1\. a) $1+\frac{1}{2}x - \frac{1}{8}x^2 + \frac{1}{16}x^3$ B3

b) $4^{\frac{1}{2}}\left(1+\frac{1}{2}x\right)^{\frac{1}{2}}$ B1

$1+\frac{1}{4}x - \frac{1}{32}x^2 + \frac{1}{128}x^3$ ALLOW ONE ERROR M1

$2+\frac{1}{2}x - \frac{1}{16}x^2 + \frac{1}{64}x^3$ A1

c) $-2 < x < 2$ OR $|x| < 2$ B1 (DO NOT ALLOW $\leq$)

2\. $3x^2 + \boxed{2y + 2x\frac{dy}{dx}} = \boxed{e^y\frac{dy}{dx}}$ M3

REARRANGES CORRECTLY & CONVINCINGLY TO $\frac{dy}{dx} = \frac{3x^2+2y}{e^y - 2x}$ MA1

MAKES DIRECT REFERENCE TO ORIGINAL EQUATION AND GIVES THE FINAL GIVEN A1

3\. $\pi\int_1^e \left(x^{\frac{3}{2}}\sqrt{\ln x}\right)^2 dx$ B1

$\frac{1}{4}x^4\ln x \boxed{-\int \frac{1}{4}x^4 \times \frac{1}{x}\, dx}$ O.E M1 M1

$\frac{1}{4}x^4\ln x - \frac{1}{16}x^4$ M1

SUBSTITUTES LIMITS CORRECTLY M1

SHOWS $\pi\left[\frac{1}{4}e^4 - \frac{1}{16}e^4 + \frac{1}{16}\right]$ O.E BEFORE GIVING THE FINAL ANSWER A1

4. a) $t^2 - 8t + 12 = 0$ OR $t - 4 = 0$ M1

$t = \begin{cases} 2 \\ 6 \end{cases}$ BOTH $t = 4$ M1 M1

$(0,-2)$ & $(0,2)$ $(-4,0)$ A1 A1

b) $\frac{dy}{dx} = \frac{1}{2t-8}$ M1

SHOWS $t = 5$ IS NEEDED B1

IMPLIES OR SHOWS THAT GRADIENT IS $\frac{1}{2}$ M1

$y - 1 = -2(x+3)$ ft GRADIENT M1

SIMPLIFIES TO THE ANSWER GIVEN A1

(IF NO MARKS ARE AWARDED IN THIS PART AWARD 1 MARK FOR SIGHT OF $\frac{dy/dt}{dx/dt}$ OR $\frac{dy}{dt} \times \frac{dt}{dx}$)

c) SOLVES $t = y+4$ M1

SUBS INTO THE OTHER & GENUINELY REACHES THE ANSWER GIVEN MA1

5. a) $(13,23,7)-(11,15,4)$ OR $(2,8,3)$ B1

$\underline{r} = (11,15,4) + \lambda(2,8,3)$ O.E   MUST HAVE $\underline{r} =$ M1 STRUCTURE

A1 ALL CORRECT

b) $2x + 8y + 3z = 0$ B1

$\left.\begin{array}{l} x = 2\lambda + 11 \\ y = 8\lambda + 15 \\ z = 3\lambda + 4 \end{array}\right)$ OR $\left.\begin{array}{l} x = 2\lambda + 13 \\ y = 8\lambda + 23 \\ z = 3\lambda + 7 \end{array}\right)$ O.E.   AT LEAST 2 OR OF 3 CORRECT   M1

$2(2\lambda+11) + 8(8\lambda+15) + 3(3\lambda+4) = 0$
OR
$2(2\lambda+13) + 8(8\lambda+23) + 3(3\lambda+7) = 0$ M1

SHOWS $\lambda = -2$ OR $\lambda = -3$ dep A1

SHOWS OR REFERS TO THE PARAMETRICS BEFORE $(7,-1,-2)$ IS QUOTED   A1

c) SIGHT OF $\sqrt{4+64+9}$ OR $\sqrt{49+1+4}$ O.E   B1

$\frac{1}{2} \times \sqrt{77} \times \sqrt{54}$ M1

$\frac{3}{2}\sqrt{462}$ OR AWRT 32.2 A1 c.a.o

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a) 4×1.5 OR 6 M1

$\pi r^2 = 6$ M1

$r = \sqrt{\frac{6}{\pi}}$ OR A.W.R 1.38 A1

b) $\frac{dA}{dr} = 2\pi r$ OR $\frac{dr}{dA} = \frac{1}{2\pi r}$ B1

$\left(\frac{dr}{dt} =\right) \frac{1}{2\pi r} \times 1.5$ OR $\frac{dr}{dt} = \frac{dr}{dA} \times \frac{dA}{dt}$ M1

$\left(\frac{dr}{dt} =\right) = \frac{1}{2\pi \times 1.38\ldots} \times 1.5$ M1

A.W.R.T 0.173 A1

7. a) $\frac{1}{m-10}\,dm = -k\,dt$ OR SIMILAR M1

INTEGRATES BOTH SIDES OF "THEIR SEPARATED" EQUATION, SO LONG AS IT APPEARS SEPARATED B1

$$\ln|m-10| = -kt + C$$
OR $$\alpha \ln|m-10| = \pm t + c$$
OR $$\alpha \ln|\alpha m - 10\alpha| = \pm t + c$$
M1

ELIMINATES THE LOGARITHM CORRECTLY M1

ARRIVES CORRECTLY & CONVINCINGLY TO THE ANSWER GIVEN A1

b) OBTAINS $A = 110$ OR CORRECTLY SUBSTITUTES $t=0$ $m=120$ B1

$60 = 10 + \text{"}110\text{"}e^{-3k}$ M1

REARRANGES CORRECTLY — SUBTRACT DIVIDE

e.g. $\frac{50}{\text{"}110\text{"}} = e^{-3k}$ M1

TAKES LOGS AND SIMPLIFIES TO THE ANSWER GIVEN A1

(ACCEPT $k = -\frac{1}{3}\ln\frac{5}{11}$ & I.S.W)

c) $(m=)\ 10 + \text{"}A\text{"}e^{-\text{"}k\text{"}\times 6}$ M1

A.W.R.T 32.7 (ACCEPT 33 WITH WORKINGS A1

$\left(\frac{360}{11}\right)$

8. a) CORRECT METHOD, ELIMINATION OR EQUATING COEFFICIENTS M1

$A=2 \quad B=-1 \quad C=1$ B3

b) $2u\frac{du}{dx}=1$ or $\frac{du}{dx}=\frac{1}{2}(x+1)^{-\frac{1}{2}}$ B1

LIMITS CHANGED TO $u=2 \quad u=3$
(ALLOW 1 MISTAKE IF METHOD IS SHOWN) B1

(OR CHANGES BACK INTO x AT THE END WITH ORIGINAL LIMITS)

$$\int_2^3 \frac{u}{x} 2u \, du \quad \text{M1}$$

$$\int_2^3 \frac{2u^2}{u^2-1} \, du \quad \text{M1}$$

MUST SHOW LIMITS IN AT LEAST ONE OF THESE

$$\int_2^3 \frac{2u^2}{(u+1)(u-1)} \, du$$

$$\int_2^3 \text{"} 2 + \frac{1}{u-1} - \frac{1}{u+1} \text{"} \, du \quad \text{A1}$$

$$2u + \ln|u-1| - \ln|u+1| \quad \text{M1}$$

$[\ldots\ldots] - [\ldots\ldots]$ CORRECTLY OR SIGHT OF 2.405... M1
(ALLOW 1 MINOR ERROR)

$2+\ln 2+\ln 3-\ln 4$ OR $2+\ln\frac{3}{2}$ OR SIMILAR A1

c) 0.4410 B1

d) $\frac{1}{2}\left[0.6667+0.3750+2\left(0.5590+0.4899+\text{"}0.4410\text{"}+0.4041\right)\right]$ M1

ANSWER OF 2.4, 2.41, 2.415 OR BETTER A1

e) TRAPEZIUM OVERESTIMATES + ANSWER 0.01 OR BETTER MA1