

# Mark Scheme (Results) November 2009

IGCSE

## IGCSE Mathematics (4400) Paper 4H Higher Tier

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## November 2009 IGCSE Mathematics (4400) Mark Scheme - Paper 4H

Except for questions \* where the mark scheme states otherwise the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.

[\* Questions 2(b), 21 and 22]

Trial and improvement methods for solving equations score no marks, even if they lead to a correct solution.

Q	Working	Answer	Mark	Notes
1.	$\frac{350.26}{0.3}$		2	M1 for 350.26
		1167.5333		A1 Accept 1dp or better Also accept 1167.53̇ or $\frac{17513}{15}$
				Total 2 marks

2. (a)		$n(n - 4)$	2	B2 B1 for factors which, when expanded and simplified, give two terms, one of which is correct except $(n + 2)(n - 2)$ and similar SC B1 for $n(n - 4n)$
(b)	$5x = 8 - 2$ or $-5x = 2 - 8$ or $5x = 6$ or $-5x = -6$		3	M2 M1 for $5x + 2 = 8$
		$1\frac{1}{5}$ oe		A1 dep on M2 Do not accept $\frac{-6}{-5}$
				Total 5 marks

Q	Working	Answer	Mark	Notes
3. (a)(i)		62	2	B1 cao
(ii)		alternate angles		B1 Accept 'alternate' but not 'Z angles'
(b)	$\frac{180-62}{2}$ or $\frac{180-62}{2}$ or 59		2	M1
		121		A1 cao
				Total 4 marks

4. (a)	$1 - (0.4 + 0.5)$		2	M1
		0.1		A1 Also accept $\frac{0.1}{1}$
(b)	$0.4 \times 80$ or $\frac{n}{80} = 0.4$		2	M1
		32		A1 cao
				Total 4 marks

5. (a)	$\frac{161}{3500} \times 100$		2	M1 for $\frac{161}{3500}$ oe inc 0.046
		4.6		A1 cao
(b)	1% = $\$ \frac{338}{5.2}$ or 65 seen or 5.2% (of amount) = 338		3	M1 M2 for $\frac{338}{5.2} \times 100$ or $\frac{338}{0.052}$
	"65" $\times 100$			M1
		6500		A1
				Total 5 marks

Q	Working	Answer	Mark	Notes
6. (a)		Reflection in the line $y = 4$	2	B2 B1 for reflection, reflects etc B1 for $y = 4$ or eg 'dotted line' but, if given, equation must be correct
(b)		Enlargement with scale factor $1\frac{1}{2}$ , centre (1,6)	3	B3 B1 for enlargement, enlarge etc B1 for $1\frac{1}{2}$ oe B1 for (1,6)
				Total 5 marks

7.	1 + 9 + 2 or 12 or 5 seen		3	M1 May be implied by 1 correct answer
		5 10 45		A2 A1 for one correct
				Total 3 marks

8.	Arcs of equal radii $> \frac{1}{2}AB$ , centres $A, B$ , which intersect twice		2	M1
	Perpendicular bisector within guidelines			A1
				Total 2 marks

Q	Working	Answer	Mark	Notes
9. (a)		Correct line	2	B2 Must be a single straight line passing through at least 3 of (0, -2), (3, 0), (6, 2), (9, 4) B1 for a single straight line with a positive gradient passing through either (0, -2) or (3, 0) or for 3 of 4 points (0, -2), (3, 0), (6, 2), (9, 4) correct with at most 1 point incorrect Allow $\pm 2\text{mm}$
(b)	Lines $x = 3$ and $x = 6$ drawn		3	B1
	Lines $y = 2$ and $y = 4$ drawn			B1
		R shown		B1 Condone omission of label Accept shading in or shading out, if consistent Award 3 marks for correct labelled rectangle, even if not shaded Award 2 marks for a correct unshaded rectangle without a correct label SC B1 for region bounded by $2 \leq x \leq 4$ and $3 \leq y \leq 6$
				Total 5 marks

10. (a)	6.2	C	$5 \times 23 + 15 \times 3 + 25 \times 2 + 35 \times 3$ $= 115 + 45 + 50 + 105$		3	M1 for finding at least 3 products $x \times f$ consistently within intervals (inc end points)
						M1 (dep) for use of at least 3 correct halfway values
					315	A1 cao isw after 315
(b)	6.1	A		19 4 7	3	B3 B1 for each value cao
						Total 6 marks

Q	Working	Answer	Mark	Notes
11. (a)	$64 = 2^6$ and $80 = 2^4 \times 5$ or 1,2,4,8,16,32,64 and 1,2,4,5,8,10,16,20,40,80 or $2^4$		2	M1 Need not be product of powers; accept products or lists ie 2,2,2,2,2,2 and 2,2,2,2,5 Prime factors may be shown as factor trees or repeated division
		16		A1 cao
(b)	$2^6 \times 5$ oe eg $2^4 \times 4 \times 5$ , $16 \times 4 \times 5$ or 64,128,192,256,320 and 80,160,240,320		2	M1
		320		A1 cao
				Total 4 marks

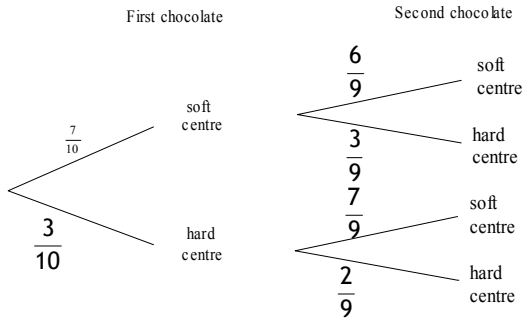
12. (a)	$p^2 - 4p + 7p - 28$		2	M1 for 4 correct terms ignoring signs or for 3 terms with correct signs
		$p^2 + 3p - 28$		A1 cao
(b)		$12x^5y^6$	2	B2 B1 for any two parts correct
(c)		$9q^4$	2	B2 B1 for either 9 or $q^4$
				Total 6 marks

13. (a)	$18 \times \frac{15}{12}$		2	M1 for $\frac{15}{12}$ (1.25) oe or $\frac{18}{12}$ (1.5) oe seen
		22.5		A1 cao
(b)	eg $20 \div \frac{15}{12}$ , $20 \times \frac{12}{15}$ , $12 \times \frac{20}{15}$		2	M1 for eg $20 \div 1.25$ , $20 \times 0.8$ , $12 \times 1.\dot{3}$
		16		A1 cao
				Total 4 marks

Q	Working	Answer	Mark	Notes
14. (a)		-8 (8) 12 10 8 12	2	B2 for all correct (B1 for 3 correct)
(b)		Points	2	B1 Allow $\pm \frac{1}{2}$ sq ft from table if at least B1 scored in (a)
		Curve		B1 ft if B1 for points Award for single curve (not line segments) which does not miss more than one plotted point by more than $\frac{1}{2}$ square
				Total 4 marks

15. (a)(i)	$2 \times 58$	116	2	B1 cao
(ii)		eg angle at the centre = $2 \times$ angle at the circumference		B1 Three key points must be mentioned 1. angle at centre/middle/ <i>O</i> /origin 2. twice/double/ $2 \times$ or half/ $\frac{1}{2}$ as appropriate 3. angle at circumference/ edge/ perimeter/arc ( <i>NOT</i> e.g. angle <i>B</i> , angle <i>ABC</i> , angle at top, angle at outside)
(b)(i)	$180 - 58$	122	2	B1 cao
(ii)		eg sum of opposite angles of a cyclic quadrilateral = $180^\circ$		B1 Accept reason which includes 'opposite' and 'cyclic' and nothing incorrect Also award if (b)(i) is correct and reason is given as 'angle at the centre = $2 \times$ angle at the circumference' or ignore additional reason(s)
				Total 4 marks



Q	Working	Answer	Mark	Notes			
16. (a)	<p style="text-align: center;">First chocolate                      Second chocolate</p> 		2	<b>B2</b> for completely correct diagram, inc labels (accept clear abbreviations eg S and H) <b>(B1 for branches with at least 3 correct probabilities in the correct place)</b>			
(b)	$\frac{7}{10} \times \frac{3}{9} + \frac{3}{10} \times \frac{7}{9} + \frac{3}{10} \times \frac{2}{9}$ $\left( = \frac{21}{90} + \frac{21}{90} + \frac{6}{90} \right)$ <p>or <math>\frac{7}{10} \times \frac{3}{9} + \frac{3}{10} \left( = \frac{21}{90} + \frac{3}{10} \right)</math></p>		3	<b>M1</b> for one correct product	<b>M2</b> for $1 - \frac{7}{10} \times \frac{6}{9}$	<b>SC M1</b> for $\frac{7}{10} \times \frac{3}{10}$ or $\frac{3}{10} \times \frac{7}{10}$ or $\frac{3}{10} \times \frac{3}{10}$	for method marks ft from their tree diagram, provided probabilities < 1
				<b>M1</b> for completely correct expression	<b>SC M2</b> for $1 - \frac{7}{10} \times \frac{7}{10}$	<b>SC M1 (dep)</b> for sum of above products or for $\frac{7}{10} \times \frac{3}{10} + \frac{3}{10}$	
			$\frac{48}{90}$	<b>A1</b> for $\frac{48}{90}$ oe inc $\frac{8}{15}$ or for 0.53 or for answer rounding to 0.53			
							<b>Total 5 marks</b>

Q	Working	Answer	Mark	Notes
17. (a)	$\frac{8.6 \times (1 + 0.2)}{(1 - 0.2)}$ or $\frac{10.32}{0.8}$		2	M1 for correct substitution
		12.9 oe		A1
(b)	$T(1 - e) = n(1 + e)$		5	M1 removes fractions
	$T - eT = n + en$			M1 expands brackets
	$en + eT = T - n$			M1 collects terms
	$e(n + T) = T - n$			M1 factorises
		$\frac{T - n}{T + n}$		A1 for $\frac{T - n}{T + n}$ oe
				Total 7 marks

18.	$8.3^2 - 7.2^2$ $= 68.89 - 51.84 = 17.05$		5	M1 for $8.3^2 - 7.2^2$
	$\sqrt{8.3^2 - 7.2^2} = 4.129\dots$			M1 for $\sqrt{8.3^2 - 7.2^2}$
	tan and $\frac{4.129\dots}{3.9}$			M2 M1 for tan and $\frac{3.9}{4.129\dots}$ Accept <i>CD</i> rounded or truncated to at least 1 dp (4.12916...)
		46.6		A1 Accept answer rounding to 46.6 (4.1 → 46.43... 4.12 → 46.57... 4.13 → 46.64...)
				Total 5 marks

Alternative methods for Q18 appear on the next two pages.

Question 18 Alternative methods

Method 1

Working	Answer	Mark	Notes
$8.3^2 - 7.2^2$ $= 68.89 - 51.84 = 17.05$		5	M1 for $8.3^2 - 7.2^2$
$\sqrt{8.3^2 - 7.2^2} = 4.129\dots$ $\sqrt{4.129^2 + 3.9^2} = 5.679\dots$			M1 for $\sqrt{8.3^2 - 7.2^2}$
cos and $\frac{3.9}{"5.679"}$			M2 M1 for cos and $\frac{"5.679"}{3.9}$ Accept <i>BC</i> rounded or truncated to at least 1 dp (5.67978...)
	46.6		A1 Accept answer rounding to 46.6
			Total 5 marks

Method 2

Working	Answer	Mark	Notes
$8.3^2 - 7.2^2$ $= 68.89 - 51.84 = 17.05$		5	M1 for $8.3^2 - 7.2^2$
$\sqrt{8.3^2 - 7.2^2} = 4.129\dots$ $\sqrt{4.129^2 + 3.9^2} = 5.679\dots$			M1 for $\sqrt{8.3^2 - 7.2^2}$
sin and $\frac{"4.129"}{"5.679"}$			M2 M1 for sin and $\frac{"5.679"}{"4.129"}$ Accept <i>CD</i> rounded or truncated to at least 1 dp (4.12916...) and <i>BC</i> rounded or truncated to at least 1 dp (5.67978...)
	46.6		A1 Accept answer rounding to 46.6
			Total 5 marks

Method 3

Working	Answer	Mark	Notes
Correct method for finding $\angle A$		5	M1 eg for $\cos \angle A = \frac{7.2}{8.3}$ ( $\angle A = 29.83\dots^\circ$ )
$\sqrt{11.1^2 + 8.3^2 - 2 \times 11.1 \times 8.3 \cos 29.8}$			M1 for correct Cosine Rule expression for calculating $BC$
$\cos$ and $\frac{3.9}{5.679}$			M2 M1 for $\cos$ and $\frac{5.679}{3.9}$ Accept $BC$ rounded or truncated to at least 1 dp (5.67978...)
	46.6		A1 Accept answer rounding to 46.6
			Total 5 marks

Method 4

Working	Answer	Mark	Notes
Correct method for finding $\angle A$		5	M1 eg for $\cos \angle A = \frac{7.2}{8.3}$ ( $\angle A = 29.83\dots^\circ$ )
$\sqrt{11.1^2 + 8.3^2 - 2 \times 11.1 \times 8.3 \cos 29.8}$			M1 for correct Cosine Rule expression for calculating $BC$
$\sin B = \frac{8.3 \sin 29.8}{5.68}$			M2 for correct expression for $\sin B$ M1 for correct statement of Sine Rule eg $\frac{\sin B}{8.3} = \frac{\sin 29.8}{5.68}$
	46.6		A1 Accept answer rounding to 46.6
			Total 5 marks

Q	Working	Answer	Mark	Notes
19. (a)		$3t^2 - 10t$	2	B2 B1 for $3t^2$ or $-10t$ Ignore further differentiation seen in body or on answer line
(b)	$6t - 10 = 20$		2	M1 for linear expression including either $6t$ or $-10$
			5	A1 ft from " $6t - 10$ " = 20 if M1 scored
				Total 4 marks

20. (a)		14	1	B1 cao
(b)		9	1	B1 cao
(c)(i)		6 3 2	3	B2 B1 for 2 correct
(ii)		11		B1 cao
				Total 5 marks

21.	$12 \times 12 = 18(d - 18)$	$12 \times 12 = 18x$		4	M1 or for $r^2 = 12^2 + (18 - r)^2$
	$144 = 18d - 324$	$x = 8$			M1 or for $r^2 = 144 + 324 - 18r - 18r + r^2$
	$18d = 468$	$(d=)8+18$			M1 or for $36r = 468$
				26	A1 dep on all method marks
					Total 4 marks

Alternative methods for Q21 appear on the next page.

Question 21 Alternative methods

Method 1

Working	Answer	Mark	Notes
Complete, correct method for finding $\angle AOM$ or $\angle BOM$ or $\angle OAB$ or $\angle OBA$		4	M1 eg $\tan \angle ALM = \frac{12}{18}$ $\angle ALM = 33.69^\circ$ $\angle AOM = 2 \times 33.69^\circ = 67.38^\circ$ $AL = \sqrt{12^2 + 18^2} = \sqrt{468} = 21.63 \text{ cm}$ $\cos \angle ALB = \frac{468 + 468 - 576}{2 \times 468} = 0.3846$ $\angle ALB = 67.38^\circ$ $\angle ALM = 33.69^\circ$ $\angle AOM = 2 \times 33.69^\circ = 67.38^\circ$ $\tan \angle ALM = \frac{12}{18}$ $\angle ALM = 33.69^\circ$ $\angle OAM = 90^\circ - 2 \times 33.69^\circ = 22.62^\circ$
Correct numerical expression for length of $OA$ or $OM$			M1 eg $\frac{12}{\sin 67.38^\circ}$ or $\frac{24 \sin 22.62^\circ}{\sin 134.76^\circ}$ (= 13) or $\frac{12}{\tan 67.38^\circ}$ or $12 \tan 22.62^\circ$ (= 5)
Length of $OA$ or $OM$ used to find diameter			M1 eg $2 \times "13"$ or $2 \times (18 - "5")$ dep on both previous M1s
	26		A1 dep on all method marks Accept answer rounding to 26.0
			Total 4 marks

Method 2

Working	Answer	Mark	Notes
$AM = 12, OM = 5, OA = 13$ and $13 + 5 = 18$ or $18 - 5 = 13$		4	M3 for use of Pythagorean triple 5-12-13 or use of $OM = 5$ Pythagoras to obtain $\sqrt{5^2 + 12^2} = 13$ for $OA$ and justification
	26		A1 dep on M3
			Total 4 marks

Q	Working	Answer	Mark	Notes
22.	$y = 3x + 4$		7	B1 for correct rearrangement
	$x^2 + (3x + 4)^2 = 34$			M1 for correct substitution
	$x^2 + 9x^2 + 12x + 12x + 16 = 34$ or $x^2 + 9x^2 + 24x + 16 = 34$			B1 (indep) for correct expansion of $(3x + 4)^2$ even if unsimplified
	$10x^2 + 24x - 18 = 0$			B1 for correct simplification Condone omission of '= 0'
	$(5x - 3)(2x + 6) = 0$ or $(5x - 3)(x + 3) = 0$ or $(10x - 6)(x + 3) = 0$  or $\frac{-24 \pm \sqrt{1296}}{20}$ or $\frac{-12 \pm \sqrt{324}}{10}$  or $\frac{-12}{10} \pm \frac{\sqrt{324}}{10}$ or $\frac{-6}{5} \pm \frac{\sqrt{81}}{5}$			B1 for correct factorisation Condone omission of '= 0'  or for correct substitution into the quadratic formula and correct evaluation of ' $b^2 - 4ac$ '  or for using square completion correctly as far as indicated
	$x = \frac{3}{5}$ or $x = -3$			A1 for both values of $x$
		$x = \frac{3}{5}, y = 5\frac{4}{5}$ $x = -3, y = -5$		A1 for complete, correct solutions Need not be explicitly paired
				Total 7 marks
				<b>TOTAL FOR PAPER: 100 MARKS</b>

**Note**

The mark scheme for an alternative method for Q22 is on the next page.

Question 22 Alternative method

Working	Answer	Mark	Notes
$x = \frac{y-4}{3}$		7	B1 for correct rearrangement
$\left(\frac{y-4}{3}\right)^2 + y^2 = 34$			M1 for correct substitution
$\frac{y^2 - 4y - 4y + 16}{9} + y^2 = 34$ or $y^2 - 4y - 4y + 16 + 9y^2 = 306$ or $\frac{y^2 - 8y + 16}{9} + y^2 = 34$ or $y^2 - 8y + 16 + 9y^2 = 306$			B1 (indep) for correct expansion of $(y-4)^2$ even if unsimplified
$10y^2 - 8y - 290 = 0$			B1 for correct simplification Condone omission of '= 0'
$(5y - 29)(y + 5) = 0$ $(5y - 29)(2y + 10) = 0$ $(10y - 58)(y + 5) = 0$ or $\frac{8 \pm \sqrt{11664}}{20}$ or $\frac{4 \pm \sqrt{2916}}{10}$ or $\frac{4}{10} \pm \frac{\sqrt{2916}}{10}$ or $\frac{2}{5} \pm \frac{\sqrt{729}}{5}$			B1 for correct factorisation Condone omission of '= 0'  or for correct substitution into the quadratic formula and correct evaluation of ' $b^2 - 4ac$ '  or for using square completion correctly as far as indicated
$y = 5\frac{4}{5}$ or $y = -5$			A1 for both values of $y$
	$x = \frac{3}{5}, y = 5\frac{4}{5}$ $x = -3, y = -5$		A1 for complete, correct solutions
			Total 7 marks





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