Question	Scheme	Marks
6(a)	$y-5x=75,\ y=2x^2+x-21$ $\Rightarrow 2x^2+x-21=5x+75$ $\Rightarrow 2x^2-4x-96=0$ or e.g. $x^2-2x-48=0$ or $\Rightarrow y=2\left(\frac{y-75}{5}\right)^2+\frac{y-75}{5}-21$ $\Rightarrow 2y^2-320y+10350=0$ or e.g. $y^2-160y+5175=0$	M1
	$x^2-2x-48=0\Rightarrow (x-8)(x+6)=0\ \Rightarrow x=-6,\ 8$	dM1
	$x=-6\Rightarrow y=45$ or $x=8\Rightarrow y=115$	dM1
	$P(-6,\ 45)$ and $Q(8,\ 115)$	A1
		(4)
(b)	e.g. $y\leqslant 2x^2+x-21,\ y-5x\leqslant 75,\ y\geqslant 0,\ x\leqslant -3.5$ $x\leqslant a$ where $-3.5\leqslant a<3$ $(\text{or } a\leqslant x\leqslant b \text{ where } a\leqslant -15, -3.5\leqslant b\leqslant 3)$	M1A1A1
		(3)
		Total 7

Notes:

(a) **<u>Note that solutions relying on calculator technology are not acceptable so a complete method must be shown.</u>**

M1: Equates the line and the curve and rearranges to obtain a 3TQ in x
Alternatively eliminates x to obtain a 3TQ in y

dM1: Solves their 3TQ to obtain at least one value for x or y by an acceptable method e.g. factorisation, formula or completing the square. They cannot just state the roots without seeing a correct line of intermediate working.

We will condone e.g. $2x^2-4x-96=0\Rightarrow x=\dfrac{4\pm\sqrt{(-4)^2-4(2)(-96)}}{2\times 2}=-6,\ 8$

But e.g. $2x^2-4x-96=0\Rightarrow x=\dfrac{4\pm\sqrt{-4^2-4(2)(-96)}}{2\times 2}=-6,\ 8$ scores M0 as it suggests an incorrect formula but allow recovery e.g. $2x^2-4x-96=0\Rightarrow x=\dfrac{4\pm\sqrt{-4^2-4(2)(-96)}}{2\times 2}=\dfrac{4\pm\sqrt{784}}{4}=-6,\ 8$ and condone a missing trailing bracket e.g. $x=\dfrac{4\pm\sqrt{(-4)^2-4(2)(-96}}{2\times 2}=-6,\ 8$

If they factorise do **not** accept $2x^2-4x-96=0\Rightarrow (x+6)(x-8)=0\Rightarrow x=-6,\ 8$

Depends on the previous method mark.

dM1: Uses at least one x value to find at least one y value (or vice versa) using either of the given equations.
Depends on the <u>FIRST</u> method mark and depends on having solved a 3TQ in x or y.
May be implied by their values. You may need to check (for both equations).

A1: All correct. Must be correctly paired but ignore any labelling regarding P and Q, just look for the correct paired values. This may be explicit as a coordinate pair or implied by e.g. $x = 8$, $y = 115$.
Condone coordinates written without brackets e.g. $-6,\ 45$

Depends on all previous marks so 1011 is not possible.

Candidates who show <u>no</u> working for solving their 3TQ can score a maximum 1010
Correct answers with no working scores no marks.

(b) **Allow strict or non-strict inequalities and allow a mixture for the first 2 marks.**

M1: Obtains at least 2 of the required inequalities e.g. 2 of:

$$y \leqslant 2x^2 + x - 21,\ y - 5x \leqslant 75,\ y \geqslant 0,\ x \leqslant a \text{ where } -3.5 \leqslant a < 3$$

Allow equivalents e.g. $y < 5x + 75$

Allow e.g. $0 \leqslant y \leqslant 2x^2 + x - 21$ or e.g. $0 < y < 5x + 75$ each of which would count as 2 correct inequalities.

Do **not** allow e.g. $R \leqslant 2x^2 + x - 21$

A1: Any **3** of the 4 required inequalities.

A1: All correct and consistent. For consistency, the inequalities for y must be either all strict or all non-strict. The restriction on x will depend on their chosen x value. For example

$y \geqslant 0,\ y \leqslant 5x + 75,\ y \leqslant 2x^2 + x - 21,\ x < 0$ scores full marks

$y \geqslant 0,\ y \leqslant 5x + 75,\ y \leqslant 2x^2 + x - 21,\ x < -3.5$ scores M1A1A0

If there are extra **incorrect** inequalities then score A0

Question	Scheme	Marks
7(a)(i)	$\mathrm{f}(x)=2x^3-kx^2+14x+24 \Rightarrow \left(\mathrm{f}'(x)=\right)6x^2-2kx+14$	M1A1
	$\left(\mathrm{f}''(x)=\right)12x-2k$	A1ft
(ii)		**(3)**
(b)	$6x^2-2kx+14=12x-2k \Rightarrow 6(5)^2-2k(5)+14=12(5)-2k \Rightarrow k=...$	M1
	$k=13$	A1
		(2)
(c)	$k=13 \Rightarrow 6x^2-38x+40=0 \Rightarrow x=...$	M1
	$x="\frac{4}{3}" \Rightarrow y=12\left("\frac{4}{3}"\right)-2\times13$ or $y=6\left("\frac{4}{3}"\right)^2-2\times13\times\left("\frac{4}{3}"\right)+14$	M1
	$x=\frac{4}{3},\ y=-10$	A1
		(3)
		Total 8

Notes:

In part (a), penalise the inclusion of "+ *c*" on either derivative only once on the first occurrence.

(a)(i)

M1: For $x^3 \rightarrow \ldots x^2$ or $x^2 \rightarrow \ldots x$ or $14x \rightarrow 14$

A1: Correct simplified first derivative. The $"\mathrm{f}'(x)="$ is not required.

Do not allow x^1 for x.

Isw can be applied once a correct simplied derivative is seen.

(ii)

A1ft: Correct simplified second derivative. Follow through their first derivative

The $"\mathrm{f}''(x)="$ is not required.

Isw can be applied once a correct simplied second derivative is seen. **Must follow M1**

(b)

M1: Sets $\mathrm{f}'(x) = \mathrm{f}''(x)$, substitutes $x = 5$ and solves a linear equation in k to find a value for k.

May substitute $x = 5$ into $\mathrm{f}'(x)$ and $\mathrm{f}''(x)$ first, then equate and solve for k.

A1: $k = 13$

(c)

M1: Substitutes their k into the equated $\mathrm{f}'(x) = \mathrm{f}''(x)$ and solves the resulting 3TQ to obtain at least one value for x by any means including a calculator.

M1: Substitutes their x (not 5) and their k into $\mathrm{f}'(x)$ or $\mathrm{f}''(x)$ to find a value for y.

May be implied by their values so you may need to check.

A1: Correct coordinates. May be seen as $x = .., y = \ldots$ or as a coordinate pair but condone missing brackets e.g. $\frac{4}{3}, -10$. Award this mark as soon as the correct values are seen.

Allow a "made up" k in (c).