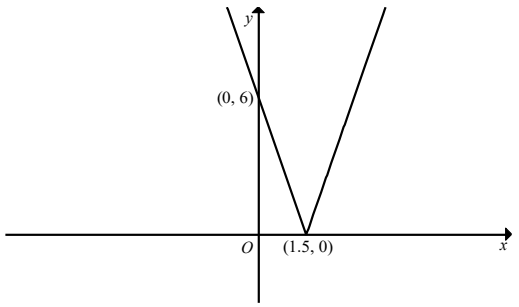
Question	Answer	Marks	Partial Marks
1(a)	Fully correct graph with intercepts marked  	**B2**	**B1** for a graph of correct shape with vertex on x-axis
1(b)	$4x - 6 = 2x$ and $4x - 6 = -2x$ oe	**M1**	
	$x = 3$ $x = 1$	**A2**	**A1** for either correct
	Alternative method		
	$12x^2 - 48x + 36 = 0$ oe	**(B1)**	
	Factorises or solves	**(M1)**	
	$x = 1$, $x = 3$	**(A1)**	
2(a)	$5 - 2(x - 1)^2$	**B3**	Mark final expression **B2** for $-2(x - 1)^2$ or **B1** for $(x - 1)^2$ or $b = -2$, $c = -1$ and **B1** for $5 + b(x + c)^2$ oe with numerical values of b and c or $a = 5$
2(b)	f ≤ *their* 5	**B1**	**STRICT FT** of *their* 5 from **(a)**
3	$5x^2 - 20x + 26$ [= 0]	**M1**	Condone one slip in expansion of brackets or collection of terms
	Correctly finds $b^2 - 4ac$ for *their* $5x^2 - 20x + 26$ [= 0] e.g. $(-20)^2 - 4(5)(26)$	**M1**	**FT** *their* $5x^2 - 20x + 26 = 0$ providing the discriminant is negative for *their* equation
	$400 - 520 < 0$ or -120	**A1**	
	Alternative method		
	$5x^2 - 20x + 26$ [= 0]	**(M1)**	Condone one slip in expansion of brackets or collection of terms
	Completes the square $5(x - 2)^2 + 6$ and states the correct minimum point (2, 6)	**(M1)**	**FT** *their* $5x^2 - 20x + 26 = 0$ providing the minimum point has positive y-coordinate
	Correct conclusion e.g. Minimum point at $y = 6$ therefore does not intersect x-axis oe	**(A1)**	

Question	Answer	Marks	Partial Marks
4(a)	$4(y-3)^2 = 36-9$ or $4y^2-24y+9\,[=0]$	**M1**	
	$y = 3 \pm \sqrt{\frac{27}{4}}$ or exact equivalent, soi	**A1**	
	$3+\sqrt{\frac{27}{4}}-\left(3-\sqrt{\frac{27}{4}}\right)$ oe	**M1**	**FT** *their* $a \pm \sqrt{b}$ providing b is not a square number
	$\sqrt{27}$ or $3\sqrt{3}$ or exact equivalent, nfww	**A1**	
4(b)	Eliminates one unknown and simplifies terms: $2x^2+83 = x^2-20x$ oe, soi	**M1**	
	$x^2+20x+83=0$	**A1**	
	Applies quadratic formula or completes the square: $x = \frac{-20 \pm \sqrt{20^2-4[1](83)}}{2}$	**M1**	**FT** *their* 3-term quadratic
	$x = -10 \pm \sqrt{17}$	**A1**	
	$y = \frac{1}{-10 \pm \sqrt{17}} \times \frac{-10 \mp \sqrt{17}}{-10 \mp \sqrt{17}}$	**M1**	**FT** *their* $x = a \pm \sqrt{b}$ providing previous **M1** awarded
	$x = -10 \pm \sqrt{17}$, $y = -\frac{10}{83} \mp \frac{\sqrt{17}}{83}$	**A1**	**dep** on all marks previously awarded
5(a)(i)	30 240	**2**	**M1**for $3 \times 7! \times 2$ or ${}^3P_1 \times {}^7P_7 \times {}^2P_1$ oe
5(a)(ii)	17 280	**2**	**M1**for $4! \times 6!$ oe or ${}^4P_4 \times {}^6P_5$ oe
5(b)(i)	35	**2**	**M1** for ${}^7C_4$ or 1 + 4 + 18 + 12
5(b)(ii)	51	**2**	**M1** for ${}^3C_2 \times {}^6C_2 + {}^3C_3 \times {}^6C_1$ oe or 18 + 4 + 3 + 2 + 24

Question	Answer	Marks	Partial Marks
6	$\frac{\mathrm{d}}{\mathrm{d}x}(\sin^2 x) = 2\sin x\cos x$ soi	**B1**	
	$\cos x \times \textit{their}(2\sin x\cos x) +$ $(\textit{their} - \sin x) \times \sin^2 x$	**M1**	**FT** *their* $\frac{\mathrm{d}}{\mathrm{d}x}(\sin^2 x)$
	$\cos x \times \textit{their}(2\sin x\cos x) + (-\sin x) \times \sin^2 x$ isw	**A1**	**FT** *their* $\frac{\mathrm{d}}{\mathrm{d}x}(\sin^2 x)$
	$\frac{\delta y}{h} = \textit{their}(2\sin 3\cos^2 3 - \sin^3 3)$ or better	**M1**	**FT** *their* derivative
	0.274h or 0.2738[08...]h where the coefficient of h is rot to 4 or more sf	**A1**	**dep** on correct derivative seen
7	$\frac{\mathrm{d}y}{\mathrm{d}x} = 2mx + \frac{1}{2}$	**B1**	
	$\frac{\mathrm{d}^2 y}{\mathrm{d}x^2} = 2m$	**B1**	
	$m = \frac{1}{4}$ and $n = -\frac{5}{4}$ and no other values	**2**	**M1** for $3(2m) = \left(2mx + \frac{1}{2}\right)^2 - \left(mx^2 + \frac{x}{2} + n\right)$ soi

Question	Answer	Marks	Partial Marks
8(a)	$S_{30} = \frac{30}{2}\{2a + 29d\} = -1065$	**B1**	
	$S_{50} - S_{30} =$ $\frac{50}{2}\{2a + 49d\} - \left(\frac{30}{2}\{2a + 29d\}\right) = -2210$ or $S_{50} = \frac{50}{2}\{2a + 49d\} = -2210 - 1065$	**B1**	
	Solves *their* linear equations in a and d as far as a = .. or d = … Some correct pairs are e.g. $150a + 2175d = -5325$ $150a + 3675d = -9825$ or $30a + 435d = -1065$ $50a + 1225d = -3275$ or $2a + 49d = -131$ $2a + 29d = -71$	**M1**	**dep** on an attempt to form *their* equations using at least one sum formula
	$a = 8$, $d = -3$	**A2**	**A1** for each
8(b)	$4 + 4r + 4r^2 = 7$ or $\frac{4(1-r^3)}{1-r} = 7$ oe	**B1**	
	$4r^2 + 4r - 3[= 0]$ oe	**B1**	
	Solves or factorises *their* 3-term quadratic oe e.g. $(2r - 1)(2r + 3)$ [= 0]	**M1**	
	$r = 0.5$, -1.5	**A1**	
	$\left[\frac{4}{1-0.5} =\right]$ 8 only, nfww	**A1**	
9(a)	Valid explanation: Range of g is g > 0 oe	**B1**	
9(b)	$\frac{1}{\left(\frac{3x^2}{4x-1}\right)^2}$	**M1**	
	$\frac{(4x-1)^2}{9x^4}$ or simplified equivalent, isw	**A1**	

Question	Answer	Marks	Partial Marks
9(c)	$3x^2 - 4xy + y[=0]$ or $3y^2 - 4xy + x[=0]$	**B1**	
	$[x =]\dfrac{-(-4y) \pm \sqrt{(-4y)^2 - 4(3)(y)}}{2(3)}$ oe or $[y =]\dfrac{-(-4x) \pm \sqrt{(-4x)^2 - 4(3)(x)}}{2(3)}$ oe	**M1**	**FT** *their* expression providing it has at most one sign error
	Justifies the negative square root	**B1**	
	$f^{-1}(x) = \dfrac{2x - \sqrt{x(4x-3)}}{3}$	**A1**	
10(a)	$\tan^2 x + 2\tan x \sec x + \sec^2 x$ or $\left(\dfrac{\sin x}{\cos x} + \dfrac{1}{\cos x}\right)^2$	**M1**	
	$\dfrac{\sin^2 x}{\cos^2 x} + 2 \times \dfrac{\sin x}{\cos x} \times \dfrac{1}{\cos x} + \dfrac{1}{\cos^2 x}$ or factorises $\dfrac{1}{\cos^2 x}(\sin x + 1)^2$ oe	**A1**	
	$\dfrac{(1+\sin x)^2}{1-\sin^2 x}$	**A1**	
	$\dfrac{(1+\sin x)(1+\sin x)}{(1-\sin x)(1+\sin x)} = \dfrac{1+\sin x}{1-\sin x}$ or $\dfrac{(1+\sin x)^2}{(1-\sin x)(1+\sin x)} = \dfrac{1+\sin x}{1-\sin x}$	**A1**	must be fully justified
10(b)	$7\sin 3\theta = 5$	**B1**	
	One correct value for 3θ soi e.g. 45.58… 134.4… 405.5… 494.4…	**M1**	
	15.2 or 15.19 to 15.195 44.8 or 44.80 to 44.81 135.2 or 135.19 to 135.195 164.8 or 164.80 to 164.81	**A2**	with no extras in range **A1** for any 2 correct, ignoring extras

Question	Answer	Marks	Partial Marks
11	$P = 2\left(\frac{\pi x}{4}\right) + x + 2\left(\frac{400}{x} - \frac{x}{2}\right)$ oe	**B2**	**B1** for rectangle length = $\frac{400}{x}$ soi
	Correct first derivative $\frac{\pi}{2} - \frac{800}{x^2}$	**B1**	**FT** *their P* providing it is of the form $\frac{a}{x} + bx$ oe with *a* an integer and *b* a constant
	Equates *their* $\frac{dP}{dx}$ to 0 and solves for *x*	**M1**	**FT** provided one term of *their* derivative is correct
	$x = \frac{40}{\sqrt{\pi}}$ or 22.6 or 22.56[75...]	**A1**	
	$P = \frac{\pi}{2}\left(\frac{40}{\sqrt{\pi}}\right) + \frac{800}{\frac{40}{\sqrt{\pi}}}$	**M1**	**FT** *their* value of *x* provided it is greater than 0
	P = 70.9 or 70.89[81...]	**A1**	
12(a)	$\overrightarrow{OP} = \frac{4}{7}\mathbf{b} + \lambda\left(\mathbf{c} - \frac{4}{7}\mathbf{b}\right)$ and $\overrightarrow{OP} = \mathbf{b} + \mu\left(\frac{4}{7}\mathbf{c} - \mathbf{b}\right)$	**B3**	**B2** for $\overrightarrow{OP} = \frac{4}{7}\mathbf{b} + \lambda\left(\mathbf{c} - \frac{4}{7}\mathbf{b}\right)$ or $\overrightarrow{OP} = \mathbf{b} + \mu\left(\frac{4}{7}\mathbf{c} - \mathbf{b}\right)$ oe or **B1** for $\overrightarrow{OP} = \left(their\,\frac{4}{7}\right)\mathbf{b} + \lambda\left(\mathbf{c} - \left(their\,\frac{4}{7}\right)\mathbf{b}\right)$ or $\overrightarrow{OP} = \mathbf{b} + \mu\left(\left(their\,\frac{4}{7}\right)\mathbf{c} - \mathbf{b}\right)$ or
	Equates components e.g.: $\left(their\,\frac{4}{7}\right)(1-\lambda) = (1-\mu)$ or $\lambda = their\,\frac{4}{7}\mu$	**M1**	**FT** providing at least **B1** awarded and two expressions for $\overrightarrow{OP}$ in terms of **b, c**, λ and μ found
	$\frac{4}{7}(1-\lambda) = (1-\mu) \quad \lambda = \frac{4}{7}\mu$ oe	**A1**	
	$\lambda = \frac{4}{11}$ and $\mu = \frac{7}{11}$ oe and conclusion $AP : AC$ = 4 : 11 therefore $AP : PC$ = 4 : 7 $BP : BD$ = 7 : 11 therefore $DP : PB$ = 4 : 7 oe	**A2**	**A1** for $\lambda = \frac{4}{11}$ or $\mu = \frac{7}{11}$ oe

Question	Answer	Marks	Partial Marks
12(b)	$\overrightarrow{OP} = \frac{4}{11}(\mathbf{b}+\mathbf{c})$ or $\overrightarrow{OP} = \frac{4}{11}\mathbf{b} + \frac{4}{11}\mathbf{c}$ and $\overrightarrow{OP}$ and $\overrightarrow{OQ}$ are scalar multiples of each other and have a point in common oe	**2**	**M1** for $\overrightarrow{OP} = \frac{4}{11}(\mathbf{b}+\mathbf{c})$ or $\overrightarrow{OP} = \frac{4}{11}\mathbf{b} + \frac{4}{11}\mathbf{c}$