Question	Scheme	Marks	AOs
12(a)	$4\|1-3\|-5=\ldots$ or $4\|-1-3\|-5=\ldots$	M1	1.1b
	3 and 11	A1	1.1b
		(2)	
(b)	$2(-5)+17=\ldots$	M1	1.1b
	$\text{gf}(x)\geq 7$	A1	2.2a
		(2)	
(c)	$k\ldots-4$	B1	2.2a
	Minimum at $(3,-5)$ so $k\ldots-\frac{5}{3}$	M1	3.1a
	$k<"-\frac{5}{3}"$	A1ft	1.1b
		A1	2.5
		(4)	
			(8 marks)

Notes

(a)

M1: Attempts $4|1-3|-5=\ldots$ or $4|-1-3|-5=\ldots$ proceeding to a value.
Either correct value (3 or 11) that is clearly their answer can imply the M mark.
Alternatively, attempts any of $-4(-1-3)-5$ or $-4(1-3)-5$ or $-4(-1)+7$ or $-4(1)+7$ i.e. without the modulus signs using the 'left' branch of the function.

A1: Both 3 and 11 found and no other values that are clearly meant to be their answers (i.e. ignore reference to $a=1$ or $a=-1$). Accept "3, 11" or "3 or 11" or "3 and 11" or {3, 11} but not (3, 11). Condone $y=3, 11$ but not $x=3, 11$.

(b)

M1: Attempts $2(-5)+17$ which may be implied by sight of 7 used in their range, including in an incorrect range e.g. $f(x)>7$
Alternatively, attempts $\text{gf}(x)=2(4|x-3|-5)+17$ $(=8|x-3|+"7")$ **and** replaces $|x-3|$ with 0 or x with 3 or simply deduces the minimum value of their "7" in this case.
Must be an attempt at gf and not fg.

A1: Deduces the range $\text{gf}(x)\geq 7$ using correct notation.
Condone $y\geq 7$ but **not** e.g. $x\geq 7$ or $g(x)\geq 7$ or $f(x)\geq 7$ or $\text{fg}(x)\geq 7$
Other acceptable notation includes: $\text{gf}(x)\in[7,\infty)$
Do **not** accept $\text{gf}(x)\in[7,\infty]$ or $\text{gf}(x)\in(7,\infty)$

(c)

B1: Deduces $k\ldots-4$ allow any equality or inequality here. Condone $k\ldots\pm 4$ (but not just $k\ldots 4$) and condone e.g. "gradient … – 4"
May be seen coming from e.g. $kx=-4x+7\rightarrow(k+4)x=7$ or $x=\frac{7}{k+4}$ which is acceptable but see the note below. Should not be x or y for this mark but may be m.
Note: Finding the 'discriminant' of a linear equation e.g. $(k+4)x-7=0$ in order to obtain $k\ldots-4$ is invalid and cannot earn either the B1 or the final A1 mark unless there is an alternative valid reason given.

M1: Attempts to use the vertex to find the (upper) limit for k. Look for $\frac{\pm 5}{\pm 3}$ but allow this mark to be scored for $\frac{\pm B}{\pm A}$ if there is clear evidence that they think the vertex is at (A, B)

Allow use of *m*, *x*, *y* or another variable for this mark.

Alt 1 via squaring and the discriminant:

$$kx = 4|x-3|-5 \Rightarrow kx+5 = 4|x-3|$$

$$\Rightarrow k^2x^2+10kx+25=16\left(x^2-6x+9\right)$$

$$\Rightarrow \left(k^2-16\right)x^2+\left(10k+96\right)x-119=0$$

$$\Rightarrow \left(10k+96\right)^2-4\left(k^2-16\right)\left(-119\right)=0$$

$$\Rightarrow 576k^2+1920k+1600=0 \Rightarrow k=-\frac{5}{3}$$

Scores M1 for setting $kx = 4|x-3|-5$, isolating $|x-3|$ (or $4|x-3|$), squaring both sides, using $b^2-4ac\ldots0$ where … is any equality or inequality, and solving the resulting 3TQ using the usual rules and may be by calculator, leading to a value for *k*.
Condone slips in expanding the brackets.

Alt 2 via solving simultaneous equations:

$$\text{e.g. } kx = 4(x-3)-5 \Rightarrow x=\frac{-17}{k-4}$$

$$kx=4(3-x)-5 \Rightarrow \left(k+4\right)x=7$$

$$\Rightarrow \left(k+4\right)\left(\frac{-17}{k-4}\right)=7 \Rightarrow k=-\frac{5}{3}$$

Scores M1 for setting $kx=4(x-3)-5$ and $kx=4(3-x)-5$, eliminating *x*, and solving for *k*

A1ft: Uses their value of *k*, found using one of the above methods, as the upper end of the range for *k*, i.e., $k<"-\frac{5}{3}"$ which may be seen as part of their range. Condone $k\leq"-\frac{5}{3}"$ for this mark.
Score once seen as an upper limit and do not withhold if they then incorrectly combine as e.g. $-\frac{5}{3}<k<-4$
Condone the use of *m* for this mark, but not *x* or *y*.

A1: $-4\leq k<-\frac{5}{3}$ o.e. and no other solutions seen. Their range must use *k* and not e.g. *x*, *y* or *m*.

Other acceptable notation includes: $k\in\left[-4,-\frac{5}{3}\right)$, "$k<-\frac{5}{3}$ and $k\geq-4$", $k<-\frac{5}{3}\cap k\geq-4$

Do not accept e.g. "$k<-\frac{5}{3}$, $k\geq-4$" or "$k<-\frac{5}{3}$ or $k\geq-4$" or "$k<-\frac{5}{3}\cup k\geq-4$"

Allow $-1.\dot{6}$ but **not** –1.6 or –1.6…for $-\frac{5}{3}$