1 Obtain $1 - 6x$ B1
State correct unsimplified x^2 term. Binomial coefficients must be expanded. M1
Obtain … $+ 24x^2$ A1 [3]

2 Use of correct quotient or product rule to differentiate x or t M1
Obtain correct $\dfrac{3}{(2t+3)^2}$ or unsimplified equivalent A1
Obtain $-2e^{-2t}$ for derivative of y B1
Use $\dfrac{dy}{dx} = \dfrac{\frac{dy}{dt}}{\frac{dx}{dt}}$ or equivalent M1
Obtain -6 cwo A1 [5]

Alternative:
Eliminate parameter and attempt differentiation $\left(y = e^{\frac{-6x}{1-2x}} \right)$ B1
Use correct quotient or product rule M1
Use chain rule M1
Obtain $\dfrac{dy}{dx} = \dfrac{-6}{(1-2x)^2} e^{\frac{-6x}{1-2x}}$ A1
Obtain -6 cwo A1

3 **(i)** Attempt multiplication and use $i^2 = -1$ M1
Obtain $3 + 4i$ A1
Obtain 5 for <u>modulus</u> B1 [3]

(ii) Draw complete circle with centre corresponding to their w^2 … B1√
… and radius corresponding to their $|w^2|$ B1√
Shade the correct region cwo B1 [3]

4 **(i)** Obtain derivative of form $k\cos 3x \sin 3x$, any constant k M1
Obtain $-24\cos 3x \sin 3x$ or unsimplified equivalent A1
Obtain $-6\sqrt{3}$ or exact equivalent A1 [3]

(ii) Express integrand in the form $a + b\cos 6x$, where $ab \neq 0$ M1
Obtain $2 + 2\cos 6x$ o.e. A1
Obtain $2x + \frac{1}{3}\sin 6x$ or equivalent, condoning absence of $+ c$, ft on a, b A1√ [3]

5 State or imply form $\frac{A}{2x+1}+\frac{B}{x+2}$ B1

Use relevant method to find A or B M1

Obtain $\frac{4}{2x+1}-\frac{1}{x+2}$ A1

Integrate and obtain $2\ln(2x+1)-\ln(x+2)$ (ft on their A, B) B1√B1√

Apply limits to integral containing terms $a\ln(2x+1)$ and $b\ln(x+2)$ and apply a law of logarithms correctly. M1

Obtain given answer $\ln 50$ correctly A1 [7]

6 **(i)** State general vector for point on line, e.g.
$-5\mathbf{i}+3\mathbf{j}+6\mathbf{k}+s(10\mathbf{i}+5\mathbf{j}-5\mathbf{k})$ or $5\mathbf{i}+8\mathbf{j}+\mathbf{k}+t(10\mathbf{i}+5\mathbf{j}-5\mathbf{k})$ or equiv B1

Substitute their line into equation of plane and solve for parameter M1

Obtain correct value, $s=\frac{2}{5}$ or $t=-\frac{3}{5}$ or equivalent A1

Obtain (–1, 5, 4) o.e. A1 [4]

(ii) State or imply normal vector to p is $2\mathbf{i}-\mathbf{j}+4\mathbf{k}$ B1

Carry out process for evaluating scalar product of two relevant vectors M1

Using correct process for moduli, divide scalar product by the product of the moduli and evaluate arcsin(..) or arccos(..) of the result. M1

Obtain 5.1° or 0.089 rads A1 [4]

7 **(i)** Attempt integration by parts M1

Obtain $-x^{-1}\ln x+\int\frac{1}{x^2}\,\mathrm{d}x$, $\frac{x\ln x-x}{x^2}+2\int\frac{\ln x}{x^2}\,\mathrm{d}x-2\int\frac{1}{x^2}\,\mathrm{d}x$ or equivalent A1

Obtain $-x^{-1}\ln x-x^{-1}$ or equivalent A1

Use limits correctly, equate to $\frac{2}{5}$ and attempt rearrangement to obtain a in terms of $\ln a$ M1

Obtain given answer $a=\frac{5}{3}(1+\ln a)$ correctly A1 [5]

(ii) Use valid iterative formula correctly at least once M1

Obtain final answer 3.96 A1

Show sufficient iterations to › 4 dp to justify accuracy to 2 dp or show sign change in interval (3.955, 3.965) A1 [3]

[4 → 3.9772 → 3.9676 → 3.9636 → 3.9619]

SR: Use of $a_{n+1}=\mathrm{e}^{\left(\frac{3}{5}a_n-1\right)}$ to obtain 0.50 also earns 3/3.

8	**(i)**	Obtain or imply $R = 4$		B1	
		Use appropriate trigonometry to find α		M1	
		Obtain $\alpha = 52.24$ or better from correct work		A1	[3]
	(ii)	**(a)** State or imply $\theta - \alpha = \cos^{-1}(-4 \div R)$		M1	
		Obtain 232.2 or better		A1	[2]
		(b) Attempt at least one value using $\cos^{-1}(3 \div R)$		M1	
		Obtain one correct value e.g. ± 41.41°		A1	
		Use $\frac{1}{2}\theta - \alpha = \cos^{-1}\left(\frac{3}{R}\right)$ to find θ		M1	
		Obtain 21.7		A1	[4]
9	**(i)**	State $\frac{\mathrm{d}A}{\mathrm{d}t} = k\sqrt{2A-5}$		B1	[1]
	(ii)	Separate variables correctly and attempt integration of each side		M1	
		Obtain $(2A-5)^{\frac{1}{2}} = \ldots$ or equivalent		A1	
		Obtain = kt or equivalent		A1	
		Use $t = 0$ and $A = 7$ to find value of arbitrary constant		M1	
		Obtain $C = 3$ or equivalent		A1	
		Use $t = 10$ and $A = 27$ to find k		M1	
		Obtain $k = 0.4$ or equivalent		A1	
		Substitute $t = 20$ and values for C and k to find value of A		M1	
		Obtain 63	cwo	A1	[9]
10	**(i)**	Attempt to solve for m the equation p(–2) = 0 or equivalent		M1	
		Obtain $m = 6$		A1	[2]
		Alternative:			
		Attempt p(z) ÷ (z + 2), equate a constant remainder to zero and solve for m.		M1	
		Obtain $m = 6$		A1	
	(ii)	**(a)** State $z = -2$		B1	
		Attempt to find quadratic factor by inspection, division, identity, …		M1	
		Obtain $z^2 + 4z + 16$		A1	
		Use correct method to solve a 3-term quadratic equation		M1	
		Obtain $-2 \pm 2\sqrt{3}\mathrm{i}$ or equivalent		A1	[5]
		(b) State or imply that square roots of answers from part **(ii)(a)** needed		M1	
		Obtain $\pm\mathrm{i}\sqrt{2}$		A1	
		Attempt to find square root of a further root in the form $x + \mathrm{i}y$ or in polar form		M1	
		Obtain $a^2 - b^2 = -2$ and $ab = (\pm)\sqrt{3}$ following their answer to part **(ii)(a)**		A1√	
		Solve for a and b		M1	
		Obtain $\pm(1 + \mathrm{i}\sqrt{3})$ and $\pm(1 - \mathrm{i}\sqrt{3})$		A1	[6]