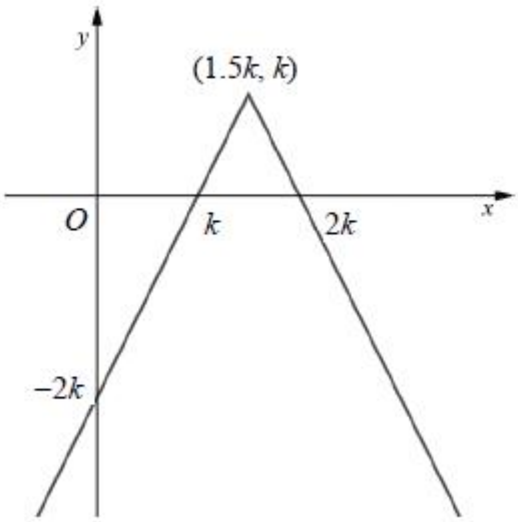
Mark Scheme

Q1.

Question	Scheme	Marks	AOs
(a)			
	∧ shape in any position	B1	1.1b
	Correct x-intercepts or coordinates	B1	1.1b
	Correct y-intercept or coordinates	B1	1.1b
	Correct coordinates for the vertex of a ∧ shape	B1	1.1b
		(4)	
(b)	$x = k$	B1	2.2a
	$k-(2x-3k)=x-k \Rightarrow x=...$	M1	3.1a
	$x=\frac{5k}{3}$	A1	1.1b
	Set notation is required here for this mark $\left\{x : x<\frac{5k}{3}\right\} \cap \{x : x>k\}$	A1	2.5
		(4)	
(c)	$x = 3k$ **or** $y = 3 - 5k$	B1ft	2.2a
	$x = 3k$ **and** $y = 3 - 5k$	B1ft	2.2a
		(2)	
			(10 marks)

Notes

(a) **Note that the sketch may be seen on Figure 4**

B1: See scheme

B1: Correct x-intercepts. Allow as shown or written as $(k, 0)$ and $(2k, 0)$ and condone coordinates written as $(0, k)$ and $(0, 2k)$ as long as they are in the correct places.

B1: Correct y-intercept. Allow as shown or written as $(0, -2k)$ or $(-2k, 0)$ as long as it is in the correct place. Condone $k - 3k$ for $-2k$.

B1: Correct coordinates as shown

Note that the marks for the intercepts and the maximum can be seen away from the sketch but the coordinates must be the right way round or e.g. as $y = 0, x = k$ etc. These marks can be awarded without a sketch but if there is a sketch, such points must not contradict the sketch.

(b)

B1: Deduces the correct critical value of $x = k$. May be implied by e.g. $x > k$ or $x < k$

M1: Attempts to solve $k - (2x - 3k) = x - k$ or an equivalent equation/inequality to find the other critical value. Allow this mark for reaching $k = \ldots$ or $x = \ldots$ as long as they are solving the required equation.

A1: Correct value

A1: Correct answer using the correct set notation.

Allow e.g. $\left\{x : x \in \mathbb{R}, k < x < \frac{5k}{3}\right\}$, $\left\{x : k < x < \frac{5k}{3}\right\}$, $x \in \left(k, \frac{5k}{3}\right)$ and allow "|" for ":"

But $\left\{x : x < \frac{5k}{3}\right\} \cup \{x : x > k\}$ scores A0 $\quad$ $\left\{x : k < x,\ x < \frac{5k}{3}\right\}$ scores A0

(c)

B1ft: Deduces one correct coordinate. Follow through their maximum coordinates from (a) so allow $x = 2\times$"$1.5k$" or $y = 3 - 5\times$"k" but must be in terms of k.

Allow as coordinates or $x = ..,\ y = \ldots$

B1ft: Deduces both correct coordinates. Follow through their maximum coordinates from (a) so allow $x = 2\times$"$1.5k$" and $y = 3 - 5\times$"k" but must be in terms of k.

Allow as coordinates or $x = ..,\ y = \ldots$

If coordinates are given the wrong way round and not seen correctly as $x = \ldots, y = \ldots$

e.g. $(3 - 5k, 3k)$ this is B0B0

Alternative to part (b) by squaring:

$$k-|2x-3k|=x-k\Rightarrow|2x-3k|=2k-x$$

$$4x^2-12kx+9k^2=4k^2-4kx+x^2\Rightarrow3x^2-8kx+5k^2=0$$

$$(3x-5k)(x-k)=0\Rightarrow x=\frac{5k}{3},\ k$$

Score M1 for isolating the $|2x-3k|$, squaring both sides to obtain 3 appropriate terms for each side, collects terms to obtain $Ax^2+Bkx+Ck^2=0$ and solves for x

A1 for $x=\dfrac{5k}{3}$ and B1 for $x=k$

Then A1 as in the scheme.

(**Q11 9MA0/02, Oct 2021**)

Q2.

Question	Scheme	Marks	AOs
(a)	$N_A - N_B = (3+4)-(8-6) = ...$	M1	3.4
	5000 (subscribers)	A1	3.2a
		(2)	
(b)	$(T=)3$	B1	3.4
	This was the point when company A had the lowest number of subscribers	B1	2.4
		(2)	
(c)			
	$-t+7=2t+2$ o.e. or $t+1=14-2t$ o.e.	B1	3.1a
	$-t+7=2t+2$ o.e. $\Rightarrow t=...$ or $t+1=14-2t$ o.e. $\Rightarrow t=...$	M1	3.4
	One of the two critical values $t=\frac{5}{3}$ or $t=\frac{13}{3}$	A1	1.1b
	Chooses the outside region for their two values of t Both of $t<"\frac{5}{3}"$, $t>"\frac{13}{3}"$	A1ft	2.2a
	$\left\{t\in\mathbb{R}:t<\frac{5}{3}\right\}\cup\left\{t\in\mathbb{R}:t>\frac{13}{3}\right\}$	A1	2.5
		(5)	
(d)	The number of subscribers will become negative (when $t>7$)	B1	3.5b
		(1)	
		(10 marks)	

Notes

(a)

M1: Uses the models to find the difference when $t=0$. Allow slips in evaluating N_A and N_B but it must be clear that $t=0$ is being used. Just 5 with no working implies M1.

A1: 5000 or 5 thousand (subscribers) (5 is A0)

(b)

B1: $(t/T=)3$ Just look for the number 3 so e.g. $t>3$ or e.g. "just after 3" is acceptable.

If more than one value is offered then score B0 unless it is clear that the 3 is intended.
Must be seen in (b) not just on their diagram.

B1: Any acceptable reason e.g.

- This was the point when company A had the lowest number of subscribers
- After this point the number of subscribers started to increase
- It is the minimum
- Condone "it is the turning point"
- The graph changes direction
- It is the vertex
- The gradient becomes positive
- N_A increased

Allow this mark even if the first B mark was not scored e.g. $T=3.5$ because the graph starts to increase scores B0B1

Do not allow contradictory statements.

Do not allow:

- The graph reflects at $t=3$ on its own without further clarification

(c)

B1: Forms one valid equation (allow an equation or any inequality sign)

M1: Attempts to solve one valid equation (allow an equation or any inequality sign)

A1: For either $t=\frac{5}{3}$ or $t=\frac{13}{3}$ only (allow an equation or any inequality sign) or exact equivalent

Must be seen or used in part (c).

See notes below for attempts that use "squaring" to find the values of *t*.

A1ft: Chooses the outside region for their **two** values of t where $t>0$.

So for $t=a$ and $t=b$ where $0<a<b$ should be $t<a$, $t>b$. Allow , /or/and/$\cup$/$\cap$

Condone if incorrectly combined e.g. $"\frac{13}{3}"<t<"\frac{5}{3}"$ but **not** $"\frac{5}{3}"<t<"\frac{13}{3}"$

A1: Fully correct solution in the form $\left\{t:t<\frac{5}{3}\right\}\cup\left\{t:t>\frac{13}{3}\right\}$ or $\left\{t|t<\frac{5}{3}\right\}\cup\left\{t|t>\frac{13}{3}\right\}$ or

$\left(0,\frac{5}{3}\right)\cup\left(\frac{13}{3},5\right)$ either way around but condone $\left\{t<\frac{5}{3}\right\}\cup\left\{t>\frac{13}{3}\right\}$, $\left\{t:t<\frac{5}{3}\cup t>\frac{13}{3}\right\}$,

$\left\{t<\frac{5}{3}\cup t>\frac{13}{3}\right\}$ or $\left(-\infty,\frac{5}{3}\right)\cup\left(\frac{13}{3},\infty\right)$.

It is not necessary to mention R , e.g. $\left\{t:t\in\mathrm{R},t>\frac{13}{3}\right\}\cup\left\{t:t\in\mathrm{R},t<\frac{5}{3}\right\}$

Look for $\{\ \}$ and $\cup$ or condone $\left(-\infty,\frac{5}{3}\right)\cup\left(\frac{13}{3},\infty\right)$

Do not allow solutions not in set notation such as $t<\frac{5}{3}$ or $t>\frac{13}{3}$.

Note that a lower bound for $t<\frac{5}{3}$ and an upper bound for $t>\frac{13}{3}$ are not required but may be included e.g. $\left\{t\in\mathbb{R}:0<t<\frac{5}{3}\right\}\cup\left\{t\in\mathbb{R}:\frac{13}{3}<t<5\right\}$ or $\left\{t\in\mathbb{R}:0\leqslant t<\frac{5}{3}\right\}\cup\left\{t\in\mathbb{R}:\frac{13}{3}<t\leqslant 5\right\}$

Note that the marks in this part require **valid** equations to be solved. They must have removed the mod brackets and arrived at an equation equivalent to $-t+7=2t+2$ or $t+1=14-2t$ (all you need to check initially is whether their equation **without mod brackets** is equivalent to one of these).

Note that $\left\{t:t<\frac{5}{3},\ t>\frac{13}{3}\right\}$ is condoned for the A1ft but not for the final A1.

If x is used in their set notation then final A0, but we would condone this for the penultimate A1ft.

See notes below for answers given with no working.

(d)

B1: Requires any indication that the number of subscribers will become negative. E.g.

- It allows negative subscribers (which isn't possible)
- $8-|2t-6|\ \ldots 0\Rightarrow t\leqslant 7$ so not valid after $t=7$ but condone not valid for t after (any value above 7)

But not

- Subscribers will become zero

Guidance for attempts that use "squaring" to find the values of t in (c): **Way 1:**		
$(-t+7)^2=(2t+2)^2$ o.e. or $(t+1)^2=(14-2t)^2$ o.e.	B1	3.1a
$(-t+7)^2=(2t+2)^2 \Rightarrow t=...$ o.e. (Gives -9 and $\frac{5}{3}$) or $(t+1)^2=(14-2t)^2 \Rightarrow t=...$ o.e. (Gives 15 and $\frac{13}{3}$)	M1	3.4
One of the two critical values $t=\frac{5}{3}$ or $t=\frac{13}{3}$	A1	1.1b
Chooses the outside region for their two values of t Both of $t<"\frac{5}{3}"$, $t>"\frac{13}{3}"$	A1ft	2.2a
$\left\{t\in\mathbb{R}: t<\frac{5}{3}\right\}\cup\left\{t\in\mathbb{R}: t>\frac{13}{3}\right\}$	A1	2.5
Way 2:		
$\|t-3\|+4=8-\|2t-6\| \Rightarrow \|t-3\|+\|2t-6\|=4 \Rightarrow 3t-9=4$ o.e.	B1	3.1a
$(3t-9)^2=4^2 \Rightarrow 9t^2-54t+81=16 \Rightarrow 9t^2-54t+65=0 \Rightarrow t=...$ (Gives $\frac{5}{3}$ and $\frac{13}{3}$)	M1	3.4
One of the two critical values $t=\frac{5}{3}$ or $t=\frac{13}{3}$	A1	1.1b
Chooses the outside region for their two values of t Both of $t<"\frac{5}{3}"$, $t>"\frac{13}{3}"$	A1ft	2.2a
$\left\{t\in\mathbb{R}: t<\frac{5}{3}\right\}\cup\left\{t\in\mathbb{R}: t>\frac{13}{3}\right\}$	A1	2.5

B1: Forms one valid equation and squares both sides (allow an equation or any inequality sign)
May be implied by e.g. $(t-3+4)^2=(8-(2t-6))^2$
Alternatively, arrives at $3t-9=4$ (o.e.) as in way 2.
M1: Attempts to solve one valid equation after squaring both sides (allow an equation or any inequality sign). Note that it is acceptable to just solve $3t-9=4$
A1: As in main scheme. **A1ft**: As in main scheme. **A1**: As in main scheme.

Note: the following is common and scores 00000.

$$|t-3|+4=8-|2t-6| \Rightarrow (t-3)^2+4=8-(2t-6)^2$$

Which typically leads to

$$t=\frac{15\pm4\sqrt{15}}{5}$$

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<u>**Guidance for answers only in part (c):**</u>

$t \ldots \text{awrt}\,1.7$ or $t \ldots \text{awrt}\,4.3$ where … is any inequality or equation scores **11000**

$t \ldots \frac{5}{3}$ or $t \ldots \frac{13}{3}$ where … is any inequality or equation scores **11100** for one correct c.v.

Both $t < \text{awrt}\,1.7$ and $t > b$ where $\left\{b > \frac{5}{3}\right\}$ scores **11010** for outside region.

Both $t < a$ and $t > \text{awrt}\,4.3$ where $\left\{a < \frac{13}{3}\right\}$ scores **11010** for outside region.

Both $t < \frac{5}{3}$ and $t > b$ where $\left\{b > \frac{5}{3}\right\}$ scores **11110** for outside region with one correct.

Both $t < a$ and $t > \frac{13}{3}$ where $\left\{a < \frac{13}{3}\right\}$ scores **11110** for outside region with one correct.

Both $t < \frac{5}{3}$ and $t > \frac{13}{3}$ scores **11110** for outside region with one correct.

Fully correct e.g. $\left\{t : t < \frac{5}{3}\right\} \cup \left\{t : t > \frac{13}{3}\right\}$ scores **11111**

(**Q12 9MA0/02, June 2023**)

Q3.

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

Notes

(a)

M1: Attempts $4|1-3|-5=...$ or $4|-1-3|-5=...$ 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. $\text{f}(x)>7$
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 $\text{g}(x)\geq 7$ or $\text{f}(x)\geq 7$ 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 … 4) and condone e.g. "gradient … − 4"

May be seen coming from e.g. $kx = -4x + 7 \rightarrow (k+4)x = 7$ or $x = \dfrac{7}{k+4}$ 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 $\dfrac{\pm 5}{\pm 3}$ but allow this mark to be scored for $\dfrac{\pm B}{\pm A}$ 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:

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

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

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

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

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

Scores M1 for setting $kx = 4|x-3| - 5$, isolating $|x-3|$ (or $4|x-3|$), squaring both sides, using $b^2 - 4ac \ldots 0$ 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:

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

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

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

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 $k \le "-\frac{5}{3}"$ 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:	$-4 \le k < -\frac{5}{3}$ 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 $k \ge -4$", $k < -\frac{5}{3} \cap k \ge -4$ Do not accept e.g. "$k < -\frac{5}{3}$, $k \ge -4$" or "$k < -\frac{5}{3}$ or $k \ge -4$" or "$k < -\frac{5}{3} \cup k \ge -4$" Allow $-1.\dot{6}$ but **not** -1.6 or $-1.6\ldots$ for $-\frac{5}{3}$

(**Q12 9MA0/02, June 2025**)

Q4.

Question	Scheme	Marks	AOs
(a)	$x = 2$ **or** $y = 5$	B1	1.1b
	$P(2, 5)$	B1	2.2a
		(2)	
(b)	$16 - 4x = 3(x-2) + 5 \Rightarrow x = \ldots$	M1	1.1b
	$x = \frac{17}{7}$	A1	2.1
		(2)	
(c)	$k_{\max} = 3$ or $k_{\min} = \frac{"5" - 4}{"2"}$	M1	3.1a
	$\frac{1}{2} < k < 3$	A1	2.5
		(2)	
			(6 marks)

Notes

(a)

B1: One correct coordinate. Either $x = 2$ or $y = 5$ or (2, …) or (…,5) seen.

B1: Deduces (2, 5) Accept written separately e.g. $x = 2$, $y = 5$ isw after a correct answer. Condone 2, 5 without the brackets.

(b)

M1: Attempts to solve the correct equation without modulus signs $16-4x=3(x-2)+5 \Rightarrow x = ...$ Must reach a value for x. Ignore attempts at e.g. $16-4x=3(2-x)+5$

A1: $x=\frac{17}{7}$ o.e. exact answer and no other values. If other values have been found they must be rejected or the $x=\frac{17}{7}$ clearly selected. Answer only implies both marks.

Note: $x =$ "2.75" coming from $5 = 16 - 4x$ may be found as part of their working to establish which branch of the modulus graph the line $y = 16 - 4x$ intersects. If this is the case it need not be "rejected" provided it is not clearly stated as one of their solutions.

Those that achieve $|x|=\frac{17}{7}$ can score BOD M1A0.

Alternative by squaring:

$$16-4x=3|x-2|+5 \Rightarrow 11-4x=3|x-2|$$

$$\Rightarrow 16x^2-88x+121=9\left(x^2-4x+4\right)$$

$$\Rightarrow 7x^2-52x+85=0 \Rightarrow x=5,\ \frac{17}{7}$$

M1: Isolates the $|x-2|$ (or $3|x-2|$), squares both sides and solves the resulting 3TQ using the usual rules and may be by calculator, leading to a value for x.

A1: Selects the $\frac{17}{7}$ or rejects any other values as in main scheme.

(c)

M1: Correct method to find either critical value (following through on their P).

Either k {=} 3 or k {=} $\frac{"5"-4}{"2"}$ scores M1 without evidence of an incorrect method.

Note that $k = 3$ occasionally appears from use of the discriminant on $x(k-3)+5=0$, and scores M0 unless there is an alternative valid reason given.

Allow the use of e.g. $m =$ in place of $k =$ here but do not allow $x =$ or $y =$

A1: Correct range in terms of k in acceptable notation with no incorrect method seen.

Use of e.g. x is A0. Allow "and" or "$\cap$" to join the regions but not "or" or "," or "$\cup$"

Accept e.g. $(0.5,3)$; $k \in \left(\frac{1}{2},3\right)$; $k<3$ and $k>\frac{1}{2}$; $k>\frac{1}{2} \cap k<3$

but not $\frac{1}{2}<x<3$; $\frac{1}{2} \leq k \leq 3$; $\left[\frac{1}{2},3\right]$; $k>\frac{1}{2} \cup k<3$; $k>\frac{1}{2}, k<3$; $k>\frac{1}{2}$ or $k<3$

Alt 1 via solving simultaneous equations:

$$\text{e.g. } kx+4=3(x-2)+5 \Rightarrow kx+4=3x-1 \Rightarrow x=-\frac{5}{k-3}$$

$$kx+4=3(2-x)+5 \Rightarrow kx+4=11-3x \Rightarrow (k+3)x=7$$

$$\Rightarrow (k+3)\left(\frac{-5}{k-3}\right)=7 \Rightarrow k=\frac{1}{2}$$

M1: Sets $kx+4=3(x-2)+5$ and $kx+4=3(2-x)+5$, eliminates x, and solves for k

A1: As main scheme.

Alt 2 via squaring and the discriminant:

$$kx+4=3|x-2|+5 \Rightarrow kx-1=3|x-2|$$

$$\Rightarrow k^2x^2-2kx+1=9(x^2-4x+4)$$

$$\Rightarrow (k^2-9)x^2+(36-2k)x-35=0$$

$$\Rightarrow (36-2k)^2-4(k^2-9)(-35)=0$$

$$\Rightarrow 144k^2-144k+36=0 \Rightarrow k=\frac{1}{2}$$

M1: Sets $kx+4=3|x-2|+5$, isolates $|x-2|$ (or $3|x-2|$), squares both sides, uses $b^2-4ac\ldots0$ where … is any equality or inequality, and solves the resulting 3TQ using the usual rules and may be by calculator, leading to a value for k.

Condone slips in expanding the brackets.

A1: As main scheme.

Alt 3 via Domain for the right hand branch of the modulus graph:

$$kx+4=3x-1 \Rightarrow x=\frac{-5}{k-3}>2 \quad \left\{\text{or } x=\frac{5}{3-k}>2\right\}$$

$$\Rightarrow k-3<0 \quad \{\text{and } \Rightarrow -5<2(k-3)\}$$

$$\Rightarrow k<3 \quad \{\text{and } \Rightarrow 0.5<k\}$$

M1: Sets $kx+4=3(x-2)+5$, makes x the subject, sets >2 and deduces a critical value.

A1: As main scheme.

(**Q06 9MA0/01, June 2024**)

Q5.

Question	Scheme	Marks	AOs
(a)	For either $x=4$ or $y=10$	M1	1.1b
	$(4, 10)$	A1	1.1b
		(2)	
(b)	$-x+4+10=3x \Rightarrow x=\ldots$	M1	1.1b
	$x=\frac{7}{2}$	A1	2.1
		(2)	
			(4 marks)

Notes:

(a)

M1: One correct coordinate. May be seen embedded as $(4,10)$ or e.g. $4,10$

A1: $(4,10)$ but may be given $x=4$ $y=10$ Condone $4,10$

(b)

M1: For an attempt to solve $-x+4+10=3x \Rightarrow x=\ldots$ or the equivalent equation e.g. $-x+4=3x-10 \Rightarrow x=\ldots$, $x-4=10-3x \Rightarrow x=\ldots$ etc.

A1: $x=\frac{7}{2}$ oe only. There must be no extra solutions.

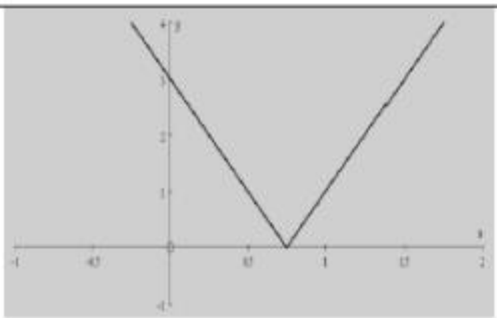
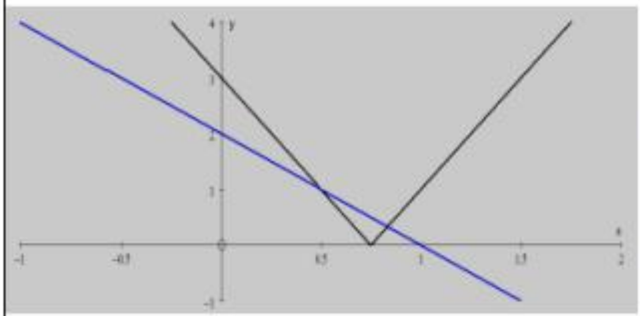
Alternative by squaring:

$$|x-4|+10=3x \Rightarrow |x-4|=3x-10 \Rightarrow x^2-8x+16=(3x-10)^2=9x^2-60x+100$$

$$\Rightarrow 8x^2-52x+84=0 \Rightarrow x=\frac{7}{2} \text{ only}$$

(**Q01 9MA0/02/M, June 2025**)

Q6.

Question Number	Scheme		Marks
(a)		V shaped graph	B1
		Touches x axis at ¾ and cuts y axis at 3	B1
			(2)
(b)		Solves $4x-3=2-2x$ or $3-4x=2-2x$ to give either value of x	M1
		Both $x=\frac{5}{6}$ and $x=\frac{1}{2}$ or $x>\frac{5}{6}$ or $x<\frac{1}{2}$	A1

(a)

B1 A 'V' shaped graph. The position is not important. Do not accept curves. See practice and qualification items for clarity. Accept a V shape with a 'dotted' extension of $y = 4x - 3$ appearing under the x axis.

B1 The graph **meets** the x axis at $x = \frac{3}{4}$ and **crosses** the y axis at $y = 3$. Do not allow multiple meets or crosses

If they have lost the previous B1 mark for an extra section of graph underneath the x axis allow for **crossing** the x axis at $x = \frac{3}{4}$ and **crosses** the y axis at $y = 3$.

Accept marked elsewhere on the page with A and B marked on the graph and $A = \left(\frac{3}{4}, 0\right)$ and $B = (0,3)$

Condone $\left(0, \frac{3}{4}\right)$ and (3, 0) marked on the correct axis

(b)

M1 Attempts to solve $|4x-3| ... 2-2x$ finding at least one solution. You may see … replaced by either = or >

Accept as evidence $\pm 4x \pm 3 = 2 - 2x \Rightarrow x = ..$

Accept as evidence $\pm 4x \pm 3 > 2 - 2x \Rightarrow x > ...$, or $x < ..$

A1 Both critical values $x = \frac{5}{6}$ and $x = \frac{1}{2}$, or one inequality, accept $x > \frac{5}{6}$ or $x < \frac{1}{2}$

Accept $x = 0.83$ and $x = 0.5$ for the critical values

Accept both of these answers with no incorrect working for both marks

dM1 Dependent upon the previous M, this is scored for selecting the outside region of their two points.

Eg if M1 has been scored for $4x - 3 = 2 - 2x \Rightarrow x = 0.83$ and $-4x - 3 = 2 - 2x \Rightarrow x = -2.5$

A correct application of M1 would be $x < -2.5, x > 0.83$

A1 Correct answer only $x < \frac{1}{2}$ or $x > \frac{5}{6}$.

Accept $x < 0.5, x > 0.8\dot{3}$

(c)

M1 **Either** sketch both lines showing a single intersection at the point $x = \frac{3}{4}$

Or solves $|4x-3| = 1\frac{1}{2} - 2x$ using both $4x - 3 = 1\frac{1}{2} - 2x$ and $-4x + 3 = 1\frac{1}{2} - 2x$ **giving one solution** $x = \frac{3}{4}$

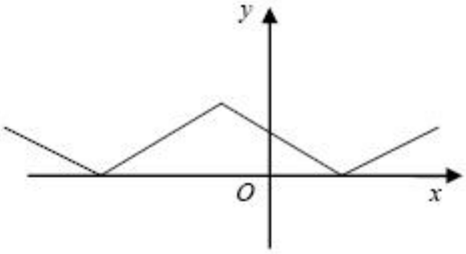
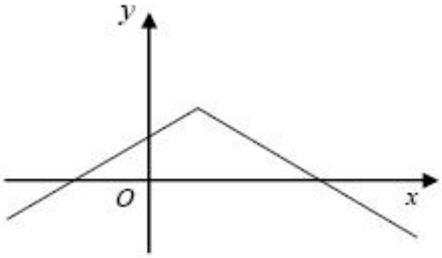
Accept $|4x-3| > 1\frac{1}{2} - 2x$ using both $4x - 3 > 1\frac{1}{2} - 2x$ and $-4x + 3 > 1\frac{1}{2} - 2x$ **giving one solution** $x ... \frac{3}{4}$

If two values are obtained using either method it is M0A0

A1 States that the solution set is all values apart from $x = \frac{3}{4}$. Do not isw in this question. Score their final statement. Accept versions of all values of x except $x = \frac{3}{4}$ or $x \in \mathbb{R}, x \neq \frac{3}{4}$, or $x < \frac{3}{4}, x > \frac{3}{4}$

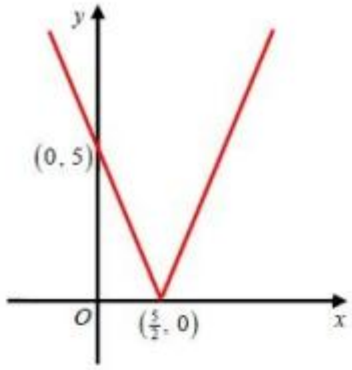
(**Q24 6665/01/R, June 2014**)

Q7.

Question Number	Scheme	Marks
(a)	 shape	B1
	Vertices correctly placed	B1 (2)
(b)	 shape	B1
	Vertex and intersections with axes correctly placed	B1 (2)
(c)	$P:(-1, 2)$	B1
	$Q:(0, 1)$	B1
	$R:(1, 0)$	B1 (3)
(d)	$x > -1$; $\quad 2 - x - 1 = \frac{1}{2}x$	M1 A1
	Leading to $x = \frac{2}{3}$	A1
	$x < -1$; $\quad 2 + x + 1 = \frac{1}{2}x$	M1
	Leading to $x = -6$	A1 (5)
		(12 marks)

(**Q22 6665/01, June 2008**)

Q8.

Question Number	Scheme	Marks
(a)	 	M1A1 (2)
(b)	$\underline{x = 20}$ $2x - 5 = -(15 + x)$; $\Rightarrow \underline{x = -\frac{10}{3}}$	B1 M1;A1 oe. (3)
(c)	$\text{fg}(2) = \text{f}(-3) = \|2(-3) - 5\|; = \|-11\| = 11$	M1;A1 (2)
(d)	$\text{g}(x) = x^2 - 4x + 1 = (x-2)^2 - 4 + 1 = (x-2)^2 - 3$. Hence $\text{g}_{\min} = -3$ Either $\text{g}_{\min} = -3$ or $\text{g}(x) \geqslant -3$ or $\text{g}(5) = 25 - 20 + 1 = 6$ $\underline{-3 \leqslant \text{g}(x) \leqslant 6}$ or $\underline{-3 \leqslant y \leqslant 6}$	M1 B1 A1 (3) **[10]**
	(a) M1: V or  or  graph with vertex on the x-axis. A1: $\left(\frac{5}{2}, \{0\}\right)$ and $(\{0\}, 5)$ seen and the graph appears in both the first and second quadrants. (b) M1: Either $2x - 5 = -(15 + x)$ or $-(2x - 5) = 15 + x$ (c) M1: ***Full method*** of inserting $\text{g}(2)$ into $\text{f}(x) = \|2x - 5\|$ or for inserting $x = 2$ into $\|2(x^2 - 4x + 1) - 5\|$. There must be evidence of the modulus being applied. (d) M1: **Full method** to establish the minimum of g. Eg: $(x \pm \alpha)^2 + \beta$ leading to $\text{g}_{\min} = \beta$. Or for candidate to differentiate the quadratic, set the result equal to zero, find x and insert this value of x back into $\text{f}(x)$ in order to find the minimum. B1: For either finding the correct minimum value of g (can be implied by $\text{g}(x) \geqslant -3$ or $\text{g}(x) > -3$) or for stating that $\text{g}(5) = 6$. A1: $\underline{-3 \leqslant \text{g}(x) \leqslant 6}$ or $\underline{-3 \leqslant y \leqslant 6}$ or $\underline{-3 \leqslant \text{g} \leqslant 6}$. **Note that:** $-3 \leqslant x \leqslant 6$ is A0. **Note that:** $-3 \leqslant \text{f}(x) \leqslant 6$ is A0. **Note that:** $-3 \geqslant \text{g}(x) \geqslant 6$ is A0. **Note that:** $\text{g}(x) \geqslant -3$ or $\text{g}(x) > -3$ or $x \geqslant -3$ or $x > -3$ with no working gains M1B1A0. **Note that for the final Accuracy Mark:** If a candidate writes down $-3 < \text{g}(x) < 6$ or $-3 < y < 6$, then award M1B1A0. If, however, a candidate writes down $\text{g}(x) \geqslant -3$, $\text{g}(x) \leqslant 6$, then award A0. If a candidate writes down $\text{g}(x) \geqslant -3$ or $\text{g}(x) \leqslant 6$, then award A0.	

(**Q23 6665/01, June 2010**)

Q9.

Question	Scheme	Marks	AOs
(a)	$f(x) \geqslant 5$	B1	1.1b
		(1)	
(b)	Uses $-2(3-x)+5=\frac{1}{2}x+30$	M1	3.1a
	Attempts to solve by multiplying out bracket, collect terms etc $\frac{3}{2}x=31$	M1	1.1b
	$x=\frac{62}{3}$ only	A1	1.1b
		(3)	
(c)	Makes the connection that there must be two intersections. Implied by either end point $k>5$ or $k \leqslant 11$	M1	2.2a
	$\{k : k \in \mathbb{R}, 5<k \leqslant 11\}$	A1	2.5
		(2)	
		(6 marks)	

Notes:

(a)

B1: $f(x) \geqslant 5$ Also allow $f(x) \in [5, \infty)$

(b)

M1: Deduces that the solution to $f(x)=\frac{1}{2}x+30$ can be found by solving $-2(3-x)+5=\frac{1}{2}x+30$

M1: Correct method used to solve their equation. Multiplies out bracket/ collects like terms

A1: $x=\frac{62}{3}$ only. Do not allow 20.6

(c)

M1: Deduces that two distinct roots occurs when $y=k$ intersects $y=f(x)$ in two places. This may be implied by the sight of either end point. Score for sight of either $k>5$ or $k \leqslant 11$

A1: Correct solution only $\{k : k \in \mathbb{R}, 5<k \leqslant 11\}$

Q10.

Question	Scheme	Marks	AOs
	For an attempt to solve **Either** $3-2x=7+x \Rightarrow x=...$ **or** $2x-3=7+x \Rightarrow x=...$	M1	1.1b
	Either $x=-\frac{4}{3}$ **or** $x=10$	A1	1.1b
	For an attempt to solve **Both** $3-2x=7+x \Rightarrow x=...$ **and** $2x-3=7+x \Rightarrow x=...$	dM1	1.1b
	For **both** $x=-\frac{4}{3}$ **and** $x=10$ with no extra solutions	A1	1.1b
		(4)	
ALT	**Alternative by squaring:**		
	$(3-2x)^2=(7+x)^2 \Rightarrow 9-12x+4x^2=49+14x+x^2$	M1	1.1b
	$3x^2-26x-40=0$	A1	1.1b
	$3x^2-26x-40=0 \Rightarrow x=...$	dM1	1.1b
	For **both** $x=-\frac{4}{3}$ **and** $x=10$ with no extra solutions	A1	1.1b
			(4 marks)
Notes:			

Note this question requires working to be shown not <u>just answers written down</u>. But correct equations seen followed by the correct answers can score full marks.

M1: Attempts to solve either correct equation.
Allow equivalent equations e.g. $3-2x=-7-x \Rightarrow x=...$

A1: One correct solution. Allow exact equivalents for $-\frac{4}{3}$ e.g. $-1\frac{1}{3}$ or $-1.\dot{3}$ but not e.g. -1.33

dM1: Attempts to solve both correct equations.
Allow equivalent equations e.g. $3-2x=-7-x \Rightarrow x=...$ **Depends on the first method mark.**

A1: For both $x=-\frac{4}{3}$ and $x=10$ with no extra solutions and neither clearly rejected but ignore any attempts to find the y coordinates whether correct or otherwise and ignore reference to e.g. $x=-7$ (from where $y=7+x$ intersects the x-axis) or $x=1.5$ (from finding the value of x at the vertex) as "extras". Allow exact equivalents for $-\frac{4}{3}$ e.g. $-1\frac{1}{3}$ or $-1.\dot{3}$ but not rounded e.g. -1.33

Isw if necessary e.g. ignore subsequent attempts to put the values in an inequality e.g. $-\frac{4}{3}<x<10$

But if e.g. $x=-\frac{4}{3}$ is obtained and a candidate states $x=\left|-\frac{4}{3}\right|$ then score A0

Alternative solution via squaring

M1: Attempts to square both sides. Condone poor squaring e.g. $(3-2x)^2 = 9 \pm 4x^2$ or $9 \pm 2x^2$

A1: Correct quadratic equation $3x^2 - 26x - 40 = 0$. The "= 0" may be implied by their attempt to solve. Terms must be collected but not necessarily all on one side so allow e.g. $3x^2 - 26x = 40$

dM1: Correct attempt to solve a **3 term** quadratic. See general guidance for solving a quadratic equation. The roots can be written down from a calculator so the method may be implied by their values. **Depends on the first method mark.**

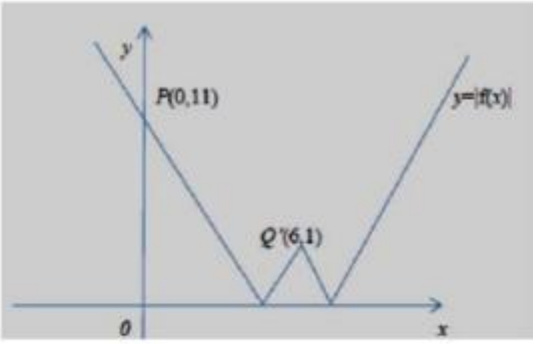
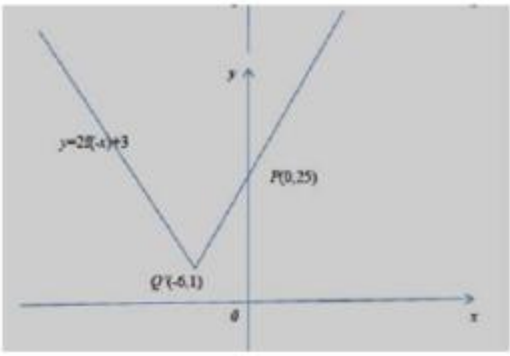
A1: For both $x = -\frac{4}{3}$ and $x = 10$ with no extra solutions and neither clearly rejected but ignore any attempts to find the y coordinates and do not count e.g. $x = -7$ (from where $y = 7 + x$ intersects the x-axis) or $x = 1.5$ (from finding the value of x at the vertex) as "extras". Allow exact equivalents for $-\frac{4}{3}$ e.g. $-1\frac{1}{3}$ or $-1.\dot{3}$ but not e.g. -1.33

Isw if necessary e.g. ignore subsequent attempts to put the values in an inequality e.g. $-\frac{4}{3} < x < 10$

But if e.g. $x = -\frac{4}{3}$ is obtained and a candidate states $x = \left|-\frac{4}{3}\right|$ then score A0

(**Q01 9MA0/02, June 2022**)

Q11.

Question Number	Scheme		Marks
(a)		'W' Shape (0, 11) and (6, 1)	B1 B1 (2)
(b)		'V' shape (-6,1) (0,25)	B1 B1 B1 (3)
(c)	One of $a = 2$ or $b = 6$ $a = 2$ and $b = 6$		B1 B1 (2)
			(7 marks)

(a)

B1 A W shape in any position. The arms of the W do not need to be symmetrical but the two bottom points must appear to be at the same height. Do not accept rounded W's.
A correct sketch of $y = f(|x|)$ would score this mark.

B1 A W shape in quadrants 1 and 2 sitting on the x axis with $P' = (0,11)$ **and** $Q' = (6,1)$. It is not necessary to see them labelled. Accept 11 being marked on the y axis for P'. Condone $P' = (11,0)$ marked on the correct axis, but $Q' = (1,6)$ is B0

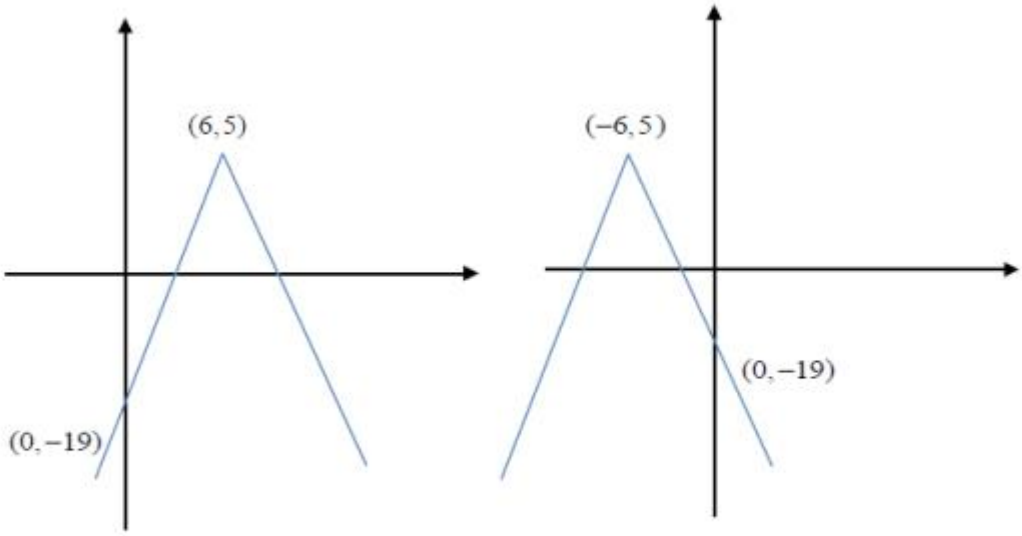
(b)

B1 Score for a V shape in any position on the grid. The arms of the V do not need to be symmetrical. Do not accept rounded or upside down V's for this mark.

B1 $Q' = (-6,1)$. It does not need to be labelled but it must correspond to the minimum point on the curve and be in the correct quadrant.

B1 $P' = (0,25)$. It does not need to be labelled but it must correspond to the y intercept and the line must cross the axis. Accept 25 marked on the correct axis. Condone $P' = (25,0)$ marked on the positive y axis.

Special case: A candidate who mistakenly sketches $y = -2f(x) + 3$ or $y = -2f(-x) + 3$ will arrive at one of the following. They can be awarded SC B1B0B0



(c)

B1 Either states $a = 2$ **or** $b = 6$.
This can be implied (if there are no stated answers given) by the candidate writing that $y = ..|x-6|-1$ or $y = 2|x-..|-1$. If they are both stated and written, the stated answer takes precedence.

B1 States both $a = 2$ **and** $b = 6$
This can be implied by the candidate stating that $y = 2|x-6|-1$
If they are both stated and written, the stated answer takes precedence.

(**Q24 6665/01, June 2014**)