| Question Number | Scheme | Marks |
|---|---|---|
| **2** | | |
| **(a)** | $\frac{3}{8}-\frac{\sqrt{71}}{8}\mathrm{i}$ | B1 (1) |
| **(b)** | $\left(x-\frac{3}{8}-\frac{\sqrt{71}}{8}\mathrm{i}\right)\left(x-\frac{3}{8}+\frac{\sqrt{71}}{8}\mathrm{i}\right)\ \left((x-4)=0\right)$ | |
| | $\left(x^2-\frac{3}{4}x+\frac{5}{4}\right)\ \left((x-4)=0\right)$ | M1A1 |
| | $x^3-\frac{19}{4}x^2+\frac{17}{4}x-5\ \ (=0)$ | dM1 |
| | $4x^3-19x^2+17x-20\ \ (=0)\quad p=17,\ q=-20$ | A1 (4) **[5]** |
| **(a)** **B1** | Correct answer only | |
| **(b)** **M1** | Attempt the multiplication of the 2 brackets with the complex terms. Allow $(x\pm\text{root})$ for the brackets. Allow "invisible" brackets. | |
| **A1** | Correct quadratic obtained - may have multiplied by the 4 (or other constant factor) and this is fine. (Need not be fully simplified but must have real terms) | |
| **dM1** | Attempt to multiply their quadratic by $(x-4)$ or may divide their quadratic into the cubic or other full method leading to at least one of $p$ or $q$. | |
| **A1** | Correct values. Values of $p$ and $q$ need not be shown explicitly but may been seen in a cubic, provided the cubic starts $4x^3-19x^2$ (isw after a correct cubic) | |
| | **Note if a candidate uses a hybrid method, mark under main scheme unless an Alt scores more marks.** | |
| | | |
| **Alt 1 (b)** | $-\frac{q}{4}=4\times\left(\frac{3}{8}+\frac{\sqrt{71}}{8}\mathrm{i}\right)\times\left(\frac{3}{8}-\frac{\sqrt{71}}{8}\mathrm{i}\right)=\ldots\rightarrow q=..$ **or** | M1 |
| | $\frac{p}{4}=4\left(\frac{3}{8}+\frac{\sqrt{71}}{8}\mathrm{i}\right)+4\left(\frac{3}{8}-\frac{\sqrt{71}}{8}\mathrm{i}\right)+\left(\frac{3}{8}+\frac{\sqrt{71}}{8}\mathrm{i}\right)\left(\frac{3}{8}-\frac{\sqrt{71}}{8}\mathrm{i}\right)\rightarrow p=\ldots$ | |
| | $\Rightarrow q=-16\times\left(\frac{9}{64}+\frac{71}{64}\right)=-20$ **or** $p=17$ | A1 |
| | E.g. $\mathrm{f}(4)=0\Rightarrow 4(4)^3-19(4)^2+4p-"20"=0\Rightarrow p=\ldots$ | |
| | or $\frac{p}{4}=4\left(\frac{3}{8}+\frac{\sqrt{71}}{8}\mathrm{i}\right)+4\left(\frac{3}{8}-\frac{\sqrt{71}}{8}\mathrm{i}\right)+\left(\frac{3}{8}+\frac{\sqrt{71}}{8}\mathrm{i}\right)\left(\frac{3}{8}-\frac{\sqrt{71}}{8}\mathrm{i}\right)\rightarrow p=\ldots$ | dM1 |
| | $p=17,\ q=-20$ | A1 (4) |

| Question Number | Scheme | Marks |
|---|---|---|
| **M1** | A correct attempt to use product of roots is $-\frac{q}{4}$ to find a value for q<br>**or** pair sum is $\frac{p}{4}$ to find a value of $p$. | |
| **A1** | Correct value for $p$ or $q$ | |
| **dM1** | Correct full method to find both $p$ and $q$. | |
| **A1** | Correct values for both | |
| **Alt 2** | Attempts at using the factor theorem are possible but unlikely to succeed.<br>Score as follows:<br>M1: Uses the factor theorem to generate two equations in the two unknowns (note they will need to use a complex root to achieve this and equate real and imaginary parts.).<br>A1: Correct equations.<br>dM1: Solves their two equations to find values for $p$ and $q$.<br>A1: Correct values<br>Send to review if unsure. | |
| | | |
| **Alt 3 (b)** | $4x^2-3x+p-12$<br>$x-4\overline{)4x^3-19x^2+px+q}$<br>$4x^3-16x^2$<br>$-3x^2+px+q$<br>$-3x^2+12x$<br>$(p-12)x+q$<br>$(p-12)x-4(p-12)$<br>$\Rightarrow q+4(p-12)=0$ & $\frac{p-12}{4}=\left(\frac{3}{8}+\frac{\sqrt{71}}{8}\mathrm{i}\right)\left(\frac{3}{8}-\frac{\sqrt{71}}{8}\mathrm{i}\right)=\frac{5}{4}$<br>$P=17, q=-20$ | M1<br>A1<br><br><br><br><br>dM1<br>A1 (4) |
| **(b)**<br>**M1** | Divides $x-4$ into the cubic to achieve a 3TQ quotient and a remainder | |
| **A1** | Correct quotient and remainder | |
| **dM1** | Correct full method to find $p$ or $q$ | |
| **A1** | Correct values | |