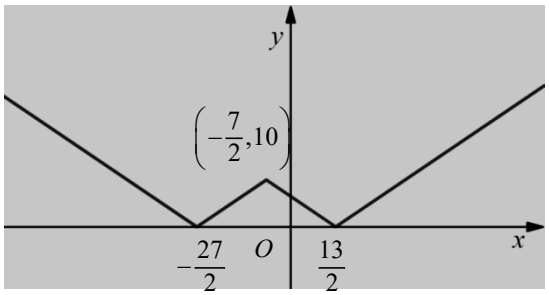
B1: Fully correct. Accept $5 < \text{ff} < 22$, $(5,22)$. Allow with y or range but $5 < x < 22$ would be B1 B0

Question Number	Scheme	Marks
7 (a)	$\left(-\frac{7}{2}, -10\right)$	B1 B1 **(2)**
(b)	Attempts to solve either $\frac{1}{2}(2x+7)-10...\frac{1}{3}x+1$ Or $-\frac{1}{2}(2x+7)-10...\frac{1}{3}x+1$	M1
	Both correct critical values $x...-\frac{87}{8}, \frac{45}{4}$	A1
	Selects outside region for their critical values	dM1
	Correct solution $x \leqslant -\frac{87}{8}, x \geqslant \frac{45}{4}$	A1 **(4)**
(c)	 Shape	B1
	Maximum	B1 ft
	One correct minimum	B1
	Fully correct	B1 **(4)** **(10 marks)**

(a) Must be answered in (a). We cannot imply from work in (c)

B1: One correct coordinate. Allow as $x = -\frac{7}{2}, y = -10$. Allow exact equivalents , e.g. $x = -\frac{14}{4}$

B1: Both coordinates correct. Allow as $x = -\frac{7}{2}, y = -10$. Allow exact equivalents , e.g. $x = -\frac{14}{4}$

(b)

M1: Attempts to solve a correct equation or inequality. They must proceed as far as x ...

Condone slips where they attempt to change the subject in an attempt to make $|2x+7|$ the subject.

So either of $\frac{1}{2}|2x+7|-10...\frac{1}{3}x+1 \Rightarrow |2x+7| = ax+b \Rightarrow 2x+7 = ax+b$

or $\frac{1}{2}|2x+7|-10...\frac{1}{3}x+1 \Rightarrow |2x+7| = ax+b \Rightarrow -2x-7 = ax+b$ are condoned for the M1

A1: Correct critical values $x...-\frac{87}{8}, \frac{45}{4}$ which may be part of an incorrect inequality

dM1: Selects outside region for their critical values. Allow these to be written as one inequality. Allow the strict inequalities here. It is dependent upon having attempted to solve **one** correct equation

A1: $x \leqslant -\frac{87}{8}, x \geqslant \frac{45}{4}$ These can be given separately but do not isw here. Condone words like "and" between. Allow other correct forms such as $x \in \left(-\infty, -\frac{87}{8}\right] \cup \left[\frac{45}{4}, \infty\right)$ **Mark their final answer**

Do not allow incorrect answers such as $\frac{45}{4} \leqslant x \leqslant -\frac{87}{8}$ or $x \in \left(-\infty, -\frac{87}{8}\right] \cap \left[\frac{45}{4}, \infty\right)$

(c) There must be a sketch for this. If the text and the graph contradict each other the graph takes precedence

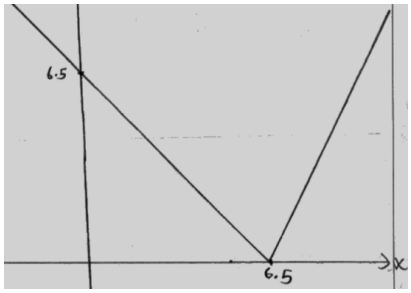
B1: W shape any position. Condone asymmetric arms.

B1ft: Maximum point but follow through on their coordinates from part (a)

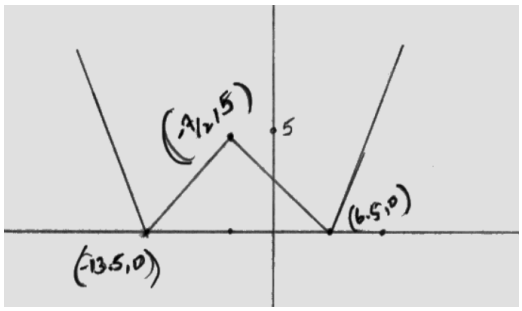
B1: Either minimum value. It must be minimum point and not just the point at which the graph crosses the x-axis. Condone $(0, 6.5)$ for $(6.5, 0)$ as long as it is on the correct axis

B1: Fully correct diagram with **ALL** points correct (allow exact equivalents) Condone asymmetric arms.

Accept a W on the x axis with both $x = \frac{13}{2}$ and $x = -\frac{27}{2}$ marked. Coordinates must be correct



B0 B0 B1 (one local minimum correct) B0

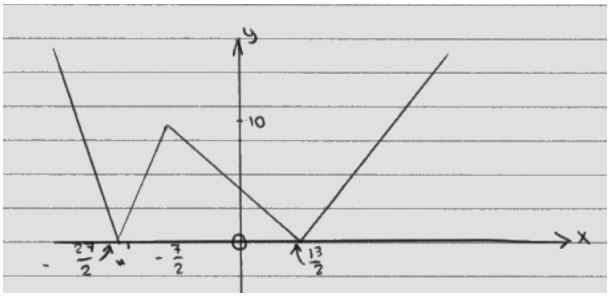


B1: W shape

B1ft: Their part (a) was $\left(-\frac{7}{2}, -5\right)$

B1: One correct local minimum. In fact both are correct

B0: Must be completely correct. Incorrect maximum point



Acceptable for all marks. It is a little asymmetric and the local maximum point is implied

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You may see attempts at part (b) via squaring. It is scored in a similar way.

Any attempt must attempt to isolate the modulus term before squaring

$$\frac{1}{2}|2x+7|-10 \ldots \frac{1}{3}x+1 \Rightarrow \frac{1}{2}|2x+7| \ldots \frac{1}{3}x+11$$

M1: Squares and attempts to solve $\frac{1}{4}(2x+7)^2 \ldots \left(\frac{1}{3}x+11\right)^2$ via a quadratic

A1: FYI Quadratic is $32x^2-12x-3915$ which has critical values of $-\frac{87}{8}$ and $\frac{45}{4}$ which may be found via a calculator

dM1: Selects outside region. It is dependent upon a correct $\frac{1}{4}(2x+7)^2...\left(\frac{1}{3}x+11\right)^2$ o.e.

A1: $x\leqslant -\frac{87}{8}, x\geqslant \frac{45}{4}$ Allow other forms such as $x\in\left(-\infty,-\frac{87}{8}\right]\cup\left[\frac{45}{4},\infty\right)$

Question Number	Scheme	Marks
8 (a)	$\log_{10} x = 2.74-0.079t$	
	$\log_{10} x = 2.74-0.079t$ | $x = p\,q^{-t}$	
	$x = 10^{2.74}\times 10^{-0.079t}$ | $\log_{10} x = \log_{10} pq^{-t}$	
	$x = 10^{2.74}\times\left(10^{0.079}\right)^{-t}$ | $\log_{10} x = \log_{10} p - t\log_{10} q$	
	A correct equation for p or q. E.g. either $\log_{10} p = 2.74$ or $\log_{10} q = 0.079$	M1
	A correct value for either p or q. Either $p =$ awrt 550 or $q =$ awrt 1.2	A1
	A correct equation for both p and q. E.g both $p = 10^{2.74}$ and $q = 10^{0.079}$	dM1
	Both $p =$ awrt 550 and $q =$ awrt 1.2 **with** proof*	A1*
		(4)
(b)	"p" is the amount of antibiotic (in mg) in the patient's bloodstream at the start	B1
		(1)
(c)	$x = 400\times 1.4^{-t} \Rightarrow \frac{dx}{dt} = -400\ln 1.4\times 1.4^{-t}$	B1
	Substitutes $t=5$ into $\frac{dx}{dt} =$ awrt -25	M1 A1
		(3)
		(8 marks)

(a)

M1:A correct equation in either p or q

For p look for $\log_{10} p = 2.74$ or $p = 10^{2.74}$ For q look for $\log_{10} q = 0.079$ or $q = 10^{0.079}$

This is implied by a correct value for either p or q (See below), $x = 550\times q^{-t}$, or $x = p\times 1.2^{-t}$

A1:Either $p =$ awrt 550, $q =$ awrt 1.2, $x = 550\times q^{\pm t}$, or $x = p\times 1.2^{-t}$

dM1:A correct equation for both p and q. E.g. sight of both $p = 10^{2.74}$ and $q = 10^{0.079}$

This may be implied by $x = 550\times 1.2^{-t}$

A1*: Both $p =$ awrt 550 and $q =$ awrt 1.2 **with** proof* as it is a "show that" question.

There must be no incorrect working. Correct values of p and q are implied by $x = 550\times 1.2^{-t}$

This "proof" part can be shown with a minimum of working

Starting with $x = p\,q^{-t}$ a minimum of $\log_{10} x = \log_{10} p - t\log_{10} q$ followed by correct equations and values is sufficient

Starting with $\log_{10} x = 2.74-0.079t$ a minimum of $x = 10^{2.74}\times 10^{-0.079t}$ followed by correct equations and/or values is sufficient