Question	Scheme	Marks
1	$[\pm(2k+6)]^2 - 4\times k\times 16$ $4k^2 - 40k + 36 = 0$ $\to \{4\}(k-1)(k-9)\{=0\} \to k = ...$ $k = 1, 9$	M1 dM1 M1 A1 [4]
		Total 4 marks

Mark	Notes
M1	**Allow working on expression, equation or any inequality for all M marks** Applies $b^2 - 4ac = [\pm(2k+6)]^2 - 4\times k\times 16$ and might be seen embedded in an attempt at the quadratic formula.
dM1	Forms a 3TQ in k by attempting to expand and collect the like terms.
M1	Attempts to solve their 3TQ in k to find at least one real value of k by any correct method (See General Principles). Condone labelling their $\boldsymbol{k}$ as $\boldsymbol{x}$ for this method mark. If there is no method shown, (use of a calculator) then the 3TQ must be correct and both k values must be fully correct ($k = 1$, $k = 9$) for evidence for this mark.
A1	For $k = 1, 9$ selected as their final answers. (Extra inequality answers for k must be rejected)

Question	Scheme	Marks
1 **ALT I** **(Via completing Square)**	$k(x - \frac{k+3}{k})^2 - \frac{(k+3)^2}{k} + 16$ $16 - \frac{(k+3)^2}{k} = 0 \to k^2 - 10k + 9 = 0$ $(k-1)(k-9)\{=0\} \to k = ...$ $k = 1,9$	M1 dM1 M1 A1 [4]
		Total 4 marks

Mark	Notes
M1	Attempts to complete the square for $kx^2 - (2k+6)x + 16$ (See General Principles) Similarly, divides both sides of the given quadratic equation by k first, then attempts to complete the square: $(x - \frac{k+3}{k})^2 - \frac{(k+3)^2}{k^2} + \frac{16}{k}$
dM1	Sets the y coordinate of their turning point to be zero (= 0 can be implied) attempts to expand and collect like terms.
M1	Solves their 3TQ or polynomial to find at least one real value of k by any correct method (See General Principles) If there is no method shown, (use of a calculator) then their 3TQ must be correct and both k values must be fully correct (k =1, k = 9)for evidence for this mark.
A1	For $k = 1, 9$ only

Question	Scheme	Marks
1 ALT II (Via sum and product of roots)	$\alpha+\beta=\pm\frac{2k+6}{k}, \alpha\times\beta=\frac{16}{k}\to\left\{\alpha+\alpha=\pm\frac{2k+6}{k}, \alpha\times\alpha=\frac{16}{k}\right\}$	M1
	$(\frac{k+3}{k})^2=\frac{16}{k}\to k^2-10k+9=0$	dM1
	$(k-1)(k-9)\{=0\}\to k=...$	M1
	$k=1\ ,\ 9$	A1
		[4]
		Total 4 marks

Mark	Notes
M1	For: $\alpha+\beta=\pm\frac{2k+6}{k}, \alpha\times\beta=\frac{16}{k}\to\left\{\alpha+\alpha=\pm\frac{2k+6}{k}, \alpha\times\alpha=\frac{16}{k}\right\}$
dM1	Uses the fact that the quadratic equation has equal roots $\alpha=\beta$, sets up a correct equation in k, expands, collects like terms to form a 3TQ (or a Cubic equation) e.g. $\left(\frac{2k+6}{2k}\right)^2=\frac{16}{k}\to 4k^3-40k^2+36k=0$ or $4k^2-40k+36=0$
M1	Solves their 3TQ or Cubic equation to find at least one real value of k by any correct method (See General Principles) If there is no method shown, (use of a calculator) then their 3TQ or Cubic must be correct and both k values must be fully correct ($k=1, k=9$) for evidence for this mark.
A1	For $k=1$, 9 only

ALT III: (**Via differentiation**)

M1: Differentiates $kx^2-(2k+6)x+16$ with respect to x to achieve a linear expression

dM1: Sets their derivative to 0, solves for x and substitutes x back to $kx^2-(2k+6)x+16=0$ to form a 3TQ.
M1A1 same as ALT II

e.g. $kx^2-(2k+6)x+16\to 2kx-2k-6=0\to x=1+\frac{3}{k}$

$$\to k\left(1+\frac{3}{k}\right)^2-(2k+6)(1+\frac{3}{k})+16=0$$

$$\to k=...$$

Send to review if not sure