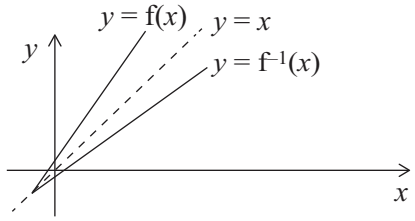
1	$y = \dfrac{6}{2x-3}$ Integral of y^2 = $\dfrac{-36}{(2x-3)} \div 2$ Use of limits 2, 3 → 12π or 37.7	B1 B1 M1 A1 [4]	co allow 2nd B1 independent of 1st. Used as 2 to 3 or 3 to 2 in integral of y^2. Co (uses area 0/4. No π Max 3/4)
2	$y = 4\sqrt{x} + \dfrac{2}{\sqrt{x}}$ **(i)** $\dfrac{dy}{dx} = 4.½.x^{-½} + 2.(-½)x^{-1.5}$ or $y = \dfrac{2}{\sqrt{x}} - \dfrac{1}{x^{1.5}}$ **(ii)** $\dfrac{dy}{dt} = \dfrac{dy}{dx} \times \dfrac{dx}{dt}$ used → = ⅞ × 0.12 = 0.105	M1 A1 A1 [3] M1 A1 [2]	Reducing "their" power by 1 once. Allow unsimplified Must be used correctly co – fraction or decimal.
3	Coeff of x^3 in $(a+x)^5 = 10 \times a^2$ Coeff of x^3 in $(2-x)^6 = -160$ → $10a^2 - 160 = 90$ → $a = 5$	B1 B1 B1 M1 A1 [5]	co co co forms an equation from 2 terms co
4	$A(-1, -5)$, $B(7, 1)$. M (3, −2) Gradient = $\frac{3}{4}$ Perpendicular gradient = $-\frac{4}{3}$ Eqn $y + 2 = -\frac{4}{3}(x-3)$ Sets x and y to 0 $C(\frac{3}{2}, 0)$ $D(0, 2)$ → Pythagoras → CD = 2.5	B1 B1 M1 M1 M1A1 [6]	co co needs to be perp. through M. Setting **one** of x or y to 0. Correct method. co.

5	$\tan x + \frac{1}{\tan x} \equiv \frac{1}{\sin x \cos x}$		
	(i) LHS $= \frac{\sin x}{\cos x} + \frac{\cos x}{\sin x}$	M1	Use of tan = sin/cos twice
	$= \frac{\sin^2 x + \cos^2 x}{\sin x \cos x} = \frac{1}{\sin x \cos x}$	M1 [2]	Use of $s^2 + c^2 = 1$ appropriately – everything correct.
	(ii) $\frac{2}{\sin x \cos x} = 3\tan x + 1$		
	Uses (i) $2(\tan x + \frac{1}{\tan x}) = 3\tan x + 1$	M1	Uses part (i) to obtain eqn in tan$x$ only
	$\rightarrow \tan^2 x + \tan x - 2 = 0$	DM1	Correct soln of quadratic eqn
	$\rightarrow$ tan$x$ = 1 or −2	B1 A1	co. Must have correct quadratic co
	$\rightarrow x = 45°$ or 116.6°	[4]	
6	**(i)** cosine rule or $2\times r \times \sin ½.(2.4)$	M1	Any complete valid method.
	$\rightarrow$ 14.9 cm	A1 [2]	co
	(ii) Perimeter = (i) $+ r\theta$	M1	Uses $s = r\theta$ with 2.4, or $\pi - 2.4$,
	$\theta = 2\pi - 2.4$,	B1	or $2\pi - 2.4$
	$\rightarrow$ 46.0 cm	A1√ [3]	Anywhere in parts (ii) or (iii). Adds 31.1 to (i) for √.
	(iii) Area = Sector + triangle		
	$½\times 8^2 (2\pi - 2.4) + ½\times 8^2 \sin 2.4$	M1 M1	
	$124.3 + 21.6 \rightarrow 146$ cm².	A1 [3]	Uses $½r^2\theta$. Uses any valid method. co
7	**(a)** $S_n = n^2 + 8n$.		
	$S_1 = 9 \rightarrow a = 9$	B1	co
	$S_2 = 20 \rightarrow a + d = 11 \rightarrow d = 2$	M1 A1	Realises that S_2 is $a + (a + d)$. co
	(or equating $n^2 + 8n$ with S_n and comparing coefficients)	[3]	
	(b) $a - ar = 9$	B1	co
	$ar + ar^2 = 30$	B1	co
	Eliminates $a \rightarrow 3r^2 + 13r - 10 = 0$	M1	Complete elimination of r or a
	or $\rightarrow 2a^2 - 57a + 81 = 0$		Correct quadratic.
	$\rightarrow r = ⅔$	A1	
	$\rightarrow a = 27$	A1 [5]	co (condone 27 or 1.5)

8	**(i)** $3\mathbf{i} - 4\mathbf{k}$, $2\mathbf{i} + 3\mathbf{j} - 6\mathbf{k}$. Dot product = 6 + 24 = 30 = $\sqrt{25} \times \sqrt{49} \cos\theta$ → angle = 31° or 0.54(1) radians.	M1 M1 M1 A1 [4]	Uses $x_1x_2 + y_1y_2 + z_1z_2$ Method for modulus Links everything correctly. co
	(ii) **OA** = $(3\mathbf{i} - 4\mathbf{k}) \times (15 \div 5)$ → $9\mathbf{i} - 12\mathbf{k}$ **OB** = $(2\mathbf{i} + 3\mathbf{j} - 6\mathbf{k}) \times (14 \div 7)$ → $4\mathbf{i} + 6\mathbf{j} - 12\mathbf{k}$.	M1 A1 A1 [3]	M mark for ×(15 ÷ 5) or ×(14 ÷ 7) A1 for **OA** A1 for **OB**
	(iii) **AB** = **b** − **a** = $-5\mathbf{i} + 6\mathbf{j}$ → Magnitude of $\sqrt{61}$ or 7.81 → Unit vector of $(-5\mathbf{i} + 6\mathbf{j}) \div \sqrt{61}$	M1 M1 A1 [3]	Correct use for either **AB** or **BA** Complete method for unit vector. co
9	$y = -x^2 + 8x - 10$		
	(i) $\frac{dy}{dx} = -2x + 8$ = 0 when $x = 4$, A is (4, 6) Equation of AB is $y - 6 = 2(x - 4)$ Sim eqns with eqn of curve → $x^2 - 6x + 8 = 0$ or $y^2 - 8y + 12 = 0$ → B (2, 2)	B1 M1A1 M1 M1 A1 A1 [7]	co Sets to 0 and attempt to solve for x. co. Correct form of equation. Eliminates x or y completely Method for quadratic eqn = 0. co (Must not be guessed from diagram)
	(ii) $\int -x^2 + 8x - 10\,dx = -\frac{x^3}{3} + 4x^2 - 10x$ Uses his x limits 2 to 4 → 9⅓	B2,1 M1 A1 [4]	3 terms, loses 1 for each error Uses x limits correctly – allow ± co – allow ± (2 must have been correctly found, not guessed)

10 $f: x \mapsto 2x+5$ $g: x \mapsto \frac{8}{x-3}$		
(i) $f^{-1} = \frac{1}{2}(x-5)$	B1	co
	M1 A1	Attempt at x the subject. co but $(f(x)$
$g^{-1} = \frac{8}{x}+3, x \neq 0$	B1√	Allow if a linear denominator.
	[4]	
(ii) 		+ve gradient, +ve y intercept +ve gradient, +ve y intercept States, or shows the line $y = x$ as a line of symmetry.
	B1 B1 B1	
	[3]	
(iii) $fg(x) = \frac{16}{x-3}+5$	B1	co
Forms eqn $\frac{16}{x-3}+5 = 5 - kx$	M1	Must lead to a quadratic
$kx^2 - 3kx + 16 = 0$		
Uses $b^2 = 4ac \rightarrow k = \frac{64}{9}$ or 0	M1 A1	Use of $b^2 - 4ac$ even if <0, >0. co Condone ‹
Set of values $0 < k < \frac{64}{9}$	A1	co
	[5]	