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- 1 Either Square both sides obtaining 3 terms on each side M1
Solve 3-term quadratic equation M1
Obtain $-\frac{4}{5}$ and 6 A1 [3]
- Or Obtain value 6 from graphical method, inspection, linear equation, ... B1
Obtain value $-\frac{4}{5}$ similarly B2 [3]
- 2 (i) Integrate to obtain form $pe^{-x} + qe^{-3x}$ where $p \neq 1, q \neq 6$ M1
Obtain $-e^{-x} - 2e^{-3x}$ (allow unsimplified) A1
Apply both limits to $pe^{-x} + qe^{-3x}$ (allow $p = 1, q = 6$) M1
Obtain $3 - e^{-a} - 2e^{-3a}$ A1 [4]
- (ii) State 3 following a result of the form $k + pe^{-x} + qe^{-3x}$ B1✓ [1]
- 3 Obtain $6y + 6x \frac{dy}{dx}$ as derivative of $6xy$ B1
Obtain $2y \frac{dy}{dx}$ as derivative of y^2 B1
Obtain $\frac{3}{x}$ and $\frac{d}{dx}(16) = 0$ B1
Substitute 1 and 2 to find value of $\frac{dy}{dx}$ M1
Obtain value $\frac{2}{3}$ as gradient of normal following their value of $\frac{dy}{dx}$ A1✓
Form equation of **normal** through (1, 2) with numerical gradient M1
Obtain $2x - 3y + 4 = 0$ A1 [7]
- 4 (a) Use power law to produce $\ln(x-4)^2$ B1
Apply logarithm laws to produce equation without logarithms M1
Obtain $(x-4)^2 = 2x$ or equivalent A1
Solve 3-term quadratic equation DM1
Obtain (finally) $x = 8$ only A1 [5]
- (b) Apply logarithms and use power law (once) M1
Obtain $\frac{\ln 10^{10}}{\ln 1.4}$ or equivalent as part of inequality or equation A1
Conclude with single integer 69 A1 [3]
- 5 (i) Differentiate to obtain $-2 \sin x + 2 \sin 2x$ or equivalent B1
Use $\sin 2x = 2 \sin x \cos x$ or equivalent B1
Equate first derivative to zero and solve for x M1
Obtain $\frac{1}{3}\pi$ A1 [4]

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- (ii) Integrate to obtain form $k_1 \sin x + k_2 \sin 2x$ M1
 Obtain correct $2 \sin x - \frac{1}{2} \sin 2x$ A1
 Apply limits 0 and their answer from part (i) M1
 Obtain $\frac{3}{4}\sqrt{3}$ or exact equivalent A1 [4]
- 6 (i) Identify $x-3$ as divisor B1
 Divide by linear expression at least as far as x term M1
 Obtain quotient $x^3 + 3x - 16$ A1
 Obtain zero remainder with no errors in the division A1
 Equate quotient to zero and confirm $x = \sqrt[3]{16-3x}$ (AG) A1 [5]
- (ii) Use iteration process correctly at least once M1
 Obtain final answer 2.13 A1
 Show sufficient iterations to 4 decimal places or show a sign change in the interval (2.125, 2.135) A1 [3]
- 7 (i) State or imply $R=13$ B1
 Use appropriate formula to find α M1
 Obtain 67.38° A1 [3]
- (ii) Attempt to find at least one value of $\cos^{-1} \frac{8}{13}$ or $\cos^{-1} \frac{8}{R}$ M1
 Obtain one correct value of θ (240.6 or 344.6) A1
 Carry out correct method to find second value of θ within the range DM1
 Obtain second correct value (344.6 or 240.6) A1 [4]
- (iii) State or imply $7 + 13 \cos(\frac{1}{2}\phi + 67.38)$ following their answers from part (i) B1^{ft}
 State 20 B1
 Attempt to find ϕ for which $\cos(\frac{1}{2}\phi + 67.38) = 1$ M1
 Obtain 585.2 A1 [4]