Question	Answer	Marks	Partial Marks
1	$x = 3$	**B1**	
	$2 - 3x = 4 + x$ oe	**M1**	
	$x = -0.5$ oe	**A1**	
2	$x^2 + 3x\left(\frac{4-2x}{5}\right) = 4$	**M1**	eliminate *x* or *y*
	$x^2 - 12x + 20 \quad (= 0)$	**A1**	3 terms on one side if eliminating *y* $5y^2 + 16y \quad (= 0)$ if eliminating *x*
	$(x-2)(x-10) \quad (= 0)$	**M1**	or $y(5y+16) \quad (= 0)$
	$x = 2$ or $x = 10$ nfww	**A1**	or correct pair
	$y = 0$ or $y = -\frac{16}{5}$ nfww	**A1**	
3	$(k+9)^2 - 4 \times 9 \ (> 0)$	**M1**	use $b^2 - 4ac$
	$k^2 + 18k + 45 \quad (> 0)$	**A1**	
	$k = -15 \quad k = -3$	**A1**	
	$k < -15$ or $k > -3$ no isw mark final answer	**A1**	not 'and' A0 if combined as one statement
4(a)	$\frac{dy}{dx} = \frac{1}{1+\sin x}$	**M1**	
	$\times \cos x = \frac{\cos x}{1+\sin x}$	**A1**	
4(b)	insert $\frac{\pi}{6}$ into *their* $\frac{dy}{dx}$	**M1**	
	$\frac{1}{\sqrt{3}}$	**A1**	not $\frac{\sqrt{3}}{3}$

Question	Answer	Marks	Partial Marks
4(c)	$their \frac{\cos x}{1+\sin x} = \frac{\sin x}{\cos x}$	**M1**	replace $\tan x$ with $\frac{\sin x}{\cos x}$
	use $\cos^2 x = 1 - \sin^2 x$ $\left(2\sin^2 x + \sin x - 1 = 0\right)$	**M1**	earned when equation reduced to a quadratic in sin$x$
	$\left(2\sin x - 1\right)\left(\sin x + 1\right) = 0$	**M1**	solve three term quadratic in sin$x$
	$x = \frac{\pi}{6}$	**A1**	or 0.524 or better radians only if M0 M0 M0 and (a) and (b) correct, allow SC2 for tan$x$ = $\frac{1}{\sqrt{3}}$, $x = \frac{\pi}{6}$
	$x = \frac{5\pi}{6}$	**A1**	or 2.62 or better radians only A0 if extra solution(s) in range
5	express an equation correctly in powers of 3 or powers of 2	**M1**	
	$x + 2y - 2 = 5$ oe ($x + 2y = 7$)	**A1**	accept unsimplified
	$2x + 1 - 2.5 = 3 + y - 0.5$ oe ($2x - y = 4$)	**A1**	accept unsimplified
	solve correct equations for x or y	**M1**	
	$x = 3$ and $y = 2$	**A1**	
6(a)	3024	**B1**	
6(b)	24	**B1**	
6(c)	${}^4P_2 \times {}^5P_2$	**M1**	4×3 × 5×4
	240 no isw	**A1**	
6(d)	${}^4P_1 \times {}^8P_3$	**M1**	4 × 8×7×6
	1344 no isw	**A1**	
7(a)	$-x\sin x + \cos x$ isw	**B2**	accept unsimplified if incorrect allow B1 for $\frac{\mathrm{d}}{\mathrm{d}x}(\cos x) = -\sin x$ clearly seen

Question	Answer	Marks	Partial Marks
7(b)	$x=\pi, y=-\pi$	**B1**	or –3.14 or better
	$x=\pi, \frac{dy}{dx}=-1$	**B1**	from correct $\frac{dy}{dx}$
	gradient of normal =1	**M1**	use $m_1m_2=-1$ with *their* grad of tangent
	$y=x-2\pi$ cso	**A1**	or $y=x-6.28$ or better fully correct solution
7(c)	$\int their(a)=x\cos x$ $\left(\int -x\sin x+\cos x dx = x\cos x\right)$	**M1**	*
	$\int \cos x dx=\sin x$	**B1**	clearly seen anywhere
	$-x\cos x+\sin x$	**A1**	implies previous marks if (a) is correct
	insert $\frac{\pi}{6}$ into *their* integral	**M1**	*** dep**
	$\frac{1}{2}-\frac{\pi\sqrt{3}}{12}$	**A1**	reject decimals
8(a)	$x^2(y+1)=8$ oe	**B1**	
	$x+2=4y$ oe	**B1**	
	$x^2\left(\frac{x+2}{4}+1\right)=8$	**M1**	eliminate *y* from correct equations
	$x^3+6x^2-32=0$	**A1**	**answer given**
8(b)	$x=2$ or $x=-4$ seen or $(x-2)$ or $(x+4)$ seen	**B1**	
	find quadratic factor	**M1**	x^2 and 16 or long division to x^2+kx or x^2 and –8 or long division to x^2+kx not from expanding two linear factors
	$(x^2+8x+16)$ or (x^2+2x-8)	**A1**	
	$(x-2)(x+4)^2$ and $x=2,-4,-4$	**A1**	answer only without working earns B1 above only

Question	Answer	Marks	Partial Marks
8(c)	no real value for $\log_2(-4)$ or $\log_2(-4+2)$	**B1**	must identify specific term in one of original equations and use $x = -4$
	$y = 1$	**B1**	
9(a)	$(AC =)\ \sqrt{300^2 + x^2}$ seen isw	**B1**	
	time for $AC = \frac{\sqrt{300^2 + x^2}}{0.9}$ oe or time for $CD = \frac{400 - x}{1.5}$ oe	**M1**	using clearly indicated value for *their* *AC* or *their CD*
	$T = \frac{\sqrt{300^2 + x^2}}{0.9} + \frac{400 - x}{1.5}$ oe seen isw	**A1**	
9(b)	$\frac{\mathrm{d}T}{\mathrm{d}x} = \frac{1}{2}\frac{\left(300^2 + x^2\right)^{-\frac{1}{2}}}{0.9} \times 2x - \frac{2}{3}$ oe	**B2**	accept unsimplified; if incorrect allow B1 for correct differentiation of $\left(300^2 + x^2\right)^{\pm\frac{1}{2}}$
	set *their* $\frac{\mathrm{d}T}{\mathrm{d}x} = 0$	**M1**	$\frac{\mathrm{d}T}{\mathrm{d}x}$ must be a function of x
	$25x^2 = 9\left(300^2 + x^2\right)$ oe	**A1**	equation in x^2 with square root removed
	$x = 225$ (m)	**A1**	
	$T = 533$ (s) or 1600/3 (exact value)	**A1**	or 8 min 53 s
10(a)	use S_4 or S_8	**M1**	
	$S_4 = \frac{4}{2}[2a + 3d] = 38 \quad (2a + 3d = 19)$	**A1**	accept unsimplified
	$S_8 = \frac{8}{2}[2a + 7d] = 38 + 86\ (2a + 7d = 31)$ or $S_8 - S_4 = \frac{8}{2}[2a + 7d] - \frac{4}{2}[2a + 3d] = 86$ $(4a + 22d = 86)$	**A1**	accept unsimplified
	solve correct equations for *a* or *d*	**M1**	
	$a = 5$ and $d = 3$	**A1**	

Question	Answer	Marks	Partial Marks
10(b)	$ar^2 = 12$ soi	**B1**	
	$ar^5 = -96$ soi	**B1**	
	solve correct equations for *a* or *r*	**M1**	
	$r = -2$ and $a = 3$	**A1**	
	insert *their a* and *r* into S_{10} $\left(S_{10} = \frac{3\left(1-(-2)^{10}\right)}{1-(-2)} \right)$	**M1**	
	–1023	**A1**	
11	$(\sqrt{7}-2)(\sqrt{7}+2) = 3$ soi	**B1**	seen anywhere
	use quadratic formula to solve for *x*	**M1**	
	$x = \frac{4 \pm \sqrt{16 - 4(\sqrt{7}-2)(\sqrt{7}+2)}}{2(\sqrt{7}-2)}$	**A1**	
	$x = \frac{4 \pm 2}{2(\sqrt{7}-2)}$	**A1**	or $4 \pm \sqrt{4}$ in numerator
	rationalise one of *their* solutions e.g. $\frac{4+2}{2(\sqrt{7}-2)} \times \frac{(\sqrt{7}+2)}{(\sqrt{7}+2)}$	**B1**	full rationalisation statement must be shown
	$x = 2 + \sqrt{7}$ nfww	**A1**	
	$x = \frac{2}{3} + \frac{1}{3}\sqrt{7}$ nfww	**A1**	accept $\frac{2+\sqrt{7}}{3}$