| Question | Scheme | Marks | AOs |
|---|---|---|---|
| **6 (a)** | $2<x<6$ | B1 | 1.1b |
| | | **(1)** | |
| **(b)** | States either $k>8$ or $k<0$ | M1 | 3.1a |
| | States e.g. $\{k:k>8\}\cup\{k:k<0\}$ | A1 | 2.5 |
| | | **(2)** | |
| **(c)** | **Please see notes for alternatives** | | |
| | States $y=ax(x-6)^2$ or $\mathrm{f}(x)=ax(x-6)^2$ | M1 | 1.1b |
| | Substitutes $(2,8)$ into $y=ax(x-6)^2$ and attempts to find $a$ | dM1 | 3.1a |
| | $y=\frac{1}{4}x(x-6)^2$ or $\mathrm{f}(x)=\frac{1}{4}x(x-6)^2$ o.e | A1 | 2.1 |
| | | **(3)** | |
| | | **(6 marks)** | |

**Notes: Watch for answers written by the question. If they are beside the question and in the answer space, the one in the answer space takes precedence**

(a)

B1: Deduces $2<x<6$ o.e. such as $x>2, x<6$ $x>2$ and $x<6$ $\{x:x>2\}\cap\{x:x<6\}$ $x\in(2,6)$

Condone attempts in which set notation is incorrectly attempted but correct values can be seen or implied E.g. $\{x>2\}\cap\{x<6\}$ $\{x>2, x<6\}$. Allow just the open interval $(2,6)$

Do not allow for incorrect inequalities such as e.g. $x>2$ or $x<6$, $\{x:x>2\}\cup\{x:x<6\}$ $x\in[2,6]$

(b)

M1: Establishes a correct method by finding one of the (correct) inequalities

States either $k>8$ (condone $k\geqslant 8$) or $k<0$ (condone $k\leqslant 0$)

Condone for this mark $y\leftrightarrow k$ or $\mathrm{f}(x)\leftrightarrow k$ and $8<k<0$

A1: Fully correct solution in the form $\{k:k>8\}\cup\{k:k<0\}$ or $\{k|k>8\}\cup\{k|k<0\}$ either way around but condone $\{k<0\}\cup\{k>8\}$, $\{k:k<0\cup k>8\}$, $\{k<0\cup k>8\}$. It is not necessary to mention $\mathbb{R}$, e.g. $\{k:k\in\mathbb{R}, k>8\}\cup\{k:k\in\mathbb{R}, k<0\}$ Look for $\{\ \}$ and $\cup$

Do not allow solutions not in set notation such as $k<0$ or $k>8$.

(c)

M1: Realises that the equation of $C$ is of the form $y=ax(x-6)^2$. Condone with $a=1$ for this mark.

So award for sight of $ax(x-6)^2$ even with $a=1$

dM1: Substitutes $(2,8)$ into the form $y=ax(x-6)^2$ and attempts to find the value for $a$.

It is dependent upon having an equation, which the ($y=$..) may be implied, of the correct form.

A1: Uses all of the information to form a correct **equation** for $C$ $y=\frac{1}{4}x(x-6)^2$ o.e.

ISW after a correct answer. Condone $\mathrm{f}(x)=\frac{1}{4}x(x-6)^2$ but not $C=\frac{1}{4}x(x-6)^2$.

Allow this to be written down for all 3 marks

Examples of alternative methods

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**Alternative I part (c):**

**Using the form $y = ax^3 + bx^2 + cx$ and setting up then solving simultaneous equations.**
**There are various versions of this but can be marked similarly**

M1: Realises that the equation of $C$ is of the form $y = ax^3 + bx^2 + cx$ and forms two equations in $a$, $b$ and $c$. Condone with $a$ =1 for this mark.

Note that the form $y = ax^3 + bx^2 + cx + d$ is M0 until $d$ is set equal to 0.

There are four equations that could be formed, only two are necessary for this mark.

Condone slips

Using $(6, 0)$ $\Rightarrow 216a+36b+6c=0$

Using $(2, 8)$ $\Rightarrow 8a+4b+2c=8$

Using $\dfrac{dy}{dx}=0$ at $x = 2$ $\Rightarrow 12a+4b+c=0$

Using $\dfrac{dy}{dx}=0$ at $x = 6 \Rightarrow 108a+12b+c=0$

dM1: Forms and solves three different equations, one of which must be using (2, 8) to find values for $a$, $b$ and $c$. A calculator can be used to solve the equations

A1: Uses all of the information to form a correct equation for $C$ $y = \frac{1}{4}x^3 - 3x^2 + 9x$ o.e.

ISW after a correct answer. Condone $f(x) = \frac{1}{4}x^3 - 3x^2 + 9x$

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**Alternative II part (c)**
**Using the gradient and integrating**

M1: Realises that the gradient of $C$ is zero at 2 and 6 so sets $f'(x) = k(x-2)(x-6)$ oe **and** attempts to integrate. Condone with $k$ = 1

dM1: Substitutes $x = 2, y = 8$ into $f(x) = k\left(...x^3 + ...x + ...\right)$ and finds a value for $k$

A1: Uses all of the information to form a correct equation for $C$ $y = \frac{3}{4}\left(\frac{1}{3}x^3 - 4x^2 + 12x\right)$ o.e.

ISW after a correct answer. Condone $f(x) = \frac{3}{4}\left(\frac{1}{3}x^3 - 4x^2 + 12x\right)$

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