Pure Mathematics 1 Practice Paper J9 MARK SCHEME

Question 1

Question Number	Scheme	Marks
(a)	$b^2-4ac>0 \Rightarrow \quad 16-4k(5-k)>0$ or equiv., e.g. $16>4k(5-k)$	M1A1
	So $\quad k^2-5k+4>0$ (Allow any order of terms, e.g. $4-5k+k^2>0$) (*)	A1cso (3)
(b)	Critical Values $\quad (k-4)(k-1)=0 \quad k= \ldots.$	M1
	$k = 1$ or 4	A1
	Choosing "outside" region	M1
	$\underline{k<1 \text{ or } k>4}$	A1 (4) [7]
	For this question, ignore (a) and (b) labels and award marks wherever correct work is seen.	
(a)	M1 for attempting to use the discriminant of the initial equation (> 0 not required, but substitution of a, b and c in the correct formula is required). If the formula b^2-4ac is seen, at least 2 of a, b and c must be correct. If the formula b^2-4ac is not seen, all 3 (a, b and c) must be correct. This mark can still be scored if substitution in b^2-4ac is within the quadratic formula. This mark can also be scored by comparing b^2 and $4ac$ (with substitution). However, use of b^2+4ac is M0. 1st A1 for fully correct expression, possibly unsimplified, with > symbol. NB must appear before the last line, even if this is simply in a statement such as $b^2-4ac>0$ or 'discriminant positive'. Condone a bracketing slip, e.g. $16-4\times k\times 5-k$ if subsequent work is correct and convincing. 2nd A1 for a fully correct derivation with no incorrect working seen. Condone a bracketing slip if otherwise correct and convincing. Using $\sqrt{b^2-4ac}>0$: Only available mark is the first M1 (unless recovery is seen).	
(b)	1st M1 for attempt to solve an appropriate 3TQ 1st A1 for both $k=1$ and 4 (only the critical values are required, so accept, e.g. $k>1$ and $k>4$). ** 2nd M1 for choosing the "outside" region. A diagram or table alone is not sufficient. Follow through their values of k. The set of values must be 'narrowed down' to score this M mark… listing everything $k<1$, $1<k<4$, $k>4$ is M0. 2nd A1 for correct answer only, condone "$k<1$, $k>4$" and even "$k<1$ and $k>4$", but "$1>k>4$" is A0. ** Often the statement $k>1$ and $k>4$ is followed by the correct final answer. Allow full marks. Seeing 1 and 4 used as critical values gives the first M1 A1 by implication. In part (b), condone working with x's except for the final mark, where the set of values must be a set of values of k (i.e. 3 marks out of 4). Use of ≤ (or ≥) in the final answer loses the final mark.	

Question 2.

Question Number	Scheme	Marks
(a)	$2x^{3/2}$ or $p=\frac{3}{2}$ (Not $2x\sqrt{x}$)	B1
	$-x$ or $-x^1$ or $q=1$	B1 (2)
(b)	$\left(\frac{dy}{dx}=\right)$ $20x^3+2\times\frac{3}{2}x^{1/2}-1$	M1
	$=\underline{20x^3+3x^{\frac{1}{2}}-1}$	A1A1ftA1ft (4) [6]
(a)	1st B1 for $p=1.5$ or exact equivalent 2nd B1 for $q=1$	
(b)	M1 for an attempt to differentiate $x^n \to x^{n-1}$ (for any of the 4 terms) 1st A1 for $20x^3$ (the -3 must 'disappear') 2nd A1ft for $3x^{\frac{1}{2}}$ or $3\sqrt{x}$. Follow through their p but they must be differentiating $2x^p$, where p is a fraction, and the coefficient must be simplified if necessary. 3rd A1ft for -1 (not the unsimplified $-x^0$), or follow through for correct differentiation of their $-x^q$ (i.e. coefficient of x^q is -1). If ft is applied, the coefficient must be simplified if necessary. 'Simplified' coefficient means $\frac{a}{b}$ where a and b are integers with no common factors. Only a single + or − sign is allowed (e.g. $--$ must be replaced by +). If there is a 'restart' in part (b) it can be marked independently of part (a), but marks for part (a) cannot be scored for work seen in (b). Multiplying by $\sqrt{x}$: (assuming this is a restart) e.g. $y=5x^4\sqrt{x}-3\sqrt{x}+2x^2-x^{3/2}$ $\left(\frac{dy}{dx}=\right)\frac{45}{2}x^{7/2}-\frac{3}{2}x^{-1/2}+4x-\frac{3}{2}x^{1/2}$ scores M1 A0 A0 (p not a fraction) A1ft. Extra term included: This invalidates the final mark. e.g. $y=5x^4-3+2x^2-x^{3/2}-x^{1/2}$ $\left(\frac{dy}{dx}=\right)20x^3+4x-\frac{3}{2}x^{1/2}-\frac{1}{2}x^{-1/2}$ scores M1 A1 A0 (p not a fraction) A0. Numerator and denominator differentiated separately: For this, neither of the last two (ft) marks should be awarded. Quotient/product rule: Last two terms must be correct to score the last 2 marks. (If the M mark has not already been earned, it can be given for the quotient/product rule attempt.)	

Question 3.

Question Number	Scheme	Marks
(a)	PQ: $m_1=\dfrac{10-2}{9-(-3)}$ $(=\frac{2}{3})$ and QR: $m_2=\dfrac{10-4}{9-a}$	M1
(b)	$m_1m_2=-1$: $\dfrac{8}{12}\times\dfrac{6}{9-a}=-1$ $\quad a=13 \quad$ (*)	M1 A1 (3)
Alt for (a)	(a) Alternative method (Pythagoras) Finds **all three** of the following $(9-(-3))^2+(10-2)^2$, (*i.e.*208) , $(9-a)^2+(10-4)^2$, $(a-(-3))^2+(4-2)^2$ Using Pythagoras (correct way around) e.g. $a^2+6a+9=240+a^2-18a+81$ to form equation Solve (or verify) for a, $a=13$ (*) (b) Centre is at (5, 3) $(r^2=)$ $(10-3)^2+(9-5)^2$ or equiv., or $(d^2=)$ $(13-(-3))^2+(4-2)^2$ $(x-5)^2+(y-3)^2=65$ $\quad$ or $x^2+y^2-10x-6y-31=0$	M1 M1 A1 (3) B1 M1 A1 M1 A1 (5)
Alt for (b)	Uses $(x-a)^2+(y-b)^2=r^2$ or $x^2+y^2+2gx+2fy+c=0$ and substitutes (-3, 2), (9, 10) and (13, 4) then eliminates one unknown Eliminates second unknown Obtains $g=-5, f=-3, c=-31$ or $a=5, b=3$, $r^2=65$	M1 M1 A1, A1, B1cao (5) **[8]**
Notes (a)	**M1**-considers gradients of PQ and QR -must be y difference / x difference (or considers three lengths as in alternative method) **M1** Substitutes gradients into product = -1 (or lengths into Pythagoras' Theorem the correct way round) **A1** Obtains $a=13$ with no errors by solution or verification. Verification can score 3/3.	
(b)	Geometrical method: **B1** for coordinates of centre – can be implied by use in part (b) **M1** for attempt to find r^2, d^2, r or d (allow one slip in a bracket). **A1** cao. These two marks may be gained implicitly from circle equation **M1** for $(x\pm5)^2+(y\pm3)^2=k^2$ or $(x\pm3)^2+(y\pm5)^2=k^2$ ft their (5,3) Allow k^2 non numerical. **A1** cao for whole equation and rhs must be 65 or $\left(\sqrt{65}\right)^2$, (similarly B1 must be 65 or $\left(\sqrt{65}\right)^2$, in alternative method for (b))	

Question Number	Scheme	Marks
Further alternatives	(i) A number of methods find gradient of PQ = 2/3 then give perpendicular gradient is −3/2 This is **M1** They then proceed using equations of lines through point Q or by using gradient QR to obtain equation such as $\dfrac{4-10}{a-9}=-\dfrac{3}{2}$ **M1** (may still have x in this equation rather than a and there may be a small slip) They then complete to give (a)= 13 **A1** (ii) A long involved method has been seen finding the coordinates of the centre of the circle first. This can be done by a variety of methods Giving centre as (c, 3) and using an equation such as $(c-9)^2+7^2=(c+3)^2+1^2$ (equal radii) or $\dfrac{3-6}{c-3}=-\dfrac{3}{2}$ **M1** (perpendicular from centre to chord bisects chord) Then using c (= 5) to find a is **M1** Finally $a=13$ **A1** (iii) Vector Method: States **PQ**. **QR** = 0, with vectors stated 12i +8j and $(9-a)$i + 6j is **M1** Evaluates scalar product so $108-12a+48=0$ **(M1)** solves to give $a=13$ **(A1)**	M1 M1 A1 M1 M1 A1 M1 M1 A1

Question 4.

Question Number	Scheme	Marks
(a)	$y-5=-\frac{1}{2}(x-2)$ or equivalent, e.g. $\dfrac{y-5}{x-2}=-\dfrac{1}{2}$, $\quad y=-\frac{1}{2}x+6$	M1A1, A1cao (3)
(b)	$x=-2 \Rightarrow y=-\frac{1}{2}(-2)+6 = 7$ (therefore B lies on the line) (or equivalent verification methods)	B1 (1)
(c)	$(AB^2 =)\ (2--2)^2+(7-5)^2, \quad =16+4=20, \quad AB=\sqrt{20}=2\sqrt{5}$	M1, A1, A1 (3)
(d)	C is $(p, -\frac{1}{2}p+6)$, so $\quad AC^2=(p-2)^2+\left(-\dfrac{1}{2}p+6-5\right)^2$	M1
	Therefore $\quad 25=p^2-4p+4+\frac{1}{4}p^2-p+1$	M1
	$25=1.25p^2-5p+5$ or $100=5p^2-20p+20$ (or better, RHS simplified to 3 terms)	A1
	Leading to: $\quad 0=p^2-4p-16 \quad (*)$	A1cso (4) [11]
(a)	M1 A1 The version in the scheme above can be written down directly (for 2 marks), and M1 A0 can be allowed if there is just one slip (sign or number). If the 5 and 2 are the wrong way round the M mark can still be given if a correct formula (e.g. $y-y_1=m(x-x_1)$) is seen, otherwise M0. If (2, 5) is substituted into $y=mx+c$ to find c, the M mark is for attempting this and the 1st A mark is for $c=6$. Correct answer without working or from a sketch scores full marks.	
(b)	A conclusion/comment is not required, except when the method used is to establish that the line through $(-2, 7)$ with gradient $-\frac{1}{2}$ has the same eqn. as found in part (a), or to establish that the line through $(-2, 7)$ and $(2, 5)$ has gradient $-\frac{1}{2}$. In these cases a comment 'same equation' or 'same gradient' or 'therefore on same line' is sufficient.	
(c)	M1 for attempting AB^2 or AB. Allow one slip (sign or number) <u>inside</u> a bracket, i.e. do <u>not</u> allow $(2--2)^2-(7-5)^2$. 1st A1 for 20 (condone bracketing slips such as $-2^2=4$) 2nd A1 for $2\sqrt{5}$ or $k=2$ (Ignore $\pm$ here).	
(d)	1st M1 for $(p-2)^2+$(linear function of p)^2. The linear function may be unsimplified but must be equivalent to $ap+b,\ a\neq 0,\ b\neq 0$. 2nd M1 (dependent on 1st M) for forming an equation in p (using 25 or 5) and attempting (perhaps not very well) to multiply out both brackets. 1st A1 for collecting like p terms and having a correct expression. 2nd A1 for correct work leading to printed answer. <u>Alternative, using the result</u>: Solve the quadratic $(p=2\pm 2\sqrt{5})$ and use one or both of the two solutions to find the length of AC^2 or $C_1C_2{}^2$: e.g. $AC^2=(2+2\sqrt{5}-2)^2+(5-\sqrt{5}-5)^2$ scores 1st M1, and 1st A1 if fully correct. Finding the length of AC or AC^2 for both values of p, or finding C_1C_2 with some evidence of halving (or intending to halve) scores the 2nd M1. Getting $AC=5$ for both values of p, or showing $\frac{1}{2}C_1C_2=5$ scores the 2nd A1 (cso).	

Question 5.

Question Number	Scheme	Marks
(a)	$\left(\frac{dy}{dx}=\right)-4+8x^{-2}$ (4 or $8x^{-2}$ for M1… sign can be wrong)	M1A1
	$x=2 \Rightarrow \quad m=-4+2=-2$	M1
	$y=9-8-\frac{8}{2}=-3$ The first 4 marks could be earned in part (b)	B1
	Equation of tangent is: $y+3=-2(x-2) \to y=1-2x$ (*)	M1 A1cso (6)
(b)	Gradient of normal $=\frac{1}{2}$	B1ft
	Equation is: $\frac{y+3}{x-2}=\frac{1}{2}$ or better equivalent, e.g. $y=\frac{1}{2}x-4$	M1A1 (3)
(c)	$(A:)\ \frac{1}{2}$, $\quad (B:)\ 8$	B1, B1
	Area of triangle is: $\frac{1}{2}(x_B \pm x_A)\times y_P$ with values for all of x_B, x_A and y_P	M1
	$\frac{1}{2}\left(8-\frac{1}{2}\right)\times 3 = \frac{45}{4}$ or 11.25	A1 (4) [13]
(a)	1st M1 for 4 or $8x^{-2}$ (ignore the signs). 1st A1 for both terms correct (including signs). 2nd M1 for substituting $x=2$ into their $\frac{dy}{dx}$ (must be different from their y) B1 for $y_P=-3$, but not if clearly found from the given equation of the tangent. 3rd M1 for attempt to find the equation of tangent at P, follow through their m and y_P. Apply general principles for straight line equations (see end of scheme). NO DIFFERENTIATION ATTEMPTED: Just assuming $m=-2$ at this stage is M0 2nd A1cso for correct work leading to printed answer (allow equivalents with $2x$, y, and 1 terms… such as $2x+y-1=0$).	
(b)	B1ft for correct use of the perpendicular gradient rule. Follow through their m, but if $m \neq -2$ there must be clear evidence that the m is thought to be the gradient of the tangent. M1 for an attempt to find normal at P using their changed gradient and their y_P. Apply general principles for straight line equations (see end of scheme). A1 for any correct form as specified above (correct answer only).	
(c)	1st B1 for $\frac{1}{2}$ and 2nd B1 for 8. M1 for a full method for the area of triangle ABP. Follow through their x_A, x_B and their y_P, but the mark is to be awarded 'generously', condoning sign errors.. The final answer must be positive for A1, with negatives in the working condoned. Determinant: Area $=\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}=\frac{1}{2}\begin{vmatrix} 2 & -3 & 1 \\ 0.5 & 0 & 1 \\ 8 & 0 & 1 \end{vmatrix}=\ldots$ (Attempt to multiply out required for M1) Alternative: $AP=\sqrt{(2-0.5)^2+(-3)^2}$, $BP=\sqrt{(2-8)^2+(-3)^2}$, Area $=\frac{1}{2}AP\times BP=\ldots$ M1 Intersections with y-axis instead of x-axis: Only the M mark is available B0 B0 M1 A0.	

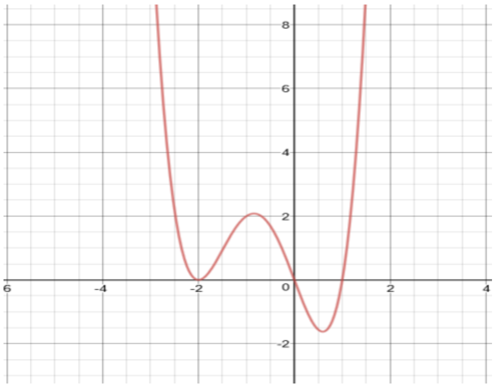
Question 6.

Question Number	Scheme	Marks
(a)	$2\pi rh + 2\pi r^2 = 800$	B1
	$h = \dfrac{400 - \pi r^2}{\pi r}$, $\quad V = \pi r^2\left(\dfrac{400-\pi r^2}{\pi r}\right) = 400r - \pi r^3 \quad (*)$	M1, M1 A1 (4)
(b)	$\dfrac{dV}{dr} = 400 - 3\pi r^2$	M1 A1
	$400 - 3\pi\ \ r^2 = 0 \qquad r^2 = \ldots, \qquad r = \sqrt{\dfrac{400}{3\pi}} \qquad (= 6.5\ (2\text{ s.f.})\ )$	M1 A1
	$V = 400r - \pi r^3 = 1737 = \dfrac{800}{3}\sqrt{\dfrac{400}{3\pi}}\ (\text{cm}^3)$	M1 A1
	(accept awrt 1737 or exact answer)	(6)
(c)	$\dfrac{d^2V}{dr^2} = -6\pi r$, Negative, $\therefore$ maximum	M1 A1
	(Parts (b) and (c) should be considered together when marking)	(2) [12]
<u>Other methods for part (c):</u>	<u>Either</u>: M: Find <u>value</u> of $\dfrac{dV}{dr}$ on each side of " $r = \sqrt{\dfrac{400}{3\pi}}$ " and consider sign. A: Indicate sign change of positive to negative for $\dfrac{dV}{dr}$, and conclude max. <u>Or</u>: M: Find <u>value</u> of V on each side of " $r = \sqrt{\dfrac{400}{3\pi}}$ " and compare with "1737". A: Indicate that both values are less than 1737 or 1737.25, and conclude max.	
Notes (a)	**B1**: For any correct form of this equation (may be unsimplified, may be implied by 1st M1) **M1** : Making h the subject of their three or four term formula **M1**: Substituting expression for h into $\pi r^2 h$ (independent mark) Must now be expression in r only. **A1**: cso	
(b)	**M1**: At least one power of r decreased by 1 **A1**: cao **M1**: Setting $\dfrac{dV}{dr}$=0 and finding a value for correct power of r for candidate **A1** : This mark may be credited if the value of V is correct. Otherwise answers should round to 6.5 (allow ± 6.5)or be exact answer **M1**: Substitute a positive value of r to give V **A1**: 1737 or 1737.25….. or exact answer	
(c)	**M1**: needs complete method **e.g.**attempts differentiation (power reduced) of their first derivative and considers its sign **A1(first method)** should be $-6\pi r$ (do not need to substitute r and can condone wrong r if found in (b)) Need to conclude maximum or indicate by a tick that it is maximum. Throughout allow confused notation such as dy/dx for dV/dr	
Alternative for (a)	$A = 2\pi r^2 + 2\pi rh$, $\frac{A}{2} \times r = \pi r^3 + \pi r^2 h$ is **M1** Equate to $400r$ **B1** Then $V = 400r - \pi r^3$ is **M1 A1**	

Question 7.

Question Number	Scheme	Marks
	$2\log_5 x = \log_5\left(x^2\right)$, $\quad \log_5(4-x) - \log_5(x^2) = \log_5 \frac{4-x}{x^2}$	B1, M1
	$\log\left(\frac{4-x}{x^2}\right) = \log 5 \quad 5x^2 + x - 4 = 0$ **or** $5x^2 + x = 4$ **o.e.**	M1 A1
	$(5x-4)(x+1) = 0 \quad x = \frac{4}{5} \quad (x = -1)$	dM1 A1 (6) **[6]**
Notes	**B1** is awarded for $2\log x = \log x^2$ anywhere. **M1** for correct use of $\log A - \log B = \log \frac{A}{B}$ **M1** for replacing 1 by $\log_k k$. **A1** for correct quadratic $(\log(4-x) - \log x^2 = \log 5 \Rightarrow 4 - x - x^2 = 5$ is **B1M0M1A0 M0A0**) **dM1** for attempt to solve quadratic with usual conventions. (Only award if previous two **M** marks have been awarded) **A1** for 4/5 or 0.8 or equivalent (Ignore extra answer).	
Alternative 1	$\log_5(4-x) - 1 = 2\log_5 x$ so $\log_5(4-x) - \log_5 5 = 2\log_5 x$	M1
	$\log_5 \frac{4-x}{5} = 2\log_5 x$	M1
	then could complete solution with $2\log_5 x = \log_5\left(x^2\right)$	B1
	$\left(\frac{4-x}{5}\right) = x^2 \quad 5x^2 + x - 4 = 0$	A1
	Then as in first method $(5x-4)(x+1) = 0 \quad x = \frac{4}{5} \quad (x = -1)$	dM1 A1 (6) **[6]**
Special cases	Complete trial and error yielding 0.8 is **M3** and **B1** for 0.8 **A1, A1** awarded for each of two tries evaluated. i.e. 6/6 Incomplete trial and error with wrong or no solution is 0/6 Just answer 0.8 with no working is **B1**	
	If log base 10 or base e used throughout - can score **B1M1M1A0M1A0**	

Question 8.

Q	Scheme		Marks
(a)		B1 for correct shape B1 for both (-2,0) and (1,0) marked on x-axis B1 for (0,0) seen	 **(3)**
(b)	a = 1 a = 3 a = 4		A1 A1 A1 **(3)**

Question 9.

Question Number	Scheme	Marks
	$(\mathrm{f}(x)=)\dfrac{3x^3}{3}-\dfrac{3x^{\frac{3}{2}}}{\frac{3}{2}}-7x(+c)$ $= x^3-2x^{\frac{3}{2}}-7x \quad (+c)$ $\mathrm{f}(4)=22 \quad \Rightarrow \quad 22=64-16-28+c$ $c=2$	M1 A1A1 M1 A1cso (5) **[5]**
	1st M1 for an attempt to integrate (x^3 or $x^{\frac{3}{2}}$ seen). The x term is insufficient for this mark and similarly the $+c$ is insufficient. 1st A1 for $\frac{3}{3}x^3$ or $-\dfrac{3x^{\frac{3}{2}}}{\frac{3}{2}}$ (An unsimplified or simplified correct form) 2nd A1 for all three x terms correct and simplified… (the simplification may be seen later). The $+c$ is not required for this mark. Allow $-7x^1$, but <u>not</u> $-\dfrac{7x^1}{1}$. 2nd M1 for an attempt to use $x=4$ <u>and</u> $y=22$ in a changed function (even if differentiated) to form an equation in c. 3rd A1 for $c=2$ with no earlier incorrect work (a final expression for f(x) is not required).	

Question 10.

Question Number	Scheme	Marks
	$y=(1+x)(4-x)=4+3x-x^2$ M: Expand, giving 3 (or 4) terms	M1
	$\int(4+3x-x^2)\mathrm{d}x=4x+\dfrac{3x^2}{2}-\dfrac{x^3}{3}$ M: Attempt to integrate	M1 A1
	$=[\ldots\ldots\ldots\ldots]_{-1}^{4}=\left(16+24-\dfrac{64}{3}\right)-\left(-4+\dfrac{3}{2}+\dfrac{1}{3}\right)=\dfrac{125}{6}$ $\left(=20\dfrac{5}{6}\right)$	M1 A1 (5) **[5]**
Notes	**M1** needs expansion, there may be a slip involving a sign or simple arithmetical error e.g. $1\times4=5$, but there needs to be a 'constant' an 'x term' and an 'x^2 term'. The x terms do not need to be collected. (Need not be seen if next line correct) Attempt to integrate means that $x^n\to x^{n+1}$ for at least one of the terms, then **M1** is awarded (even 4 becoming $4x$ is sufficient) – one correct power sufficient. **A1** is for correct answer only, not follow through. But allow $2x^2-\frac{1}{2}x^2$ or any correct equivalent. Allow $+\ c$, and even allow an evaluated extra constant term. **M1**: Substitute limit 4 and limit -1 into a changed function (must be -1) and indicate subtraction (either way round). **A1** must be exact, not 20.83 or similar. If recurring indicated can have the mark. Negative area, even if subsequently positive loses the A mark.	
Special cases	(i) Uses calculator method: **M1** for expansion (if seen) **M1** for limits if answer correct, so 0 , 1 or 2 marks out of 5 is possible (Most likely **M0 M0 A0 M1 A0**) (ii) Uses trapezium rule : not exact, no calculus – 0/5 unless expansion mark **M1** gained. (iii) Using original method, but then change all signs after expansion is likely to lead to: **M1 M1 A0, M1 A0 i.e. 3/5**	

Question 11.

Question Number	Scheme	Marks
(a)	$4(1-\cos^2 x)+9\cos x-6=0$ $\quad$ $4\cos^2 x-9\cos x+2=0$ (*)	M1 A1 (2)
(b)	$(4\cos x-1)(\cos x-2)=0$ $\quad$ $\cos x=...,$ $\quad \frac{1}{4}$	M1 A1
	$x=75.5$ $\quad (\alpha)$	B1
	$360-\alpha,$ $\quad 360+\alpha$ or $720-\alpha$	M1, M1
	284.5, 435.5, 644.5	A1 (6) [8]
(a)	**M1:** Uses $\sin^2 x=1-\cos^2 x$ (may omit bracket) **not** $\sin^2 x=\cos^2 x-1$ **A1:** Obtains the printed answer without error – **must have = 0**	
(b)	**M1:** Solves the quadratic with usual conventions **A1:** Obtains ¼ accurately- ignore extra answer 2 but penalise e.g. -2. **B1:** allow answers which round to 75.5 **M1:** $360-\alpha$ ft their value, **M1:** $360+\alpha$ ft their value or $720-\alpha$ ft **A1:** Three **and only three** correct exact answers in the range achieves the mark	
Special cases	In part (b) Error in solving quadratic (4cosx-1)(cosx+2) Could yield, **M1A0B1M1M1A1** losing one mark for the error Works in radians: Complete work in radians :Obtains 1.3 **B0**. Then allow **M1 M1** for $2\pi-\alpha$, $2\pi+\alpha$ or $4\pi-\alpha$ Then gets 5.0, 7.6, 11.3 **A0** so **2/4** Mixed answer 1.3, 360 – 1.3, 360 + 1.3, 720 – 1.3 still gets **B0M1M1A0**	

Question 12

Q	Scheme	Marks
(a)	Starting proof by using the expansion of $(a+b)^2$ $(a+b)^2$ can also be written as $(a-b)^2+4ab$ since $(a+b)^2 = a^2+2ab+b^2$ $= (a-b)^2+4ab$ Since $(a-b)^2 \geq 0$, Therefore $(a+b)^2 \geq 4ab$ (since both a and b are positive) Take square root on both sides $(a+b) > \sqrt{4ab}$	M1 A1 A1 **(3)**
(b)	If a= -1 and b = -1 this will give $-2 > \sqrt{4}$ which is not true M1 for using 2 negative values A1 for showing their values make the inequality false	M1A1 **(2)**

Question 13.

Q	Scheme	Marks
(a)	$H(t) = 0$ $15.25 + 17.8t - 4.5t^2 = 0$ $t = \dfrac{-17.8 \pm \sqrt{17.8^2 - 4(-4.5)(15.25)}}{2(-4.5)}$ $t = -0.72 \;\; or \;\; 4.68$ $t = 4.68s$	M1A1 A1 **(3)**
(b)	$H(t) = -4.5\left[t^2 - \dfrac{17.8}{4.5} - \dfrac{15.25}{4.5}\right]$ $H(t) = -4.5\left[\left(t - \dfrac{17.8}{9.0}\right)^2 - \left(\dfrac{17.8}{9.0}\right)^2 - \dfrac{15.25}{4.5}\right]$ $H(t) = \dfrac{29567}{900} - 4.5\left(t - \dfrac{89}{45}\right)^2$ $A = \dfrac{29567}{900} = 32.85$ $B = 4.5$ 1st A1 for 32.85 $C = \dfrac{89}{45} = 1.98$ 2nd A1 for both 4.5 and 1.98	M1 A1 A1 **(3)**
(c)	Max height = 32.85 Time = $\frac{89}{45}$ or 1.98s	A1 A1 **(2)**