1 *EITHER:* State or imply non-modular inequality $(x+3a)^2 > (2(x-2a))^2$, or corresponding quadratic equation, or pair of linear equations $(x+3a) = \pm 2(x-2a)$ B1

Make reasonable solution attempt at a 3-term quadratic, or solve two linear equations M1

Obtain critical values $x = \frac{1}{3}a$ and $x = 7a$ A1

State answer $\frac{1}{3}a < x < 7a$ A1

OR: Obtain the critical value $x = 7a$ from a graphical method, or by inspection, or by solving a linear equation or inequality B1

Obtain the critical value $x = \frac{1}{3}a$ similarly B2

State answer $\frac{1}{3}a < x < 7a$ B1 [4]

[Do not condone $\leqslant$ for $<$; accept 0.33 for $\frac{1}{3}$.]

2 Use correct cos 2*A* formula and obtain an equation in sin θ M1

Obtain $4\sin^2\theta + \sin\theta - 3 = 0$, or equivalent A1

Make reasonable attempt to solve a 3-term quadratic in sin θ M1

Obtain answer 48.6° A1

Obtain answer 131.4° and no others in the given range A1 √

Obtain answer 270° and no others in the given range A1 [6]

[Treat the giving of answers in radians as a misread. Ignore answers outside the given range.]

3 **(i)** *EITHER:* State or imply $n\ln x + \ln y = \ln C$ B1

Substitute *x*- and *y*-values and solve for *n* M1

Obtain $n = 1.50$ A1

Solve for *C* M1

Obtain $C = 6.00$ A1

OR: Obtain two correct equations by substituting *x*- and *y*-values in $x^n y = C$ B1

Solve for *n* M1

Obtain $n = 1.50$ A1

Solve for *C* M1

Obtain $C = 6.00$ A1 [5]

(ii) State that the graph of ln *y* against ln *x* has equation $n\ln x + \ln y = \ln C$ which is *linear* in ln *y* and ln *x*, or has equation of the form $nX + Y = \ln C$, where $X = \ln x$ and $Y = \ln y$, and is thus a straight line B1 [1]

4 **(i)** State correct expansion of $\cos(3x - x)$ or $\cos(3x + x)$ B1

Substitute expansions in $\frac{1}{2}(\cos 2x - \cos 4x)$, or equivalent M1

Simplify and obtain the given identity correctly A1 [3]

(ii) Obtain integral $\frac{1}{4}\sin 2x - \frac{1}{8}\sin 4x$ B1

Substitute limits correctly in an integral of the form $a\sin 2x + b\sin 4x$ M1

Obtain given answer following full, correct and exact working A1 [3]

5 Separate variables correctly B1
Integrate and obtain term $\ln x$ B1
Integrate and obtain term $\frac{1}{2}\ln(y^2+4)$ B1
Evaluate a constant or use limits $y = 0$, $x = 1$ in a solution containing $a\ln x$ and $b\ln(y^2+4)$ M1
Obtain correct solution in any form, e.g. $\frac{1}{2}\ln(y^2+4) = \ln x + \frac{1}{2}\ln 4$ A1
Rearrange as $y^2 = 4(x^2-1)$, or equivalent A1 [6]

6 **(i)** Using the formulae $\frac{1}{2}r^2\theta$ and $\frac{1}{2}r^2\sin\theta$, or equivalent, form an equation M1
Obtain a correct equation in r and x and/or $x/2$ in any form A1
Obtain the given equation correctly A1 [3]

(ii) Consider the sign of $x-(\frac{3}{4}\pi-\sin x)$ at $x = 1.3$ and $x = 1.5$, or equivalent M1
Complete the argument with correct calculations A1 [2]

(iii) Use the iterative formula correctly at least once M1
Obtain final answer 1.38 A1
Show sufficient iterations to at least 4 d.p. to justify its accuracy to 2 d.p., or show there is a sign change in the interval (1.375, 1.385) A1 [3]

7 **(i)** Obtain modulus $\sqrt{8}$ B1
Obtain argument $\frac{1}{4}\pi$ or 45° B1 [2]

(ii) Show 1, i and u in relatively correct positions on an Argand diagram B1
Show the perpendicular bisector of the line joining 1 and i B1
Show a circle with centre u and radius 1 B1
Shade the correct region B1 [4]

(iii) State or imply relevance of the appropriate tangent from O to the circle B1 √
Carry out complete strategy for finding $|z|$ for the critical point M1
Obtain answer $\sqrt{7}$ A1 [3]

8 **(i)** State or imply the form $\frac{A}{x+1}+\frac{B}{x+3}$ and use a relevant method to find A or B M1
Obtain $A = 1$, $B = -1$ A1 [2]

(ii) Square the result of part **(i)** and substitute the fractions of part **(i)** M1
Obtain the given answer correctly A1 [2]

(iii) Integrate and obtain $-\frac{1}{x+1}-\ln(x+1)+\ln(x+3)-\frac{1}{x+3}$ B3
Substitute limits correctly in an integral containing at least two terms of the correct form M1
Obtain given answer following full and exact working A1 [5]

9 **(i)** Use quotient or product rule to differentiate $(1 - x)/(1 + x)$ M1
Obtain correct derivative in any form A1
Use chain rule to find $\frac{dy}{dx}$ M1
Obtain a correct expression in any form A1
Obtain the gradient of the normal in the given form correctly A1 [5]

(ii) Use product rule M1
Obtain correct derivative in any form A1
Equate derivative to zero and solve for x M1
Obtain $x = \frac{1}{2}$ A1 [4]

10 **(i)** Express general point of l or m in component form, e.g. $(1 + s, 1 - s, 1 + 2s)$ or $(4 + 2t, 6 + 2t, 1 + t)$ B1
Equate at least two corresponding pairs of components and solve for s or t M1
Obtain $s = -1$ or $t = -2$ A1
Verify that all three component equations are satisfied A1 [4]

(ii) Carry out correct process for evaluating the scalar product of the direction vectors of l and m M1
Using the correct process for the moduli, divide the scalar product by the product of the moduli and evaluate the inverse cosine of the result M1
Obtain answer 74.2° (or 1.30 radians) A1 [3]

(iii) *EITHER:* Use scalar product to obtain $a - b + 2c = 0$ and $2a + 2b + c = 0$ B1
Solve and obtain one ratio, e.g. $a : b$ M1
Obtain $a : b : c = 5 : -3 : -4$, or equivalent A1
Substitute coordinates of a relevant point and values for a, b and c in general equation of plane and evaluate d M1
Obtain answer $5x - 3y - 4z = -2$, or equivalent A1

OR 1: Using two points on l and one on m, or *vice versa*, state three equations in a, b, c and d B1
Solve and obtain one ratio, e.g. $a : b$ M1
Obtain a ratio of three of the unknowns, e.g. $a : b : c = -5 : 3 : 4$ A1
Use coordinates of a relevant point and found ratio to find the fourth unknown, e.g. d M1
Obtain answer $-5x + 3y + 4z = 2$, or equivalent A1

OR 2: Form a correct 2-parameter equation for the plane,
e.g. $\mathbf{r} = \mathbf{i} + \mathbf{j} + \mathbf{k} + \lambda(\mathbf{i} - \mathbf{j} + 2\mathbf{k}) + \mu(2\mathbf{i} + 2\mathbf{j} + \mathbf{k})$ B1
State three equations in x, y, z, λ and μ M1
State three correct equations A1
Eliminate λ and μ M1
Obtain answer $5x - 3y - 4z = -2$, or equivalent A1

OR 3: Attempt to calculate vector product of direction vectors of l and m M1
Obtain two correct components of the product A1
Obtain correct product, e.g. $-5\mathbf{i} + 3\mathbf{j} + 4\mathbf{k}$ A1
Form a plane equation and use coordinates of a relevant point to calculate d M1
Obtain answer $-5x + 3y + 4z = 2$, or equivalent A1 [5]