# 2009 Mathematics

# Intermediate 2 – Units 1, 2 and 3 Paper 2

# Finalised Marking Instructions

**General Marking Principles**

These principles describe the approach to be taken when marking Intermediate 2 Mathematics papers. For more detailed guidance please refer to the notes which are included with the Marking Instructions.

**1**   Marks must be assigned in accordance with the Marking Instructions. The main principle in marking scripts is to give credit for the skills demonstrated and the criteria met. Failure to have the correct method may not preclude a candidate gaining credit for the calculations involved or for the communication of the answer.

**2**   The answer to one part of a question, even if incorrect, must be accepted as a basis for subsequent dependent parts of the question. Full marks in the dependent part(s) may be awarded provided the question is not simplified.

**3**   The following should not be penalised:

   - working subsequent to a correct answer (unless it provides firm evidence that the requirements of the question have not been met)
   - omission or misuse of units (unless marks have been specifically allocated for the purpose in the marking scheme)
   - bad form, eg $\sin x° = 0.5 = 30°$
   - legitimate variation in numerical values / algebraic expressions.

**4**   Solutions which seem unlikely to include anything of relevance must nevertheless be followed through. Candidates still have the opportunity of gaining one mark or more provided the solution satisfies the criteria for the mark(s).

**5**   Full credit should only be given where the solution contains appropriate working. Where the correct answer may be obtained by inspection or mentally, credit may be given, but reference to this will be made in the Marking Instructions.

**6**   In general markers will only be able to give credit for answers if working is shown. A wrong answer without working receives no credit unless specifically mentioned in the Marking Instructions. The rubric on the outside of the question papers emphasises that working must be shown.

**7**   Sometimes the method to be used in a particular question is explicitly stated; no credit should be given where a candidate obtains the correct answer by an alternative method.

**8**   Where the method to be used in a particular question is not explicitly stated, full credit must be given for alternative methods which produce the correct answer.

**9**   Do not penalise the same error twice in the same question.

**10**   Do not penalise a transcription error unless the question has been simplified as a result.

**11**   Do not penalise inadvertent use of radians in trigonometry questions, provided their use is consistent within the question.

**Practical Details**

The Marking Instructions should be regarded as a working document and have been developed and expanded on the basis of candidates' responses to a particular paper. While the guiding principles of assessment remain constant, details can change depending on the content of a particular examination paper in a given year.

1      Each mark awarded in a question is referenced to one criterion in the marking scheme by means of a bullet point.

2      Where a candidate has scored zero marks for any question attempted, "0" should be shown against the answer in the place in the margin.

3      Where a marker wishes to indicate how s/he has awarded marks, the following should be used:

      (a)      Correct working should be ticked, ✓ .

      (b)      Where working subsequent to an error is followed through, if otherwise correct and can be awarded marks, it should be marked with a crossed tick, ✗.

      (c)      Each error should be underlined at the point in the working where it first occurs.

4      **Do not write any comments, words or acronyms on the scripts.**

**Mathematics Intermediate 2:  Paper 2, Units 1, 2 and 3**

| Question No | Marking Scheme<br>Give 1 mark for each • | Illustrations of evidence for awarding a mark at each • |
|---|---|---|
| 1 | **Ans:   There were 3 sales fewer in 2008<br>or There were fewer sales in 2008<br>because 2997 < 3000**<br><br>•[1]   strategy:  know how to increase by 11%<br><br>•[2]   strategy:  know how to calculate 2008 sales<br><br>•[3]   process:  carry out calculations correctly and state conclusion | <br><br><br><br>•[1]   $\times 1\cdot 11$                    (= 3330)<br><br>•[2]   $3000 \times 1\cdot 11 \times 0\cdot 9$   (= 2997)<br><br><br>•[3]   3 sales less in 2008<br><br>                                          **3 marks** |

**NOTES:**

1  For an answer of "There were 3 sales fewer in 2008" without working          award 3/3

2  For the third mark candidates must refer to the sales of both 2006 and 2008 or the difference between them.

3  Where a candidate increases 3000 by 11% and then decreases 3000 by 10%, only the first mark is available.

4  Where a candidate calculates 2 increases or 2 decreases, the final mark is not available.

| Question No | Marking Scheme<br>Give 1 mark for each • | Illustrations of evidence for awarding a mark at each • |
|---|---|---|
| 2 (a) | **Ans: 172 cm**<br><br>•[1]  process:  calculate the mean | •[1]  172<br><br><br>**1 mark** |
| (b) | **Ans: 4·8 cm**<br><br>•[1]  process:  calculate $(x - \bar{x})^2$<br><br>•[2]  process:  substitute into formula<br><br>•[3]  process:  calculate standard deviation | •[1]  1, 16, 16, 36, 4, 64, 1<br><br>•[2]  $\sqrt{\dfrac{138}{6}}$<br><br>•[3]  4·8<br><br>**3 marks** |

**NOTES:**

   1   For use of alternative formula, award marks as follows:

| | |
|---|---|
| •[1]  process:  calculate $\Sigma x$ and $\Sigma x^2$ | •[1]  1204, 207226 |
| •[2]  process:  substitute into formula | •[2]  $\sqrt{\dfrac{207226 - 1204^2/7}{6}}$ |
| •[3]  process:  calculate standard deviation | •[3]  4·8 |

   2   For correct answer, without working        award 0/3

| Question No | Marking Scheme<br>Give 1 mark for each ● | Illustrations of evidence for awarding a mark at each ● |
|---|---|---|
| 3 | **Ans: 882 000 mm$^3$**<br><br>●$^1$ strategy: know to subtract the volume of two cylinders<br><br>●$^2$ process: correct substitution into formula<br><br>●$^3$ process: correct substitution into formula<br><br>●$^4$ process: calculate volume of aluminium<br><br>●$^5$ process: round volume to 3 significant figures | ●$^1$ evidence<br><br>●$^2$ $\pi \times 41^2 \times 900$<br><br>●$^3$ $\pi \times 37^2 \times 900$<br><br>●$^4$ 882 159<br><br>●$^5$ 882 000<br><br>**5 marks** |

**NOTES:**

1. The final mark is for rounding an answer correct to three significant figures. Where the answer requires no rounding, the final mark cannot be awarded.

2. SOME COMMON ANSWERS (working must be shown)

| | | |
|---|---|---|
| 3 530 000 mm$^3$ | $\left(\pi \times 82^2 \times 900 - \pi \times 74^2 \times 900\right)$ | award 4/5 |
| 8 620 000 mm | $\left(\pi \times 41^2 \times 900 + \pi \times 37^2 \times 900\right)$ | award 4/5 |
| 76 500 mm$^3$ | $\left(\frac{4}{3} \times \pi \times 41^3 - \frac{4}{3} \times \pi \times 37^3\right)$ | award 3/5 |
| 22 600 mm$^3$ | $\left(\pi \times 82 \times 900 - \pi \times 74 \times 900\right)$ | award 3/5 |
| 115 000 mm$^3$ | $\left(\pi \times 41^2 \times 82 - \pi \times 37^2 \times 74\right)$ | award 3/5 |
| 441 000 mm$^3$ | $\left(\pi \times 82 \times 900 + \pi \times 74 \times 900\right)$ | award 2/5 |
| 45 200 mm$^3$ | $\left(\pi \times (41 - 37)^2 \times 900\right)$ | award 2/5 |
| 181 000 mm$^3$ | $\left(\pi \times 8^2 \times 900\right)$ | award 1/5 |

| Question No | Marking Scheme Give 1 mark for each • | Illustrations of evidence for awarding a mark at each • |
|---|---|---|
| 4 (a) | **Ans:** $14x + 60y = 344 \cdot 30$<br><br>•$^1$ interpret: interpret the text | •$^1$ $14x + 60y = 344 \cdot 30$<br><br>**1 mark** |
| **NOTES:** | | |
| (b) | **Ans:** $21x + 40y = 368 \cdot 95$<br><br>•$^1$ interpret: interpret the text | •$^1$ $21x + 40y = 368 \cdot 95$<br><br>**1 mark** |
| **NOTES:** | | |

| Question No | Marking Scheme Give 1 mark for each • | | Illustrations of evidence for awarding a mark at each • | |
|---|---|---|---|---|
| (c) | **Ans: A car costs £11·95 and a passenger £2·95** | | | |
| | •[1] strategy: | know to solve system of equations | •[1] | evidence |
| | •[2] process: | follow a valid strategy through to produce a value for $x$ and $y$ | •[2] | a value for $x$ and $y$ |
| | •[3] process: | correct value for $x$ and $y$ | •[3] | $x = 11 \cdot 95, y = 2 \cdot 95$ |
| | •[4] communicate: | state result | •[4] | car costs £11·95, passenger costs £2·95 |
| | | | | **4 marks** |

**NOTES:**

1 Incorrect answers in (a) and/or (b) must be followed through to give the possibility of awarding 4/4

2 Any valid strategy must involve the use of two equations

3 Where the correct values for $x$ and $y$ have been obtained without using simultaneous equations, marks are available only if both values have been substituted correctly into **both** equations.

   ie    $14 \times 11 \cdot 95 + 60 \times 2 \cdot 95 = 344 \cdot 30$
           $21 \times 11 \cdot 95 + 40 \times 2 \cdot 95 = 368 \cdot 95$
           leading to $x = 11 \cdot 95, y = 2 \cdot 95$
           a car costs £11·95
           a passenger costs £2·95

                                                award 4/4

4 For an answer of $x = 11 \cdot 95, y = 2 \cdot 95$, award 3/4 (lose communication mark)

5 For wrong answer without working or based on an invalid strategy, the final mark cannot be awarded

6 Where a candidate has calculated $x$ or $y$ to be negative, the final mark is not available.

7 For the award of the final mark, the costs must be stated in pounds or pence.
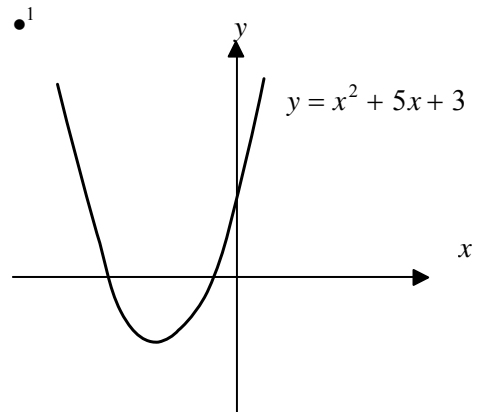
8 For the correct answer without working, award 0/4

| Question No | Marking Scheme Give 1 mark for each • | Illustrations of evidence for awarding a mark at each • |
|---|---|---|
| 5 | **Ans: 313 square inches** <br><br> •$^1$ strategy: express sector as fraction of circle <br><br> •$^2$ process: know how to calculate shaded area <br><br> •$^3$ process: substitute correctly into formula <br><br> •$^4$ process: calculate area correctly | •$^1$ $\dfrac{160}{360}$ <br><br> •$^2$ evidence of difference in area of two sectors <br><br> •$^3$ $\dfrac{160}{360} \times \pi \times \left(18^2 - 10^2\right)$ <br><br> •$^4$ 313 square inches <br><br> **4 marks** |

**NOTES:**

1. Accept variations in $\pi$; disregard premature or incorrect rounding of 160/360

2. For $160/360 \times 2 \times \pi \times (18 - 10)$   (leading to 22·3)     award 2/4

3. For $\dfrac{160}{360} \times \pi \times (18 - 10)^2$      (leading to 89·4)     award 2/4

4. Where a candidate works out the area of only one sector, eg $\dfrac{160}{360} \times \pi \times 18^2$     award 1/4

| Question No | Marking Scheme | Illustrations |
|---|---|---|
| 6 | **Ans: 68·6º** <br><br> •$^1$ strategy: know to use cosine rule <br><br> •$^2$ process: correct substitution <br><br> •$^3$ process: calculate the size of angle BPM | •$^1$ evidence <br><br> •$^2$ $\dfrac{1000^2 + 950^2 - 1100^2}{2 \times 1000 \times 950}$ <br><br> •$^3$ 68·6º <br><br> **3 marks** |

**NOTES:**

1. Where an angle other than angle BPM has been calculated ($\angle B = 53 \cdot 5^\circ$, $\angle M = 57 \cdot 8^\circ$), a maximum of 2/3 can be awarded provided that the value of the angle calculated is consistent with the application of the cos rule.

2. 1·2 (RAD), 76·2 (GRAD), with working     award 3/3

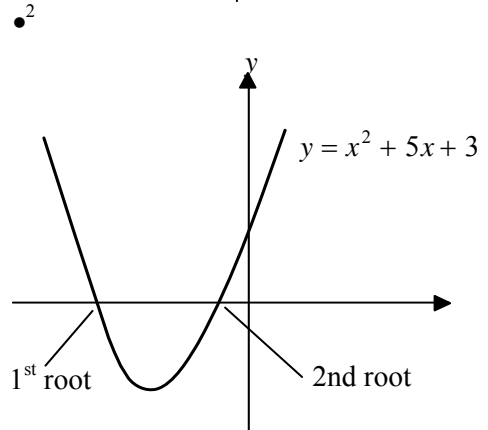| Question No | Marking Scheme<br>Give 1 mark for each • | Illustrations of evidence for awarding a mark at each • |
|---|---|---|
| 7 | **Ans:** $x = -0 \cdot 7, x = -4 \cdot 3$<br><br>•$^1$ strategy: know to use quadratic formula<br><br>•$^2$ process: substitute correctly into quadratic formula<br><br>•$^3$ process: calculate $b^2 - 4ac$<br><br>•$^4$ process: state both values of $x$ correct to 1 decimal place | •$^1$ evidence<br><br>•$^2$ $\dfrac{-5 \pm \sqrt{\left(5^2 - 4 \times 1 \times 3\right)}}{2 \times 1}$<br><br>•$^3$ 13<br><br>•$^4$ $-0 \cdot 7, -4 \cdot 3$<br><br>**4 marks** |

**NOTES:**

1  Where $b^2 - 4ac$ is calculated incorrectly, the fourth mark is available only if $b^2 - 4ac > 0$

2  Alternative method (graphical solution)

•$^1$ strategy: know to graph
$y = x^2 + 5x + 3$

•$^1$


•$^2$ communicate: indicate position of roots

•$^2$


1st root     2nd root

•$^3$ communicate: state first root correct to 1 decimal place

•$^3$ $-0 \cdot 7$

•$^4$ communicate: state second root correct to 1 decimal place

•$^4$ $-4 \cdot 3$

3  For a correct answer, without working                                      award 0/4

| Question No | Marking Scheme<br>Give 1 mark for each • | Illustrations of evidence for awarding<br>a mark at each • |
|---|---|---|
| 8 | **Ans:** $\dfrac{6x}{(x-1)(x+2)}$<br><br>•¹ process: state a valid common denominator<br><br>•² process: find correct numerator of equivalent fraction<br><br>•³ process: state answer in simplest form | •¹ any valid denominator<br><br>•² both numerators correct<br><br>•³ $\dfrac{6x}{(x-1)(x+2)}$<br><br>**3 marks** |

**NOTES:**

1. In this question, working subsequent to a correct answer should be ignored

2. For $\dfrac{2(x+2)+4(x-1)}{(x-1)(x+2)} = \dfrac{6x}{x^2-2}$  award 3/3  √√√

   $\dfrac{2(x+2)+4(x-1)}{x^2-2} = \dfrac{6x}{x^2-2}$  award 2/3  ×√√

| Question No | Marking Scheme<br>Give 1 mark for each • | Illustrations of evidence for awarding<br>a mark at each • |
|---|---|---|
| 9 | **Ans:** $h = \dfrac{2A}{(a+b)}$<br><br>•¹ process: start to re-arrange the formula<br><br>•² process: make $h$ the subject | •¹ $h(a+b) = 2A$<br><br>•² $h = \dfrac{2A}{(a+b)}$<br><br>**2 marks** |

**NOTES:**

1   For $h(a+b) = 2A$

   or $\frac{1}{2}h = \dfrac{A}{a+b}$

   or $h(a+b) = \dfrac{A}{\frac{1}{2}}$                           the first mark can be awarded

2   For a final answer of

   $h = \dfrac{2A}{a+b}$

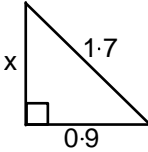   or $h = \dfrac{A}{\frac{1}{2}(a+b)}$                      award 2/2

3   For a final answer of

   $h = \dfrac{\frac{A}{\frac{1}{2}}}{a+b}$

   or $h = \dfrac{\frac{A}{a+b}}{\frac{1}{2}}$                      award 1/2

| Question No | Marking Scheme<br>Give 1 mark for each • | Illustrations of evidence for awarding<br>a mark at each • |
|---|---|---|
| 10 | **Ans:   $x = 239$ and $x = 301$**<br><br>•[1]  process:   solve equation for $\sin x^\circ$<br><br>•[2]  process:   find one value for $x$<br><br>•[3]  process:   find second value for $x$<br><br>                                        **3 marks** | •[1]   $\sin x^\circ = \dfrac{-6}{7}$ or equivalent<br><br>•[2]   $x = 239$<br><br>•[3]   $x = 301$ |

**NOTES:**

1    Where $\sin x^\circ$ is calculated incorrectly, the second and third marks are available only when $\sin x^\circ < 0$.  Where $\sin x^\circ > 0$, 1/3 can be awarded when two values of $x$ are calculated consistent with the incorrect value for $\sin x^\circ$ (working eased).

2    Where a graphical solution has been used, the first mark is available for indicating what graph is drawn and where the values occur.

3    For a correct answer, without working                               award 0/3

| Question No | Marking Scheme | Illustrations |
|---|---|---|
| 11 | **Ans:  $6\sqrt{2}$**<br><br>•[1]  strategy:  know how to rationalise<br>                denominator<br><br>•[2]  process:  simplify answer<br><br>                                      **2 marks** | •[1]   $\dfrac{12}{\sqrt{2}} \times \dfrac{\sqrt{2}}{\sqrt{2}}$<br><br>•[2]   $6\sqrt{2}$ |

**NOTES:**

1    For an answer of $\dfrac{6\sqrt{2}}{1}$, with working                   award 2/2

| Question No | Marking Scheme<br>Give 1 mark for each • | Illustrations of evidence for awarding<br>a mark at each • |
|---|---|---|
| 12 | **Ans:** $a^{-2}\,b^{4}$ or $\dfrac{b^{4}}{a^{2}}$<br><br>•¹ process: simplify one variable<br><br>•² process: simplify fully **with no subsequent errors** | <br><br><br><br>•¹ $a^{-2}$ or $b^{4}$<br><br>•² $a^{-2}\,b^{4}$<br><br><br>**2 marks** |

**NOTES:**

| Question No | Marking Scheme<br>Give 1 mark for each • | Illustrations of evidence for awarding<br>a mark at each • |
|---|---|---|
| 13 | **Ans:  8·6 metres**<br><br>•¹ strategy: know to apply sine rule in $\Delta$ BCD to find BD or other valid strategy<br><br>•² process: correct application of the sine rule or other valid strategy<br><br><br><br><br>•³ process: calculate BD<br><br><br>•⁴ strategy: know to use right-angled trig to find height of building<br><br><br>•⁵ process: correct calculation of AD | •¹ evidence<br><br><br><br>•² $\dfrac{BD}{\sin 38^{\circ}}=\dfrac{5}{\sin 17^{\circ}}$ or<br><br><br>$\dfrac{DC}{\sin 125^{\circ}}=\dfrac{5}{\sin 17^{\circ}}$<br><br><br>•³ BD = 10·5 or DC = 14·0<br><br><br>•⁴ $\sin 55^{\circ}=\dfrac{AD}{10\cdot 5}$ or $\sin 38^{\circ}=\dfrac{AD}{14\cdot 0}$<br><br><br>•⁵ 8·6<br><br>**5 marks** |

**NOTES:**

1 Disregard any errors due to premature rounding provided there is evidence.

2 Variations in answers for BD (or DC) or a wrong value for BD (or DC) must be accepted as a basis for calculating the height.

3 Where a candidate assumes that B is the midpoint of AC, the last two marks are available for a correct trig calculation.

4 Where an incorrect trig ratio is used to find the height, the fifth mark is still available.

5 For a correct answer without working,                                        award 0/5

| Question No | Marking Scheme<br>Give 1 mark for each • | Illustrations of evidence for awarding<br>a mark at each • |
|---|---|---|
| 14 | **Ans: 3·14 metres**<br><br>•[1] strategy: marshall facts and recognise right angle<br><br><br><br><br>•[2] strategy: know how to use Pythagoras<br><br>•[3] process: correct calculation of $x$<br><br>•[4] process: find height of tunnel | •[1] <br><br><br><br><br>•[2] $x^2 = 1 \cdot 7^2 - 0 \cdot 9^2$<br><br>•[3] $x = 1 \cdot 44$<br><br>•[4] 3·14 metres<br><br>**4 marks** |

**NOTES:**

1  The final mark is for adding 1·7 to a value which has been calculated.

2  SOME COMMON ANSWERS (with working):

$$\sqrt{1 \cdot 7^2 + 0 \cdot 9^2} + 1 \cdot 7 = 3 \cdot 62 \qquad \text{award 3/4}$$

$$\sqrt{1 \cdot 7^2 + 1 \cdot 8^2} + 1 \cdot 7 = 4 \cdot 18 \qquad \text{award 2/4}$$

$$\sqrt{1 \cdot 8^2 - 1 \cdot 7^2} + 1 \cdot 7 = 2 \cdot 29 \qquad \text{award 2/4}$$

$$\sqrt{3 \cdot 4^2 - 1 \cdot 8^2} = 2 \cdot 88 \qquad \text{award 1/4}$$

3  Where a candidate assumes angle XYO = angle OXY = 45°, only the final mark is available.

4  For an answer of 3·14, without working        award 0/4

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**TOTAL MARKS FOR PAPER 2**
**50**

[END OF MARKING INSTRUCTIONS]