Question number	Scheme		Marks	
8.	(a) $x^2 + kx + (8-k)$ $(=0)$ $8-k$ need not be bracketed		M1	
	$b^2 - 4ac = k^2 - 4(8-k)$		M1	
	$b^2 - 4ac < 0 \Rightarrow k^2 + 4k - 32 < 0$	(*)	A1cso	(3)
	(b) $(k+8)(k-4) = 0$ $k = ...$		M1	
	$k = -8$ $k = 4$		A1	
	Choosing 'inside' region (between the two *k* values)		M1	
	$-8 < k < 4$ or $4 > k > -8$		A1	(4)
				7

(a) 1st M: Using the *k* from the right hand side to form 3-term quadratic in *x* ('= 0' can be implied), or…

attempting to complete the square $\left(x + \frac{k}{2}\right)^2 - \frac{k^2}{4} + 8 - k \; (=0)$ or equiv., using the *k* from the right hand side.

For either approach, condone sign errors.

1st M may be implied when candidate moves straight to the discriminant.

2nd M: Dependent on the 1st M.

Forming expressions in *k* (with no *x*'s) by using b^2 and $4ac$. (Usually seen as the discriminant $b^2 - 4ac$, but separate expressions are fine, and also allow the use of $b^2 + 4ac$.

(For 'completing the square' approach, the expression must be clearly separated from the equation in *x*).

If b^2 and $4ac$ are used in the quadratic formula, they must be clearly separated from the formula to score this mark.

For any approach, condone sign errors.

If the wrong statement $\sqrt{b^2 - 4ac} < 0$ is seen, maximum score is M1 M1 A0.

(b) Condone the use of *x* (instead of *k*) in part (b).

1st M: Attempt to solve a 3-term quadratic equation in *k*.

It might be different from the given quadratic in part (a).

Ignore the use of < in solving the equation. The 1st M1 A1 can be scored if –8 and 4 are achieved, even if stated as $k < -8$, $k < 4$.

Allow the first M1 A1 to be scored in part (a).

N.B. '$k > -8$, $k < 4$' scores 2nd M1 A0

'$k > -8$ or $k < 4$' scores 2nd M1 A0

'$k > -8$ and $k < 4$' scores 2nd M1 A1

'$k = -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3$' scores 2nd M0 A0

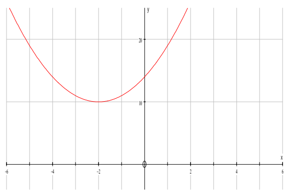
Use of ≤ (in the answer) loses the final mark.

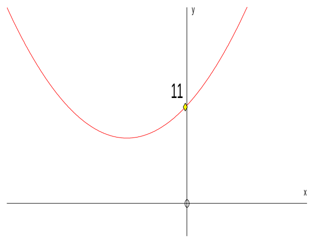
Question number	Scheme	Marks
8. (a)	[No real roots implies $b^2 - 4ac < 0$.] $b^2 - 4ac = q^2 - 4 \times 2q \times (-1)$	M1
	So $q^2 - 4 \times 2q \times (-1) < 0$ i.e. $q^2 + 8q < 0$ **(*)**	A1cso (2)
(b)	$q(q + 8) = 0$ or $(q \pm 4)^2 \pm 16 = 0$	M1
	$(q) = 0$ or -8 (2 cvs)	A1
	$-8 < q < 0$ <u>or</u> $q \in (-8, 0)$ <u>or</u> $q < 0$ and $q > -8$	A1ft (3)
		5

(a)	M1	for attempting $b^2 - 4ac$ with one of b or a correct. < 0 not needed for M1
		This may be inside a square root.
	A1cso	for simplifying to printed result with no incorrect working or statements seen.
		Need an intermediate step
	e.g.	$q^2 - -8q < 0$ or $q^2 - 4 \times 2q \times -1 < 0$ or $q^2 - 4(2q)(-1) < 0$ or $q^2 - 8q(-1) < 0$ or $q^2 - 8q \times -1 < 0$
		i.e. must have $\times$ or brackets on the $4ac$ term
		< 0 must be seen at least one line before the final answer.
(b)	M1	for factorizing or completing the square or attempting to solve $q^2 \pm 8q = 0$. A method that would lead to 2 values for q. The "= 0" may be implied by values appearing later.
	1st A1	for $q = 0$ and $q = -8$
	2nd A1	for $-8 < q < 0$. Can follow through their cvs but must choose "inside" region.
		$q < 0$, $q > -8$ is A0, $q < 0$ or $q > -8$ is A0, (-8, 0) on its own is A0
		BUT "$q < 0$ and $q > -8$" is A1
		Do not accept a number line for final mark

Question Number	Scheme	Marks
7 (a)	$b^2 - 4ac > 0 \Rightarrow \quad 16 - 4k(5-k) > 0$ or equiv., e.g. $16 > 4k(5-k)$	M1A1
	So $k^2 - 5k + 4 > 0$ (Allow any order of terms, e.g. $4 - 5k + k^2 > 0$) (*)	A1cso (3)
(b)	<u>Critical Values</u> $(k-4)(k-1) = 0 \quad k = \ldots.$	M1
	$k = 1$ or 4	A1
	Choosing "outside" region	M1
	<u>$\boldsymbol{k < 1}$ **or** $\boldsymbol{k > 4}$</u>	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 <u>not</u> 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. <u>Using</u> $\sqrt{b^2 - 4ac} > 0$: 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. <u>Seeing 1 and 4 used as critical values</u> 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 Number	Scheme	Marks
Q6	b^2-4ac attempted, in terms of p. $(3p)^2-4p=0$ o.e. Attempt to solve for p e.g. $p(9p-4)=0$ Must potentially lead to $p = k,\ k\neq 0$ $p=\frac{4}{9}$ (Ignore p = 0, if seen)	M1 A1 M1 A1cso **[4]**
	1st M1 for an attempt to substitute into b^2-4ac or $b^2=4ac$ with b or c correct Condone x's in one term only. This can be inside a square root as part of the quadratic formula for example. **Use of inequalities can score the M marks only** 1st A1 for any correct equation: $(3p)^2-4\times1\times p=0$ or better 2nd M1 for an attempt to factorize or solve their quadratic expression in p. Method must be sufficient to lead to their $p=\frac{4}{9}$. Accept factors or use of quadratic formula or $\left(p\pm\frac{2}{9}\right)^2=k^2$ (o.e. eg) $\left(3p\pm\frac{2}{3}\right)^2=k^2$ or equivalent work on <u>their</u> eqn. $9p^2=4p\Rightarrow\frac{9p^{\cancel{2}}}{\cancel{p}}=4$ which would lead to 9p = 4 is OK for this 2nd M1 ALT <u>Comparing coefficients</u> M1 for $(x+\alpha)^2=x^2+\alpha^2+2\alpha x$ and A1 for a correct equation eg $3p=2\sqrt{p}$ M1 for forming solving leading to $\sqrt{p}=\frac{2}{3}$ or better <u>Use of quadratic/discriminant formula (or any formula) Rule for awarding M mark</u> If the formula is quoted accept some correct substitution leading to a partially correct expression. If the formula is not quoted only award for a fully correct expression using their values.	

Question number	Scheme	Marks
Q10	(a) $(x+2k)^2$ or $\left(x+\frac{4k}{2}\right)^2$	M1
	$(x \pm F)^2 \pm G \pm 3 \pm 11k$ (where F and G are <u>any</u> functions of k, not involving x)	M1
	$(x+2k)^2 - 4k^2 + (3+11k)$ Accept unsimplified equivalents such as $\left(x+\frac{4k}{2}\right)^2 - \left(\frac{4k}{2}\right)^2 + 3 + 11k$, <u>and i.s.w. if necessary</u>.	A1 (3)
	(b) Accept part (b) solutions seen in part (a).	
	$"4k^2 - 11k - 3" = 0$ $(4k+1)(k-3) = 0$ $k = \ldots,$ [Or, 'starting again', $b^2 - 4ac = (4k)^2 - 4(3+11k)$ and proceed to $k = \ldots$]	M1
	$-\frac{1}{4}$ and 3 (Ignore any inequalities for the first 2 marks in (b)).	A1
	Using $b^2 - 4ac < 0$ for no real roots, i.e. $"4k^2 - 11k - 3" < 0$, to establish inequalities involving their <u>two</u> critical values m and n (<u>even if the inequalities are wrong</u>, e.g. $k < m$, $k < n$).	M1
	$-\frac{1}{4} < k < 3$ (See conditions below) Follow through their critical values. The final A1ft is still scored if the answer $m < k < n$ follows $k < m$, $k < n$. <u>Using x instead of k in the final answer</u> loses only the 2nd A mark, (condone use of x in earlier working).	A1ft (4)
	(c)  Shape $\cup$ (seen in (c))	B1
	Minimum in correct quadrant, <u>not</u> touching the x-axis, <u>not</u> on the y-axis, and there must be no other minimum or maximum.	B1
	(0, 14) or 14 on y-axis. Allow (14, 0) marked on y-axis. n.b. Minimum is at $(-2, 10)$, (but there is no mark for this).	B1 (3) **[10]**
	(b) 1st M: Forming and solving a 3-term quadratic in k (usual rules.. see general principles at end of scheme). The quadratic must come from $"b^2 - 4ac"$, or from the $"q"$ in part (a). Using <u>wrong discriminant</u>, e.g. $"b^2 + 4ac"$ will score <u>no marks</u> in part (b). 2nd M: As defined in main scheme above. 2nd A1ft: $m < k < n$, where $m < n$, for their critical values m and n. Other possible forms of the answer (in each case $m < n$): (i) $n > k > m$ (ii) $k > m$ <u>and</u> $k < n$ In this case the word "and" must be seen (implying intersection). (iii) $k \in (m, n)$ (iv) $\{k : k > m\} \cap \{k : k < n\}$ <u>Not</u> just a number line. <u>Not</u> just $k > m$, $k < n$ (without the word "and"). (c) Final B1 is dependent upon a sketch having been attempted in part (c).	

Question Number	Scheme	Marks
4. **(a)**	$(x+3)^2+2$ or $p=3$ or $\frac{6}{2}$ $q=2$	B1 B1 (2)
(b)	 U shape with min in 2nd quad (Must be above *x*-axis and not on *y*=axis) U shape crossing *y*-axis at (0, 11) only (Condone (11,0) marked on *y*-axis)	B1 B1 (2)
(c)	$b^2-4ac=6^2-4\times 11$ $=\underline{-8}$	M1 A1 (2) **6**
	Notes	
(a)	Ignore an "= 0" so $(x+3)^2+2=0$ can score both marks	
(b)	The U shape can be interpreted fairly generously. Penalise an obvious V on 1st B1 only. The U needn't have equal "arms" as long as there is a clear min that "holds water" 1st B1 for U shape with minimum in 2nd quad. Curve need not cross the *y*-axis but minimum should NOT touch *x*-axis and should be left of (not on) *y*-axis 2nd B1 for U shaped curve crossing at (0, 11). Just 11 marked on *y*-axis is fine. The point must be marked on the sketch (do not allow from a table of values) Condone stopping at (0, 11)	
(c)	M1 for some correct substitution into b^2-4ac. This may be as part of the quadratic formula but must be in part (c) and must be only numbers (no *x* terms present). Substitution into $b^2<4ac$ or $b^2=4ac$ or $b^2>4ac$ is M0 A1 for -8 only. If they write $-8<0$ treat the <0 as ISW and award A1 If they write $-8\geq 0$ then score A0 A substitution in the quadratic formula leading to -8 inside the square root is A0. So substituting into $b^2-4ac<0$ leading to $-8<0$ can score M1A1. Only award marks for use of the discriminant in part (c)	