Question 1 **(25 marks)**

(a) Write the function $f(x) = 2x^2 - 7x - 10$, where $x \in \mathbb{R}$, in the form $a(x + h)^2 + k$, where a, h, and $k \in \mathbb{Q}$.

(b) Hence, write the minimum point of f.

(c) **(i)** Explain why f must have two real roots.

(ii) Write the roots of $f(x) = 0$ in the form $p \pm \sqrt{q}$, where p and $q \in \mathbb{Q}$.

Q1	Model Solution – 25 Marks	Marking Notes
(a)	$2\left(x^2 - \frac{7}{2}x - 5\right)$ $= 2\left(\left(x - \frac{7}{4}\right)^2 - \frac{129}{16}\right)$ $= 2\left(\left(x - \frac{7}{4}\right)^2\right) - \frac{129}{8}$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit:* • $a = 2$ identified explicitly or as factor *Mid partial Credit:* • Completed square *High partial Credit:* • h or k identified from work
(b)	$\left(\frac{7}{4}, \quad \frac{-129}{8}\right)$	**Scale 10B (0, 4, 10)** *Partial Credit:* • One relevant co-ordinate identified

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<td>(c)
(i)</td>
<td>$f(x)$ has min point as $a > 0$
y co-ordinate of min < 0 $\Rightarrow$graph must cut x-axis twice hence two real roots.
or
$b^2 - 4ac = 49 + 80 > 0$
Therefore real roots</td>
<td>Scale 5B (0, 3, 5)
Partial Credit:
• Mention of $a > 0$
• $b^2 - 4ac$
• Identifies location of one or two roots, e.g. between 4 and 5.</td>
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<tr>
<td>c
(ii)</td>
<td>$2x^2 - 7x - 10 = 0$
$2\left(\left(x - \frac{7}{4}\right)^2\right) - \frac{129}{8} = 0$
$\left(x - \frac{7}{4}\right)^2 = \frac{129}{16}$
$x - \frac{7}{4} = \pm\frac{\sqrt{129}}{4}$
$x = \frac{7}{4} \pm \sqrt{\frac{129}{16}}$
OR
$2x^2 - 7x - 10 = 0$
$x = \frac{7 \pm \sqrt{49 + 80}}{4}$
$= \frac{7 \pm \sqrt{129}}{4}$
$x = \frac{7}{4} \pm \sqrt{\frac{129}{16}}$</td>
<td>Scale 5C (0, 3, 4, 5)
Low Partial Credit:
• Formula with some substitution
• Equation rewritten with some transpose

High Partial Credit:
• $x - \frac{7}{4} = \pm\frac{\sqrt{129}}{4}$ or equivalent</td>
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