Answers to Calculus Review Packet

1. (a) 30 (A1)

(b) $f'(x) = 3x^2 - 6x - 24$ (A1)(A1)(A1)

Note: *Award (A1) for each term. Award at most (A1)(A1) if extra terms present.*

(c) $f'(1) = -27$ (M1)(A1)(ft)(G2)

Note: *Award (M1) for substituting $x = 1$ into their derivative.*

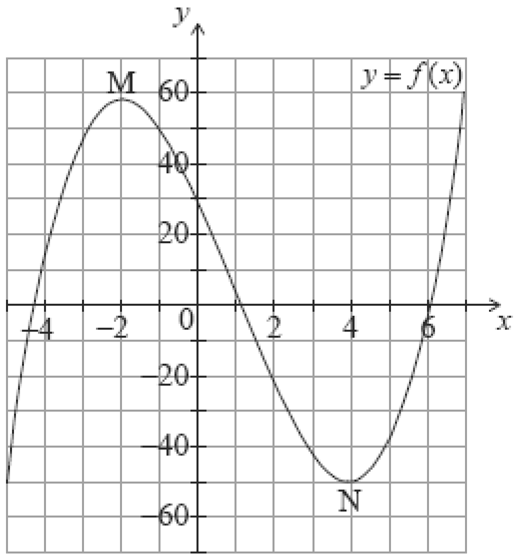
(d) (i) $f'(x) = 0$
$3x^2 - 6x - 24 = 0$ (M1)
$x = 4$; $x = -2$ (A1)(ft)(A1)(ft)

Notes: *Award (M1) for either $f'(x) = 0$ or $3x^2 - 6x - 24 = 0$ seen.*
Follow through from their derivative.
Do not award the two answer marks if derivative not used.

(ii) M(–2, 58) accept $x = -2$, $y = 58$ (A1)(ft)
N(4, –50) accept $x = 4$, $y = -50$ (A1)(ft)

Note: *Follow through from their answer to part (d) (i).*

(e)



(A1) for window
(A1) for a smooth curve with the correct shape
(A1) for axes intercepts in approximately the correct positions
(A1) for M and N marked on diagram and in approximately correct position (A4)

Note: *If window is not indicated award at most* (A*0*)*(A1)*(A*0*)*(A1)(ft).*

(f) (i) $3x^2 - 6x - 24 = 21$ (M1)

$3x^2 - 6x - 45 = 0$ (M1)

$x = 5$; $x = -3$ (A1)(ft)(A1)(ft)(G3)

Note: *Follow through from their derivative.*

OR

Award (A1) for L_1 drawn tangent to the graph of f on their sketch in approximately the correct position ($x = -3$), (A1)(ft)

(A1) for a second tangent parallel to their L_1, (A1)(ft)

(A1) for $x = -3$, (A1) for $x = 5$. (A1)(A1)

Note: *If only x = –3 is shown without working award (G2).*
If both answers are shown irrespective of working award (G3).

(ii) $f(5) = -40$ (M1)(A1)(ft)(G2)

Notes: *Award (M1) for attempting to find the image of their x = 5. Award (A1) only for (5, – 40).*
Follow through from their x-coordinate of B ***only if it has been clearly identified*** *in (f) (i).*

[21]

2. (a) $2^2 \times p + 2q - 4 = -10$ (M1)

Note: *Award (M1) for correct substitution in the equation.*

$4p + 2q = -6$ or $2p + q = -3$ (A1)

Note: *Accept equivalent simplified forms.*

(b) (i) $\frac{dy}{dx} = 2px + q$ (A1)(A1)

Note: *Award (A1) for each correct term.*
Award at most (A1)(A0) if any extra terms seen.

(ii) $4p + q = 1$ (A1)(ft)

(c) $4p + 2q = -6$

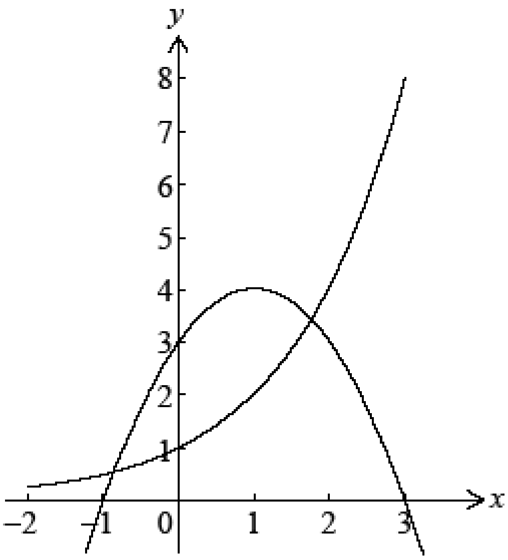
$4p + q = 1$ (M1)

Note: *Award (M1) for sensible attempt to solve the equations.*

$p = 2$, $q = -7$ (A1)(A1)(ft)(G3)

[8]

3. (a)



(A1)(A1)(A1)

Note: *Award (A1) for correct domain, (A1) for smooth curve, (A1) for y-intercept clearly indicated.*

(b) $y = 0$ (A1)(A1)

Note: *Award (A1) for y = constant, (A1) for 0.*

(c) ***Note:*** *Award (A1) for smooth parabola,*
(A1) for vertex (maximum) in correct quadrant.
(A1) for all clearly indicated intercepts x = –1, x = 3 and y = 3.
The final mark is to be applied very strictly. (A1)(A1)(A1)

(d) $x = –0.857$ $x = 1.77$ (G1)(G1)

Note: *Award a maximum of (G1) if x and y coordinates are both given.*

(e) 4 (G1)

Note: *Award (G0) for (1, 4).*

(f) $f'(x) = 2 - 2x$ (A1)(A1)

Note: *Award (A1) for each correct term.*
Award at most (A1)(A0) if any extra terms seen.

$2 - 2x = 0$ (M1)

Note: *Award (M1) for equating their gradient function to zero.*

$x = 1$ (A1)(ft)

$f(1) = 3 + 2(1) - (1)^2 = 4$ (A1)

Note: *The final (A1) is for substitution of x = 1 into f(x) and subsequent correct answer. Working must be seen for final (A1) to be awarded.*

[16]

4. (a) $f'(x) = 4x + 1$ (A1)(A1)(A1) (C3)

Note: *Award (A1) for each term differentiated correctly.*
Award at most (A1)(A1)(A0) if any extra terms seen.

(b) $f'(-3) = -11$ (A1)(ft) (C1)

(c) $4x + 1 = 0$ (M1)

$x = -\frac{1}{4}$ (A1)(ft) (C2)

[6]

5. (a) (i) $y = 0$ (A1)

(ii) $(0, -2)$ (A1)(A1)

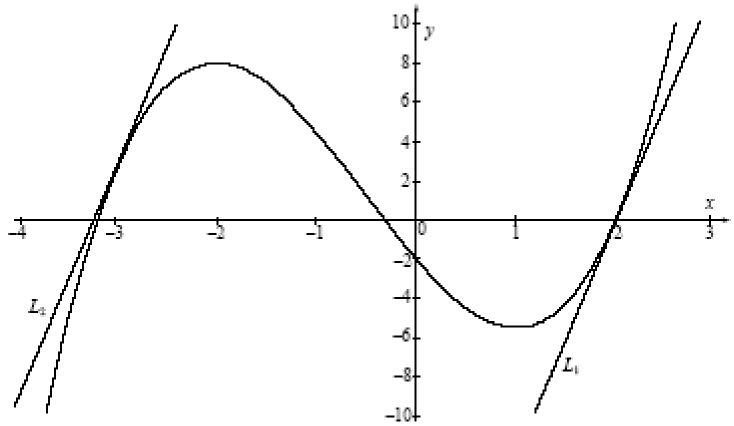
Note: *Award (A1)(A0) if brackets missing.*

OR

$x = 0, y = -2$ (A1)(A1)

Note: *If coordinates reversed award (A0)(A1)(ft).*
Two coordinates must be given.

(b)



(A4)

Note: *(A1) for appropriate window. Some indication of scale on the x-axis must be present (for example ticks). Labels not required. (A1) for smooth curve and shape, (A1) for maximum and minimum in approximately correct position, (A1) for x and y intercepts found in (a) in approximately correct position.*

(c) $\frac{dy}{dx} = 3x^2 + 3x - 6$ (A1)(A1)(A1)

Note: *(A1) for each correct term. Award (A1)(A1)(A0) at most if any other term is present.*

(d) (i) $3 \times 4 + 3 \times 2 - 6 = 12$ (M1)(A1)(AG)

Note: *(M1) for using the derivative and substituting x = 2. (A1) for correct (and clear) substitution. The 12 must be seen.*

(ii) Gradient of L_2 is 12 (can be implied) (A1)

$3x^2 + 3x - 6 = 12$ (M1)

$x = -3$ (A1)(G2)

Note: *(M1) for equating the derivative to 12 or showing a sketch of the derivative together with a line at y = 12 or a table of values showing the 12 in the derivative column.*

(iii) (A1) for L_1 correctly drawn at approx the correct point (A1)

(A1) for L_2 correctly drawn at approx the correct point (A1)

(A1) for 2 parallel lines (A1)

Note: *If lines are not labelled award at most (A1)(A1)(A0). Do not accept 2 horizontal or 2 vertical parallel lines*

(e) (i) $b = 1$ (G2)

(ii) The curve is decreasing. (A1)

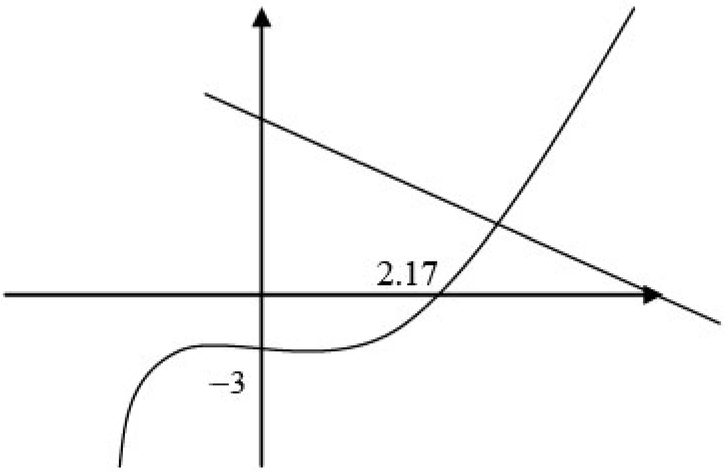
Note: *Accept any valid description.*

(iii) $y = 8$ (A1)(A1)(G2)

Note: *(A1) for "y = a constant", (A1) for 8.*

[23]

6. (a)



(G3) 3

(b) line drawn with –ve gradient and +ve y-intercept (G1)

(2.45, 2.11) (G1)(G1) 3

(c) $f'(1.7) = 3(1.7)^2 - 4(1.7) + 1$ (M1) 2

Note: *Award (M1) for substituting in their $f'(x)$*

2.87 (A1)(G2)

[8]

7. (a) for attempt at substituted $\frac{y\,distance}{x\,distance}$ (M1)

gradient = 2 (A1)(G2) 2

(b) $2x - 3$ (A1)(A1) 2

(A1) for $2x$, (A1) for –3

(c) *for their* $2x - 3$ = *their gradient and attempt to solve* (M1)

$x = 2.5$ (A1)(ft)

$y = -5.25$ ((ft) *from their x value)* (A1)(ft)(G2) 3

(d) *for seeing* $\frac{-1}{their(a)}$ solving $2x - 3 = -\frac{1}{2}$ *(or their value)* (M1)(M1)

$x = 1.25$ (A1)(ft)(G1)

$y = -6.1875$ (A1)(ft)(G1) 4

(e) (i) $2 \times 2 - 3 = 1$ ((ft) *from (b)*) (A1)(ft)(G1)

(ii) *$y = mx + c$ or equivalent method to find c $\Rightarrow -6 = 2 + c$* (M1)

$y = x - 8$ (A1)(ft)(G2) 3

(f) $x = 1.5$ (A1) 1

(g) *for substituting their answer to part (f) into the equation of the parabola* (M1)

(1.5, – 6.25) *accept* $x = 1.5, y = -6.25$ (A1)(ft)(G2)

gradient is zero (accept $\frac{dy}{dx} = 0$) (A1) 3

[18]

8. (a) $f(x) = ax^2 + 4x^{-1} - 3$

$f'(x) = 2ax - 4x^{-2}$ (A3) (C3)

Note: *(A1) for 2ax, (A1) for $-4x^{-2}$ and (A1) for derivative of –3 being zero.*

(b) $2ax - 4x^{-2} = 0$ (M1)

$2a(-1) - 4(-1)^{-2} = 0$ (M1)

$-2a - 4 = 0$

$a = -2$ (A1)(ft) (C3)

Notes: *(M1) for setting derivative function equal to 0*

(M1) for inserting $x = -1$ but do not award (M0)(M1)

[6]

9. (a) $y = x + z + z$ (M1)

Note: Award (M1) for writing a sensible equation.

$xz = 162$

$z = \frac{162}{x}$ (M1)

$y = x + \frac{2 \times 162}{x}$ (M1)

$y = x + \frac{324}{x}$ (AG)

(b) $\frac{\mathrm{d}y}{\mathrm{d}x} = 1 - \frac{324}{x^2}$ (A1)(A1)(A1)

Note: *Award (A1) for 1 and no other constant present, (A1) for –324, (A1) for* $\frac{1}{x^2}$ *or* x^{-2}.

(c) $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$

$1 - \frac{324}{x^2} = 0$ (M1)

Note: *Award (M1) for putting candidate's derivative equal to zero.*

$x^2 = 324$ (A1)(ft)

$x = 18$ (A1)(ft)(G3)

(d) $y = 18 + 9 + 9$ (M1)

Note: *Award (M1) for adding three sides of rectangle.*

$= 36$ (A1)(ft)(G2)

OR

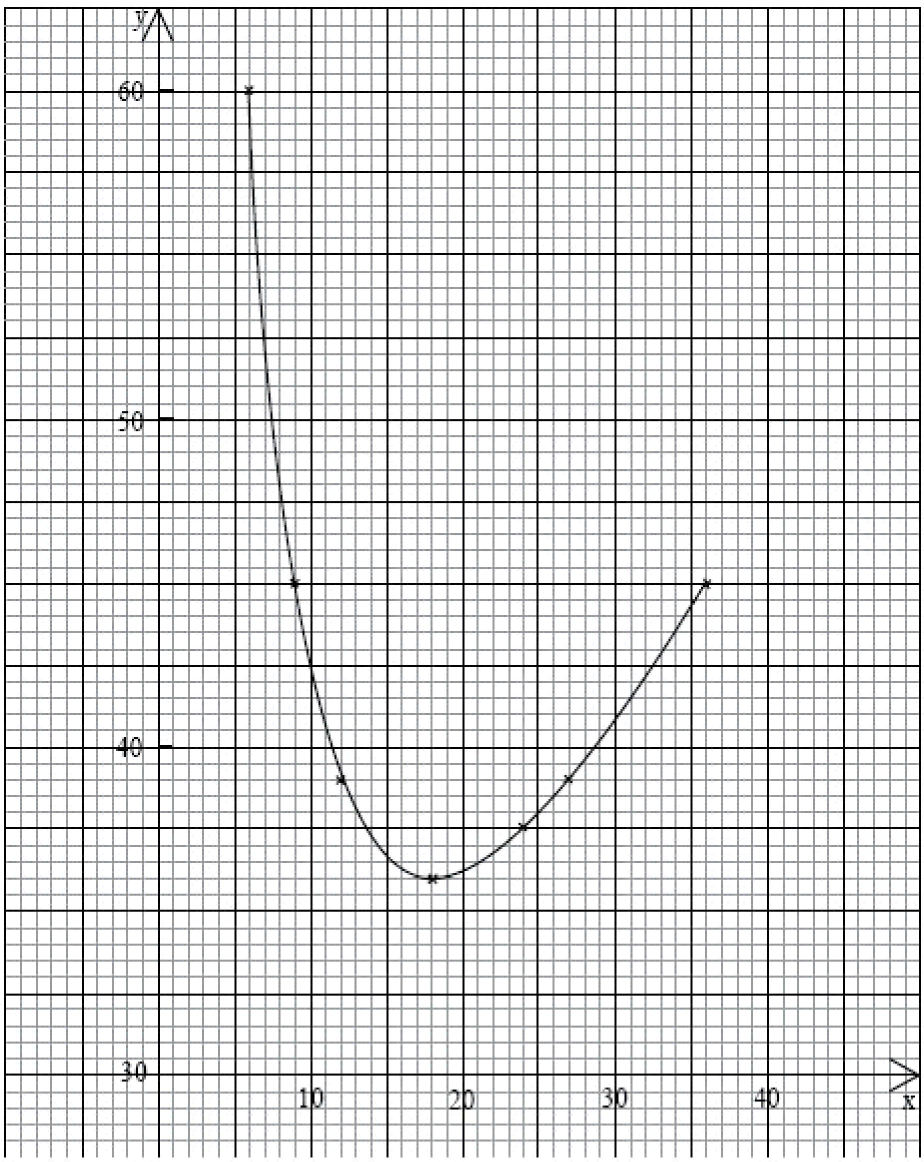
$18 + \frac{324}{18}$ (M1)

$= 36$ (A1)(ft)

(e) $a = 36$ (A1)

$b = 39$ (A1)

(f)



(A5)(ft)

Notes: *Award (A1) for correct scales and labels, (A3) for correct points plotted, (A1) for smooth curve with (18, 36) as the minimum value.*

Award (A2) for 5 or 6 points correctly plotted, (A1) for 3 or 4 points correctly plotted.

(g) $x \geq 18$ (A1)(A1)(ft)

Notes: *Award (A1) for* $x \geq$ *, (A1) for 18.*

Accept $x > 18$

[20]

10. (a) $2x^3 - 2x$ (A1) (C1)

(b) $f'(x) = 6x^2 - 2$ (A1)(ft)(A1)(ft) (C2)

Note: *Award (A1) for each term.*

(c) gradient = $f'(-1)$

$= 6(-1)^2 - 2$

$= 4$ (M1)

(A1)(ft) (C2)

(d) $\tan\theta = 4$ (A1)(ft) (C1)

[6]

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

$= 0$ (A1)

OR

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

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

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

(c) $f'(1) = -\frac{6}{1} + 1$ 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) $f'(x) = 0$

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

$x^3 = 6$

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

OR

1.82 (G3) 3

[16]

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

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

$25 = 4x^2$ (M1)

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

$x = \pm 2.5$ (A1)(A1) (C4)

[6]

13. (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)

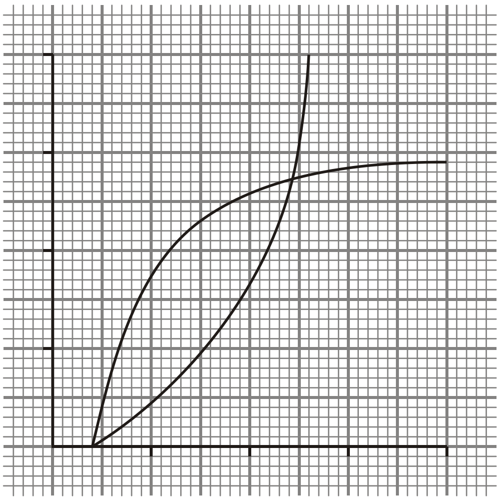
For solving attempt (M1)

For $x = 1$ (A1)

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

[6]

14. (a)



For correct axes from 0 to 4. (A1)
For correct curve $y = x^2$. (A1)
For correct curve $y = 3 - \frac{1}{x}$. (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) 4

(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]

15. (a) $f'(x) = 3x^2 + 14x - 5$ (A1)(A1)(A1) 3

(b) $f'(1) = 3 + 14 - 5 = 12$ (M1)(A1) 2

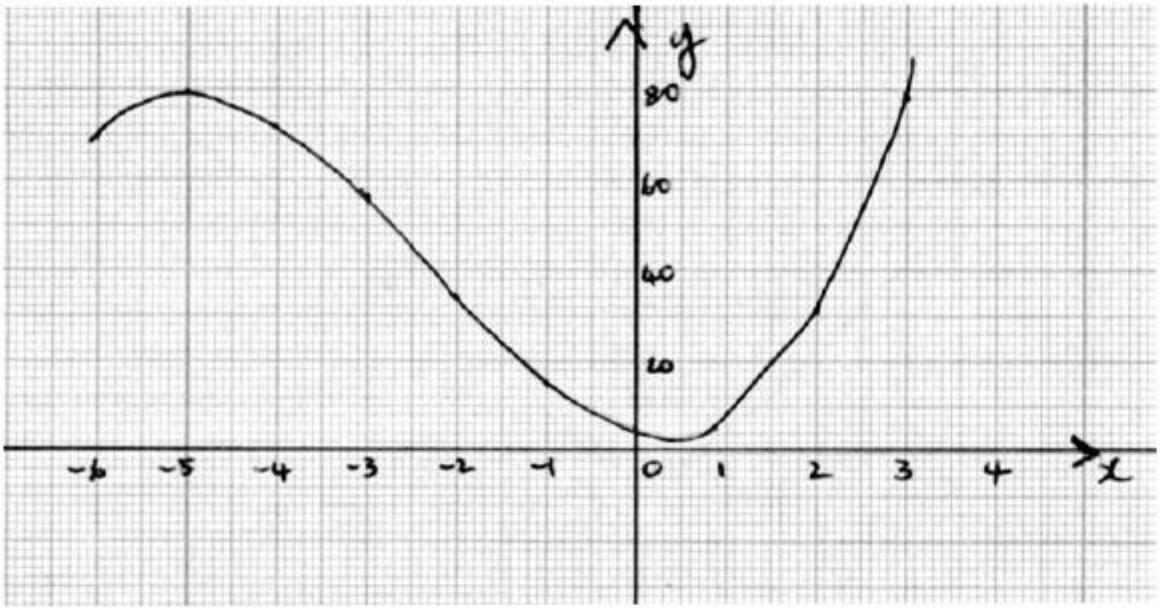
(c) $3x^2 + 14x - 5 = 0$ (M1)

$(3x - 1)(x + 5) = 0$

$x = \frac{1}{3} \text{ or } -5$ (A1)(A1) (or (G3)) 3

(d) $\left(\frac{1}{3}, 3.15\right)$ $(-5, 79)$ (A1)(A1) (or (G2)) 2

(e) (A4) 4



Note: *Award (A1) for axes labelled, (A1) for maximum, (A1) for minimum, (A1) for y-intercept.*

[14]

16. (a) $V = x^2h$ (A1) 1

(b) $A = 2x^2 + 4xh$ (A1) 1

(c) $1000 = x^2h$ (M1)

$h = \frac{1000}{x^2}$ (A1) 2

(d) $A = 2x^2 + 4x\left(\frac{1000}{x^2}\right)$ (M1)

$A = 2x^2 + \frac{4000}{x}$ (A1)

$= 2x^2 + 4000x^{-1}$ (AG) 2

(e) $\frac{dA}{dx} = 4x - 4000x^{-2}$ (A2) 2

(f) $4x - 4000x^{-2} = 0$ (M1)

$4x^3 - 4000 = 0$ (M1)

$4x^3 = 4000$

$x^3 = 1000$ (A1)

$x = 10$ (A1)

OR

$x = 10$ (G4) 4

(g) $h = \frac{1000}{100} = 10$ (A1)

$A = 2(100) + 4(10)(10)$ (M1)

$= 200 + 400 = 600$ (A1)

OR

$A = 600$ (G3) 3

[15]

17. (a) $3x^{-2}$ (A1) (C1)

Note: *Award mark for –2.*

(b) $-2 \times 3x^{-3}$ (A1)(A1)

Note: *Award (A1) for –2 × 3, (A1) for –3.*

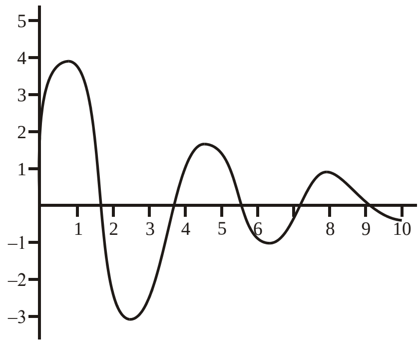
$= -6x^{-3}$ (A1)

$= -\frac{6}{x^3}$ (A1)(A1) (C5)

Note: *Award (A1) for positive power on denominator, (A1) for 3.*

[6]

18. (a)



	For labels and scales.	(A1)	
	3 maxima drawn.	(A1)	
	2 minima drawn.	(A1)	
	General shape	(A2)	5
(b)	(0.827, 4.12)	(G2)	2
(c)	0, 1.8, 3.6, 5.4, 7.2, 9 (for any one of these answers).	(G1)	1
(d)	$r = 1$	(G2)	
	Perfect positive correlation.	(R1)	3
(e)	$y = 3x$ (accept $y = 3x + 0.000274$)	(G2)	2
(f)	line on graph	(A1)	1
(g)	(0, 0) or (1.16, 3.48)	(G1) (G1)	2

[16]

19. (a) $x – 15$ (A1) 1

(b) Profit = $(x – 15)(100\,000 – 4000x)$ (M1)

$= 100000x – 4000x^2 – 1500\,000 + 60\,000x$ (A2)

Note: *Award (A1) for one error, (A0) for 2 or more errors.*

$= 160\,000x – 4000x^2 – 1500\,000$ (AG) 3

	(c)	(i) $\frac{dP}{dx} = 160000 - 8000x$	(A1)(A1)		
		(ii) $0 = 160000 - 8000x$	(M1)		
		$x = \frac{160000}{8000}$			
		$x = 20$	(A1)	4	
	(d)	Books sold = 100 000 – 4000 × 20	(M1)		
		= 20000	(A1)		
		OR			
		Books = 20 000	(A2)	2	
					[10]
20.	(a)	$y = ax^2 + bx + 6$	(A1)(A1)	2	
		$\frac{dy}{dx} = 2ax + b$			
	(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)	2	
					[6]
21.	(a)	B → D, G → L (or G → K and K → L) (both correct) (accept C, H, L)	(A1)	1	
	(b)	A → B, D → G (both correct) (accept A, E, F)	(A1)	1	
	(c)	D	(A1)	1	
	(d)	B or G (accept either)	(A1)	1	
	(e)	Point of inflexion	(A1)	1	
					[5]

22. (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]

23. (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]

24. (a) $x = 3$ (A1)

$x = 5$ (A1)

$x = 6.8 - 7.2$ (A1) 3

(b) $3 < x < 5$ (A1)(A1) 2

[5]

25. (a) (i) $f'(x) = 6x^2 - 6x - 12\ (+0) = 6x^2 - 6x - 12$ (A2)

***Note**: Award (A2) for all four items correctly differentiated,*
(A1) for 3 correct derivatives.

(ii) $f'(3) = 6(3)^2 - 6(3) - 12 = 24$ (M1) (A1) 4

(b) $6x^2 - 6x - 12 = -12$ (M1)
$\Rightarrow 6x^2 - 6x = 0$
$\Rightarrow 6x\ (x - 1) = 0$
$\Rightarrow x = 0$ or $x = 1$ (A1) (A1) 3

(c) (i) $f'(x) = 0 \Rightarrow 6x^2 - 6x - 12 = 0$ (M1)
$\Rightarrow 6\ (x^2 - x - 2) = 0$
$\Rightarrow 6(x - 2)\ (x + 1) = 0$ (M1)
$\Rightarrow x = 2$ or $x = -1$ (A1) (A1)

(ii) $x = 2, y = -15$ (A1)
Therefore, minimum is $(2, -15)$ (A1) 6

(d) $x < -1$ and $x > 2$ (A1) (A1) 2

[15]

26. (a) $s(50) = 250(50) + 5(50)^2 - 0.06(50)^3$
$= 17500$ m (A1) 1

(b) (i) 1 second = $\frac{1}{60}$ minute (M1)

50 m and 1 sec = $50\frac{1}{60}$ minute (AG)

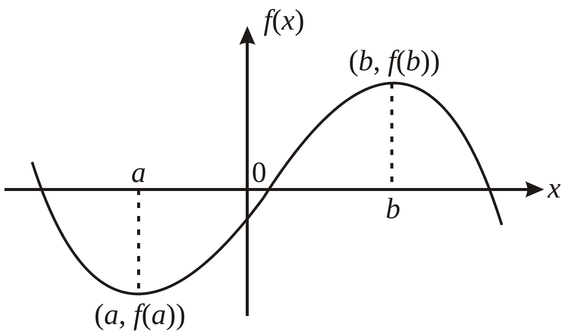
(ii) $s\left(50\frac{1}{60}\right) = 250\left(50\frac{1}{60}\right) + 5\left(50\frac{1}{60}\right)^2 - 0.06\left(50\frac{1}{60}\right)^3$ (M1)
$= 17505$ (A1)

(iii) $\frac{17505 - 17500}{1/60} = \frac{5}{1/60}$ (M1)

= 300 m per minute (A1) 5

[6]

27. (a)



(A2) 2

Note: *The curve need not be exactly like this one. The candidate's sketch must have (a, f (a)) as a minimum with a < 0, and (b, f (b)) as a maximum with b > 0.*
The turning points do not need to be on opposite sides of the x-axis.

(b) (i) False (A1)

(ii) True (A1)

(iii) False (A1)

(iv) True (A1)

(v) False (A1) 5

[7]

28. (a) (i) $l = 24 - 2x$ (A1)

(ii) $w = 9 - 2x$ (A1) 2

(b) $B = x(24 - 2x)(9 - 2x)$ (M1)
$= 4x^3 - 66x^2 + 216x$ (AG) 1

(c) $\frac{dB}{dx} = 12x^2 - 132x + 216$ (A1) 1

(d) (i) $\frac{dB}{dx} = 0 \Rightarrow x^2 - 11x + 18 = 0$
$(x - 2)(x - 9) = 0$ (M1)
$\Rightarrow x = 2$ or $x = 9$ (not possible)
Therefore, $x = 2$ cm. (A1)

(ii) $B = 4(2)^3 - 66(2)^2 + 216(2)$ (or $2 \times 20 \times 5$) (M1)
$= 200 \text{ cm}^3$ (A1) 4

[8]

29. (a) $g'(x) = 2px + q$ (A1) 1

(b) $2px + q = 2x + 6$
$\Rightarrow p = 1$ and $q = 6$ (A1)(A1) 2

(c) (i) $g'(x) = 0$
$\Rightarrow 2x + 6 = 0$ (M1)
$\Rightarrow x = -3$ (A1)

(ii) $-12 = (-3)^2 + 6(-3) + c$
$-12 = 9 - 18 + c$ (M1)
$\Rightarrow c = -3$ (A1) 4

[7]

30. (a) $\frac{dy}{dx} = 0$ at point C (A1) 1

(b) $\frac{dy}{dx}$ changes from +ve to –ve and is decreasing (A2) 2

Notes: *Award (A1) for "+ve to –ve" and, (A1) for "decreasing".*
Accept equivalent answers, e.g. "decreasing, becomes zero, and then begins to increase negatively".

[3]

31. (a) $AE^2 + OE^2 = OA^2$ .... (3)
$\Rightarrow AE^2 + k^2 = 8^2$ (M1)

Note: *Award (M1) for using and substituting correctly in equation (3).*

$AE^2 = \sqrt{64 - h^2}$ (A1) 2

(b) Volume (V) = $2h\pi r^2$ (M1)

$= 2\pi h(\text{AE}^2)$ (M1)

$= 2\pi h(64 - \text{h}^2)\ \text{cm}^3$ .... (4) (AG) 2

(c) (i) From (b) $V = 128\pi h - 2\pi h^3$ (M1)

***Note:** Award (M1) for using equation (4) or any other correct approach.*

$\frac{\text{d}V}{\text{d}h} = 128\pi - 6\pi h^2 = 0$ at maximum/minimum points (M2)

***Note:** Award (M2) for correctly differentiating V w.r.t. x.*

$\Rightarrow h = \sqrt{\frac{64}{3}} = \pm 4.62$ cm (3 s.f.) (A1)

Test to show that V is maximum when $h = 4.62$ (R1) 5

***Note:** Award (R1) for testing to confirm V is indeed maximum.*

(ii) $\text{AE}^2 = 64 - h^2$

$= 64 - \frac{64}{3} = \frac{128}{3}$ (M1)

***Notes:** Follow through with candidate's AE from part (a) (M1) is for correctly obtaining candidate's AE^2.*

Therefore maximum volume = $\pi r^2(2h) = \pi\left(\frac{128}{3}\right)\left(2\left(\sqrt{\frac{64}{3}}\right)\right)$ (M1)

***Note:** Follow through with candidate's AE^2*

$= 1238.7187... = 1239\ \text{cm}^3$ (nearest cm^3) (A1) 3

***Notes:** Correct answer only.*
Accept 1238 cm^3 if and only if candidate uses $\pi = 3.14$

[12]

32. (a)

PR	0.1	0.01	0.001
QN	2.42	2.0402	2.004002
QR	0.42	0.0402	0.004002
Gradient $\frac{\text{QR}}{\text{PR}}$	4.2	4.02	4.002

(A4) 4

***Note:** Award ½ **mark** for each correct entry. Round up to a maximum of **4 marks**.*

(b) (i) From (a) as Q $\to$ P, PR $\to$ 0 and $\frac{\text{QR}}{\text{PR}} \to 4$,

hence gradient = 4 at (1, 2) (A1) 1

***Note:** Accept gradient (slope) = 4.*

(ii)

PR	0.1	0.01	0.001	
QN	5.42	5.0402	5.004002	
QR	0.42	0.0402	0.004002	
Gradient $\frac{\text{QR}}{\text{PR}}$	4.2	4.02	4.002	(M2)

Hence $\frac{\mathrm{d}}{\mathrm{d}x}(2x^2 + 3) = 4$ at (1, 5) (A1) 3

Notes: *Award (M2) for any correct method towards conclusion.*

Accept $\frac{\mathrm{d}}{\mathrm{d}x}(2x^2 + 3) = 4x$ *(M1)*

$= 4(1)$ *at (1, 5)* *(M1)*

$= 4$ *(A1)*

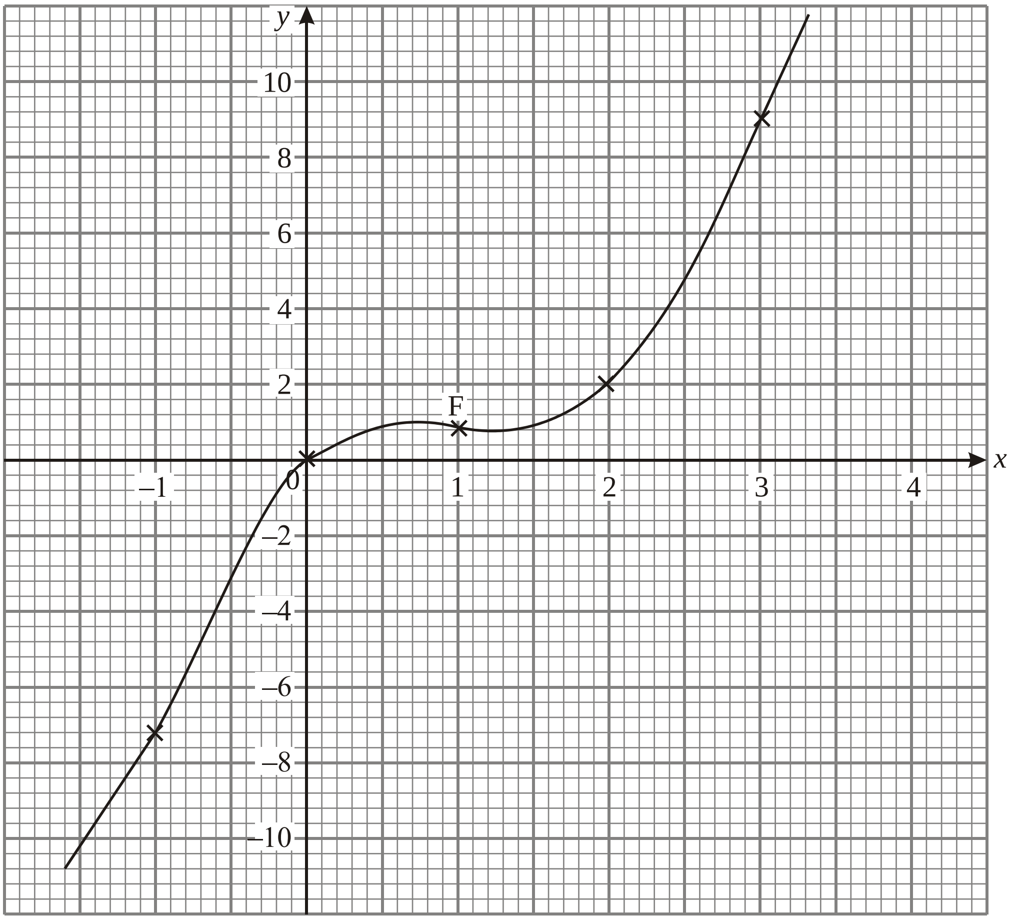
[8]

33. (a) $f'(x) = 3x^2 - 6x + 3$ (A2) 2

(b)

x	–1	0	1	2	3	
$f(x)$	–7	0	1	2	9	
$f'(x)$	12	**3**	0	**3**	12	(A3) 3

(c)



Note: *The graph does not have to be on graph paper as long as it is reasonable.* (A2) 2

(d) 12 (A1) 1

[8]

34. (a) $a = 2$, $b = 20$, $c = 9$, $d = 8$, $e = 32$ (A2) 2

Note: *Award (A2) for all 5 correct, (A1) for 3 or 4 correct, (A0) for 2 or less correct.*

(b) $A = 12x - x^2$ (C1) 1

(c) $\frac{dA}{dx} = 12 - 2x$ (A1)

A is maximum when $12 - 2x = 0$ (M1)

$\Rightarrow$ length = 6m and width = 6m (A1)

OR

length = 6m and width = 6m (A2) 3

[6]