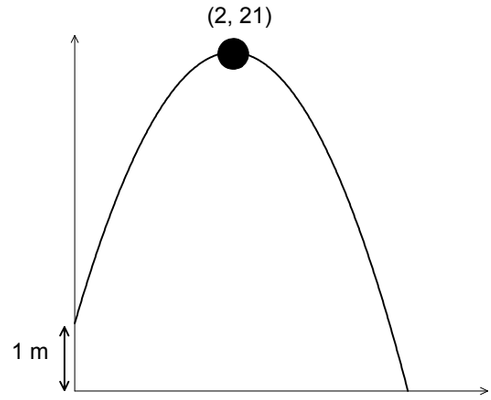
$h(2) = -5(2)^2 + 20(2) + 2$ **1 mark**

$h(2) = -20 + 40 + 2$

$h(2) = 22\,\text{m}$ **1 mark**

Value

4 53. A ball is thrown from an initial height of 1 m and follows a parabolic path as shown. After 2 seconds the ball reaches a maximum height of 21 m. Algebraically determine the quadratic function that models the path followed by the ball, and use it to determine the approximate height of the ball at 3 seconds.



$\frac{1}{a}(y-21)=(x-2)^2$ **1 mark**

$\frac{1}{a}(1-21)=(0-2)^2$ **0.5 marks**

$\frac{-20}{a}=4$

$a=-\frac{20}{4}=-5$ **0.5 marks**

$-\frac{1}{5}(y-21)=(x-2)^2$ **0.5 marks**

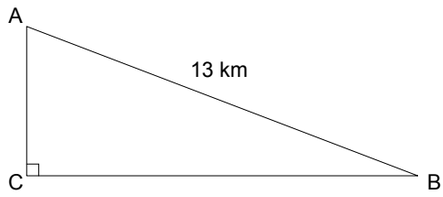
$-\frac{1}{5}(y-21)=(3-2)^2$ **0.5 marks**

$-\frac{1}{5}(y-21)=1$

$y-21=-5$

$y=16\,\text{m}$ **1 mark**

4 54. A person leaves house A and walks to house B and then to house C as shown below. The distance between houses B and C is 7 km more than the distance between houses A and C. Algebraically determine an equation to model this situation and use it to find the direct distance between houses A and C.



$AC=x$ and $BC=x+7$ **1 mark**

$x^2+(x+7)^2=13^2$ **0.5 marks**

$x^2+x^2+14x+49=169$

$2x^2+14x-120=0$ **0.5 marks**

$2(x^2+7x-60)=0$

$2(x+12)(x-5)=0$ **1 mark**

$x=-12,\ x=5$ **1 mark**

– 12 must be rejected. 0.5 marks deducted for failing to reject.

$x=5$

Therefore, the distance between houses A and C is 5 km.

Value

4 55. A volleyball follows a path given by $h(t) = -5t^2 + 10t + 2$, where *h* is the height in metres and *t* is the time in seconds since the ball was hit. Algebraically determine the approximate instantaneous rate of change in the height of the ball at 2 seconds, and describe how the height of the ball is changing at that instant.

$h(2.01) = -5(2.01)^2 + 10(2.01) + 2$ **0.5 marks**
$h(2.01) = 1.8995$ **0.5 marks**

$h(1.99) = -5(1.99)^2 + 10(1.99) + 2$ **0.5 marks**
$h(1.99) = 2.0995$ **0.5 marks**

$$IRoC = \frac{h(2.01) - h(1.99)}{2.01 - 1.99}$$
$$= \frac{1.8995 - 2.0995}{2.01 - 1.99}$$ **0.5 marks**
$$= \frac{-0.20}{0.02}$$ **0.5 marks**
$= -10$ m/s **0.5 marks**

The ball is moving downwards at a rate of 10 m/s. **0.5 marks**

4 56. Algebraically solve for *x*: $\left(\sqrt{3}\right)^{x+6} = \left(\frac{1}{9}\right)^{x}$.

$\left(3^{\frac{1}{2}}\right)^{x+6} = \left(3^{-2}\right)^{x}$ **1 mark**
$3^{\frac{1}{2}x+3} = 3^{-2x}$ **1 mark**
$\frac{1}{2}x + 3 = -2x$ **0.5 marks**
$\frac{1}{2}x + 2x = -3$ **0.5 marks**
$\frac{5}{2}x = -3$ **0.5 marks**
$5x = -6$
$x = -\frac{6}{5}$ **0.5 marks**

4 57. Algebraically solve for *x*: $\log_3\left(x^2 - 19\right) - \log_3\left(x + 3\right) = 1$.

$\log_3 \frac{x^2 - 19}{x + 3} = 1$ **1 mark**
$3^1 = \frac{x^2 - 19}{x + 3}$ **0.5 marks**
$x^2 - 19 = 3x + 9$ **0.5 marks**
$x^2 - 3x - 28 = 0$ **0.5 marks**
$(x - 7)(x + 4) = 0$ **0.5 marks**
$x = 7,\ x = -4$ **1 mark**

– 4 must be rejected. 0.5 marks deducted for failing to reject.

$x = 7$

Value

4 58. Initially there are 150 rabbits in a certain area and after 15 months there are 300 rabbits. After another 15 months there are 600 rabbits. If this pattern continues, algebraically determine the exponential equation that models this situation, and use it to determine the rabbit population after 5 years.

$y = 150(2)^{\frac{x}{15}}$ **2 marks**

$y = 150(2)^{\frac{60}{15}}$ **1 mark**

$y = 2400$ rabbits **1 mark**

4 59. The half-life of a radioactive element is 10 seconds. If 16 grams of this element are initially present, create and solve an exponential equation to determine how long it will take for 3 grams of the element to remain.

$y = 16\left(\frac{1}{2}\right)^{\frac{x}{10}}$ **1.5 marks**

$3 = 16\left(\frac{1}{2}\right)^{\frac{x}{10}}$ **0.5 marks**

$\frac{3}{16} = \left(\frac{1}{2}\right)^{\frac{x}{10}}$ **0.5 marks**

$\log\left(\frac{3}{16}\right) = \frac{x}{10}\log\left(\frac{1}{2}\right)$ **1 mark**

$\frac{x}{10} = 2.42$

$x = 24\,\text{s}$ **0.5 marks**

3 60. The endpoints of the diameter of a circle are $\text{P}(-3,4)$ and $\text{Q}(5,8)$. Determine the equation of the circle in standard form.

$\text{centre} = \left(\frac{-3+5}{2}, \frac{4+8}{2}\right)$

$\text{centre} = (1,6)$ **1 mark**

$(x-1)^2 + (y-6)^2 = r^2$

$(-3-1)^2 + (4-6)^2 = r^2$ **0.5 marks**

$16 + 4 = r^2$

$20 = r^2$ **0.5 marks**

$(x-1)^2 + (y-6)^2 = 20$ **1 mark**

Value

3 61. Given the equation $9x^2 + 18x + y^2 + 4 = 0$, state the centre and determine whether the centre lies on the line $3x + 2y - 1 = 0$.

$9x^2 + 18x + y^2 = -4$

$9(x^2 + 2x + 1) + y^2 = -4 + 9$ **1 mark**

$9(x+1)^2 + y^2 = 5$ **0.5 marks**

centre $(-1,0)$ **0.5 marks**

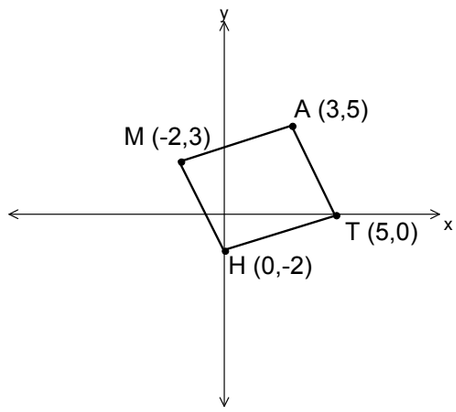
$3x + 2y - 1 = 0$

$3(-1) + 2(0) - 1 = 0$

$-4 \neq 0$ **0.5 marks**

$\therefore$ The centre does not lie on the line. **0.5 marks**

4 62. Using coordinate geometry, prove that opposite sides $\overline{MH}$ and $\overline{AT}$ of figure MATH below are congruent and parallel.



$d_{\overline{MH}} = \sqrt{(-2-3)^2 + (0+2)^2}$ **0.5 marks**

$d_{\overline{MH}} = \sqrt{(-5)^2 + (2)^2}$

$d_{\overline{MH}} = \sqrt{29}$ **0.5 marks**

$d_{\overline{AT}} = \sqrt{(0-5)^2 + (5-3)^2}$ **0.5 marks**

$d_{\overline{AT}} = \sqrt{(-5)^2 + (2)^2}$

$d_{\overline{AT}} = \sqrt{29}$ **0.5 marks**

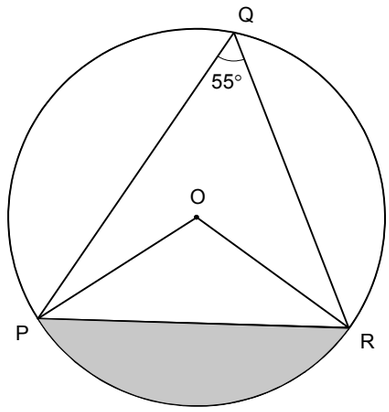
$m_{\overline{MH}} = \frac{-2-3}{0--2} = \frac{-5}{2}$ **0.5 marks**

$m_{\overline{AT}} = \frac{0-5}{5-3} = \frac{-5}{2}$ **0.5 marks**

Since $\overline{MH} = \overline{AT}$, the sides are congruent. **0.5 marks**

Since $m_{\overline{MH}} = m_{\overline{AT}}$, the sides are parallel. **0.5 marks**

4 63. In the circle with centre O shown, determine the area of the shaded region if $\angle PQR = 55°$ and the diameter of the circle is 10 cm.



$\angle POR = 110°$ **0.5 marks**
$r = 5$ **0.5 marks**

$A_{sector} = \frac{110}{360}\pi(5)^2$ **0.5 marks**
$A_{sector} = 23.998cm^2$ **0.5 marks**

$A_{\Delta} = \frac{1}{2}(5)(5)(\sin 110°)$ **0.5 marks**
$A_{\Delta} = 11.746cm^2$ **0.5 marks**

$A_{shaded} = 23.998 - 11.746$ **0.5 marks**
$A_{shaded} = 12.252cm^2$ **0.5 marks**