Mathematics C1

1. (*a*) Gradient of $AB = \frac{\text{increase in } y}{\text{increase in } x}$ — M1

Gradient of $AB = -^1/_3$ (or equivalent) — A1

(*b*) A correct method for finding the equation of *AB*(*CD*) using candidate's gradient for *AB* — M1

Equation of *AB* : $y - 3 = -^1/_3\,[x - (-2)]$ (or equivalent) — A1

Equation of *AB* : $x + 3y - 7 = 0$ (convincing) — A1

Use of $m_{AB} \times m_{CD} = -1$ — M1

Equation of *CD* : $y - 8 = 3(x - 3)$ (or equivalent)
(f.t. candidate's gradient of *AB*) — A1

Special case:
Verification of equation of *AB* by substituting coordinates of **both** *A* and *B* into the given equation — B1

(*c*) An attempt to solve equations of *AB* and *CD* simultaneously — M1

$x = 1$, $y = 2$ (convincing) (c.a.o.) — A1

Special case
Substituting (1, 2) in equations of **both** *AB* and *CD* — M1

Convincing argument that coordinates of *D* are (1, 2) — A1

(*d*) A correct method for finding the mid-point of *AB* — M1

E(4, 1) — A1

A correct method for finding the length of *ED* — M1

$ED = \sqrt{10}$ (f.t. candidate's coordinates of *E*) — A1

2. (*a*) $\sqrt{20} = 2\sqrt{5}$ — B1

$\frac{\sqrt{35}}{\sqrt{7}} = \sqrt{5}$ — B1

$\frac{20}{\sqrt{5}} = 4\sqrt{5}$ — B1

$\sqrt{20} + \frac{\sqrt{35}}{\sqrt{7}} - \frac{20}{\sqrt{5}} = -\sqrt{5}$ (c.a.o.) — B1

(*b*) $\frac{2 + \sqrt{3}}{5 + 2\sqrt{3}} = \frac{(2 + \sqrt{3})(5 - 2\sqrt{3})}{(5 + 2\sqrt{3})(5 - 2\sqrt{3})}$ — M1

Numerator: $10 - 4\sqrt{3} + 5\sqrt{3} - 2 \times 3$ — A1

Denominator: $25 - 12$ — A1

$\frac{2 + \sqrt{3}}{5 + 2\sqrt{3}} = \frac{4 + \sqrt{3}}{13}$ (c.a.o.) — A1

Special case
If M1 not gained, allow B1 for correctly simplified numerator or denominator following multiplication of top and bottom by $5 + 2\sqrt{3}$

3. $\frac{dy}{dx} = 4x - 10$

(an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 3$ in candidate's expression for $\frac{dy}{dx}$ m1

Gradient of tangent at $P = 2$ (c.a.o.) A1

Equation of tangent at P: $y - 4 = 2(x - 3)$ (or equivalent)

(f.t. candidate's value for $\frac{dy}{dx}$ provided both M1 and m1 awarded) A1

4. (*a*) $(a + b)^5 = a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4 + b^5$ (-1 for each error)

(-1 for any subsequent 'simplification') B2

(*b*) (i) $\left(1 + \frac{x}{2}\right)^5 \approx 1^5 + 5\left(\frac{x}{2}\right)1^4 + \frac{5(5-1)}{2}\left(\frac{x}{2}\right)^2 1^3 + \frac{5(5-1)(5-2)}{2 \times 3}\left(\frac{x}{2}\right)^3 1^2$

Two terms correct B1

Other two terms correct B1

$\left(1 + \frac{x}{2}\right)^5 \approx 1 + \frac{5(x)}{2} + \frac{10(x)^2}{4} + \frac{10(x)^3}{8}$ B1

(ii) An attempt to substitute $x = 0{\cdot}1$ in candidate's expression for $\left(1 + \frac{x}{2}\right)^5$ M1

$1{\cdot}05^5 \approx 1{\cdot}276(25)$ (c.a.o.) A1

5. (*a*) An expression for $b^2 - 4ac$, with $c = \pm k$ and at least one of a or b correct M1

$b^2 - 4ac = 2^2 - 4 \times 3 \times (-k)$ A1

Putting $b^2 - 4ac > 0$ m1

$4 + 12k > 0 \Rightarrow k > -{}^1/_3$ (o.e.)

(f.t. only for $c = k$ in original expression for $b^2 - 4ac$) A1

(*b*) Finding critical points $x = -2$, $x = 7$ B1

$-2 \le x \le 7$ **or** $7 \ge x \ge -2$ **or** $[-2, 7]$ **or** $x \le 7$ and $-2 \le x$ **or** a correctly worded statement to the effect that x lies between -2 and 7 (inclusive)

(f.t. candidate's critical points) B2

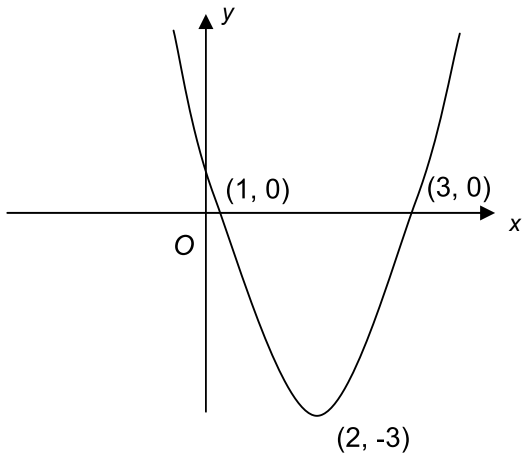
Note: $-2 < x < 7$,
$x \le 7, -2 \le x$
$x \le 7 \quad -2 \le x$
$x \le 7$ or $-2 \le x$ all earn B1

6.	(*a*)	$y + \delta y = 3(x + \delta x)^2 - 4(x + \delta x) + 7$		B1
		Subtracting y from above to find δy		M1
		$\delta y = 6x\delta x + 3(\delta x)^2 - 4\delta x$		A1
		Dividing by δx and letting $\delta x \to 0$		M1
		$\frac{dy}{dx} = \lim_{\delta x \to 0} \frac{\delta y}{\delta x} = 6x - 4$	(c.a.o.)	A1
	(*b*)	Required derivative = $5 \times ½ \times x^{-1/2} - 3 \times (-3) \times x^{-4}$		B1, B1

7.	$p = 0·9$	B1
	A convincing argument to show that the value 4 is correct	B1
	$x^2 + 1·8x - 3·19 = 0 \Rightarrow (x + 0·9)^2 = 4$	M1
	$x = 1·1$	A1
	$x = -2·9$	A1

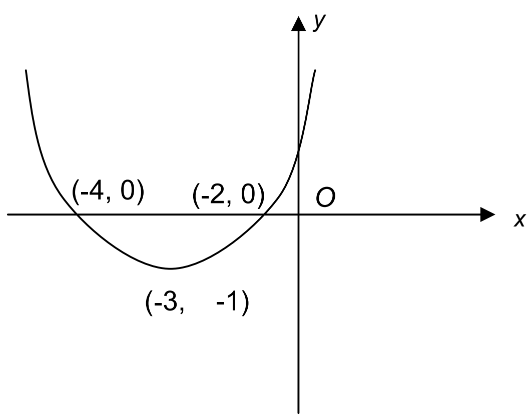
8.	(*a*)	Use of $f(-2) = -24$	M1
		$-48 + 4a + 6 - 2 = -24 \Rightarrow a = 5$	A1
		Special case	
		Candidates who assume $a = 5$ and show $f(-2) = -24$ are awarded	B1
	(*b*)	Attempting to find $f(r) = 0$ for some value of r	M1
		$f(-1) = 0 \Rightarrow x + 1$ is a factor	A1
		$f(x) = (x + 1)(6x^2 + ax + b)$ with one of a, b correct	M1
		$f(x) = (x + 1)(6x^2 - x - 2)$	A1
		$f(x) = (x + 1)(2x + 1)(3x - 2)$ (f.t. only $6x^2 + x - 2$ in above line)	A1
		Special case	
		Candidates who find one of the remaining factors, $(2x + 1)$ or $(3x - 2)$, using e.g. factor theorem, are awarded	B1

9. (*a*)



Concave up curve and minimum point = (2, k) with $k < -1$	B1
Minimum point = (2, –3)	B1
Both points of intersection with x-axis	B1

(*b*)



Concave up curve and y-coordinate of minimum = –1	B1
x-coordinate of minimum = –3	B1
Both points of intersection with x-axis	B1

10. (*a*) $\frac{dy}{dx} = 3x^2 - 12$ B1

Putting derived $\frac{dy}{dx} = 0$ M1

$x = 2, -2$ (both correct) (f.t. candidate's $\frac{dy}{dx}$) A1

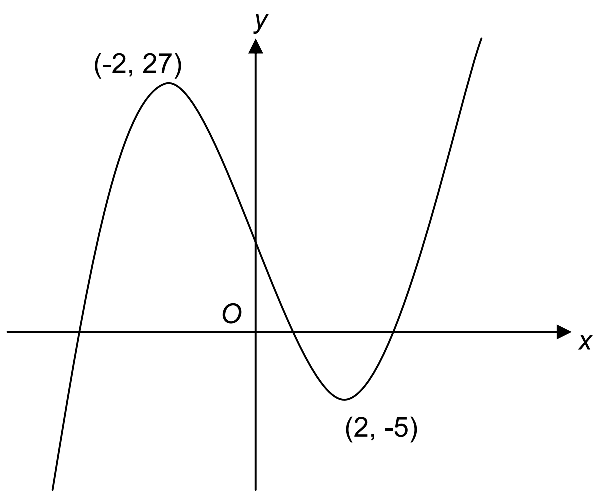
Stationary points are (2, –5) and (–2, 27) (both correct) (c.a.o) A1

A correct method for finding nature of stationary points M1

(–2, 27) is a maximum point (f.t. candidate's derived values) A1

(2, –5) is a minimum point (f.t. candidate's derived values) A1

(*b*)



Graph in shape of a positive cubic with two turning points M1

Correct marking of both stationary points
(f.t. candidate's derived maximum and minimum points) A1

(*c*) $k > 27$ B1

$k < -5$ B1

Special case

$k \geq 27$, $k \leq -5$ (both) awarded B1