1. a) $(x+1)(x+4)$ B1

CORRECT METHOD OF ELIMINATION OR COMPARING COEFFICIENTS M1

$\frac{3}{x+4} + \frac{-2}{x+1}$ SEEN OR IMPLIED A1 A1

b) $\alpha\ln(x+4) + b\ln(x+1)$ (OR USING $|\,|$) MA1

$[3\ln 6 - 2\ln 3] - [3\ln 4 - 2\ln 1]$ O.E M1

$\ln\frac{3}{8}$ c.q.d A1

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2. a) $1 - 6x + 24x^2 - 80x^3$ B3

$2x - 12x^2 + 48x^3 - 160x^4$ A2 -1 eeoo

b) $|x| < \frac{1}{2}$ OR $-\frac{1}{2} < x < \frac{1}{2}$ B1

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3. $\frac{1}{y}\,dy = \frac{1}{\cos^2 4x}\,dx$ O.E M1 dep

INTEGRATES BOTH SIDES (INTEGRAL SIGNS) M1

$\ln y = \frac{1}{4}\tan 4x + C$ A1 A1 A1

EITHER APPLY CONDITION

$3 = \frac{1}{4} + C$ M1

$\ln y = \frac{1}{4}\tan 4x + \frac{11}{4}$ M1

$y = e^{\frac{1}{4}\tan 4x + \frac{11}{4}}$

OR $y = e^{\frac{1}{4}(11+\tan 4x)}$ A1

OR

$y = e^{\frac{1}{4}\tan 4x + c}$

$y = Ae^{\frac{1}{4}\tan 4x}$ M1

APPLIES CONDITION

$A = e^{11/4}$ M1

CONVINCINGLY & CORRECTLY ARRIVES AT THE ANSWER A1

4. $2u\dfrac{du}{dx} = -14x$ OR $\dfrac{du}{dx} = -7(16-7x^2)^{-\frac{1}{2}}$ o.e. B1

NEW LIMITS 3, 4 OR SUBSTITUTING ORIGINAL LIMITS AT THE END B1

$\displaystyle\int_4^3 \frac{x}{u}\left(-\frac{u}{7x}\,du\right)$ M1A1 (Allow out minor error)

$\displaystyle\int_4^3 -\frac{1}{7}\,du$ A1

$\left[-\frac{1}{7}u\right]_4^3$ OR $\left[\frac{1}{7}u\right]_4^3$ M1A1

CORRECTLY ARRIVES TO $\frac{1}{7}$ A1

[ACCEPT ANALOGOUS IF $u = 16-7x^2$ HAS BEEN USED]

ACCEPT ALSO WITHOUT SUBSTITUTION

$$\int \frac{x}{\sqrt{16-7x^2}}\,dx = \int x(16-7x^2)^{-\frac{1}{2}}\,dx$$

$$= \left[-\frac{1}{7}(16-7x^2)^{\frac{1}{2}}\right]_0^1$$

$$= -\frac{1}{7}\times 9^{\frac{1}{2}} - \left(-\frac{1}{7}\times 16^{\frac{1}{2}}\right)$$

$$= -\frac{3}{7} + \frac{4}{7}$$

$$= \frac{1}{7}$$

5. a)

$(0,-3,7)-(7,4,0)$ OR $(-7,-7,7)$ B1

$\underline{r} = (7,4,0) + \lambda(-7,-7,7)$ o.e. M1 STRUCTURE (MUST HAVE $\underline{r} = \dots$)
M1 All correct

b) EQUATES ANY 2 PARAMETRIC COMPONENTS

E.g.
$$\begin{aligned} \mu+3 &= -7\lambda+7 \\ 3\mu-4 &= -7\lambda+4 \\ 2\mu-2 &= 7\lambda \end{aligned} \quad \text{OR} \quad \begin{pmatrix} \mu+3=\lambda+7 \\ 3\mu-4=-\lambda \\ 2\mu-2=\lambda+4 \end{pmatrix}$$
M1

SOLVES EQUATIONS M1

$\mu = 2$ A1

$\lambda = \frac{2}{7}, -\frac{2}{7}$ OR -2 OR 2 A1

CHECKS THE COMPONENT NOT USED & CONCLUDES MA1

$C(5,2,2)$ A1

c) DOTS $(1,2,3)\cdot(7,-7,7)$ OR $(1,2,3)\cdot(1,1,-1)$ o.e. M1

OBTAINS ZERO (3 NUMBER SUM MUST BE SEEN) + CONCLUSION A1

d)
$$\begin{aligned} \mu+3 &= 4 \\ 2\mu-2 &= 0 \\ 3\mu-4 &= -1 \end{aligned}$$
M1

OBTAINS $\mu=1$ FOR ALL AND COMMENTS A1

OR

SIGHT OF $\mu=1$ B1

&
$$\begin{aligned} 1+3 &= 4 \\ 2\times1-2 &= 0 \\ 3\times1-4 &= -1 \end{aligned}$$
+ COMMENT A1

e) $(6,4,5)$ B1 2 correct co-ordinates
B1 All 3 correct

6. a) $\ln y = \ln 2^{\sin 2x}$ M1

$= \sin 2x \times \ln 2$

$\frac{1}{y}\frac{dy}{dx} = 2\cos 2x \times \ln 2$ M1 M1 M1

$\frac{dy}{dx} = 2y \ln 2 \times \cos 2x$ MA1

$\frac{dy}{dx} = 2 \times 2^{\sin 2x} \times \ln 2 \times \cos 2x$ A1 c.a.o

(ACCEPT WITHOUT WORKINGS THE FINAL ANSWER FOR FULL MARKS)

b) IMPLIES/STATES GRADIENT IS 0 B1

IMPLIES/STATES $y=2$ B1

MUST EXPLICITLY STATE THAT THE EQUATION OF THE TANGENT IS $y=2$ A1

7. a) $\cos 2\theta = 0$, $2\theta = \frac{\pi}{2}$, $\theta = \frac{\pi}{4}$ A1 OR $\cos 2\theta = \frac{1}{2}$, $2\theta = \frac{\pi}{3}$, $\theta = \frac{\pi}{6}$ A1 B1

$$\int_{\frac{\pi}{4}}^{\frac{\pi}{6}} (\sec\theta)(-2\sin 2\theta)\, d\theta \quad \text{OR} \quad \int_{\frac{\pi}{6}}^{\frac{\pi}{4}} (\sec\theta)(2\sin 2\theta)\, d\theta$$

M1 ($\sec\theta$)
M1 ($2\sin 2\theta$)
M1 (CORRECT PLACING OF LIMITS)

CORRECTLY & CONVINCINGLY ARRIVES AT THE ANSWER

$$\int_{\pi/6}^{\pi/4} 4\sin\theta\, d\theta$$ MA1

b) $-4\cos\theta$ M1

$2\sqrt{3} - 2\sqrt{2}$ O.E A1

c) $\pi \int_{\dots}^{\dots} \sec^2\theta\,(-2\sin 2\theta)\, d\theta$

M1 STRUCTURE FOR V (INC π)
MA1 All correct

SIGHT OF SIMPLIFICATION TO $k\tan\theta$ M1

$k\ln|\sec\theta|$ OR $k|\cos\theta|$ M1

$4\pi\left(\ln(\sqrt{2}) - \ln\left(\frac{2\sqrt{3}}{3}\right)\right)$ O.E e.g. $2\pi\ln\frac{3}{2}$ A1

8. a) $\frac{r}{h} = \frac{18}{72}$ o.e B1

$r = \frac{1}{4}h$ o.e A1

$V = \frac{1}{3}\pi\left(\frac{1}{4}h\right)^2 h = \frac{1}{48}\pi h^3$ MA1

b) $\frac{dh}{dV} \times \frac{dV}{dt}$ (SIGHT OF) B1

$\frac{1}{16}\pi h^2$ B1

$\frac{16}{\pi h^2} \times 6\pi$ M1

$\frac{96}{4^2}$ OR $\frac{96}{16}$ BEFORE SHOWING $\underline{\underline{6}}$ A1 c.a.o

c) 12.5×60 OR $\underline{750}$ B1

"750" $\times 6\pi$ OR 4500π M1

"4500π" $= \frac{1}{48}\pi h^3$ M1

$h = 60$ MA1

FINAL ANSWER $\frac{2}{75}$ $\underline{\underline{\text{OR}}}$ $0.02666\ldots$ A1