

| Question number | Scheme | Marks |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1. (a)</p> <p>(b)</p> | <p>$f(1) = 0, 2 - 1 + p + 6 = 0$ so $p = -7$</p> <p>$f(-\frac{1}{2}) = -\frac{1}{4} - \frac{1}{4} + \frac{7}{2} + 6 = 9$</p> | <p>M1 A1 (2)</p> <p>M1 A1 (2)</p> <p>(4 marks)</p> |
| <p>2. (a)</p> <p>(b)</p> | <p>$\int (3 + 4x^3 - \frac{2}{x^2}) dx = 3x + x^4 + \frac{2}{x} + c$</p> <p>$\int_1^2 (3 + 4x^3 - \frac{2}{x^2}) dx = \left[3x + x^4 + \frac{2}{x} \right]_1^2$</p> <p>$= (6 + 16 + 1) - (3 + 1 + 2)$</p> <p>$= 17$</p> | <p>M1 A2(1, 0)</p> <p>(3)</p> <p>M1</p> <p>A1 (2)</p> <p>(5 marks)</p> |
| <p>3. (a)</p> <p>(b)</p> <p>(c)</p> | <p>Arc $BD = r\theta = 0.4 \times 6 = 2.4$</p> <p>Cosine Rule: $AB^2 = 6^2 + 12^2 - 2 \times 6 \times 12 \times \cos(0.4^c) = 47.36\dots$</p> <p>$\therefore AB = 6.88\dots\dots$</p> <p>Perimeter = $6 + 6.88 + 2.4 = 15.3$ (cm) (3 sig. figs)</p> | <p>B1 (1)</p> <p>M1 A1</p> <p>A1 (3)</p> <p>B1ft (1)</p> <p>(5 marks)</p> |
| <p>4.</p> | <p>$\log_3 x^2 - \log_3 (x - 2) = 2$</p> <p>$\log_3 \left(\frac{x^2}{x - 2} \right) = 2$</p> <p>$\frac{x^2}{x - 2} = 3^2$</p> <p>$x^2 - 9x + 18 = 0$</p> <p>$(x - 6)(x - 3) = 0$</p> <p>$x = 3, 6$</p> | <p>Use of $\log x^n$ rule M1</p> <p>Use of $\log a - \log b$ rule M1</p> <p>Getting out of logs M1</p> <p>Correct 3TQ = 0 A1</p> <p>Attempt to solve 3TQ M1</p> <p>Both A1</p> <p>(6 marks)</p> |

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| <p>5. (a)</p> <p>(b)</p> <p>(c)</p> | <p>$ar = 9$ $ar^4 = 1.125$</p> <p>Dividing gives $r^3 = \frac{1.125}{9} = \frac{1}{8}$</p> <p>So $r = \frac{1}{2}$</p> <p>Using $ar = 9$, $a = \frac{9}{\frac{1}{2}} = 18$</p> <p>$S_\infty = \frac{a}{1-r} = \frac{18}{1-\frac{1}{2}} = 36$</p> | <p>M1</p> <p>M1</p> <p>A1 (3)</p> <p>M1, A1 (2)</p> <p>M1 A1 (2)</p> <p>(7 marks)</p> |
| <p>6. (a)</p> <p>(b)</p> <p>(c)</p> | <p>$(x - 3)^2 + (y + 2)^2 (= 9 + 4 + 12)$ Attempt to complete the square</p> <p>\therefore Centre is at $(3, -2)$</p> <p>$(\dots)^2 + (\dots)^2 = 12 + 4 + 9 = 25 = 5^2$ ft their centre</p> <p>\therefore Radius = 5</p> <p>$PQ = 10$ means PQ is a diameter and so angle PRQ is 90°</p> <p>Pythagoras' Theorem gives $QR^2 = 10^2 - 3^2 = 91$</p> <p>So $QR = 9.54\dots = 9.5$ (1 d.p.)</p> | <p>M1</p> <p>A1 (2)</p> <p>M1</p> <p>A1 (2)</p> <p>M1</p> <p>M1</p> <p>A1 (3)</p> <p>(7 marks)</p> |
| <p>7. (a)</p> <p>(b)</p> | <p>$\frac{n(n-1)}{2!}k^2 = \frac{n(n-1)(n-2)}{3!}k^3$ One coefficient (no $\binom{n}{r}$)</p> <p>e.g. $3k^2 = (n-2)k^3$ A correct equation, no cancelling</p> <p>$3 = (n-2)k$ (*) Cancel at least $n(n-1)$</p> <p>$A = nk = 4$</p> <p>$3 = 4 - 2k$</p> <p>So $k = \frac{1}{2}$, and $n = 8$</p> | <p>M1</p> <p>A1</p> <p>M1</p> <p>A1 cso (4)</p> <p>B1</p> <p>M1</p> <p>A1, A1 (4)</p> <p>(8 marks)</p> |

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| <p>8. (a)</p> <p>Or (b)</p> | <p>$x - 20^\circ = 115.9^\circ \dots$ Or $244.08^\circ \dots$</p> <p>$x = 136^\circ, 264^\circ$</p> <p>$3 \frac{\sin \theta}{\cos \theta} = 2 \cos \theta$ $3 \sin \theta = 2 \cos^2 \theta = 2(1 - \sin^2 \theta)$ $2 \sin^2 \theta + 3 \sin \theta - 2 = 0$ $(2 \sin \theta - 1)(\sin \theta + 2) = 0$ $\sin \theta = -2$ (No solution) $\sin \theta = \frac{1}{2}$ So $\theta = 30^\circ, 150^\circ$</p> | <p>Any solution (awrt 116° or 244°) B1 360° – candidate’s first answer M1 + 20° at correct stage M1 A1 (4)</p> <p>Use of $\tan \theta = \frac{\sin \theta}{\cos \theta}$ M1 Use of $\cos^2 \theta = 1 - \sin^2 \theta$ M1 3 term quadratic in $\sin = 0$ A1 Attempt to solve M1 At least $\frac{1}{2}$ A1 Both A1 (6) (10 marks)</p> |
| <p>9. (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> | <p>Surface Area = $2\pi r h + \pi r^2$ $h = \frac{250 - \pi r^2}{2\pi r}$ $V = \pi r^2 h = \pi r^2 \times \frac{(250 - \pi r^2)}{2\pi r}$ $V = 125r - \frac{\pi r^3}{2}$ (*)</p> <p>$\frac{dV}{dr} = 125 - \frac{3\pi}{2} r^2$ $\frac{dV}{dr} = 0 \Rightarrow r^2 = \frac{250}{3\pi}$ so $r = \sqrt{\frac{250}{3\pi}} = 5.15\dots$</p> <p>$\frac{d^2V}{dr^2} = -3\pi r$ When $r = 5.15\dots$ this is < 0, therefore a maximum</p> <p>Max V is $125(5.15\dots) - \frac{\pi (5.15\dots)^3}{2}$ i.e. Maximum volume is $429.19\dots = 429 \text{ (cm}^3\text{)}$</p> | <p>B1 Attempt $h =$ M1 $V =$ and sub for h M1 A1 c.s.o. (4)</p> <p>M1 M1 A1 (3)</p> <p>M1 A1 (2)</p> <p>M1 A1 (2) (11 marks)</p> |

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| 10. (a) | $y = 9 - 8 - \frac{2}{\sqrt{4}} = 0 \therefore b = 4 \quad (*)$ | B1 c.s.o. (1) |
| (b) | $\frac{dy}{dx} = -2 + x^{-\frac{3}{2}}$ | M1 |
| | When $x = 1$ gradient $= -2 + 1 = -1$ | A1 |
| | So equation of the tangent is $y - 5 = -1(x - 1)$ | M1 |
| | i.e. $y + x = 6 \quad (*)$ | A1 c.s.o. (4) |
| (c) | Let $y = 0$ and $x = 6$ so D is $(6, 0)$ | B1 (1) |
| (d) | Area of triangle $= \frac{1}{2} \times 5 \times 5 = 12.5$ | B1 |
| | $\int_1^4 (9 - 2x - 2x^{-\frac{1}{2}}) dx = \left[9x - x^2 - 2\frac{x^{\frac{1}{2}}}{\frac{1}{2}} \right]_1^4$ | Ignore limits M1 A1 |
| | $= (36 - 16 - 4 \times 2) - (9 - 1 - 4)$ | Use of limits M1 |
| | $= 12 - 4$ | A1 |
| | $= 8$ | A1 |
| | So shaded area is $12.5 - 8 = 4.5$ | A1 (6) (12 marks) |

| Qn | Specification | AO1 | AO2 | AO3 | AO4 | AO5 | Total |
|-----------|----------------------|------------|------------|------------|------------|------------|--------------|
| 1 | 1 | 2 | 2 | | | | 4 |
| 2 | 7.1 | 2 | 3 | | | | 5 |
| 3 | 4.4, 4.2 | 1 | 1 | | 1 | 2 | 5 |
| 4 | 5.2 | 3 | 3 | | | | 6 |
| 5 | 3.1 | 3 | 4 | | | | 7 |
| 6 | 2.1, 2.2 | 3 | 2 | 1 | | 1 | 7 |
| 7 | 3.2 | 4 | 4 | | | | 8 |
| 8 | 4.3 4.4, 4.5 | 5 | 3 | | 2 | | 10 |
| 9 | 6 | 2 | 2 | 4 | 2 | 1 | 11 |
| 10 | 7.2 +C1 | 5 | 5 | | | 2 | 12 |
| | Totals | 30 | 29 | 5 | 5 | 6 | 75 |