Question Number	Scheme	Marks
2(a)	$R = 25$	B1
	$\tan\alpha = \frac{24}{7} \Rightarrow \alpha = ...$	M1
	$\alpha = 1.287$	A1
		(3)
(b)(i)	$\text{Min} = \frac{5}{90 - 3\times"25"\times(-1)}$	M1
	$= \frac{1}{33}$	A1
(b)(ii)	$(2x + "1.287") = \pi, ... \Rightarrow x = ...$	M1
	$\Rightarrow x = \frac{\pi - "1.287"}{2} = 0.927$	A1
		(4)
		Total 7

Notes:

(a)

B1: Correct value. May be seen embedded in e.g. $(\text{f}(x) =)25\cos(x + ...)$.

Condone e.g. $R = \sqrt{7^2 + (-24)^2} = 25$

Do not allow ± 25 unless the -25 is rejected.

M1: Allow for: $\tan\alpha = \pm\frac{24}{7}$, $\tan\alpha = \pm\frac{7}{24}$, $\cos\alpha = \pm\frac{7}{\text{their } R}$, $\sin\alpha = \pm\frac{24}{\text{their } R}$ leading to a value for α.

If no method is shown it may be implied by their value for α as awrt 1.3 rads or awrt 74°

A1: Awrt 1.287 Isw once the mark is awarded. Must be in radians.

May be seen embedded in e.g. $(\text{f}(x) =)...\cos(x + 1.287)$.

Apply isw if correct R and α are seen followed by e.g. $(\text{f}(x) =)25\cos(x - 1.287)$.

Mark (b)(i) and (ii) together.

(b)(i)

M1: Award for $\frac{5}{90 + 3\times\text{Their } R}$.

May be implied by their value (which may be a decimal) and may be seen embedded in e.g. coordinates $\left(\frac{\pi - 1.287}{2}, \frac{1}{33}\right)$ which would score (i) M1 A1 and (ii) M1

A1: For $\frac{1}{33}$ only.

Note that both marks are available in (b)(i) even if their α is incorrect.

(b)(ii) **Note that (b)(ii) can be marked independently.**

M1: For an attempt to solve $2x \pm "1.287" = \pi$ to obtain a value for x. May be implied by awrt 0.927

Condone a sign slip but the order of operations must be essentially correct e.g.

$2x \pm "1.287" = \pi \Rightarrow 2x = \pi \pm "1.287" \Rightarrow x = \frac{\pi \pm "1.287"}{2}$

Condone an attempt to solve e.g. $2x \pm "74°" = 180°$ but not mixed units e.g. $2x \pm "1.287" = 180$

A1: For awrt 0.927

Question Number	Scheme	Marks
3(a)	$\log_{10} y = \pm\frac{2}{3.5}\log_{10} x - 2$	M1
	$\log_{10} y = -\frac{4}{7}\log_{10} x - 2$	A1
		(2)

Notes:

M1: Obtains an equation of the form $\log_{10} y = \pm\frac{2}{3.5}\log_{10} x - 2$ oe e.g. $\log_{10} y = -\frac{4}{7}\log_{10} x + \log_{10} 0.01$

Note $y = -\frac{4}{7}x - 2$ or $y = \pm\frac{2}{3.5}\log_{10} x - 2$ or $\log_{10} y = -\frac{4}{7}x - 2$ score M0

If this is attempted via simultaneous equations e.g. $0 = -3.5m + c,\ -2 = c$ it is scored for reaching a gradient of $\pm\frac{2}{3.5}$ which may be implied by awrt 0.57 and then $\log_{10} y = \pm\frac{2}{3.5}\log_{10} x - 2$ as above.

Condone log or lg for $\log_{10}$ but not ln or any other incorrect base.

A1: Correct equation $\log_{10} y = -\frac{4}{7}\log_{10} x - 2$ or equivalent.

e.g. $7\log_{10} y + 4\log_{10} x + 14 = 0,\quad \log_{10} y = -\frac{4}{7}\log_{10} x + \log_{10} 0.01$

Condone $\log_{10} y = -\frac{2}{3.5}\log_{10} x - 2$ and isw once a correct equation is seen.

Condone log or lg for $\log_{10}$ but not ln

(b)	$\log_{10} y = -\frac{4}{7}\log_{10} x - 2 \Rightarrow$ $y = 10^{\left(-\frac{4}{7}\log_{10} x - 2\right)}$ or $y = 10^{\left(\log_{10} x^{-\frac{4}{7}} - 2\right)}$ or $y = 10^{-\frac{4}{7}\log_{10} x} \times 10^{-2}$ or e.g. $\log_{10} y = \log_{10} x^{-\frac{4}{7}} - 2 \Rightarrow \log_{10} \frac{y}{x^{-\frac{4}{7}}} = -2$ or e.g. $\log_{10} y = -\log_{10} x^{\frac{4}{7}} - 2 \Rightarrow \log_{10} yx^{\frac{4}{7}} = -2$	M1
	$y = 10^{\left(\log_{10} x^{-\frac{4}{7}} - 2\right)}$ or $y = 10^{-\frac{4}{7}\log_{10} x} \times 10^{-2} \Rightarrow y = x^{-\frac{4}{7}} \times 10^{-2}$ or e.g. $10^{\log_{10} \frac{y}{x^{-\frac{4}{7}}}} = 10^{-2} \Rightarrow \frac{y}{x^{-\frac{4}{7}}} = 10^{-2}$ or $10^{\log_{10} yx^{\frac{4}{7}}} = 10^{-2} \Rightarrow yx^{\frac{4}{7}} = 10^{-2}$	dM1
	$y = \frac{1}{100} x^{-\frac{4}{7}}$ oe	A1
		(3)
		Total 5

Do not allow marks for part (a) to be scored in part (b)

Main method: Starting from an equation of the form $\log_{10} y = m\log_{10} x + c$ where m and c are non-zero.

M1: Correctly applies $10^{\text{lhs}} = 10^{\text{rhs}}$ to their $\log_{10} y = m\log_{10} x + c$ including the use of $10^{\log_{10} y} = y$

e.g. $\log_{10} y = m\log_{10} x + c \Rightarrow y = 10^{m\log_{10} x + c}$ or $\log_{10} y = m\log_{10} x + c \Rightarrow y = 10^{m\log_{10} x} \times 10^{c}$

or combines their $\log_{10} y$ and $m\log_{10} x$ correctly to obtain $\log_{10} yx^{m} = \pm c$ or equivalent e.g.

$\log_{10} y = m\log_{10} x + c \Rightarrow \log_{10} y = \log_{10} x^{m} + c \Rightarrow \log_{10} y - \log_{10} x^{m} = c \Rightarrow \log_{10} \frac{y}{x^{m}} = \pm c$

May be implied by their work. Note that e.g.

$\log_{10} y = -\frac{4}{7}\log_{10} x - 2 \Rightarrow y = 10^{-\frac{4}{7}\log_{10} x} - 10^{2}$ scores M0

dM1: Depends on the previous method mark.

Complete and correct work to obtain an equation in x and y only or for obtaining values for p and q which must not involve logs.

You can condone sign slips with their constant term but the log work must be correct.

A1: Correct **<u>equation</u>** in the form required $y = \frac{1}{100} x^{-\frac{4}{7}}$ or e.g. $y = 0.01x^{-\frac{4}{7}}$ or e.g. $y = 10^{-2} x^{-\frac{4}{7}}$ or e.g.

$y = \frac{x^{-\frac{4}{7}}}{100}$ from correct work. Allow equivalent exact values for q e.g. $q = -\frac{8}{14}$ but not e.g. $q = -\frac{2}{3.5}$

Note that the correct answer does not imply the method marks and you need to check carefully.