1	(2, 7) to (10, 3) Mid-point (6, 5) Gradient = −½ Perp gradient = 2 Eqn $y-5=2(x-6)$ Sets y to 0, → (3½, 0)	 B1 B1 B1√ M1 A1 [5]	 co co co Must be correct form of Perp co $x = 3½$ only is ok.
2	$(1+x^2)(\frac{x}{2}-\frac{4}{x})^6$. Term in $x^2 = 15 \times \frac{1}{16} \times (-4)^2 = 15$ Constant term $= 20 \times \frac{1}{8} \times (-4)^3 = -160$ Coefficient of $x^2 = -145$	 B1 B1 B1 B1 B1√ [5]	 B1 unsimplified. B1 15. B1 unsimplified. B1 −160 Uses 2 terms. √ on previous answers
3	reflex angle θ is such that $\cos\theta = k$, **(i)** **(a)** $\sin\theta = -\sqrt{(1-k^2)}$ **(b)** Uses $t=s/c$ → $\frac{-\sqrt{1-k^2}}{k}$ **(ii)** θ is in 4th quadrant. 2θ lies between 540° and 720° $\sin 2\theta$ is negative in both these quadrants.	 B1 B1 [2] B1√ [1] B1 B1 [2]	 (−) B1 rest B1 √ for **(i)** ÷ k. co co
4	**(i)** $\frac{1}{2}r^2\theta = \frac{1}{2}r^2\theta - \frac{1}{2}r^2\sin\theta$ → $2\sin\theta = \theta$ → p = 2. **(ii)** Chord length = $8\sin 1.2 \times 2$ (14.9) (or from cosine rule) Arc length = 2.4×8 (19.2) Perimeter = sum of these = 34.1	 B1 B1 [2] M1 B1 A1 [3]	 Correct equation. All ok – answer given. Needs ×2. Any method ok. co
5	**(i)** $\frac{1}{\cos\theta}-\frac{\cos\theta}{1+\sin\theta} \equiv \tan\theta$. $\text{LHS} = \frac{1+s-c^2}{c(1+s)} = \frac{s^2+s}{c(1+s)} = \frac{s}{c}$ $= \tan\theta$ **(ii)** → $\tan\theta + 2 = 0$ ie $\tan\theta = -2$ → $\theta = 116.6°$ or 296.6°	M1 M1M1 A1 [4] M1 A1 A1√ [3]	Correct addition of fractions Use of $s^2+c^2=1$. $(1+s)$cancelled. → answer given. Uses part **(i).** Allow $\tan\theta=\pm 2$ Co. √ for 180°+ and no other solutions in the range.

6	**(i)** GP 8 $8r$ $8r^2$ AP 8 $8+8d$ $8+20d$ $8r = 8+8d$ and $8r^2 = 8+20d$ Eliminates d → $2r^2 - 5r + 3 = 0$ → $r = 1.5$ (or 1)	B1 B1 M1 A1 [4]	B1 for each equation. Correct elimination. co (no penalty for including $r = 1$)
	(ii) 4th term of GP = $ar^3 = 8 \times 27/8 = 27$ If $r = 1.5$, $d = 0.5$ 4th term of AP = $a + 3d = 9½$	B1√ M1A1 [3]	co needs $a + 3d$ and correct method for d
7	**(i)** $(\mathbf{b}-\mathbf{a}).(\mathbf{b}-\mathbf{c}) = \begin{pmatrix}-2\\-1\\2\end{pmatrix}.\begin{pmatrix}3\\2\\4\end{pmatrix}$ → $-6 - 2 + 8 = 0$ → 90°	M1 M1 A1 [3]	**AB** = **b** − **a** once (**a** – **b** is ok) Use of x_1x_2... with **AB** and **CB** All correct
	(ii) Unit vector = $⅓\begin{pmatrix}2\\1\\-2\end{pmatrix}$	M1	Method for unit vector.
	CD = 12 × unit vector = $\pm\begin{pmatrix}8\\4\\-8\end{pmatrix}$	M1	Knows to multiply by 12 or ±4**BA**
	OD = **OC** + **CD** = $\begin{pmatrix}12\\9\\-2\end{pmatrix}$	M1 A1 [4]	Correct method. co
8	$\frac{d^2y}{dx^2} = 2x - 1$ → $\int \frac{dy}{dx} = x^2 - x + c$	B1	Correct integration (ignore +c)
	= 0 when $x = 3$ → $c = -6$	M1 A1	Uses a constant of integration. co
	$x^2 - x - 6 = 0$ when $x = -2$ (or 3)	A1	Puts dy/dx to 0
	→ $\int y = ⅓x^3 - ½x^2 - 6x$ (+k)	B1√B1√	√ first 2 terms, √ for cx.
	= −10 when x =3	M1	Correct method for k
	→ $k = 3½$		
	→ $y = 10\frac{5}{6}$	A1 [8]	Co –r 10.8

9 $y = 8 - \sqrt{4-x}$		
(i) $\frac{dy}{dx} = -\frac{1}{2}(4-x)^{-\frac{1}{2}} \times -1$	B1 B1	Without (−1). For (×−1).
$\int y\,dx = 8x - \frac{(4-x)^{\frac{3}{2}}}{\frac{3}{2}} \div -1$	3 × B1 [5]	B1 for "8x" and +c". B1 for all except ÷(−1). B1 for ÷(−1). (n.b. these 5 marks can be gained in(ii) or (iii))
(ii) Eqn $y - 7 = ½(x-3)$ → $y = ½x + 5½$	M1A1 [2]	M1 unsimplified. A1 as $y=mx+c$
(iii) Area under curve = ∫ from 0 to 3 (58/3) Area under line = ½(5½ + 7)×3 Or $\left[¼x^2 + \frac{11x}{2}\right]$ from 0 to 3 → $\frac{58}{3} - \frac{75}{4} = \frac{7}{12}$	M1 M1 M1 A1 [4]	Use of limits – needs use of "0" Correct method M1 Subtraction. A1 co
10 f : $x \mapsto 2x - 3$, $x \in \mathbb{R}$, g : $x \mapsto x^2 + 4x$, $x \in \mathbb{R}$.		
(i) ff = 2(2x − 3) −3 Solves = 11 → x = 5 (or 2x−3 =11, x = 7. 2x−3=7 → x = 5)	M1 A1 [2]	Either forms ff correctly, or solves 2 equations co
(ii) min at x = − 2 → Range ≥ −4	M1 A1 [2]	Any valid method – could be guesswork.
(iii) $x^2 + 4x - 12$ (> 0) → x = 2 or − 6 → x < − 6 , x > 2.	M1 A1 A1 [3]	Makes quadratic = 0 + 2 solutions Correct limits – even if >,<,≥,≤,= co
(iv) gf(x) = (2x − 3)² + 4(2x − 3) = p → 4x² − 4x − 3 − p = 0 Uses "$b^2 - 4ac$" 16 = 16(−3 −p) → p = − 4	B1 M1 A1 [3]	co unsimplified Use of discriminant co
(v) − 2	B1 [1]	co
(vi) $y = (x+2)^2 - 4$ $\sqrt{y+4} = x + 2$ h^{-1} (x) = $\sqrt{x+4} - 2$	B2,1 M1 A1 [4]	−1 for each error Correct order of operations co with x, not y. ± left A0.