4(c)(i)	$\left(\frac{\mathrm{d}^2y}{\mathrm{d}x^2}=\right)-x^{-\frac{3}{2}}+\frac{27}{4}x^{-\frac{5}{2}}$ oe e.g. $-x^{-\frac{3}{2}}+6.75x^{-\frac{5}{2}}$	B1ft
(ii)	$\left(\left(\frac{\mathrm{d}^2y}{\mathrm{d}x^2}\right)_{x=\frac{9}{4}}=\right)-\left(\frac{9}{4}\right)^{-\frac{3}{2}}+\frac{27}{4}\left(\frac{9}{4}\right)^{-\frac{5}{2}}\left(=\frac{16}{27}(0.5925...)\right)$ $\left(\frac{\mathrm{d}^2y}{\mathrm{d}x^2}\right)>0$ so (local) minimum	B1
		(2)
(d)	$0<x<\frac{9}{4}$	B1ft
		(1)
		Total 7

(c)(i)

B1ft: Correct simplified second derivative.
Follow through their first derivative provided there are 2 terms with **different** fractional (non-integer) powers.

$\frac{\mathrm{d}^2y}{\mathrm{d}x^2}=$ is not required.

Condone $-1x^{-\frac{3}{2}}+\frac{27}{4}x^{-\frac{5}{2}}$ for $-x^{-\frac{3}{2}}+\frac{27}{4}x^{-\frac{5}{2}}$

Inclusion of "+ *c*" scores B0ft as with the first derivative.

(ii)

B1: Fully correct working, reasoning and conclusion. This requires:

- a correct second derivative
- substitutes $x=\frac{9}{4}$ to obtain $\frac{16}{27}$ or awrt 0.6 or truncated 0.5
- reference to the sign (> 0 or positive). Must see the evaluation as it is not obviously positive but allow if expression is not fully evaluated as long as it is clear it is positive (e.g. $\frac{8}{9}-\frac{8}{27}>0$).
- reference to minimum

Condone work that doesn't specifically reference $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ e.g.

$-\left(\frac{9}{4}\right)^{-\frac{3}{2}}+\frac{27}{4}\left(\frac{9}{4}\right)^{-\frac{5}{2}}=\frac{16}{27}>0$ so minimum is fine for this mark.

(d)

B1ft: For $0<x<\frac{9}{4}$. Allow $0<x$,, $\frac{9}{4}$ and allow equivalent statements e.g.

$\left(0,\frac{9}{4}\right)$, $\left(0,\frac{9}{4}\right]$.

Follow through their positive *x* value from part (b). Condone an answer of $x<\frac{9}{4}$ or

x ,, $\frac{9}{4}$ Condone 0 ,, x ,, $\frac{9}{4}$

Do not allow $-\infty<x<\frac{9}{4}$

Question Number	Scheme	Marks
5(a)	$(2+ax)^6 = 2^6 + \binom{6}{1}2^5(ax) + \binom{6}{2}2^4(ax)^2 + ...$	M1
	$= 64 + 192ax + 240a^2x^2 + ...$	A1A1
		(3)
(b)	$\left(3+\frac{1}{x}\right)^2 = 9 + \frac{6}{x} + \frac{1}{x^2}$ or $9 + \frac{3}{x} + \frac{3}{x} + \frac{1}{x^2}$	B1
	$f(x) = \left(9 + \frac{6}{x} + \frac{1}{x^2}\right)\left(64 + 192ax + 240a^2x^2 + ...\right) = ...$ Constant term is $9\times 64 + 6\times 192a + 240a^2$	M1
	$576 + 1152a + 240a^2 = 576 \Rightarrow 1152a + 240a^2 = 0$ $\Rightarrow 1152 + 240a = 0 \Rightarrow a = ...$	**d**M1
	$a = -\frac{24}{5}$	A1
		(4)
		Total 7

(a)

M1: Attempts the binomial expansion up to at least the second term to obtain the correct structure for the **2nd or 3rd term** i.e. the correct binomial coefficient (allow alternative notation) with the correct power of 2 and the correct power of ax.
The binomial coefficients do not have to be evaluated but must be correct if they are.
If awarding this mark for the x^2 term you can condone missing brackets e.g.
${}^6C_2 \times 2^4 \times ax^2$

Alternatively writes e.g. $(2+ax)^6 = 2^6\left(1+\frac{ax}{2}\right)^6 = 2^6\left(1+\frac{6}{2}ax + \frac{6\times 5}{2}\left(\frac{ax}{2}\right)^2 + ...\right)$

which can also score M1 for the expansion up to at least the second term with an acceptable structure for either the **2nd or 3rd term**. They do not have to multiply out the brackets for this mark but the 2^6 cannot be omitted unless it is later recovered.

Condone missing brackets e.g. $\frac{6\times 5}{2}\times\frac{ax^2}{2}$

A1: For any 2 correct simplified terms in any order (Allow a^2x^2 or $(ax)^2$ for the third term **for this mark**)
Allow terms to be listed.
Do **not** allow $64x^0$ for 64 or $192ax^1$ for $192ax$

A1: All correct and in any order. Allow terms to be listed. Must be a^2x^2 not $(ax)^2$ for the 3rd term but allow (ax) for ax.
Apply isw if they divide through by e.g. 2 or 4 or 16 or set their expression = 0

Ignore any extra terms if attempted.