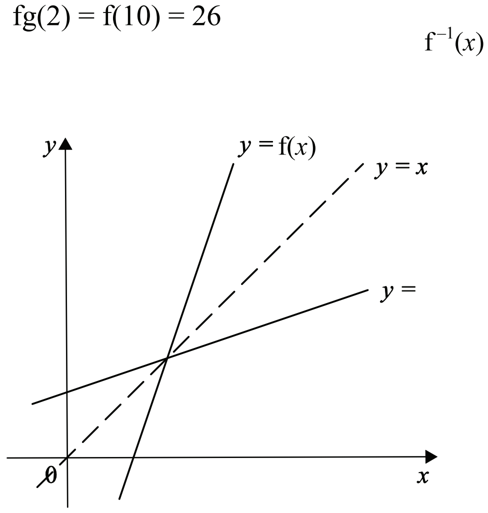
1 $(a+x)^5+(1-2x)^6$ Coeff of x^3 in 1st $= 10 \times a^2$ Coeff of x^3 in 2nd $= 20 \times (-2)^3$ $\rightarrow\ 10a^2 - 160 = 90$ $\rightarrow\ a = 5$	B1 B1 + B1 M1 A1 [5]	co co Forming an equation for a + solution co (condone ±)
2 $y = mx + 4$ $\quad y = 3x^2 - 4x + 7$ Equate $\rightarrow 3x^2 - (4+m)x + 3 = 0$ Uses $b^2 - 4ac \rightarrow (4+m)^2 - 36$ Solution of quadratic $m = 2$ or -10 Set of values $m > 2$ or $m < -10$	M1 M1 DM1 A1 A1 [5]	Eliminates y (or x) completely Any use of $b^2 - 4ac$ Method shown. Correct end-values co
3 $\frac{x}{a}+\frac{y}{b}=1$ $P(a, 0)$ and $Q(0, b)$ Distance $\rightarrow \sqrt{(a^2+b^2)}=\sqrt{45}$ Gradients $\rightarrow \frac{-a}{b}=\frac{-1}{2}$ Solution of sim eqns $\rightarrow a = 6, b = 3$	M1 A1 M1 A1 A1 [5]	 M1 even if sign(s) incorrect. Correct values a and b (both)
4 (a) $y=\frac{2x^3+5}{x}=2x^2+\frac{5}{x}$ d/dx $= 4x-\frac{5}{x^2}$ or $4x-5x^{-2}$	M1 A1 + A1 [3]	Knows to divide numerator by x co
(b) $\int(3x-2)^5\,dx=\frac{(3x-2)^6}{6}\div 3\ (+c)$ $\int_0^1(3x-2)^5\,dx=\left[\frac{(3x-2)^6}{18}\right]$ Limits used correctly $\rightarrow -3½$	B1 B1 M1 A1 [4]	B1 without "÷ 3". B1 for "÷ 3". (ignore $(+c)$) Uses limits after integration. co
5 (i) $\overrightarrow{PQ} = 3\mathbf{i} + 6\mathbf{j} - 3\mathbf{k}$ $\overrightarrow{RQ} = -3\mathbf{i} + 8\mathbf{j} + 3\mathbf{k}$	B2,1 B1 [3]	Allow B2,1 for either one, B1 for the other.
(ii) $\overrightarrow{PQ}.\overrightarrow{RQ} = -9 + 48 - 9 = 30$ $= \sqrt{54}\sqrt{82}\cos RQP$ $\rightarrow RQP = 63.2°$	M1 M1 M1 A1 [4]	Use of $x_1x_2 + y_1y_2 + z_1z_2$ Correct use of modulus All linked correctly co

6	**(a)**	$ar^2 = 20$	B1	co
		$\frac{a}{1-r} = 3a$	B1	co
		Soln of equations → ($r = ⅔$) $a = 45$	M1 A1 [4]	Complete method to find a. co
	(b)	$a + 7d = 3(a + 2d)$	M1	Use of $a + (n-1)d$
		$\rightarrow 2a = d$	A1	co
		$S_8 = 4(2a + 7d) = 32d$ or $64a$	M1	correct use of S_n formula once.
		$S_4 = 2(2a + 3d) = 8d$ or $16a$	A1 [4]	ag
7	**(i)**	$AX = 6\tan\frac{\pi}{3} = 6\sqrt{3}$	B1 [1]	ag
	(ii)	Area of triangle = $\frac{1}{2} \times 6 \times 6\sqrt{3}$	M1	Use of $\frac{1}{2}bh$
		Area of sector = $\frac{1}{2}\, 6^2 \times \frac{\pi}{3}$	M1	Use of $\frac{1}{2}r^2\theta$
		Area shaded = $18\sqrt{3} - 6\pi$	A1 [3]	co
	(iii)	Arc $AB = 6 \times \frac{\pi}{3} = 2\pi$	M1	Use of $r\theta$
		$OX = 6 \div \cos\frac{\pi}{3} = 12$, $BX = 6$	B1	Use of trig to find (OX and then) BX.
		Perimeter = $6\sqrt{3} + 2\pi + 6$	M1 A1 [4]	
8	**(i)**	$\left(\frac{1}{\sin\theta} - \frac{1}{\tan\theta}\right)^2 \equiv \frac{1-\cos\theta}{1+\cos\theta}$		
		$\left(\frac{1}{\sin\theta} - \frac{\cos\theta}{\sin\theta}\right)^2 = \frac{(1-\cos\theta)^2}{\sin^2\theta}$	M1	Use of tan = sin/cos
		$= \frac{(1-\cos\theta)(1-\cos\theta)}{1-\cos^2\theta} = \frac{1-\cos\theta}{1+\cos\theta}$	M1 A1 [3]	Use of $\sin^2 + \cos^2 = 1$. All correct. (NB ag. – ensure cancelling has been done)
	(ii)	$\left(\frac{1}{\sin\theta} - \frac{1}{\tan\theta}\right)^2 = \frac{2}{5}$		
		$\frac{1-\cos\theta}{1+\cos\theta} = \frac{2}{5}$	M1	Uses part **(i)** to obtain an eqn in $\cos\theta$
		$\cos\theta = \frac{3}{7}$	A1	co
		$\theta = 64.6°$ or $295.4°$	A1 A1 √ [4]	co. √ for 360 – "1st answer".

9 $\frac{dy}{dx} = \frac{2}{\sqrt{x}} - 1 \quad P(9, 5)$		
(i) $y = 4\sqrt{x} - x\ (+c)$ Uses (9, 5) in an integrated expression $\rightarrow c = 2$	B1 B1 M1 A1 [4]	Ignore + c. Substitution of point after integration. co.
(ii) $\frac{dy}{dx} = 0 \rightarrow x = 4, y = 6$	M1 A1 A1 [3]	Attempt to solve $dy/dx = 0$. x correct. y correct.
(iii) $\frac{d^2y}{d^2x} = -x^{\frac{-3}{2}} \rightarrow$ –ve $\rightarrow$ Max	B1 B1√ [2]	co. √ for correct deduction.
(iv) $\frac{dy}{dx} = -\frac{1}{3}$ Perpendicular $m = 3$ $\tan\theta = 3$ Angle is $\tan^{-1}3$ $k = 3$	M1 A1 [2]	Use of $m_1m_2 = -1$ Needs $k = 3$

10 $f : x \mapsto 3x - 4$ $g : x \mapsto 2(x-1)^3 + 8$		
(i) fg(2) = f(10) = 26	M1 A1 [2]	Must use g first, then f. co
(ii) 	B1 B1 B1 [3]	$y = f(x)$ correct in 1st, 4th quadrants. $y = f^{-1}(x)$ correct in 1st, 2nd quadrants. $y = x$ marked, or quoted.
(iii) $g'(x) = 6(x-1)^2$ $g'(x) > \rightarrow$ no turning points $\rightarrow$ g is 1 : 1, g has an inverse.	B1 B1√ B1√ [3]	co allow only for incorrect "6" following from incorrect "6"
(iv) $f^{-1}(x) = \frac{x+4}{3}$ Attempt at making x Order correct. – 8, ÷ 2, $\sqrt[3]{\ }$, + 1 $g^{-1}(x) = \sqrt[3]{\frac{x-8}{2}} + 1$	B1 M1 M1 A1 [4]	co May change x and y first. Must all be correct, but allow for + 8, – 1 co as function of x, not y.