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7. (a) $5^{x+1} = 8 + 4(5^{-x}) \rightarrow 5u = 8 + 4u^{-1}$ $\rightarrow 5u^2 - 8u - 4 = 0$ $\rightarrow u = 2$ or -0.4 Soln of $5^x = 2 \rightarrow x = \lg 2 \div \lg 5$ $\rightarrow x = 0.431$	B1 B1 M1 M1 A1 [5]	B1 for $5u$ and B1 for $4u^{-1}$ Solution of a quadratic. Allow for any soln of $5^x = k$. co.
(b) $\log(p-q) = \log p - \log q$ $= \log(p/q)$ $p - q = p/q$ $\rightarrow p = \dfrac{q^2}{q-1}$	B1 M1 A1 [3]	co. Eliminating lg + good algebra. co.

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5 [5]	(i) $\dfrac{1}{\sqrt{32}} = 2^{\frac{-5}{2}}$ (ii) $(64)^{\frac{1}{x}} = 2^{\frac{6}{x}}$ (iii) LHS $= 2^{\frac{6}{x}-x}$ $\dfrac{6}{x} - x = -\dfrac{5}{2} \Rightarrow 2x^2 - 5x - 12 = 0 \Rightarrow (2x+3)(x-4) = 0 \Rightarrow x = 4$ or -1.5	B1 B1B1√ M1 A1

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3 (i) $p = \dfrac{\sqrt{3}+1}{\sqrt{3}-1} \rightarrow p = \dfrac{\sqrt{3}+1}{\sqrt{3}-1} \times \dfrac{\sqrt{3}+1}{\sqrt{3}+1}$ $\rightarrow p = \dfrac{3+2\sqrt{3}+1}{3-1} = 2 + \sqrt{3}$	M1 A1 A1 [3]	× top and bottom by √3 + 1 Denominator = 2 co
(ii) either $p - \dfrac{1}{p} = 2 + \sqrt{3} - \dfrac{1}{2+\sqrt{3}}$ or $p - \dfrac{1}{p} = \dfrac{p^2-1}{p}$ $\rightarrow 2\sqrt{3}$	M1 A1 [2]	Complete method. co.

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7 (i) $2^{2x} = 2^{x+2} + 5$ $2^{2x} = u^2 \quad 2^{x+2} = 4u$ Solution of quadratic $u^2=4u+5$ $2^x = 5 \rightarrow x = \lg 5 \div \lg 2$ $\rightarrow \quad x = 2.32$ **(ii)** $2\log_9 3 + \log_5(7y - 3) = \log_2 8.$ $2\times\frac{1}{2} + \ldots = 3$ $\log_5(7y - 3) = 2$ $(7y - 3) = 25 \rightarrow y = 4$	B1 B1 M1 M1 A1 [5] B1 B1 M1 A1 [4]	co co Correct method of solution of quad=0 From $2^x = k$ to x by correct method co – loses if more than one answer given. For ½ For RHS = 3 From $\log_5$ to $5^p = k$. co

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3 [5]	**(i)** $9^{x+1} \Rightarrow 3^{2x+2}$ **(ii)** $\sqrt[3]{27^{2x}} \Rightarrow 3^{2x}$ **(iii)** Substitute **(i)** and **(ii)** into expression Correctly cancel powers involving x simplify $\Rightarrow$ 2 / 3	B1 B1 B1√ M1 A1

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1 $\frac{8-3\sqrt{2}}{4+3\sqrt{2}}\frac{\left(4-3\sqrt{2}\right)}{\left(4-3\sqrt{2}\right)}$ $\frac{32-12\sqrt{2}-24\sqrt{2}+18}{16-18}$ $\frac{50-36\sqrt{2}}{-2}$ $a = -25, b = 18$	M1 DM1 A1 [3]	M1 for attempt to rationalise DM1 for attempt to expand out and simplify Allow A1 at this stage

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8 **(i)** $a=\frac{1}{2}$	B1 [1]	
(ii) $b=\frac{1}{3}$ (allow 0.33 or better)	B1 [1]	
(iii) $3\log_3 x+\log_3 y=8$ $\log_3 x+\log_3 y=2$ $\log_3 x=3,\ x=27$	M1	M1 for reducing equations to terms of base 3 logs
$\log_3 y=-1,\ y=\frac{1}{3}$	DM1	DM1 for dealing with simultaneous equations and logs to get final answers
Allow solutions using index notation	A1 A1 [4]	A1 for each

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8 **(i)** $(2x+1)\log 2=\log 20$ or $2x\log 2=\log 10$ M1
attempt at valid solution M1
1.66 A1

(ii) express in powers of 5 (or 25 or 125) M1

$\frac{5^{4y-1}}{5^{2y}}=\frac{5^{3y+9}}{5^{4-2y}}$ A1

$4y-1-2y=3y+9-(4-2y)$ M1
-2 A1 [7]

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5 **(i)** express as powers of 2 (or 4 or 8) M1
applies rules of indices $[2x-(5-x)=4x-3(x-3)]$ DM1
7 A1

(ii) $\lg(2y+10)+\lg y=\lg\{y(2y+10)\}$ or $2=\lg 100$ B1
$2y^2+10y=100$ oe B1
5 only B1

[6]

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5 **(a)** $3^{2(2x-1)} = 3^{3x}$	B1		B1 for $3^{2(2x-1)}$
$4x-2=3x$	B1		B1 for 3^{3x}
$x=2$	B1		B1 for $x=2$
		[3]	
(b) $a^{-2}b$ or $\frac{b}{a^2}$ (allow here)	B1		B1 for each
$p=-2, q=1$	B1		
		[2]	

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7 **(i)** 4.5 B1

(ii) –9 B1

(iii) $\log X + \log Y$ M1
15 A1

(iv) $\frac{\log X}{\log Y}$ M1
1.5 A1

6

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5 **(i)** $(3+\sqrt{2})^2 + (3-\sqrt{2})^2 = 22$	M1		M1 for use of Pythagoras
$AC = \sqrt{22}$	A1		
		[2]	

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10 **(a)** 2 lg 5=lg25 B1
$2 = \lg 100$ B1
$\lg(175x-75) = \lg(100x+300)$ M1
5 A1

(b) Substitute and express as equation in u M1
$3u^2 - 28u + 9 = 0$ A1
Solve 3 term quadratic M1
$u = \frac{1}{3}$ and 9 A1
$x = -1$ and 2 A1

9

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6	(i) $\frac{1}{2}x + 2y$	B1 B1 [2]	B1 for each term
	(ii) $y - 1$	M1 A1 [2]	M1 for difference of 2 logarithms
	(iii) $\frac{\log_8 64}{\log_8 2} + \frac{\log_8 p}{\log_8 2}$ $= 6 + 3x$	M1 B1 A1 [3]	M1 for attempt at a valid method B1 for 6 A1 for $+ 3x$

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8	(a) $2^{3-4x}\,2^{2x+8} = 2$ $3 - 4x + 2x + 8 = 1$ $x = 5$	M1 DM1 A1 [3]	M1 for to obtain powers of 2, 4 or 8 DM1 for attempt to equate powers of 2, 4 or 8, using addition
	(b) (i) $2\sqrt{3}$	M1 A1 [2]	M1 for attempt to obtain each term in terms of $\sqrt{3}$
	(ii) $\frac{3 + \sqrt{5}\left(\sqrt{5} + 2\right)}{\sqrt{5} - 2\left(\sqrt{5} + 2\right)}$ leading to $\frac{5\sqrt{5} + 11}{1}$	M1 A1 A1 [3]	M1 for attempt to rationalise A1 for numerator A1 for denominator (can be implied)