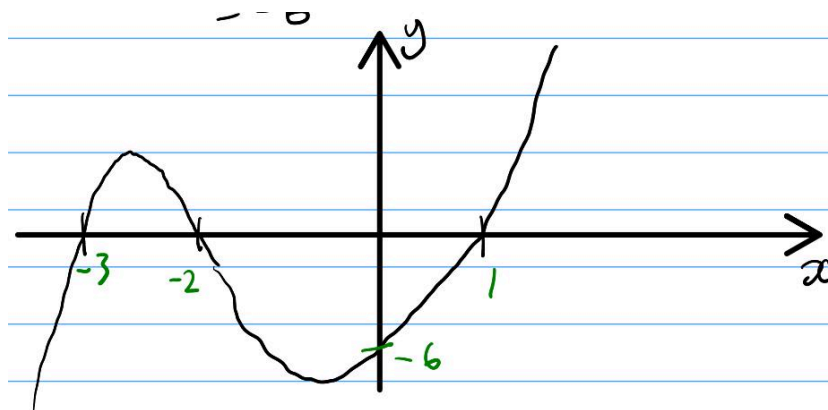
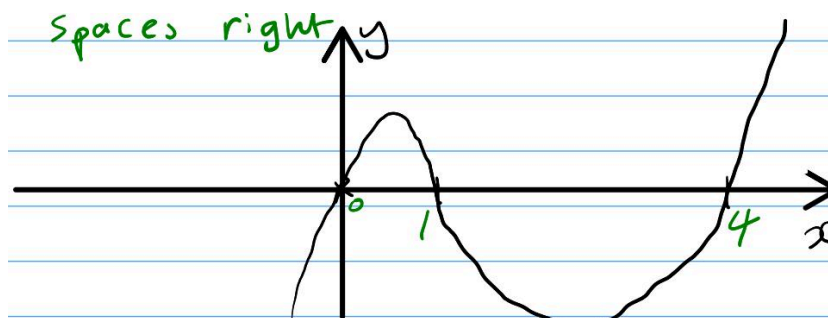


1

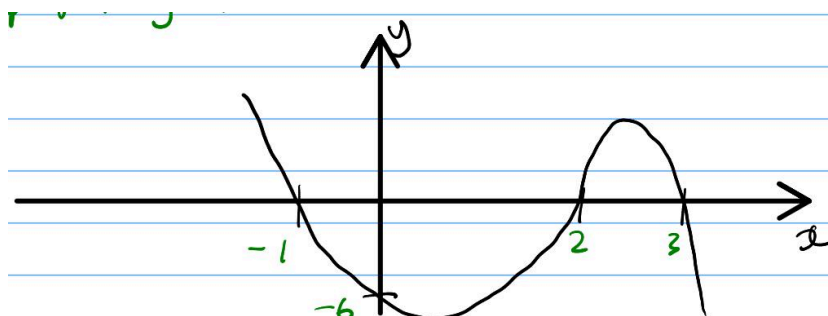
- (a)
- Positive cubic shape. (B1)
 - Crosses x -axis at $-3, -2, 1$. (B1)
 - Crosses y -axis at -6 . (B1)



- (bi)
- Translation 3 units right. (M1)
 - Intercepts at $(0, 0), (1, 0), (4, 0)$. (A1)



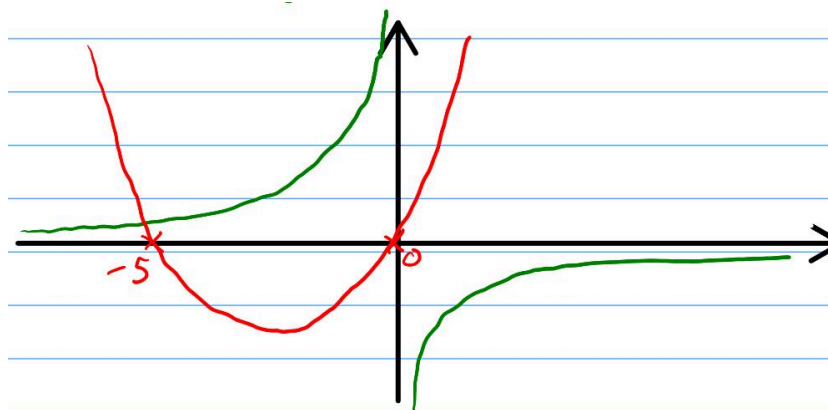
- (bii)
- Reflection in the y -axis. (M1)
 - Intercepts at $(-1, 0), (2, 0), (3, 0)$ and y -intercept at -6 . (A1)



(Total for question 1 is 7 marks)

2

- (a)
- $y = x(x + 5)$ crosses x at 0 and -5 . (B1)
 - Correct parabola shape. (B1)
 - Correct negative reciprocal graph shape (quadrants 2 and 4). (B1)
 - Correct relative positions showing one intersection. (B1)

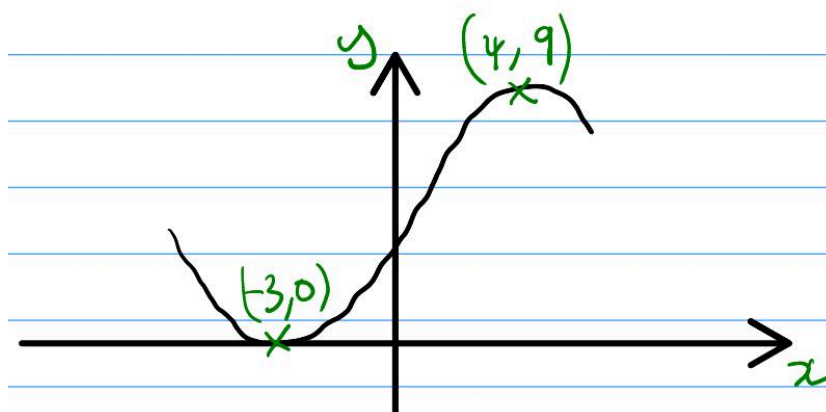


- (b)
- One real solution. (B1)
 - Because the graphs of $y = x^2 + 5x$ and $y = -\frac{1}{x}$ intersect exactly once. (B1)

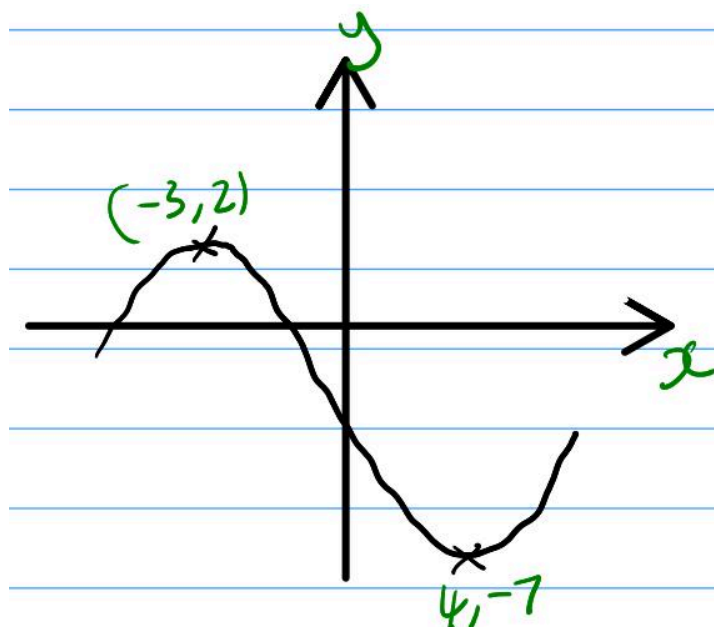
(Total for question 2 is 6 marks)

3

- (i)
- Translation 2 units up. (M1)
 - Minimum at $(-3, 0)$ and maximum at $(4, 9)$. (A1)



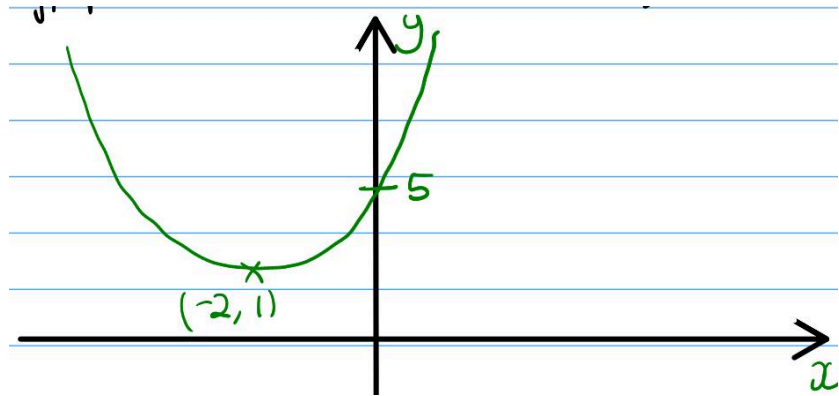
- (ii)
- Reflection in the x -axis. (M1)
 - Maximum at $(-3, 2)$ and minimum at $(4, -7)$. (A1)



(Total for question 3 is 4 marks)

4

- (a)
- $f(x) = (x + 2)^2 - 4 + 5 = (x + 2)^2 + 1$ (M1) (A1)
 - Min point at $(-2, 1)$ (B1)
- (b)
- y -intercept at $(0, 5)$. (B1)
 - Correct shape and position (does not cross x -axis). (B1)
 - Vertex at $(-2, 1)$ labeled. (B1)

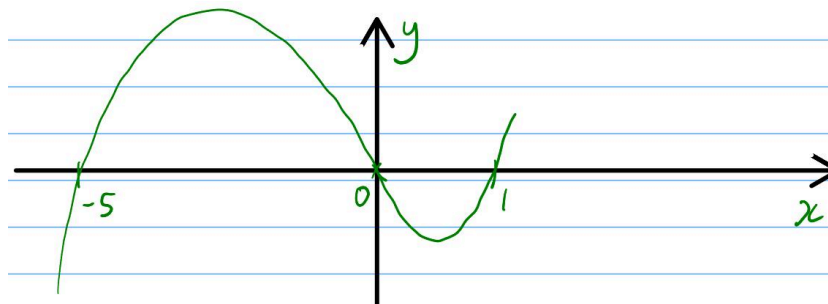


- (ci)
- Double y coordinate: $(-2, 2)$. (B2)
- (cii)
- Half x coordinate: $(-1, 1)$. (B2)

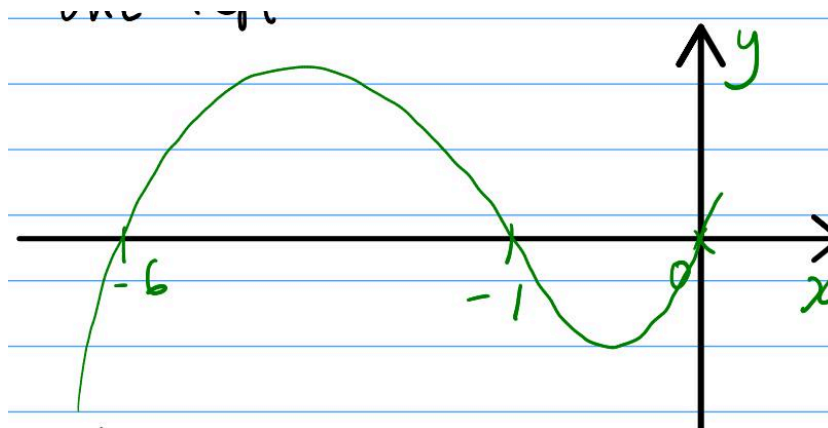
(Total for question 4 is 10 marks)

5

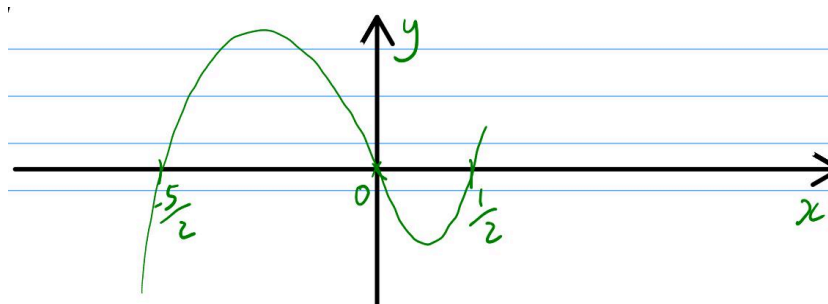
- (a)
- $x(x^2 + 4x - 5) = x(x + 5)(x - 1)$. (M1)
 - Intercepts at $x = 0, -5, 1$. (A1)
 - Positive cubic shape. (B1)



- (bi)
- Translation 1 unit left. (M1)
 - Intercepts at $x = -6, -1, 0$. (A1)



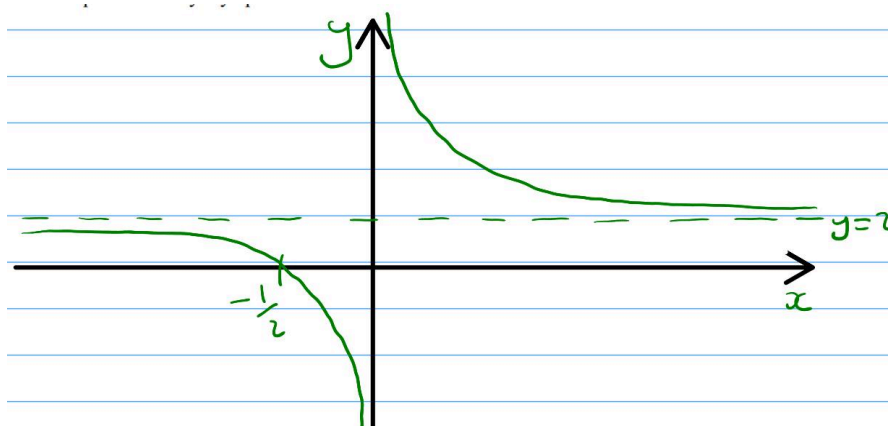
- (bii)
- Stretch parallel to x -axis scale factor 0.5. (M1)
 - Intercepts at $x = -2.5, 0, 0.5$. (A1)



(Total for question 5 is 7 marks)

6

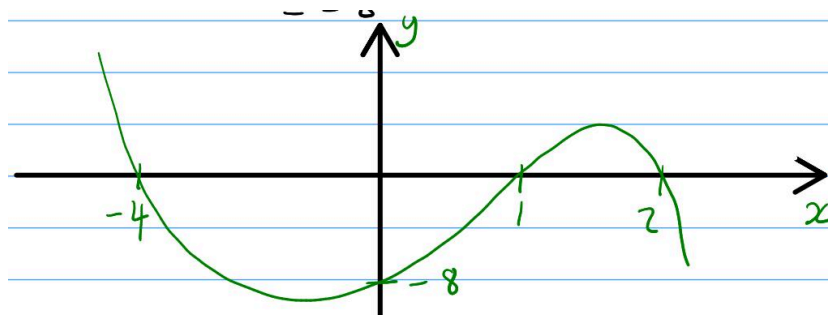
- Horizontal asymptote at $y = 2$. (B1)
- Vertical asymptote at $x = 0$. (B1)
- x -intercept at $x = -0.5$. (B1)



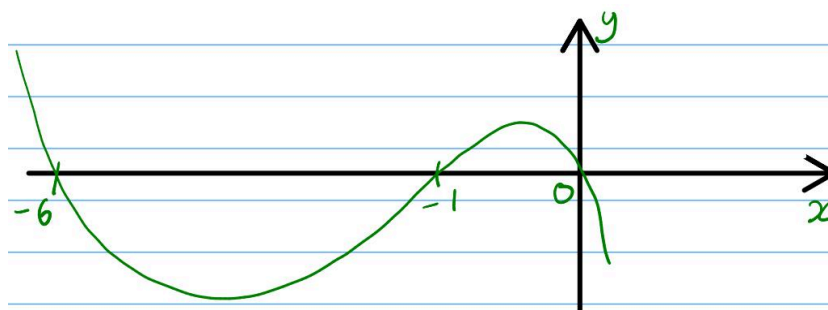
(Total for question 6 is 3 marks)

7

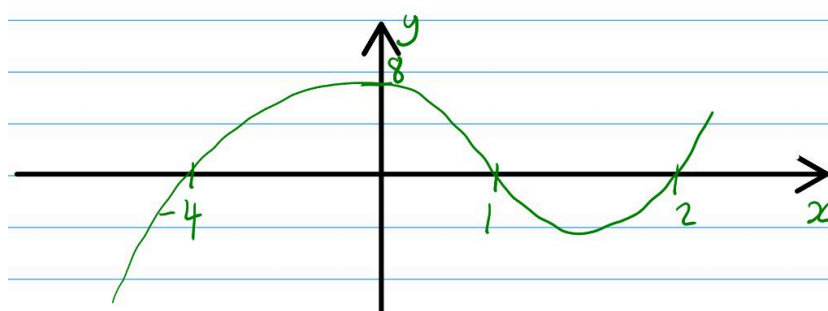
- (a)
- Negative cubic shape. (B1)
 - x -intercepts at $-4, 1, 2$. (B1)
 - y -intercept at -8 . (B1)



- (bi)
- Translation 2 units left. (M1)
 - Intercepts at $x = -6, -1, 0$. (A1)



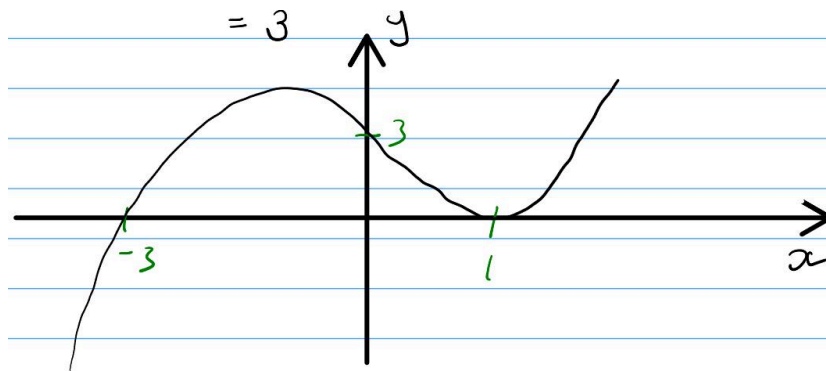
- (bii)
- Reflection in the x -axis. (M1)
 - Intercepts at $x = -4, 1, 2$ and y -intercept at 8 . (A1)



(Total for question 7 is 7 marks)

8

- (a)
- Positive cubic shape. (B1)
 - x -intercepts at -3 and 1 (repeated root). (B1)
 - y -intercept at 3 . (B1)



- (b)
- Substitute $(x + 2)$ for x : $(x + 2 + 3)(x + 2 - 1)^2$. (M1)
 - $y = (x + 5)(x + 1)^2$. (A1)

(Total for question 8 is 5 marks)

9

- (a)
- Replace x with $(x - 4)$. (M1)
 - $y = \frac{2}{x-5}$. (A1)
- (b)
- Stretch parallel to the y -axis. (B1)
 - Scale factor 1.5 (or $3/2$). (B1)

(Total for question 9 is 4 marks)

10

- (a) Figure 2. (B1)
- (b) Figure 5. (B1)

(Total for question 10 is 2 marks)

11 $f(2x) = 10$ when $x = 2$. (B1)

(Total for question 11 is 1 mark)

- 12
- $C_1 : y = (x - 2)^2$ and $L_1 : y = \frac{1}{3}x$. (B1)
 - $(x - 2)^2 = \frac{1}{3}x \Rightarrow 3(x^2 - 4x + 4) = x \Rightarrow 3x^2 - 13x + 12 = 0$. (M1)
 - $(3x - 4)(x - 3) = 0 \Rightarrow x = 3, x = \frac{4}{3}$. (A1)
 - Points are $(3, 1)$ and $(\frac{4}{3}, \frac{4}{9})$. (M1)
 - $d^2 = (3 - \frac{4}{3})^2 + (1 - \frac{4}{9})^2 = (\frac{5}{3})^2 + (\frac{5}{9})^2 = \frac{25}{9} + \frac{25}{81} = \frac{250}{81}$. (M1)
 - $d = \frac{\sqrt{250}}{9} = \frac{5\sqrt{10}}{9}$. (A1)

(Total for question 12 is 6 marks)

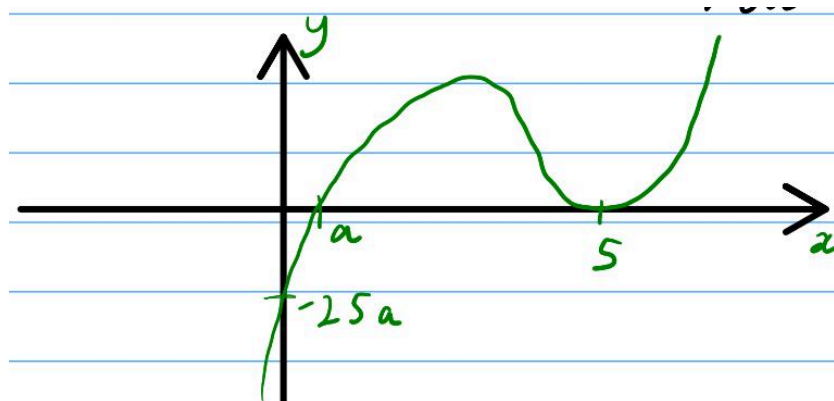
- 13
- (a) $y = \frac{1}{x-2}$. (B1)
- (b) $x = 2$ and $y = 0$. (B2)

(Total for question 13 is 3 marks)

- 14
- (a) $y = \frac{1}{x} + 2$. (B1)
- (b) $y = 2$ and $x = 0$. (B2)

(Total for question 14 is 3 marks)

- 15
- (a)
- Positive cubic shape. (B1)
 - x -intercepts at a and 5 (repeated root). (B1)
 - y -intercept at $-25a$. (B1)



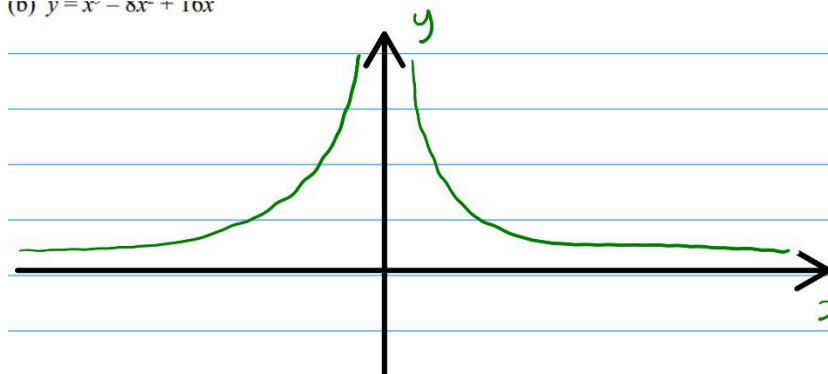
- (b)
- $a < x < 5$ or $x > 5$. (M1)
 - $\{x : a < x < 5\} \cup \{x : x > 5\}$. (A1)

(Total for question 15 is 5 marks)

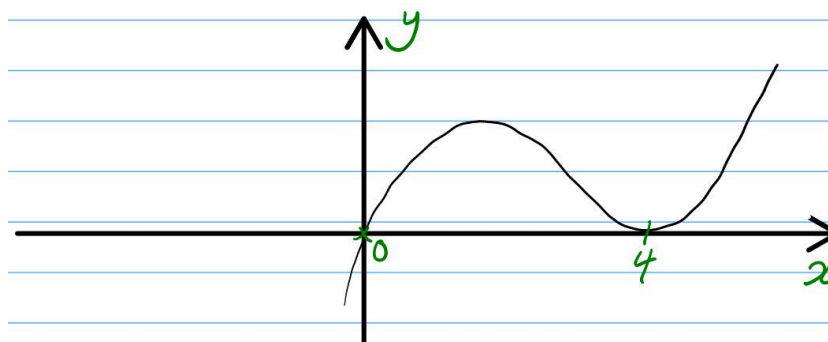
16

- (a)
- Correct shape in 1st and 2nd quadrants. (B1)
 - Asymptotic to both axes. (B1)

(b) $y = x^2 - 8x + 16x$



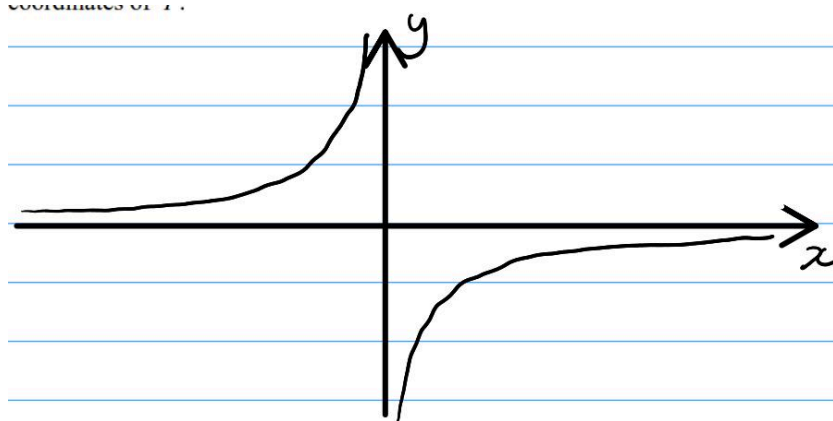
- (b)
- $x(x^2 - 8x + 16) = x(x - 4)^2$. (M1)
 - x -intercepts at 0 and 4 (repeated root). (A1)
 - Positive cubic shape. (B1)
 - Correct relative positions of intercepts. (B2)



(Total for question 16 is 7 marks)

17

- (a) • Correct shape in 2nd and 4th quadrants. (B1)



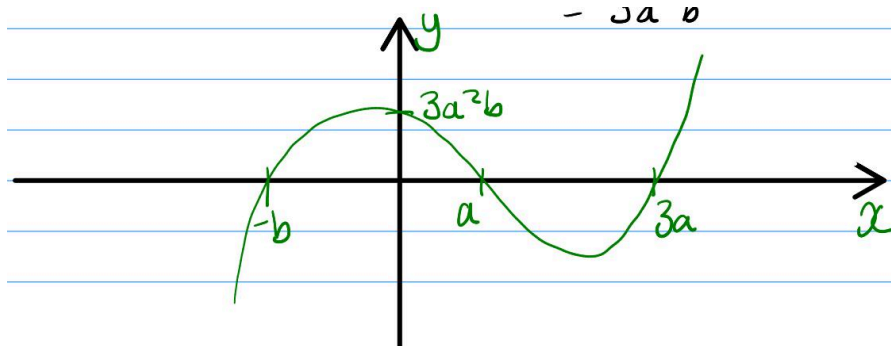
(b) $y = \frac{-2}{x-2}$. (B2)

- (c) • y coordinate is doubled: $-1 \times 2 = -2$. (M1)
• $P = (2, -2)$. (A1)

(Total for question 17 is 5 marks)

18

- Positive cubic shape. (B1)
• x -intercepts at $a, 3a, -b$. (B1)
• y -intercept at $3a^2b$. (B2)



(Total for question 18 is 4 marks)

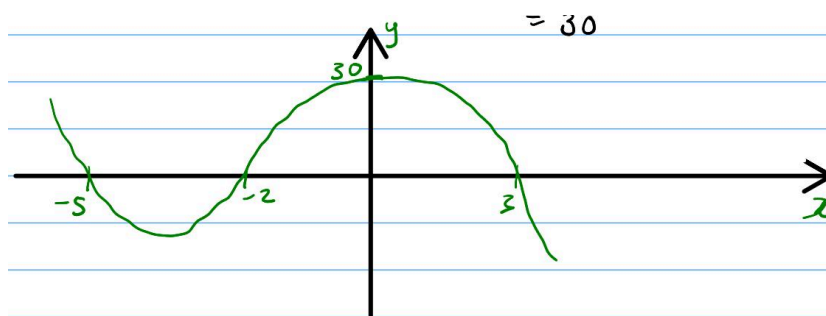
19

- Replace x with $2x$. (M1)
• $y = (2x - 2)^2$. (A1)

(Total for question 19 is 2 marks)

20

- (a)
- Negative cubic shape. (B1)
 - x -intercepts at $-5, -2, 3$. (B1)
 - y -intercept at 30 . (B2)

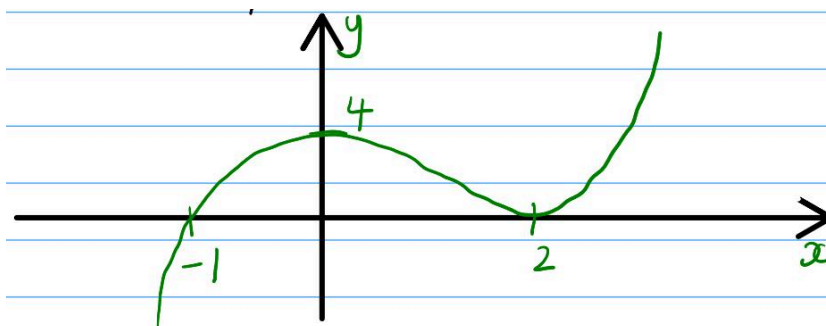


- (b)
- Replace x with $(x - 2)$. (M1)
 - $y = (x - 2 + 5)(x - 2 + 2)(3 - (x - 2)) = (x + 3)(x)(5 - x)$. (A1)

(Total for question 20 is 6 marks)

21

- (a)
- Positive cubic shape. (B1)
 - x -intercepts at -1 and 2 (repeated root). (B1)
 - y -intercept at 4 . (B1)

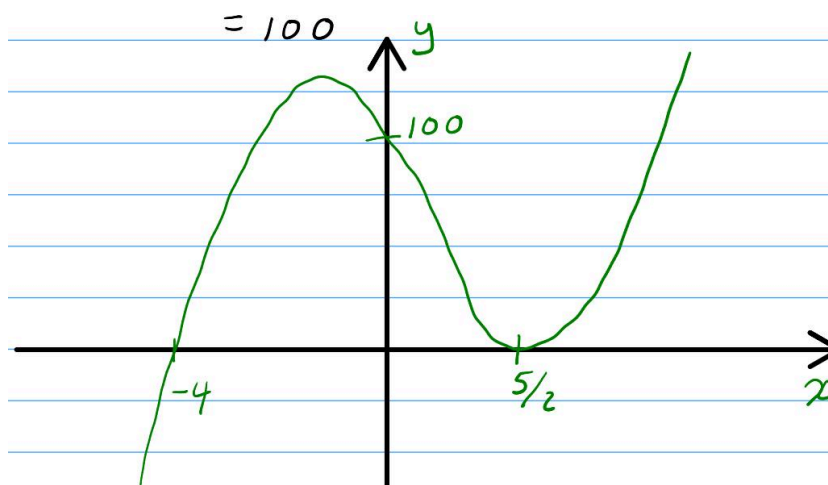


- (b)
- $x \leq -1$ or $x = 2$. (B2)

(Total for question 21 is 5 marks)

22

- (a)
- Positive cubic shape. (B1)
 - x -intercepts at -4 and 2.5 (repeated root). (B1)
 - y -intercept at 100 . (B1)

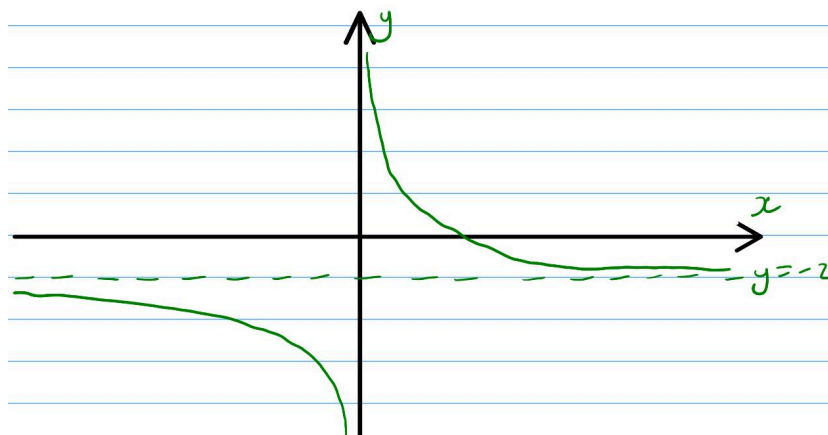


- (bi) $x \geq -4$. (B1)
- (bii)
- $2x = -4 \Rightarrow x = -2$. (B1)
 - $2x = 2.5 \Rightarrow x = 1.25$. (B1)

(Total for question 22 is 6 marks)

23

- (a)
- Reciprocal shape in 1st and 3rd quadrants relative to asymptotes. (B1)
 - Horizontal asymptote $y = -2$. (B1)
 - Vertical asymptote $x = 0$. (B1)

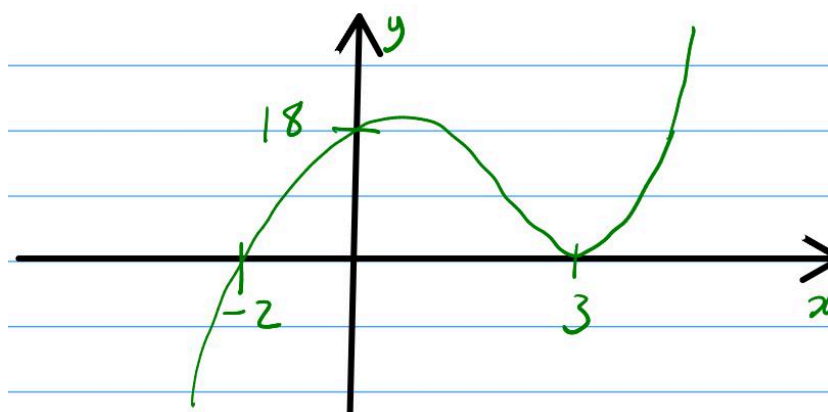


- (b)
- $\frac{k^2}{x} - 2 = -3x + 4$. (M1)
 - $k^2 - 2x = -3x^2 + 4x \Rightarrow 3x^2 - 6x + k^2 = 0$. (A1)
- (c)
- For a tangent, $b^2 - 4ac = 0$. (M1)
 - $(-6)^2 - 4(3)(k^2) = 0 \Rightarrow 36 - 12k^2 = 0$. (M1)
 - $k^2 = 3 \Rightarrow k = \pm\sqrt{3}$. (A1)

(Total for question 23 is 8 marks)

24

- (a)
- Positive cubic shape. (B1)
 - x -intercepts at -2 and 3 (repeated root). (B1)
 - y -intercept at 18 . (B1)



- (b)
- Curve passes through origin if x -intercept is shifted to 0 . (M1)
 - $k = -2$ (shifts $x = 2$ to 0) or $k = 3$ (shifts $x = -3$ to 0). (A1)

(Total for question 24 is 5 marks)

25

- (a)
- $x(3x^2 - 11x + 6) = 0$. (M1)
 - $x(3x - 2)(x - 3) = 0$. (M1)
 - $x = 0, x = \frac{2}{3}, x = 3$. (A1)
- (b)
- Let $x = (y + 2)^2$. (M1)
 - $(y + 2)^2 = 0 \Rightarrow y = -2$. (A1)
 - $(y + 2)^2 = 3 \Rightarrow y = -2 \pm \sqrt{3}$. (A1)
 - $(y + 2)^2 = \frac{2}{3} \Rightarrow y = -2 \pm \sqrt{\frac{2}{3}}$. (A1)

(Total for question 25 is 6 marks)
