| Q | Marking instructions | AO | Marks | Typical solution |
| --- | --- | --- | --- | --- |
| **10(a)** | States −2.5<br>OE | 2.2a | B1 | −2.5 |
| | **Subtotal** | | **1** | |

| Q | Marking instructions | AO | Marks | Typical solution |
| --- | --- | --- | --- | --- |
| **10(b)** | Explains that many-to-one function is when distinct values of $x$ give the same value for $y$ | 2.4 | E1 | Many-to-one function is when two or more $x$ values give the same $y$ value.<br><br>This graph is many-to-one because you can draw a horizontal line and it will cross the graph twice. |
| | Uses the shape of the graph to justify their answer<br>or<br>gives an example of two $x$ values eg $f(0) = f(4)$<br>or<br>states turning or minimum or maximum points indicate many-to-one | 2.4 | E1 | |
| | **Subtotal** | | **2** | |

| Q | Marking instructions | AO | Marks | Typical solution |
| --- | --- | --- | --- | --- |
| **10(c)(i)** | Equates $x$ and $\dfrac{x^2+10}{2x+5}$ | 3.1a | M1 | $x = \dfrac{x^2+10}{2x+5}$<br>$x(2x+5) = x^2+10$<br>$2x^2+5x = x^2+10$<br>$x^2+5x-10=0$ |
| | Rearranges with at least one intermediate step to obtain quadratic equation AG<br>Condone $0 = x^2 + 5x - 10$ | 2.1 | R1 | |
| | **Subtotal** | | **2** | |

| Q | Marking instructions | AO | Marks | Typical solution |
| --- | --- | --- | --- | --- |
| **10(c)(ii)** | Obtains $\dfrac{-5\pm\sqrt{65}}{2}$<br>Ignore any labels<br>ISW | 1.1b | B1 | $x = \dfrac{-5\pm\sqrt{65}}{2}$ |
| | **Subtotal** | | **1** | |

| Q | Marking instructions | AO | Marks | Typical solution |
| --- | --- | --- | --- | --- |
| **10(d)** | Uses quotient rule to obtain an expression in the form of<br>$\frac{Ax(2x+5)+B(x^2+10)}{(2x+5)^2}$<br>or<br>uses product rule to obtain an expression in the form of<br>$Cx(2x+5)^{-1}+D(x^2+10)(2x+5)^{-2}$<br>or<br>uses implicit differentiation to obtain an equation of the form<br>$Ax\frac{dy}{dx}+By+C\frac{dy}{dx}=Dx$<br><br>$A$, $B$, $C$ and $D$ can be any values but not 0<br>Condone missing brackets | 3.1a | M1 | $\mathrm{f}'(x)=\frac{2x(2x+5)-2(x^2+10)}{(2x+5)^2}$<br>$=\frac{2x^2+10x-20}{(2x+5)^2}$<br><br>$\mathrm{f}'(x)=0 \Leftrightarrow 2x^2+10x-20=0$<br>$x^2+5x-10=0$<br><br>This is the same equation solved in part c(i) so $P$ and $Q$ must be stationary points. |
| | Obtains fully correct $\mathrm{f}'(x)$<br>or<br>obtains $2x\frac{dy}{dx}+2y+5\frac{dy}{dx}=2x$<br><br>ACF<br>May be unsimplified | 1.1b | A1 | |
| | Equates their $f'(x)$ or their numerator of $f'(x)$ to 0<br>or sets $\frac{\mathrm{d}y}{\mathrm{d}x}=0$ | 1.1a | M1 | |
| | Rearranges to obtain<br>$x^2+5x-10=0$ or<br>$2x^2+10x-20=0$ and links it to the equation in part **c(i)** or their answer to **c(ii)**<br>or<br>solves their quadratic $\mathrm{f}'(x)=0$ correctly<br>or<br>deduces $y=x$ and substitutes to get $x=\frac{x^2+10}{2x+5}$ then rearranges to get $x^2+5x-10=0$ | 1.1a | M1 | |

| | | | | |
|---|---|---|---|---|
| | Completes a reasoned argument by using $x = \dfrac{-5 \pm \sqrt{65}}{2}$ to conclude that $P$ and $Q$ are stationary points<br><br>CSO<br><br>Must have brackets correct throughout | 2.1 | R1 | |
| | **Subtotal** | | **5** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **10(e)** | Deduces critical regions from their answer to **c(ii)**<br>condone strict inequalities or poor notation or decimal values | 2.2a | M1 | $x \le \dfrac{-5-\sqrt{65}}{2}$ and $x \ge \dfrac{-5+\sqrt{65}}{2}$<br><br>$\left\{x : x \le \dfrac{-5-\sqrt{65}}{2}\right\} \cup \left\{x : x \ge \dfrac{-5+\sqrt{65}}{2}\right\}$ |
| | Writes correct range in correct set notation<br>eg<br>$\left(-\infty, \dfrac{-5-\sqrt{65}}{2}\right] \cup \left[\dfrac{-5+\sqrt{65}}{2}, \infty\right)$<br><br>Accept other letters for $x$ or using $f(x)$ provided consistent throughout set<br>Follow through their answer to **c(ii)** | 2.5 | A1F | |
| | **Subtotal** | | **2** | |

| | | | | |
|---|---|---|---|---|
| | **Question 10 Total** | | **13** | |