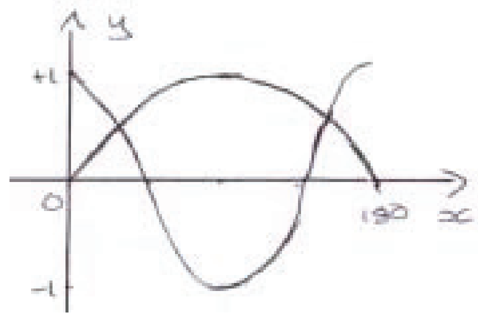
1	**(i)** $(2-y)^5 = 32 - 80y + 80y^2$ **(ii)** $(2-(2x-x^2))^5$ "y" = "$2x-x^2$" $\rightarrow 80 + 320 = 400$	B2,1 [2] M1 M1 A1 [3]	−1 for each error. Accept 2^5. Allow for $y = 2x + x^2$ Needs to consider exactly 2 terms. CO – accept $400x^2$, accept full expansion if $400x^2$ is part of it.
2	f : $x \mapsto 3x + a$, g : $x \mapsto b - 2x$ **(i)** $f^2(x) = 3(3x+a)+a$ $f^2(2) = 18 + 4a = 10 \rightarrow a = -2$ $g^{-1}(x) = \dfrac{b-x}{2} \rightarrow \dfrac{b-2}{2} = 3 \quad b = 8$ or $g(3) = 2 \rightarrow b - 6 = 2 \quad b = 8$ **(ii)** $fg(x) = 3(b-2x)+a$ $= 22 - 6x$	 B1 B1 M1 A1 [4] M1 A1√ [2]	 Must be correct – unsimplified ok co Correct method leading to a value for b co Must be fg not gf. √ on a and b $(3b + a - 6x)$ must be two term answer.
3	$\overrightarrow{OA} = 5\mathbf{i} + \mathbf{j} + 2\mathbf{k}$, $\overrightarrow{OB} = 2\mathbf{i} + 7\mathbf{j} + p\mathbf{k}$ **(i)** $\overrightarrow{OA}.\overrightarrow{OB} = 10 + 7 + 2p$ $= 0 \rightarrow p = -8\frac{1}{2}$ **(ii)** $\mathbf{AB} = -3\mathbf{i} + 6\mathbf{j} + 2\mathbf{k}$ Modulus = $\sqrt{(9+36+4)}$ Magnitude 28 $\rightarrow$ 28 ×unit vector $\rightarrow -12\mathbf{i} + 24\mathbf{j} + 8\mathbf{k}$.	M1 DM1 A1 [3] B1 M1 M1 A1 [4]	Use of $x_1x_2 + y_1y_2 + z_1z_2$ ....=0 co co (accept negative) For modulus Scales by ×28 ÷ modulus. Co – could leave as "4 × …".
4	**(i)** $y^2 + 2x = 13$, $2y + x = 8$ $\rightarrow y^2 - 4y + 3 = 0$, $x^2 - 8x + 12 = 0$ $\rightarrow$ (2, 3) and (6, 1) **(ii)** Removes $x \rightarrow y^2 + 2(k-2y) = 13$ Uses $b^2 - 4ac$ on "quadratic = 0) $\rightarrow k = 8\frac{1}{2}$ or $\dfrac{dy}{dx} = -\frac{1}{2} = \dfrac{-1}{y} \rightarrow y=2, x=4\frac{1}{2}, k=8\frac{1}{2}$	M1 A1 DM1 A1 [4] M1 DM1 A1 [3]	Complete elimination of x or y co (allow multiples) – needs 3 terms Solution of quadratic = 0 Needs all 4 coordinates. Complete elimination of x or y. Use of discriminant =0, <0 or >0 Co (M1 equating m of line and curve M1 x to y A1 for k)

5 **(i)** 	B1 B1 B1 [3]	y = sin$x$ (0,0). (π,0) + curve y = cos2x One full cycle. y = cos2x starts and finishes at (0, 1) and oscillates between −1 and +1. Do not penalise graphs from 0 to 360.
(ii) Evidence of sin 30 = cos 60 = 0.5 Other root is 150º	B1 B1 [2]	co co
(iii) $0 \le x < 30$ and $150 < x \le 180$ (x < 30 or x > 150 ok)	B1 B1√ [2]	Condone < or ≤ throughout
6 **(i)** D to AX = $6\sin\frac{\pi}{3}$ = 6√3÷2 E to AX = 10sinθ Equate these → $\theta = \sin^{-1}\frac{3\sqrt{3}}{10}$.	B1 B1 B1 [3]	co Needs –√3÷2 not just 3√3. co Correct method. ag. Use of decimals loses this B mark.
(ii) Arc DX = 6.⅓π = 2π Arc EX = 10×0.5464 =5.464 Horizontal steps = 6cos⅓π and 10cosθ DE = 10 + 6 − 6cos⅓π − 10cosθ Perimeter = arc DX + arc BX + DE → 16.20	B1 M1 M1 M1 A1 [5]	co Use of $s=r\theta$ radians. Attempt at both steps needed Full method for DE. Co – must be exactly 16.20, not more or less places.
7 $\frac{dy}{dx} = 5 - \frac{8}{x^2}$, Normal $3y + x = 17$		
(i) Gradient of line = −⅓ $\frac{dy}{dx} = 3 \rightarrow x = 2,\ y = 5$	B1 M1 DM1 A1 [4]	co Use of $m_1m_2 = -1$ DM1 solution. A1 co.
(ii) $y = 5x + 8x^{-1}(+c)$ Uses (2, 5) → $c = -9$	B1 B1 M1 A1 [4]	co.co. doesn't need +c. Use of +c following integration. co.

8 $y=\sqrt{8x-x^2}$		
(i) $\frac{dy}{dx}=\frac{1}{2}(8x-x^2)^{-\frac{1}{2}}\ \times(8-2x)$	B1 B1	B1 for everything but ×(8-2x) B1 for × (8−2x), even if B0
$=0$ when $x=4$.	M1	Sets to 0 + attempt at solution.
→ (4, 4)	A1 [4]	Co – A0 if fortuitous because of B0 earlier.
(ii) $y=0$ when $x=0$ or 8	B1	
Vol = $\pi\int(8x-x^2)dx$		Anywhere
$=\pi\left[4x^2-\frac{x^3}{3}\right]$	B2,1	−1 for each error (not including π)
→ $\frac{256\pi}{3}$	B1 [4]	co
9 (i) Gradient of AC = ½	B1	co
Gradient of BD = − 2	M1	Use of m_1m_2 = − 1 with AC
Eqn of BD is $y-6=-2(x-3)$	M1	Correct formula for straight line
Eqn of AC is $y+1=\frac{1}{2}(x+1)$	M1	Solution.
Sim eqns → M (5, 2)	A1	co
Vector move – or midpoint back → D (7, − 2)	M1 A1√ [7]	Correct method. √ on M.
(ii) Ratio of $AM : MC$ = √45 : √20	M1	Correct distance formula.
or Vector step → 3 : 2	A1 [2]	Looks at the two x or y steps. Must be numerical, 1.5 ok, not as roots
10 (a) $a=-15$, $n=25$		
(i) Use of S_n → $d=3$.	M1 A1 [2]	Must be correct formula. co
(ii) Last term = $a+24d$	M1	Must be $a+24d$
→ 57	A1√	√ for his d.
(or 525 = ½ × 25 × (−15 + l) → l = 57)	[2]	
(iii) Positive terms are 3,6, ...57		
Either a = 0 or 3, n = 19 or 20	M1	Correct use of formula for S_n.
Use of S_{19} or S_{20}		
→ 570	A1 [2]	co
(b) $r=1.05$	B1	In either part **(i)** or **(ii)**.
(i) 11th term = ar^{10} = $6516 or $6520	B1 [2]	co
(ii) $S_{11}=\frac{4000\times(1.05^{11}-1)}{.05}$	M1	Correct sum formula with their r.
= $56800 or (56827)	A1 [2]	co