GCE AS MARKING SCHEME

SUMMER 2025

AS
MATHEMATICS
UNIT 1 PURE MATHEMATICS A
2300U10-1

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

WJEC GCE AS MATHEMATICS

UNIT 1 PURE MATHEMATICS A

SUMMER 2025 MARK SCHEME

Q	Solution	Mark	Notes
1	$(x-1)(x+6) < 9 - 2x - x^2$		
			Allow = for first 4 marks.
	$x^2 + 5x - 6 < 9 - 2x - x^2$	B1	correctly remove brackets
			oe allow 4 terms expansion
	$2x^2 + 7x - 15 < 0$	M1	collect terms
	$(2x-3)(x+5) < 0$	m1	$ax^2 + bx + c = (px+q)(rx+s)$
			$pr = a$, $qs = c$, oe
			ft their quadratic
	Critical values $= -5, \frac{3}{2}$ (or 1.5)	B1	si, cao
	$-5 < x < \frac{3}{2}$	A1	ft CVs, allow $x < \frac{3}{2}$ **and** $x > -5$, ISW
			oe notation, e.g. $(x > -5) \cap \left(x < \frac{3}{2}\right)$

Q	Solution	Mark	Notes
2(a)	Gradient of $L_1 = \frac{5-0}{3-(-2)}$	M1	si correct method for grad L_1
	$= 1$	A1	si
	Equation of L_1 is $y - 0 = 1(x - (-2))$	A1	$y - 5 = 1(x - 3)$ isw
	$y = x + 2$		
	OR		
	$y = mx + c$		
	$0 = -2m + c;\ \ 5 = 3m + c$	(M1)	
	$5 = 5m$	(A1)	correct elimination of one variable
	$m = 1, c = 2$	(A1)	
2(b)	Gradient of $L_2 = -1$	M1	$-\frac{1}{\text{grad } L_1}$, si
	Equation of L_2 is $y - 5 = -1(x - 3)$	A1	ft their grad L_1, isw
	$y + x = 8$		
	At C, $y = 0$, $x = 8$	A1	cao
	C is the point $(8, 0)$		
	OR		
	Gradient of $L_2 = -1$	(M1)	$-\frac{1}{\text{grad } L_1}$, si
	$\frac{y-5}{x-3} = -1$	(A1)	ft their grad L_1
	At C, $y = 0$, $\frac{0-5}{x-3} = -1$, $x = 8$	(A1)	cao
	C is the point $(8, 0)$		

Q	Solution	Mark	Notes
2(c)	Length of $AB = \sqrt{(5-0)^2 + \left(3-(-2)\right)^2}$	M1	si
	$= \sqrt{50}\ \left(= 5\sqrt{2}\right)$	A1	
	Length of $BC = \sqrt{(5-0)^2 + (3-8)^2}$	(M1)	if not awarded previously
	$= \sqrt{50}\ \left(= 5\sqrt{2}\right)$	(A1)	if not awarded previously
	In the right-angled triangle *ABC*, *AB* = *BC*.		
	Therefore, *ABC* is an isosceles triangle	A1	conclusion required (*AB* = *BC*) Lengths must be correctly calculated
OR	Gradient *AB* = 1, hence angle *BAC* = 45°.	(M1)	
	Angle *BCA* = 180° – 90° – 45° = 45°	(A1)	
	Hence angle *BAC* = angle *BCA*,		
	ABC is an isosceles triangle	(A1)	conclusion required (*AB* = *BC,* or angle *BAC* = angle *BCA*)
OR	Midpoint *AC* has *x* coordinate $\frac{1}{2}(-2+8) = 3$	(M1)	
	∴ Perpendicular from *B* to *AC* bisects *AC*.	(A1)	
	ABC is an isosceles triangle	(A1)	conclusion required (*AB* = *BC*)

Q	Solution	Mark	Notes
2(c) continued			
	Area $ABC = \frac{1}{2} \times AB \times BC$	M1	any correct method used, Only FT for M1 provided C is of the form $(p, 0)$
	Area $ABC = \frac{1}{2} \times \sqrt{50} \times \sqrt{50}$		
	$= 25$	A1	cao
OR			
	Area $ABC = \frac{1}{2} \times AC \times \text{height}$	(M1)	any correct method used Only FT for M1 provided C is of the form $(p, 0)$
	Area $ABC = \frac{1}{2} \times 10 \times 5$		
	$= 25$	(A1)	cao

Q	Solution	Mark	Notes
3(a)	$\dfrac{(a^2)^4(\sqrt{a})^{-\frac{8}{3}}}{a^{-\frac{1}{3}}} = \dfrac{(a)^8(\sqrt{a})^{-\frac{8}{3}}}{a^{-\frac{1}{3}}}$	B1	$(a^2)^4 = a^8$, si
	$= \dfrac{a^8 \times a^{-\frac{4}{3}}}{a^{-\frac{1}{3}}}$	B1	$(\sqrt{a})^{-\frac{8}{3}} = a^{-\frac{8}{6}}$ or $\frac{1}{a^{\frac{8}{6}}}$ or $\frac{1}{a^{\frac{4}{3}}}$ or $a^{-\frac{4}{3}}$, si
	$(= a^{8-\frac{4}{3}-(-\frac{1}{3})}) = a^7$	B1	cao B0 for $a^{\frac{21}{3}}$
3(b)	$\dfrac{3 - a\sqrt{3}}{2 + 3\sqrt{3}} = \dfrac{(3 - a\sqrt{3})(2 - 3\sqrt{3})}{(2 + 3\sqrt{3})(2 - 3\sqrt{3})}$	M1	$\times$ by conjugate top and bottom, si
	$= \dfrac{6 - 2a\sqrt{3} - 9\sqrt{3} + 9a}{4 + 6\sqrt{3} - 6\sqrt{3} - 27}$	A1	numerator or denominator correctly expanded.
	$= \dfrac{6 - 2a\sqrt{3} - 9\sqrt{3} + 9a}{-23}$	A1	cao, oe, must be a fraction, ISW Numerator may be $(3 - a\sqrt{3})(2 - 3\sqrt{3})$ Correct version denom simplified
	$= \dfrac{(6 + 9a) - (2a + 9)\sqrt{3}}{-23}$ or $\dfrac{(2a + 9)\sqrt{3} - (6 + 9a)}{23}$		

Q	Solution	Mark	Notes
4(a)	At A and B, $-x + 16 = x^2 - 4x + 6$	M1	
	$x^2 - 3x - 10 = 0$	m1	quadratic in the form $f(x) = 0$
	$(x - 5)(x + 2) = 0$		
	$x = -2$ and $x = 5$	A1	cao, or $(-2, 18)$ or $(5, 11)$
	$y = 18$ and $y = 11$	A1	cao, 2nd correct pair
	$A(-2, 18)$ and $B(5, 11)$		
4(b)	Area of trapezium		
	$= \frac{1}{2}(18 + 11) \times 7$		
	$= \frac{203}{2} = 101.5$	B1	
	Area under curve		
	$= \int_{-2}^{5}(x^2 - 4x + 6)\,\mathrm{d}x$	M1	attempt to integrate, at least one index increased by +1 limits not required
	$= \left[\frac{x^3}{3} - 2x^2 + 6x\right]_{-2}^{5}$	A1	correct integration for quadratic, limits not required
	$= \left[\frac{5^3}{3} - 2 \times 5^2 + 6 \times 5\right]$		
	$- \left[\frac{(-2)^3}{3} - 2 \times (-2)^2 + 6 \times (-2)\right]$	m1	correct use of their limits, si
	$= \frac{133}{3} = 44.333\ldots$		
	Required area = area trap – area under curve	m1	Condone incorrect order
	Required area $\left(= \frac{203}{2} - \frac{133}{3}\right) = \frac{343}{6}$ or $57\frac{1}{6}$	A1	cao 57.166…
	Note: Must be supported by workings		

Q	Solution	Mark	Notes
4(b)	Alternative Solution		
	$(-x + 16) - (x^2 - 4x + 6)$	(M1)	attempt to subtract, any order
	$= (-x^2 + 3x + 10)$	(A1)	or $-(-x^2 + 3x + 10)$
	$\int_{-2}^{5}((-x + 16) - (x^2 - 4x + 6))\,\mathrm{d}x$	(M1)	attempt to integrate at least one index increased by +1 limits not required
	$= \int_{-2}^{5}(-x^2 + 3x + 10)\,\mathrm{d}x$		
	$= \left[\frac{-x^3}{3} + \frac{3x^2}{2} + 10x\right]_{-2}^{5}$	(A1)	correct integration for their quadratic, limits not required
	$= \left[\frac{-5^3}{3} + \frac{3\times5^2}{2} + 10\times5\right]$		
	$- \left[\frac{-(-2)^3}{3} + \frac{3\times(-2)^2}{2} + 10\times(-2)\right]$	(m1)	correct use of their limits, si
	$= \frac{343}{6}$ or $57\frac{1}{6}$	(A1)	cao 57.166…

Notes

Correct answers unsupported by workings, mark as follows:

$\frac{343}{6}$ or $57\frac{1}{6}$ or 57.166…SC2

$\frac{203}{2}$ or 101.5 SC1

$\frac{133}{3}$ or 44.333…SC1

Both $\frac{133}{3}$ or 44.333… and $\frac{203}{2}$ or 101.5 SC1

Q	Solution	Mark	Notes
5	Discriminant = $k^2 - 4 \times 1 \times (k + 3)$	M1	An expression for $b^2 - 4ac$ with at least two of a, b or c correct
	Discriminant = $k^2 - 4k - 12$	A1	cao
	If distinct real roots, discriminant > 0	M1	allow $\geq$ May be implied by later work
	$k^2 - 4k - 12 > 0$		
	$(k + 2)(k - 6) > 0$		
	Critical values, $k = -2, 6$	B1	ft their quadratic
	$k < -2$ or $k > 6$	A2	ft their critical values, oe notation Condone omission of 'or' Allow comma instead of 'or' A1 for one or more $\leq, \geq$, OR 'and' not 'or' used, OR $-2 > k > 6$.

Q	Solution	Mark	Notes
6(a)	Let $f(x) = x^3 - 3x^2 - 6x + 8$		$y = x^3 - 3x^2 - 6x + 8$
	$f(1) = 1 - 3 - 6 + 8 = 0$	M1	correct use of factor theorem x any value si by a correct root.
	so $(x - 1)$ is a factor.	A1	or $(x + 2)$, $(x - 4)$
	$f(x) = (x - 1)(x^2 + ax + b)$	M1	ft their linear factor a or b correct
	$f(x) = (x - 1)(x^2 - 2x - 8)$	A1	cao or $f(x) = (x - 4)(x^2 + x - 2)$ or $f(x) = (x + 2)(x^2 - 5x + 4)$
	$(x^2 - 2x - 8) = (x + 2)(x - 4)$ or $(x^2 + x - 2) = (x + 2)(x - 1)$ or $(x^2 - 5x + 4) = (x - 1)(x - 4)$	m1	constant terms multiply to give -8, or -2 or $+4$ or formula with correct a, b, c
	When $f(x) = 0$, $x = -2, 1, 4$	A1	cao

Note 1

One use of factor theorem to get one factor or root M1 A1

Second use of factor theorem to get second factor or root M1 A1

Third factor or root M1 A1

Do not award final A1 if only factors and not roots found

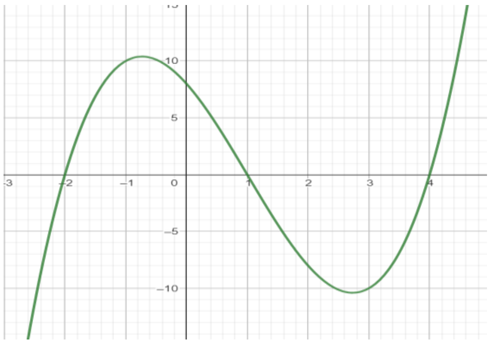
Note 2

Answers only with no working 0 marks.

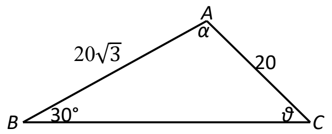
Q	Solution	Mark	Notes
6(b)	Attempt to differentiate	M1	at least one index decreased by 1
	$\frac{\mathrm{d}y}{\mathrm{d}x} = 3x^2 - 6x - 6$	A1	
	$3x^2 - 6x - 6 = 0$	m1	Equating to 0, si
	$x^2 - 2x - 2 = 0$		
	$x = \frac{2 \pm \sqrt{(-2)^2 - 4 \times 1 \times (-2)}}{2}$		$(x - 1)^2 - 3 = 0$
	$x = \frac{2 \pm \sqrt{12}}{2}$		$x - 1 = \pm\sqrt{3}$
	$x = -0.732$ and $x = 2.732$	A1	$x = 1 \pm\sqrt{3}$, cao
	Any correct method to determine nature	M1	eg $f''(x)$, +ve cubic
			For next 2 marks, ignore incorrect x values if smaller root gives max and larger root gives min.
	$x = -0.732$ is a maximum	A1	
	$x = 2.732$ is a minimum	A1	cso

<u>Note</u>

Correct answers with no working 0 marks.

Q	Solution	Mark	Notes
6(c)		G1	positive cubic curve
		G1	(−2, 0), (1, 0), (4, 0), (0, 8) Allow marked on axes, ft (a)
		G1	Max in 2nd quadrant Min in 4th quadrant

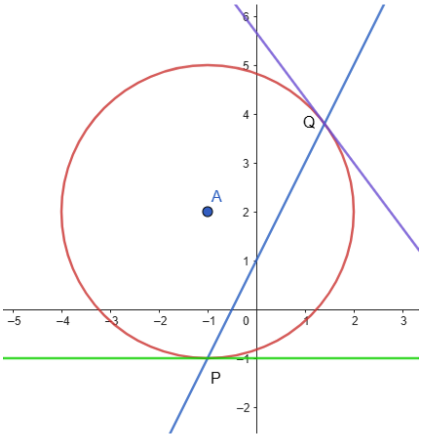
Q	Solution	Mark	Notes
7			



	sine rule: $\frac{20}{\sin 30} = \frac{20\sqrt{3}}{\sin C}$	M1	
	$\sin C$ (= $\sin 30°\sqrt{3}$) = $\frac{\sqrt{3}}{2}$	A1	si by one correct angle
	$\theta = 60°$ or $120°$	A1	both
	$\alpha = 90°$ or $30°$	A1	either value, si by correct area
	Required area = $\frac{1}{2} \times 20 \times 20\sqrt{3}$ ($\sin 90°$)	m1	use of $\frac{1}{2}bc\sin A$
	= $200\sqrt{3}$ (cm^2)		
	or Required area = $\frac{1}{2} \times 20 \times 20\sqrt{3} \sin 30°$		
	= $100\sqrt{3}$ (cm^2)	A1	both areas correct, must be **exact**
	OR		
	$20^2 = (20\sqrt{3})^2 + x^2 - 2 \times 20\sqrt{3} \times x \times \cos 30°$	(M1)	$x = BC$
	$x^2 - 60x + 800 = 0$	(A1)	
	$(x - 40)(x - 20) = 0$		
	$x = 20, 40$	(A1A1)	A1 for each value
	Area = $\frac{1}{2}ac\sin B$	(m1)	used
	Area = $100\sqrt{3}$ (cm^2), $200\sqrt{3}$ (cm^2)	(A1)	

Q	Solution	Mark	Notes
8(a)	$x^2 + y^2 + 2x - 4y = 4$		
	$(x + 1)^2 + (y - 2)^2 - 1 - 4 = 4$	M1	$r^2 = g^2 + f^2 - c$, $g = 1, f = -2, c = -4$ $(x \pm 1)^2$ and $(y \pm 2)^2$ required in the equation
	$(x + 1)^2 + (y - 2)^2 = 9 = 3^2$		
	Centre $A(-1, 2)$	B1	
	Radius = 3	A1	
8(b)(i)	$x^2 + (2x + 1)^2 + 2x - 4(2x + 1) = 4$	M1	$\left(\frac{y-1}{2}\right)^2 + y^2 + 2\left(\frac{y-1}{2}\right) - 4y = 4$
	$x^2 + 4x^2 + 4x + 1 + 2x - 8x - 4 = 4$		
	$5x^2 - 2x - 7 = 0$	m1	quadratic in the form $f(x \text{ or } y) = 0$
			$5y^2 - 14y - 19 = 0$
	$(5x - 7)(x + 1) = 0$		$(5y - 19)(y + 1) = 0$
	$x = -1$ and $x = \frac{7}{5} = 1.4$	A1	cao or $(-1, -1)$ or $\left(\frac{7}{5}, \frac{19}{5}\right)$ or $(1.4, 3.8)$
	$y = -1$ and $y = \frac{19}{5} = 3.8$	A1	cao 2nd correct pair ISW
	$(-1, -1)$ and $\left(\frac{7}{5}, \frac{19}{5}\right)$		

Q	Solution	Mark	Notes



8(b)(ii) $P(-1,-1)$, Centre $(-1,2)$

Gradient of tangent at $P = 0$ — B1 — no ft for incorrect $(-1,-1)$ coord

$Q\left(\frac{7}{5},\frac{19}{5}\right)$, Centre $A(-1,2)$ — Full ft for their $\left(\frac{7}{5},\frac{19}{5}\right)$ coordinates and centre A.

Gradient of AQ (radius) $= \dfrac{2-\frac{19}{5}}{-1-\frac{7}{5}}$ — M1 — oe eg $2-\frac{19}{5} = m(-1-\frac{7}{5})$

$= \dfrac{-9}{-12} = \dfrac{3}{4}$

Gradient of tangent at $Q = -\frac{4}{3}$ — A1

Q	Solution	Mark	Notes
9	$f(x+h) = 2(x+h)^2 + (x+h)$	B1	
	$f(x+h) = 2x^2 + 4xh + 2h^2 + x + h$		
	$f(x+h) - f(x) = 2x^2 + 4xh + 2h^2 + x + h - (2x^2 + x)$	M1	attempt to subtract $f(x)$
	$= 4xh + 2h^2 + h$	A1	
	$\frac{f(x+h) - f(x)}{h} = 4x + 2h + 1$		
	$f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$	M1	M0 if incorrect defn of $f'(x)$ seen
	$= \lim_{h\to 0} (4x + 2h + 1)$		
	$f'(x) = 4x + 1$	A1	All correct
	OR		
	$y + \delta y = 2(x + \delta x)^2 + (x + \delta x)$	(B1)	
	$y + \delta y = 2x^2 + 4x\delta x + 2(\delta x)^2 + x + \delta x$		
	Subtract $y = 2x^2 + x$ from $y + \delta y$	(M1)	
	$\delta y = 4x\delta x + 2(\delta x)^2 + \delta x$	(A1)	
	$\frac{\delta y}{\delta x} = 4x + 2(\delta x) + 1$		
	$\frac{\mathrm{d}y}{\mathrm{d}x} = \lim_{\delta x\to 0} \frac{\delta y}{\delta x}$	(M1)	M0 if incorrect defn of $\frac{\mathrm{d}y}{\mathrm{d}x}$ seen
	$= \lim_{\delta x\to 0} (4x + 2(\delta x) + 1)$		
	$\frac{\mathrm{d}y}{\mathrm{d}x} = 4x + 1$	(A1)	All correct

Q	Solution	Mark	Notes
10	$15(1 - \cos^2\theta) + 2\cos\theta = 14$	M1	$\sin^2\theta + \cos^2\theta = 1$
	$15\cos^2\theta - 2\cos\theta - 1 = 0$		
	$(3\cos\theta - 1)(5\cos\theta + 1) = 0$		
	$\cos\theta = \frac{1}{3}, -\frac{1}{5}$	A1	
	$\cos\theta = \frac{1}{3},$		
	$\theta = 70.53°$	B1	ft
	$\theta = 289.47°$	B1	ft
	$\cos\theta = -\frac{1}{5},$		
	$\theta = 101.54°$	B1	ft
	$\theta = 258.46°$	B1	ft

Notes

Ignore roots outside $0° < \theta < 360°$

-1 for each incorrect root within range.

FT for different values of $\cos x$.

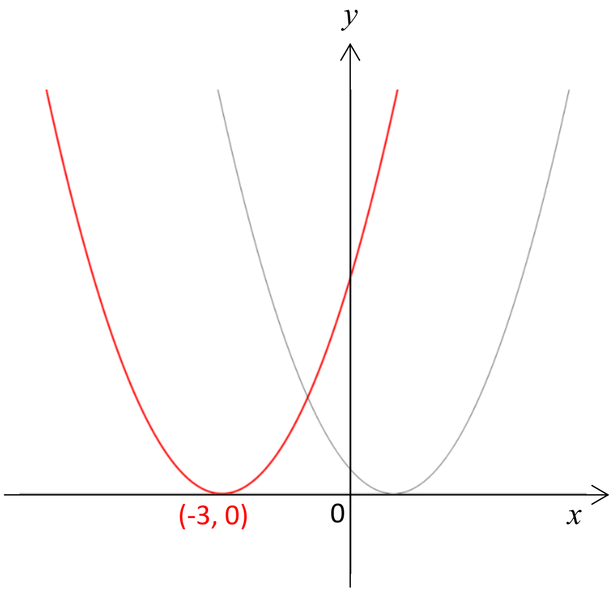
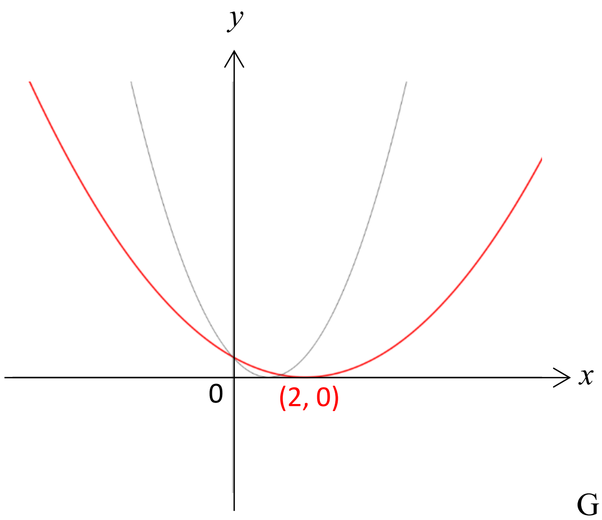
Correct angles from +ve sign B1 B1

Correct angles from -ve sign. B1 B1

Only follow through for cos, i.e. do not follow through for other trig functions, e.g. sin

Q	Solution	Mark	Notes
11(a)	Differentiate $f(x) = x^3 - 9x^2 + 28x + 4$	M1	
	$f'(x) = 3x^2 - 18x + 28$	A1	
	$= 3(x-3)^2 + 1$	m1	$(x-3)$ seen
			oe eg f'' and f'''
			Calculation of $b^2 - 4ac < 0$, therefore no solutions, and one +ve $f'(x)$
	Hence $f'(x) > 0$ for all values of x.	A1	cso
	Therefore $f(x)$ is an increasing function.		
		FT $f'(x)$ in (a) if possible.	
11(b)	Gradient $= 4 = 3(x-3)^2 + 1$	M1	$3x^2 - 18x + 28 = 4$
	$(x-3) = \pm 1$		$3x^2 - 18x + 24 = 0$
			$x^2 - 6x + 8 = 0$
			$(x-2)(x-4) = 0$
	$x = 2$ and $x = 4$	A1	
	$f(2)\ (= 2^3 - 9(2^2) + 28(2) + 4) = 32$		
	$f(4)\ (= 4^3 - 9(4^2) + 28(4) + 4) = 36$	A1	cao si either value correct
	Equation of tangent is $y - 32 = 4(x-2)$	M1	oe eg $y = 4x + c$
	$y = 4x + 24$		
	Equation of tangent is $y - 36 = 4(x-4)$	A1	cao both correct answers, isw, oe eg $y = 4x + c$
	$y = 4x + 20$		

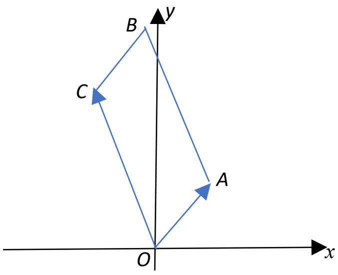
<u>Note</u>: Unsupported answers 0 marks

Q	Solution	Mark	Notes
12(a)		G1 B1	+ve quadratic, shift to the left min (–3, 0)
12(b)		G1 B1	'wider' +ve quadratic, must pass through the same point on y-axis min (2, 0)

Q	Solution	Mark	Notes
13			
	$3\sin^2 x - \cos^2 x = 2$		
	$3\sin^2 x - \cos^2 x = 2\sin^2 x + 2\cos^2 x$	M1	$\sin^2 x + \cos^2 x = 1$ used
	$\sin^2 x = 3\cos^2 x$	A1	convincing
	OR		
	$3\sin^2 x - \cos^2 x = 2$		
	$\sin^2 x = 2 - 2\sin^2 x + \cos^2 x$		
	$\sin^2 x = 2(1 - \sin^2 x) + \cos^2 x$	(M1)	$\sin^2 x + \cos^2 x = 1$ used
	$\sin^2 x = 2\cos^2 x + \cos^2 x$	(A1)	
	$\sin^2 x = 3\cos^2 x$		
	$\tan^2 x = 3$	M1	si, use of $\tan x = \frac{\sin x}{\cos x}$
	$\tan x = \pm\sqrt{3} = \pm 1.732\ldots$	A1	cao

Q	Solution	Mark	Notes
13	<u>Alternative solution</u>		
	$3\sin^2 x - (1 - \sin^2 x) = 2$	M1	$\cos^2 x + \sin^2 x = 1$ used once
	$4\sin^2 x = 3$		
	$\sin^2 x = ¾$		
	$3(1 - \cos^2 x) - \cos^2 x = 2$	(M1)	(if not awarded above)
	$4\cos^2 x = 1$		
	$\cos^2 x = ¼$		
	$\sin^2 x = 3 \times ¼$		
	Therefore, $\sin^2 x = 3\cos^2 x$	A1	convincing
	$\tan^2 x = 3$	M1	$\frac{\sin x}{\cos x} = \tan x$ used
	$\tan x = \pm\sqrt{3} = \pm 1.732\ldots$	A1	cao
	OR		
	$\sin x = \pm\frac{\sqrt{3}}{2}$		oe for $\cos x = \pm\frac{1}{2}$
	$\tan x = \tan\left(\sin^{-1}\left(\pm\frac{\sqrt{3}}{2}\right)\right)$	(M1)	
	$\tan x = \pm\sqrt{3} = \pm 1.732\ldots$	(A1)	cao

Q	Solution	Mark	Notes
14			



	$\mathbf{b} = \mathbf{a} + \mathbf{c}$	M1	si by correct **b**
	$\mathbf{b} = 3\mathbf{i} + 4\mathbf{j} - 5\mathbf{i} + 12\mathbf{j}$		
	$\mathbf{b} = -2\mathbf{i} + 16\mathbf{j}$	A1	oe notation
	$\lvert\mathbf{b}\rvert = \sqrt{(-2)^2 + 16^2}$	M1	ft their **b** of equivalent difficulty
	$\lvert\mathbf{b}\rvert = \sqrt{260}$ or $2\sqrt{65}$ or $16.12(45155)$	A1	ft their **b**

Q	Solution	Mark	Notes
15(a)	$\log_3 36 - \log_3 18^2 + \log_3 180 + \log_3 x = 2$	B1	correct use of power law (18^2=324)
	$\log_3\left(\frac{36 \times 180x}{18^2}\right) = 2$	B1	correct use of addition law
			($36 \times 180 = 6480$)
		B1	correct use of subtraction law
			$\left(\frac{36}{18^2} = \frac{1}{9}\right)$
	$\log_3(20x) = 2$		
	$20x = 3^2 = 9$	M1	eliminating logs
			$2 = \log_3 9$
	$x = \frac{9}{20} = 0.45$	A1	cao
	OR		
	$\log_3 x = 2 - \log_3 36 + 2\log_3 18 - \log_3 180$	M1	attempt to use calculator
	$\log_3 x = 2 - 2.726833028$	A1	any correct answer from calculator
	$\log_3 x = -0.7268330279$	A1	si
	$x = 3^{-0.7268330279}$	m1	
	$x = 0.45 = \frac{9}{20}$	A1	cao

<u>Note</u>: No workings, no marks

Q	Solution	Mark	Notes
15(b)	$2 \times 4^x + 5 \times 2^x - 3 = 0$		
	$2 \times (2^2)^x + 5 \times 2^x - 3 = 0$	B1	$4^x = (2^2)^x = (2^x)^2 = 2^{2x}$ or $y = 2^x$
	$2 \times (2^x)^2 + 5 \times 2^x - 3 = 0$	M1	recognise quadratic
	$(2(2^x) - 1)(2^x + 3) = 0$		
	$2^x = \frac{1}{2}$	A1	
	$2^x = -3$	A1	
	Either $2^x = \frac{1}{2} = 2^{-1}$		
	$x = -1$	A1	FT for $2^x = 3$, $x = \log_2 3 = 1.5849 ...$
	or $2^x = -3$, no solution	A1	FT for $2^x = -\frac{1}{2}$, no solution

Note:

No workings, no marks

SC1 for $x = -1$ from trial and improvement

Q	Solution	Mark	Notes
16(a)	$a_0 = {}^7C_0(2)^7(-1)^0$		
	$a_0 = 128$	B1	
	$a_2 = {}^7C_2(2)^{7-2}(-1)^2$	M1	
	$a_2 = 672$	A1	condone $672x^4$
	$a_7 = {}^7C_7(2)^{7-7}(-1)^7$		
	$a_7 = -1$	B1	condone $-x^{14}$
			Mark final answers
16(b)	$x = 1$ or -1	B1	seen
	$(2-1)^7 = 128 + a_1 + a_2 + a_3 + a_4 + a_5 + a_6 - 1$	M1	ft a_0, a_7 (a_2), must substitute $x = 1$ or -1 into both sides
	$1 = 128 + a_1 + a_2 + a_3 + a_4 + a_5 + a_6 - 1$		
	$a_1 + a_2 + a_3 + a_4 + a_5 + a_6 = -126$	A1	convincing
	<u>Alternative Solution</u>		
	$(a_0 +)\ a_1x^2 + a_2x^4 + a_3x^6 + a_4x^8 + a_5x^{10} + a_6x^{12}\ (+\ a_7x^{14})$		
	$= (128) - 448x^2 + 672x^4 - 560x^6 + 280x^8 - 84x^{10} + 14x^{12}\ (-\ x^{14})$		
		M1	expansion of $(2 - x^2)^7$ may be seen in part (a) Allow one slip
	$x = 1$ or -1	B1	si
	$a_1 + a_2 + a_3 + a_4 + a_5 + a_6$		
	$= -448 + 672 - 560 + 280 - 84 + 14$		
	$= -126$	A1	convincing