C1

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

Gradient of $AB = {}^1/_3$ (or equivalent) A1

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

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

(f.t. the candidate's value for the gradient of *AB*)

Equation of *AB* : $x - 3y + 7 = 0$

(f.t. one error if both M1's are awarded) A1

(*c*) A correct method for finding *C* M1

$C(17, 8)$ A1

(*d*) (i) An attempt to use the fact that gradient of *L* = gradient of *AB* M1

Equation of *L* : $y = {}^1/_3\,x - {}^1/_6$ (o.e.) A1

(f.t. the candidate's value for the gradient of *AB*)

(ii) Putting $y = 0$ in candidate's equation for *L* M1

$D(0{\cdot}5, 0)$ (f.t. candidate's equation for *L*) A1

(iii) A correct method for finding the length of *AD* M1

$AD = 2{\cdot}5$ (c.a.o.) A1

2. $\dfrac{\sqrt{2}}{10 - 7\sqrt{2}} = \dfrac{\sqrt{2} \times (10 + 7\sqrt{2})}{(10 - 7\sqrt{2})(10 + 7\sqrt{2})}$ M1

Numerator: $10\sqrt{2} + 14$ A1

Denominator: $100 - 98$ A1

$\dfrac{\sqrt{2}}{10 - 7\sqrt{2}} = 5\sqrt{2} + 7$ (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 $10 - 7\sqrt{2}$

3. An expression for $b^2 - 4ac$, with at least two of a, b, c correct M1

$b^2 - 4ac = (3k - 1)^2 - 4 \times 2 \times (3k^2 - 1)$ A1

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

$5k^2 + 2k - 3 < 0$ (convincing) A1

Finding critical values $k = -1$, $k = {}^3/_5$ B1

$-1 < k < {}^3/_5$ **or** ${}^3/_5 > k > -1$ **or** $(-1, {}^3/_5)$ **or** $-1 < k$ and $k < {}^3/_5$ **or** a correctly worded statement to the effect that k lies strictly between -1 and ${}^3/_5$

(f.t. only critical values of ± 1 and $\pm {}^3/_5$) B2

Note:

$-1 \le k \le {}^3/_5$

$-1 < k$, $k < {}^3/_5$

$-1 < k \;\; k < {}^3/_5$

$-1 < k$ or $k < {}^3/_5$

all earn B1

4. (*a*) $y + \delta y = 6(x + \delta x)^2 + 4(x + \delta x) - 9$ B1

Subtracting y from above to find δy M1

$\delta y = 12x\delta x + 6(\delta x)^2 + 4\delta x$ A1

Dividing by δx and letting $\delta x \to 0$ M1

$\frac{dy}{dx} = \lim_{\delta x \to 0} \frac{\delta y}{\delta x} = 12x + 4$ (c.a.o.) A1

(*b*) Required derivative = $3 \times (-4) \times x^{-5} - 7 \times ({}^1/_3) \times x^{-2/3}$ B1, B1

5. $(1 + \sqrt{3})^5 = (1)^5 + 5(1)^4(\sqrt{3}) + 10(1)^3(\sqrt{3})^2 + 10(1)^2(\sqrt{3})^3 + 5(1)(\sqrt{3})^4 + (\sqrt{3})^5$

(five or six terms correct) B2

(four terms correct) B1

$(1 + \sqrt{3})^5 = 1 + 5\sqrt{3} + 30 + 30\sqrt{3} + 45 + 9\sqrt{3}$

(six terms correct) B2

(four or five terms correct) B1

$(1 + \sqrt{3})^5 = 76 + 44\sqrt{3}$ (f.t. one error) B1

6. Either $p = -0{\cdot}7$ or a sight of $(x - 0{\cdot}7)^2$ B1

A convincing argument to show that the value 9 is correct B1

$x^2 - 1{\cdot}4x - 8{\cdot}51 = 0 \Rightarrow (x - 0{\cdot}7)^2 = 9$ M1

$x = 3{\cdot}7$ A1

$x = -2{\cdot}3$ A1

7. (*a*) An attempt to calculate $(-2)^3 - 3$ M1
Remainder = -11 A1

(*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
$f(x) = (x + 1)(6x^2 - 5x - 6)$ A1
$f(x) = (x + 1)(3x + 2)(2x - 3)$ (f.t. only $6x^2 + 5x - 6$ in above line) A1
Roots are $x = -1, -{}^2/_3, {}^3/_2$ (f.t. for factors $3x \pm 2$, $2x \pm 3$) A1

Special case

Candidates who, after having found $x + 1$ as one factor, then find one of the remaining factors by using e.g. the factor theorem, are awarded B1

8. (*a*) y-coordinate at $P = 2$ B1

$\frac{dy}{dx} = 2x - 6$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 5$ in candidate's expression for $\frac{dy}{dx}$ m1

Use of candidate's numerical value for $\frac{dy}{dx}$ as gradient of tangent at P m1

Equation of tangent at P: $y - 2 = 4(x - 5)$ (or equivalent)
(f.t. only candidate's value for y-coordinate at P) A1

(*b*) (i) $x^2 - 6x + 7 = \frac{1}{2}x - 2$ (o.e.) M1

An attempt to collect terms, form and solve quadratic equation m1

$2x^2 - 13x + 18 = 0 \Rightarrow (x - 2)(2x - 9) = 0 \Rightarrow x = 2, x = 4^1/_2$
(both values, c.a.o.) A1

When $x = 2$, $y = -1$, when $x = 4^1/_2$, $y = {}^1/_4$
(both values f.t. one numerical slip) A1

(ii) Values of $\frac{dy}{dx}$ at points of intersection of C and L are 3 and -2
(at least one correct, f.t. candidate's derived x-coordinates at points of intersection of C and L) B1

Use of the fact that

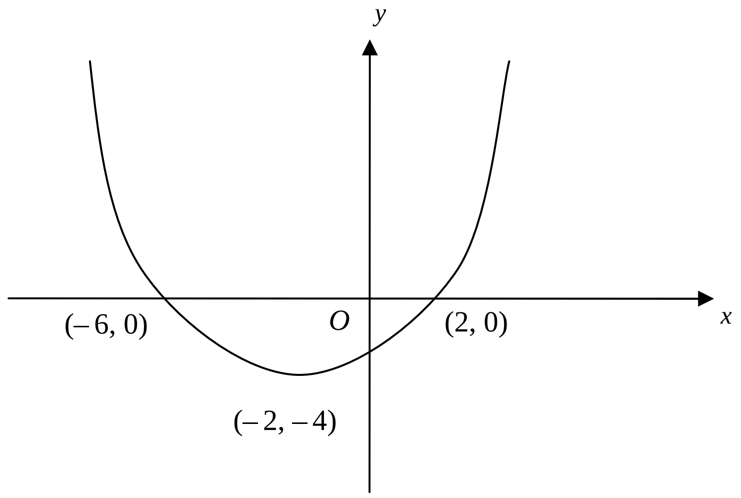
$$\text{gradient of normal} = -\frac{1}{\frac{dy}{dx}}$$

at at least one of the candidate's points of intersection of C and L M1

Normal to C at point with x-coordinate 2 has gradient ½
(c.a.o.) A1

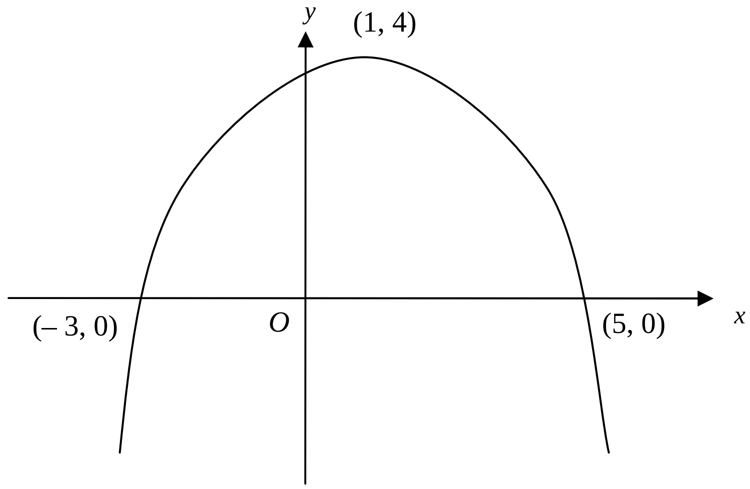
Since gradient of L = ½, L and this normal must coincide A1

9. (*a*)



Concave up curve and *y*-coordinate of minimum = – 4	B1
x-coordinate of minimum = – 2	B1
Both points of intersection with *x*-axis	B1

(*b*)



Concave down curve and *x*-coordinate of maximum = 1	B1
y-coordinate of maximum = 4	B1
Both points of intersection with *x*-axis	B1

10. (*a*) $\frac{dy}{dx} = 3x^2 + 2kx - 9$ B1

Putting derived $\frac{dy}{dx} = 0$ when $x = -1$ M1

$3 - 2k - 9 = 0 \Rightarrow k = -3$ (convincing) A1

(*b*) An attempt to solve $3x^2 - 6x - 9 = 0$ M1

x-coordinate of R is 3 A1

(*c*) A correct method for finding nature of stationary points yielding **either** Q is a maximum point **or** R is a minimum point M1

Correct conclusion for other point

(f.t. candidate's value for x-coordinate of R) A1