Topic X1: Indices, surds and quadratics (Pre-TT A) [50] MARKSCHEME

1.

(i)	$\frac{12(3-\sqrt{5})}{(3+\sqrt{5})(3-\sqrt{5})}$	M1		Multiply numerator and denom by $3-\sqrt{5}$
	$=\frac{12(3-\sqrt{5})}{9-5}$	A1		$(3+\sqrt{5})(3-\sqrt{5})=9-5$
	$=9-3\sqrt{5}$	A1	3	
(ii)	$3\sqrt{2}-\sqrt{2}$	M1		Attempt to express $\sqrt{18}$ as $k\sqrt{2}$
	$=2\sqrt{2}$	A1	2 [5]	

2.

(i)	$n=-2$	B1 [1]	
(ii)	$n=3$	B1 [1]	
(iii)		M1	$\sqrt{4^3}$ or $64^{\frac{1}{2}}$ or $\left(4^{\frac{1}{2}}\right)^3$ or $\left(4^3\right)^{\frac{1}{2}}$ or $4\times\sqrt{4}$ with brackets correct if used
	$n=\frac{3}{2}$	A1 [2]	

3.

Question	Scheme	Marks	AOs
10	Realises that $k=0$ will give no real roots as equation becomes $3=0$ (proof by contradiction)	B1	3.1a
	(For $k\neq 0$) quadratic has no real roots provided $b^2<4ac$ so $16k^2<12k$	M1	2.4
	$4k(4k-3)<0$ with attempt at solution	M1	1.1b
	So $0<k<\frac{3}{4}$, which together with $k=0$ gives $0\leqslant k<\frac{3}{4}$ *	A1*	2.1
			(4 marks)

Notes:

B1: Explains why $k=0$ gives no real roots
M1: Considers discriminant to give quadratic inequality – does not need the $k\neq 0$ for this mark
M1: Attempts solution of quadratic inequality
A1*: Draws conclusion, which is a printed answer, with no errors (dependent on all three previous marks)

4.

2 (i)	x^2	B1	1	cao
(ii)	$\frac{3y^4\times 1000y^3}{2y^5}$	B1		$1000y^3$ soi
	$=1500y^2$	B1		1500
		B1	3 [4]	y^2

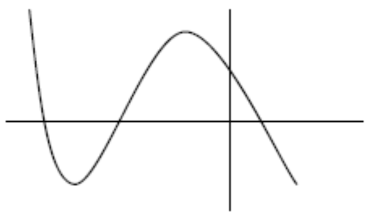
5.

4	Let $y = x^{\frac{1}{3}}$ $y^2 + 3y - 10 = 0$ $(y-2)(y+5) = 0$ $y = 2, y = -5$ $x = 2^3, x = (-5)^3$ $x = 8, x = -125$	*M1 DM1 A1 DM1 A1 ft 5 **5**	Attempt a substitution to obtain a quadratic or factorise with $\sqrt[3]{x}$ in each bracket Correct attempt to solve quadratic Both values correct Attempt cube Both answers correctly followed through **SR** B2 $x = 8$ from T & I

6.

6 (i)	$2(x^2 - 12x + 40)$ $= 2[(x-6)^2 - 36 + 40]$ $= 2[(x-6)^2 + 4]$ $= 2(x-6)^2 + 8$	B1 B1 M1 A1 4	$a = 2$ $b = 6$ $80 - 2b^2$ or $40 - b^2$ or $80 - b^2$ or $40 - 2b^2$ (their b) $c = 8$
(ii)	$x = 6$	B1 ft 1	
(iii)	$y = 8$	B1 ft 1 **6**	

7.

8 (i)	$x = \dfrac{8 \pm \sqrt{(-8)^2 - (4 \times -1 \times 5)}}{-2}$ $= \dfrac{8 \pm \sqrt{84}}{-2}$ $= -4 - \sqrt{21}$ or $= -4 + \sqrt{21}$	M1 A1 A1 3	Correct method to solve quadratic $x = \dfrac{8 \pm \sqrt{84}}{-2}$ Both roots correct and simplified
(ii)	$x \le -4 - \sqrt{21}$, $x \ge -4 + \sqrt{21}$	M1 A1 2	Identifying $x \le$ their lower root, $x \ge$ their higher root $x \le -4 - \sqrt{21}$, $x \ge -4 + \sqrt{21}$ (not wrapped, no 'and')
(iii)		B1 B1 B1 B1 B1 5 **10**	Roughly correct negative cubic with max and min (-4, 0) (0, 20) Cubic with 3 distinct real roots Completely correct graph

8.

Let $y = (x + 2)^2$ $y^2 + 5y - 6 = 0$ $(y + 6)(y - 1) = 0$ $y = -6$ or $y = 1$ $(x + 2)^2 = 1$ $x = -1$ or $x = -3$	B1 M1 A1 M1 A1 A1 6 **6**	Substitute for $(x + 2)^2$ to get $y^2 + 5y - 6$ (= 0) Correct method to find roots Both values for y correct Attempt to work out x One correct value Second correct value and no extra real values

9.

Question	Scheme	Marks	AOs
6 (a)	Attempts to use an appropriate model; e.g. $y = A(3-x)(3+x)$ or $y = A(9-x^2)$	M1	3.3
	e.g. $y = A(9-x^2)$ Substitutes $x = 0,\ y = 5\ \Rightarrow 5 = A(9-0)\ \Rightarrow\ A = \frac{5}{9}$	M1	3.1b
	$y = \frac{5}{9}(9-x^2)$ or $y = \frac{5}{9}(3-x)(3+x),\ \{-3 \leqslant x \leqslant 3\}$	A1	1.1b
		(3)	
(b)	Substitutes $x = \frac{2.4}{2}$ into their $y = \frac{5}{9}(9-x^2)$	M1	3.4
	$y = \frac{5}{9}(9-x^2) = 4.2 > 4.1 \Rightarrow$ Coach can enter the tunnel	A1	2.2b
		(2)	
(b) Alt 1	$4.1 = \frac{5}{9}(9-x^2) \Rightarrow x = \frac{9\sqrt{2}}{10}$, so maximum width $= 2\left(\frac{9\sqrt{2}}{10}\right)$	M1	3.4
	$= 2.545... > 2.4 \quad \Rightarrow$ Coach can enter the tunnel	A1	2.2b
		(2)	
(c)	E.g. • Coach needs to enter through the centre of the tunnel. This will only be possible if it is a one-way tunnel • In real-life the road may be cambered (and not horizontal) • The quadratic curve *BCA* is modelled for the entrance to the tunnel but we do not know if this curve is valid throughout the entire length of the tunnel • There may be overhead lights in the tunnel which may block the path of the coach	B1	3.5b
		(1)	
		(6 marks)	