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

Gradient of $AC = 4/3$ (or equivalent) A1

(ii) A correct method for finding the equation of AC using candidate's gradient for AC M1

Equation of AC: $y - 4 = 4/3[x - (-6)]$ (or equivalent)
(f.t. candidate's gradient for AC) A1

Equation of AC: $4x - 3y + 36 = 0$ (convincing) A1

(iii) [Gradient of $BD = \dfrac{\text{increase in } y}{\text{increase in } x}$ M1]

(to be awarded only if corresponding M1 is not awarded in part (i))

Gradient of $BD = -3/4$ (or equivalent) A1

An attempt to use the fact that the product of perpendicular lines $= -1$ (or equivalent) M1

Gradient $AC \times$ Gradient $BD = -1 \Rightarrow AC, BD$ perpendicular A1

(iv) [A correct method for finding the equation of BD using the candidate's gradient for BD M1]

(to be awarded only if corresponding M1 is not awarded in part (ii))

Equation of BD: $y - 11 = -{}^{3}/_{4}[x - (-7)]$ (or equivalent)
(f.t. candidate's gradient for BD) A1

Note: Total mark for part (*a*) is 9 marks

(*b*) (i) An attempt to solve equations of AC and BD simultaneously M1

$x = -3, y = 8$ (convincing) A1

(ii) A correct method for finding the length of BE M1

$BE = 15$ A1

2. (*a*) $\frac{5\sqrt{7} - \sqrt{3}}{\sqrt{7} - \sqrt{3}} = \frac{(5\sqrt{7} - \sqrt{3})(\sqrt{7} + \sqrt{3})}{(\sqrt{7} - \sqrt{3})(\sqrt{7} + \sqrt{3})}$ M1

Numerator: $5 \times 7 + 5 \times \sqrt{7} \times \sqrt{3} - \sqrt{7} \times \sqrt{3} - 3$ A1
Denominator: $7 - 3$ A1
$\frac{5\sqrt{7} - \sqrt{3}}{\sqrt{7} - \sqrt{3}} = 8 + \sqrt{21}$ (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 $\sqrt{7} - \sqrt{3}$

(*b*) $\sqrt{15} \times \sqrt{20} = 10\sqrt{3}$ B1
$\sqrt{75} = 5\sqrt{3}$ B1
$\frac{\sqrt{60}}{\sqrt{5}} = 2\sqrt{3}$ B1
$(\sqrt{15} \times \sqrt{20}) - \sqrt{75} - \frac{\sqrt{60}}{\sqrt{5}} = 3\sqrt{3}$ (c.a.o.) B1

3. (*a*) $\frac{dy}{dx} = 2x - 8$

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

Value of $\frac{dy}{dx}$ at $P = -2$ (c.a.o.) A1
Gradient of normal = $\frac{-1}{\text{candidate's value for } \frac{dy}{dx}}$ m1
Equation of normal to C at P: $y - (-5) = {}^1/_2(x - 3)$ (or equivalent)

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

(*b*) Putting candidate's expression for $\frac{dy}{dx} = 4$ M1
x-coordinate of $Q = 6$ A1
y-coordinate of $Q = -2$ A1
$c = -26$ A1
(f.t. candidate's expression for $\frac{dy}{dx}$ and at most one error in the enumeration of the coordinates of Q for all three A marks provided both M1's are awarded)

4. (*a*) $(1 + x)^6 = 1 + 6x + 15x^2 + 20x^3 + \ldots$

All terms correct B2

Three terms correct B1

(*b*) An attempt to substitute $x = -0{\cdot}01$(or $x = -0{\cdot}1$) in the expansion of part (*a*) (f.t. candidate's coefficients from part (*a*)) M1

$(0{\cdot}99)^6 \approx 1 - 6 \times 0{\cdot}01 + 15 \times 0{\cdot}0001 - 20 \times 0{\cdot}000001$

(At least three terms correct, f.t. candidate's coefficients from part (*a*)) A1

$(0{\cdot}99)^6 = 0{\cdot}94148 = 0{\cdot}9415$ (correct to four decimal places) (c.a.o.) A1

5. (*a*) $a = 2$ B1

$b = 3$ B1

$c = -25$ B1

(*b*) $6x^2 + 36x - 17 = 3\,[a(x + b)^2 + c] + k$ ($k \neq 0$, candidate's a, b, c) M1

Least value $= 3c + 4$ (candidate's c) A1

6. (*a*) An expression for $b^2 - 4ac$, with at least two of a, b or c correct M1

$b^2 - 4ac = k^2 - 4 \times 2 \times 18$ A1

Candidate's expression for $b^2 - 4ac < 0$ m1

$-12 < k < 12$ (c.a.o.) A1

(*b*) Finding critical values $x = -0{\cdot}5$, $x = 0{\cdot}6$ B1

A statement (mathematical or otherwise) to the effect that

$x \leq -0{\cdot}5$ or $0{\cdot}6 \leq x$ (or equivalent) (f.t. only $x = \pm 0{\cdot}5$, $x = \pm 0{\cdot}6$) B2

Deduct 1 mark for each of the following errors

the use of < rather than ≤

the use of the word 'and' instead of the word 'or'

7. (*a*) $y + \delta y = -(x + \delta x)^2 + 5(x + \delta x) - 9$ B1

Subtracting y from above to find δy M1

$\delta y = -2x\delta x - (\delta x)^2 + 5\delta x$ A1

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

$\frac{dy}{dx} = \lim_{\delta x \to 0} \frac{\delta y}{\delta x} = -2x + 5$ (c.a.o.) A1

(*b*) $\frac{dy}{dx} = \frac{3}{4} \times \frac{1}{3} \times x^{-2/3} + (-2) \times 12 \times x^{-3}$ B1, B1

Either $8^{-2/3} = \frac{1}{4}$ **or** second term $= (-)\frac{24}{512}$ (or equivalent fraction) B1

$\frac{dy}{dx} = \frac{1}{64}$ (or equivalent) (c.a.o.) B1

8. (*a*) Use of $f(-2) = 0$ M1

$-96 + 4k + 26 - 6 = 0 \Rightarrow k = 19$ A1

Special case

Candidates who assume $k = 19$ and show $f(-2) = 0$ are awarded B1

(*b*) $f(x) = (x + 2)(12x^2 + ax + b)$ with one of a, b correct M1

$f(x) = (x + 2)(12x^2 - 5x - 3)$ A1

$f(x) = (x + 2)(4x - 3)(3x + 1)$(f.t. only $12x^2 + 5x - 3$ in above line) A1

Special case

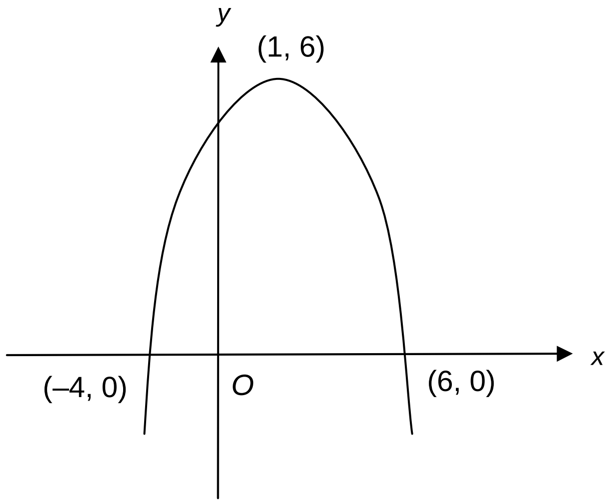
Candidates who find one of the remaining factors,
$(4x - 3)$ or $(3x + 1)$, using e.g. factor theorem, are awarded B1

(*c*) Attempting to find $f(1/2)$ M1

Remainder $= -\frac{25}{4}$ A1

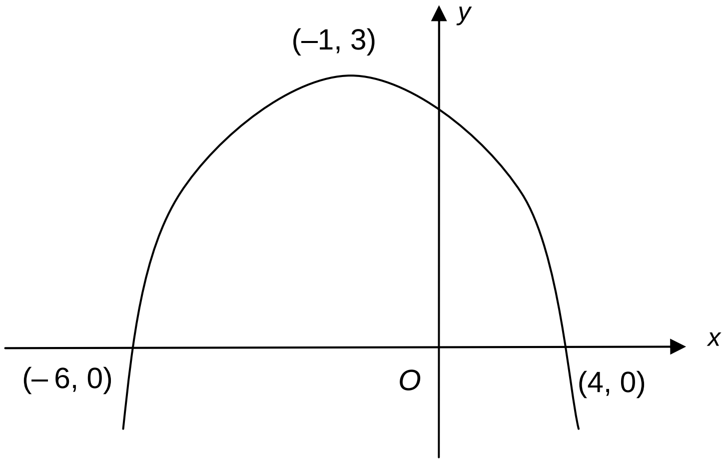
If a candidate tries to solve (*c*) by using the answer to part (*b*), f.t. when candidate's expression is of the form $(x + 2) \times$ two linear factors

9. (*a*)



Concave down curve with maximum at $(1, a)$, $a \neq 3$	B1
Maximum at (1, 6)	B1
Both points of intersection with x-axis	B1

(*b*)



Concave down curve with maximum at $(b, 3)$, $b \neq 1$	B1
Maximum at (–1, 3),	B1
Both points of intersection with x-axis	B1

10. (*a*) $\frac{dy}{dx} = \frac{3}{2}x^2 - 6$ B1

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

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

Stationary points are $(-2, 11)$ and $(2, -5)$ (both correct) (c.a.o.) A1

A correct method for finding nature of stationary points yielding
either $(-2, 11)$ is a maximum point
or $(2, -5)$ is a minimum point (f.t. candidate's derived values) M1
Correct conclusion for other point
(f.t. candidate's derived values) A1