1. A function $g(x) = x^3 + 6x^2 + 12x + 18$

(a) Find $g'(x)$.

(3)

(b) Solve $g'(x) = 0$.

(2)

(c) (i) Calculate the values of $g'(x)$ when

(a) $x = -3$;

(b) $x = 0$.

(ii) Hence state whether the function is increasing or decreasing at

(a) $x = -3$;

(b) $x = 0$.

(4)
(Total 9 marks)

2. Consider the function $g(x) = x^4 + 3x^3 + 2x^2 + x + 4$.

Find

(a) $g'(x)$

(3)

(b) $g'(1)$

(2)
(Total 5 marks)

3. A function is given as $y = ax^2 + bx + 6$.

(a) Find $\dfrac{dy}{dx}$.

(2)

(b) If the gradient of this function is 2 when x is 6 write an equation in terms of a and b.

(2)

(c) If the point (3, –15) lies on the graph of the function find a second equation in terms of a and b.

(2)
(Total 6 marks)

4. (a) Differentiate the following function with respect to x:

$$f(x) = 2x - 9 - 25x^{-1}$$

(b) Calculate the x-coordinates of the points on the curve where the gradient of the tangent to the curve is equal to 6.

(Total 6 marks)

5. (a) Differentiate the function $y = x^2 + 3x - 2$.

(b) At a certain point (x, y) on this curve the gradient is 5. Find the co-ordinates of this point.

(Total 6 marks)

6. Consider the function $f(x) = \frac{3}{x^2} + x - 4$.

(a) Calculate the value of $f(x)$ when $x = 1$.

(2)

(b) Differentiate $f(x)$.

(4)

(c) Find $f'(\text{l})$.

(2)

(d) Explain what $f'(\text{l})$ represents.

(2)

(e) Find the equation of the tangent to the curve $f(x)$ at the point where $x = 1$.

(3)

(f) Determine the x-coordinate of the point where the gradient of the curve is zero.

(3)
(Total 16 marks)

7. (a) On the same graph sketch the curves $y = x^2$ and $y = 3 - \frac{1}{x}$ for values of x from 0 to 4 and values of y from 0 to 4. Show your scales on your axes.

(4)

(b) Find the points of intersection of these two curves.

(4)

(c) (i) Find the gradient of the curve $y = 3 - \frac{1}{x}$ in terms of x.

(ii) Find the value of this gradient at the point (1, 2).

(4)

(d) Find the equation of the tangent to the curve $y = 3 - \frac{1}{x}$ at the point (1, 2).

(3)
(Total 15 marks)

1. (a) $g'(x) = 3x^2 + 12x + 12$ (A3) 3

(b) $3x^2 + 12x + 12 = 0$

$x^2 + 4x + 4 = 0$ (M1)

$(x + 2)^2 = 0$

$x = –2$ (A1)

or (G2) 2

(c) (i) $x = –3 \Rightarrow \frac{dy}{dx} = 3$ (A1)

(ii) $x = 0 \Rightarrow \frac{dy}{dx} = 12$ (A1)

(iii) (a) Increasing (A1)

(b) Increasing (A1) 4

[9]

2. (a) $g'(x) = 4x^3 + 9x^2 + 4x + 1$ (A3) 3

Note: *Award (A3) for all five terms correctly differentiated, (A2) for four terms, (A1) for three terms, (A0) for two or less terms correctly differentiated.*

(b) $g'(1) = 4(1)^3 + 9(1)^2 + 4(1) + 1$ (M1)

$= 4 + 9 + 4 + 1$

$= 18$ (A1)

OR

18 (G2) 2

[5]

3. (a) $y = ax^2 + bx + 6$ (A1)(A1)

$\frac{dy}{dx} = 2ax + b$

(b) Gradient = 2 when $x = 6$.

Therefore, $2 = 2a \times 6 + b$ (M1)

$2 = 12a + b$ (A1) 2

(c) $y = –15$ when $x = 3$.

Therefore, $–15 = 9a + 3b + 6$

or $–21 = 9a + 3b$ or $–7 = 3a + b$ (M1)(A1)

[6]

4. (a) $f'(x) = 2 + 25x^{-2}$ (A2) (C2)

(b) $2 + 25x^{-2} = 6$ (M1)

$25 = 4x^2$ (M1)

$x^2 = \dfrac{25}{4}$

$x = \pm 2.5$ (A1)(A1)

[6]

5. (a) $2x + 3$ (–1 for each extra term) (A2) (C2)

Note: *If correct and an extra term included, award (A1) only.*

(b) Equating the gradient to 5 ($2x + 3 = 5$) (M1)

For solving attempt (M1)

For $x = 1$ (A1)

Co-ordinates (1, 2) (A1) (C4)

[6]

6. (a) $f(1) = \dfrac{3}{1^2} + 1 - 4$ (M1)

$= 0$ (A1)

OR

$f(1) = 0$ (G2) 2

(b) $f'(x) = -\dfrac{6}{x^3} + 1$ (A4) 4

Note: *Award (A2) for* $\dfrac{3}{x^2}$ *correctly differentiated and (A1) for each other term correctly differentiated.*

(c) $f'(1) = -\dfrac{6}{1} + 1$ for substituting $f'(x)$ (M1)

$= -5$ (A1)

OR

$f'(1) = -5$ (G2) 2

(d) The gradient of the curve where $x = 1$. (A2) 2

Note: *Award (A1) for gradient and (A1) for $x = 1$ or at point (1, 0).*

(e) $y = 0$, $x = 1$, $m = –5$ for using $y = mx + c$ with their correct values of m, x and y. (M1)

$0 = –5 \times 1 + c$

$c = 5$ (A1)

$y = –5x + 5$ (A1)

OR

$y = –5x + 5$ (G3) 3

(f) $f'(x) = 0$

$1 - \dfrac{6}{x^3} = 0$ (M1)(A1)

$x^3 = 6$

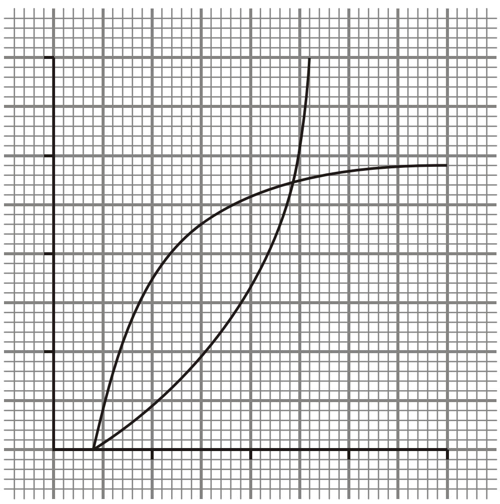
$x = \sqrt[3]{6}$ (1.82) (A1)

OR

1.82 (G3) 3

[16]

7. (a)



For correct axes from 0 to 4. (A1)

For correct curve $y = x^2$. (A1)

For correct curve $y = 3 - \dfrac{1}{x}$. (A1)

For two intersections. (A1) 4

(b) (0.347, 0.121) or $x = 0.347$, $y = 0.121$ (by GDC) (G1)(G1)

(1.53, 2.35) or $x = 1.53$, $y = 2.35$. (G1)(G1)

(c)	(i)	$\frac{dy}{dx} = \frac{1}{x^2}$ for losing the constant.	(A1)	
		For attempting to write $\frac{1}{x}$ as a power (can be implied).	(M1)	
		For correct answer $\frac{1}{x^2}$ or x^{-2}.	(A1)	
	(ii)	1	(A1)	4
(d)	For using $y = mx + c$ or equivalent with their m, to find c.		(M1)	
	$c = 1$		(A1)	
	$y = x + 1$		(A1)	3
			[15]	