Question Number	Scheme	Notes	Marks
5	$5x^2-4x+2=0$		
	Solutions that rely on solving the given quadratic/finding values for p and q are likely to score a maximum of 0010 11010 if the relevant work is seen		
(a)(i)	$\frac{1}{p}\times\frac{1}{q}$ or $\frac{1}{pq}=\frac{2}{5}\Rightarrow pq=\frac{5}{2}$*	Shows product of roots $=\frac{2}{5}$ followed by $pq=\frac{5}{2}$ Minimum as shown. Allow e.g., $qp=2.5$ Note that $\frac{1}{pq}=\frac{1}{\frac{2}{5}}\Rightarrow pq=\frac{5}{2}$ is B0 No clearly incorrect work/statements.	**B1***
	May see: $\left(x-\frac{1}{p}\right)\left(x-\frac{1}{q}\right)=x^2-\left(\frac{1}{p}+\frac{1}{q}\right)x+\frac{1}{pq}=x^2-\frac{4}{5}x+\frac{2}{5}\Rightarrow\frac{1}{pq}=\frac{2}{5}\Rightarrow pq=\frac{5}{2}$* Must not be any clearly incorrect work/statements.		
	Assuming result: $pq=\frac{5}{2}\Rightarrow\frac{1}{p}\times\frac{1}{q}=\frac{2}{5}$ requires conclusion e.g., "Hence true"		
(a)(ii) **May use work from (i)**	$\frac{1}{p}+\frac{1}{q}=-\frac{(-4)}{5}$	Uses sum of roots to achieve a correct equation in p and q	**M1**
	$\frac{1}{p}+\frac{1}{q}=\frac{p+q}{pq}$	States or uses $\frac{1}{p}+\frac{1}{q}=\frac{p+q}{pq}$	**M1**
	$\frac{p+q}{pq}=\frac{p+q}{\frac{5}{2}}=\frac{4}{5}\Rightarrow p+q=\frac{4}{5}\times\frac{5}{2}=2$	"$p+q=2$" from correct work. Allow "$2=q+p$"	**A1**
			(4)
Alt $x\to\frac{1}{z}$	$x\to\frac{1}{z}\Rightarrow 5\left(\frac{1}{z}\right)^2-4\left(\frac{1}{z}\right)+2=0$	Correctly replaces x with e.g., $\frac{1}{z}$ and allow $\frac{1}{x}$	**1st M1**
	$2z^2-4z+5=0$	Obtains a 3TQ in "z", "w" etc.	**2nd M1**
	$pq=\frac{5}{2}$	States $pq=\frac{5}{2}$ following correct work	**B1*** **1st mark**
	$p+q=2$	"$p+q=2$" from correct work	**A1**

Question Number	Scheme	Notes	Marks
5(b)	$\frac{p}{p^2+1}+\frac{q}{q^2+1}=\frac{pq^2+p+p^2q+q}{p^2q^2+p^2+q^2+1}$ $\frac{p}{p^2+1}\times\frac{q}{q^2+1}=\frac{pq}{p^2q^2+p^2+q^2+1}$ M1: For $p\left(q^2+1\right)+q\left(p^2+1\right)\rightarrow pq^2+p+p^2q+q$ or $\left(p^2+1\right)\left(q^2+1\right)\rightarrow p^2q^2+p^2+q^2+1$ Allow equivalents e.g., $pq\left(p+q\right)+p+q$ provided the initial expansion has been carried out A1: Both correct (expression for denominator seen correctly once) Do not accept pq^2 for $\left(pq\right)^2$ unless it is clearly recovered		**M1** **A1**
	$\text{sum}=\frac{pq\left(p+q\right)+p+q}{\left(pq\right)^2+\left(p+q\right)^2-2pq+1}=\frac{\frac{5}{2}\times2+2}{\left(\frac{5}{2}\right)^2+2^2-2\times\frac{5}{2}+1}=\frac{7}{\frac{25}{4}}=\ldots\left(\frac{28}{25}\text{or}1.12\right)$ $\text{product}=\frac{pq}{\left(pq\right)^2+\left(p+q\right)^2-2pq+1}=\frac{\frac{5}{2}}{\left(\frac{5}{2}\right)^2+2^2-2\left(\frac{5}{2}\right)+1}=\frac{\frac{5}{2}}{\frac{25}{4}}\ldots\left(\frac{2}{5}\text{ or }0.4\right)$ Obtains a value for either the new sum or new product using $\underline{pq=\frac{5}{2}}$ and a value for $p+q$ which could be their answer from part (a)(ii) and may have been stated as e.g., $\frac{1}{p}+\frac{1}{q}$ or it could be inconsistent with their answer to (a)(ii). May be slips. At least one of their expressions must have included both *pq* and *p*+*q* and have been completely in terms of *pq* and *p*+*q* including at least one use of $p^2+q^2=\left(p+q\right)^2-2pq$. Accept just sum = $\frac{28}{25}$ or product = $\frac{2}{5}$ if there is no clearly incorrect work otherwise some evidence of all of the above conditions and not just values must be seen. **Requires previous M mark.**		**dM1**
	Note that for the numerator of the sum it is possible to use $pq^2+p+p^2q+q=p+q+\left(p+q\right)\left(p^2+q^2\right)-\left(p^3+q^3\right)=p+q+\left(p+q\right)\left(\left(p+q\right)^2-2pq\right)-\left(\left(p+q\right)^3-3pq\left(p+q\right)\right)$ in which case both $p^2+q^2=\left(p+q\right)^2-2pq$ and $p^3+q^3=\left(p+q\right)^3-3pq\left(p+q\right)$ must be used		
	The above work may be embedded within $x^2\pm\left(\text{sum}\right)x\pm\text{product}$		
	$x^2-\frac{28}{25}x+\frac{2}{5}$	Applies $x^2-\left(\text{sum}\right)x+\text{product}$ correctly for their stated **values** for new sum and product. Not dependent.	**M1**
	$25x^2-28x+10=0$	Correct quadratic (or integer multiple) with "= 0" Allow a different variable e.g., *z* for *x* Allow e.g., $a=25$, $b=-28$, $c=10$ provided $ax^2+bx+c=0$ is seen otherwise score M1A0	**A1**
			(5)
			Total 9