C1

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

Gradient of $AB = -2$ (or equivalent) A1

(*b*) Use of gradient $L_1 \times$ gradient $AB = -1$ M1

A correct method for finding the equation of L_1 using candidate's gradient for L_1 M1

Equation of L_1: $y - (-1) = 1/2\,(x - 9)$ (or equivalent)
(f.t. candidate's gradient for AB) A1

Equation of L_1: $x - 2y - 11 = 0$ (or equivalent)
(f.t. one error if all three M's are awarded) A1

(*c*) (i) An attempt to solve equations of L_1 and L_2 simultaneously M1

$x = 3, y = -4$ (convincing.) A1

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

$BC = \sqrt{45}$ (or equivalent) A1

(iii) A correct method for finding the coordinates of the mid-point of BC M1

Mid-point of BC has coordinates $(6, -2{\cdot}5)$ A1

(iv) Equation of AC: $x = 3$ B1

2. (*a*) **Either:**

$\dfrac{9(\sqrt{3}+1)+7(\sqrt{3}-1)}{(\sqrt{3}-1)(\sqrt{3}+1)}$ M1

Numerator: $9\sqrt{3}+9+7\sqrt{3}-7$ A1

Denominator: $3-1$ A1

$\dfrac{9}{\sqrt{3}-1}+\dfrac{7}{\sqrt{3}+1} = 8\sqrt{3}+1$ (c.a.o.) A1

Or:

$\dfrac{9}{\sqrt{3}-1} = \dfrac{9(\sqrt{3}+1)}{(\sqrt{3}-1)(\sqrt{3}+1)}$, $\dfrac{7}{\sqrt{3}+1} = \dfrac{7(\sqrt{3}-1)}{(\sqrt{3}-1)(\sqrt{3}+1)}$

(at least one) M1

Numerators: $9\sqrt{3}+9$, $7\sqrt{3}-7$ (both correct) A1

Denominators: $3-1$ (both correct) A1

$\dfrac{9}{\sqrt{3}-1}+\dfrac{7}{\sqrt{3}+1} = 8\sqrt{3}+1$ (c.a.o.) A1

(*b*) $\dfrac{90}{\sqrt{3}} = 30\sqrt{3}$ B1

$\sqrt{6}\times\sqrt{8} = 4\sqrt{3}$ B1

$(2\sqrt{3})^3 = 24\sqrt{3}$ B1

$\dfrac{90}{\sqrt{3}} - \sqrt{6}\times\sqrt{8} - (2\sqrt{3})^3 = 2\sqrt{3}$ (c.a.o.) B1

3. y-coordinate at $P = -5$ B1

$\dfrac{dy}{dx} = 6x - 9$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 2$ in candidate's expression for $\dfrac{dy}{dx}$ m1

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

Equation of tangent at P: $y-(-5) = 3(x-2)$ (or equivalent)
(f.t. only candidate's derived value for y-coordinate at P) A1

4. $a = -3$ B1

$b = 2$ B1

A negative quadratic graph M1

Maximum point (3, 2) (f.t. candidate's values for a, b) A1

5. (*a*) $x^2 + (4k + 3)x + 7 = x + k$ M1

$x^2 + (4k + 2)x + (7 - k) = 0$ A1

An attempt to apply $b^2 - 4ac$ to the candidate's quadratic M1

$b^2 - 4ac = (4k + 2)^2 - 4 \times 1 \times (7 - k)$

(f.t. candidate's quadratic) A1

Candidate's expression for $b^2 - 4ac > (\geq)\ 0$ m1

$4k^2 + 5k - 6 > 0$ (convincing) A1

(*b*) Finding critical values $k = -2$, $k = 0{\cdot}75$ B1

A statement (mathematical or otherwise) to the effect that

$k < -2$ or $0{\cdot}75 < k$ (or equivalent) (f.t. only $k = \pm 2$, $k = \pm 0{\cdot}75$) B2

Deduct 1 mark for each of the following errors

the use of $\leq$ rather than $<$

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

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

Subtracting y from above to find δy M1

$\delta y = 14x\delta x + 7(\delta x)^2 - 5\delta x$ A1

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

$\frac{dy}{dx} = \lim_{\delta x \to 0} \frac{\delta y}{\delta x} = 14x - 5$ (c.a.o.) A1

(*b*) Required derivative $= 4 \times {}^2/_5 \times x^{-3/5} - 9 \times (-1) \times x^{-2}$

(completely correct answer) B2

(one correct term) B1

7. (*a*) $(3 + 2x)^4 = 3^4 + 4 \times 3^3 \times (2x) + 6 \times 3^2 \times (2x)^2 + 4 \times 3 \times (2x)^3 + (2x)^4$

(all terms correct) B2

(three or four terms correct) B1

$(3 + 2x)^4 = 81 + 216x + 216x^2 + 96x^3 + 16x^4$

(all terms correct) B2

(three or four terms correct) B1

(–1 for incorrect further 'simplification')

(*b*) Coefficient of $x = {}^nC_1 \times \frac{1}{4}(x)$ B1

Coefficient of $x^2 = {}^nC_2 \times \frac{1}{4^2}(x^2)$ B1

$\frac{n(n-1)}{2} \times \frac{1}{4^m} = k \times n \times \frac{1}{4}$ (o.e.) ($m = 1$ or 2, $k = 5$ or ${}^1/_5$) M1

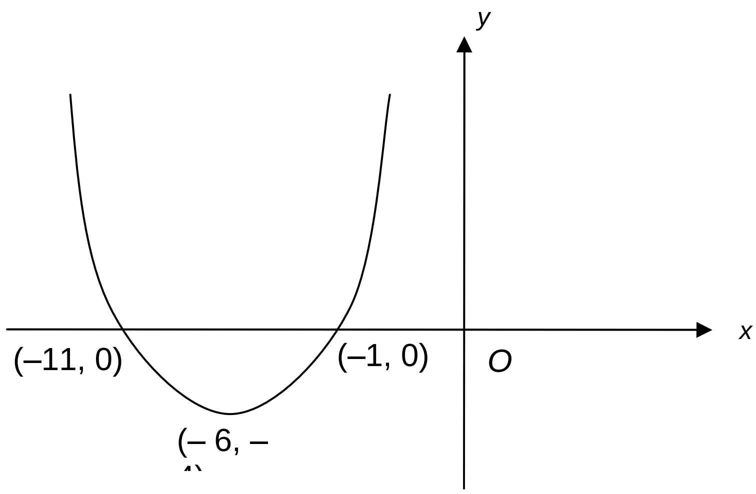
$n = 41$ (c.a.o.) A1

8. (*a*) Use of $f(-2) = 0$ M1
$-8p - 4 + 62 + q = 0$ A1
Use of $f(1) = -36$ M1
$p - 1 - 31 + q = -36$ A1
Solving candidate's simultaneous equations for p and q M1
$p = 6$, $q = -10$ (convincing) A1

Note:
Candidates who assume $p = 6$, $q = -10$ and then verify that $x + 2$ is a factor and that dividing the polynomial by $x - 1$ gives a remainder of -36 may be awarded M1 A1 M1 A1 M0 A0

(*b*) $f(x) = (x + 2)(6x^2 + ax + b)$ with one of a, b correct M1
$f(x) = (x + 2)(6x^2 - 13x - 5)$ A1
$f(x) = (x + 2)(2x - 5)(3x + 1)$ A1
(f.t. only for $f(x) = (x + 2)(2x + 5)(3x - 1)$ from $6x^2 + 13x - 5$)

9. (*a*)



Concave up curve and y-coordinate of minimum $= -4$ B1
x-coordinate of minimum $= -6$ B1
Both points of intersection with x-axis B1

(*b*) $y = -\frac{1}{2} f(x)$ B2

If B2 not awarded
$y = rf(x)$ with r negative B1

10. (*a*) $V = x(8 - 2x)(5 - 2x)$ M1

$V = 4x^3 - 26x^2 + 40x$ (convincing) A1

(*b*) $\frac{dV}{dx} = 12x^2 - 52x + 40$ B1

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

$x = 1, (10/3)$ (f.t. candidate's $\frac{dV}{dx}$) A1

Stationary value of V at $x = 1$ is 18 (c.a.o) A1

A correct method for finding nature of the stationary point yielding a maximum value (for $0 < x < 2{\cdot}5$) B1