Cambridge Assessment International Education

# Cambridge O Level

**MATHEMATICS (SYLLABUS D)** **4024/21**

Paper 2 **October/November 2021**

MARK SCHEME

Maximum Mark: 100

**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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## Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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| Maths-Specific Marking Principles | |
|---|---|
| 1 | Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing. |
| 2 | Unless specified in the question, answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected. |
| 3 | Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points. |
| 4 | Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw). |
| 5 | Where a candidate has misread a number in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 mark for the misread. |
| 6 | Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear. |

**Abbreviations**

| | |
|---|---|
| cao | correct answer only |
| dep | dependent |
| FT | follow through after error |
| isw | ignore subsequent working |
| oe | or equivalent |
| SC | Special Case |
| nfww | not from wrong working |
| soi | seen or implied |

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 1(a) | 90.99 | **2** | **M1** for $84.25+\frac{8}{100}\times 84.25$ oe<br>or **B1** for 6.74 |
| 1(b)(i) | 48.18 final answer | **2** | **M1** for 960 × 4.3 + 30 × 23<br>or 960 × 0.043 + 30 × 0.23<br><br>If 0 scored, **SC1** for answer 222.09 |
| 1(b)(ii) | 140 | **3** | **M1** for 3080 – 30 × 28 oe<br>or 30.8 – 30 × 0.28 oe<br>**M1** for *their* 2240 ÷ 16 oe |
| 1(c)(i) | $7.87 \times 10^5$ final answer | **1** | |
| 1(c)(ii) | 29.1 or 29.06... | **2** | **M1** for $\frac{2.62\times10^5-2.03\times10^5}{2.03\times10^5}[\times 100]$ oe<br>or for $\frac{2.62\times10^5}{2.03\times10^5}\times 100$ oe |
| 1(c)(iii) | 275 000 or $2.75 \times 10^5$ nfww | **2** | **M1** for $\frac{(100-4)}{100}x=2.64\times10^5$ soi |
| 2(a)(i) | 1 final answer | **1** | |
| 2(a)(ii) | 2 final answer | **1** | |
| 2(a)(iii) | 9 | **2** | **M1** for $\frac{2}{80}[\times 360]$ oe or $\frac{360}{80}[\times 2]$ oe |
| 2(b)(i) | 150 | **3** | **M2** for<br>$0.6\times30+30+4.4\times15+1.6\times15+0.4\times30$ oe<br><br>or **M1** for 2 or more correct products soi |
| 2(b)(ii) | $\frac{1}{10}$ is 15 and 12 spend more than 90 minutes, so he is wrong | **2** | **FT** *their* 150<br>**B1FT** for 12 spend more than 90 minutes<br>or $30\times$*their* 0.4 evaluated<br>or for $\frac{1}{10}$ is 15 or $\frac{1}{10}$ of *their*150 evaluated |

| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 3(a)(i) | *AO* and *BO* are radii, so 2 equal sides | **1** | |
| 3(a)(ii) | [ $B\hat{E}C$ = ] 22° nfww | **3** | **B1** for $\angle BOC = 68°$ soi or for $\angle BOA = 112°$ soi or $\angle OBC = 56°$ soi<br>**B1** for $\angle OCE$ or $\angle ACE = 90°$ soi |
| 3(b) | 16.1 or 16.08 to 16.09 | **3** | **M2** for $\frac{96}{360}\times\pi\times\left(\left(7.4+1.2\right)^2-7.4^2\right)$ oe<br>or **M1** for $\frac{96}{360}\times\pi\times\left(7.4+1.2\right)^2$ or $\frac{96}{360}\times\pi\times7.4^2$ |
| 4(a)(i) | 27.1 to 27.2 | **4** | **B1** for $\angle RPQ = 130°$ soi<br>**M2** for $\sin[\ ]=\frac{3.8\sin(their 130)}{7.5}$ oe<br>or **M1** for $\frac{7.5}{\sin(their 130)}=\frac{3.8}{\sin[\ ]}$ oe |
| 4(a)(ii) | 297.1 to 297.2 | **2** | **FT** 270 + *their* 27.2, where $0 \leqslant$ *their* 27.2 $\leqslant 90$<br>or for 320 – *their* $\angle PQR$ where $0 \leqslant$ *their* $\angle PQR \leqslant 90$<br>**M1** for 180 + 90 + *their* 27.2 oe<br>or for 360 – (40 + 180 – 130 – *their* 27.2)<br>or for 360 – 40 – *their* $\angle PQR$ |
| 4(b) | 35.3 to 35.4 | **4** | **M1** for $\frac{16.5}{45}$<br>**M1** for [time =] 65 – 15 – *their* 22 oe<br>**M1** for $\frac{16.5}{their\ 28}[\times 60]$ |
| 5(a)(i) | $\frac{6}{10}$ oe | **1** | |
| 5(a)(ii) | Correct tree diagram<br> | **2** | **M1** for $\frac{6}{10}$ and $\frac{4}{10}$ placed correctly once |

| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 5(a)(iii) | $\frac{12}{25}$ oe | **2** | **M1** for $\frac{4}{10}\times\frac{6}{10}[\times 2]$ |
| 5(b) | $\frac{5}{22}$ final answer | **3** | **M2** for $\frac{5}{12}\times\frac{3}{11}\times 2$ oe<br>or **M1** for $\frac{5}{12}\times\frac{3}{11}$ oe<br>If 0 scored, **SC1** for answer $\frac{5}{24}$ |
| 6(a)(i) | $8^2+(2x)^2=(3x+5)^2$ | **M1** | |
| | $9x^2+15x+15x+25$ | **B1** | Expansion of brackets |
| | $64+4x^2=9x^2+15x+15x+25$<br>leading to $5x^2+30x-39=0$ | **A1** | |
| 6(a)(ii) | $\frac{-30\pm\sqrt{30^2-4\times5\times-39}}{2\times5}$ oe or<br>$\frac{-30}{10}\pm\sqrt{\left(\frac{30}{10}\right)^2-\frac{-39}{5}}$ oe | **B2** | **B1** for $\sqrt{30^2-4\times5\times-39}$ oe<br>or for $\frac{-30\pm\sqrt{their\,1680}}{2\times5}$ oe<br>or $\left(x+\frac{30}{10}\right)^2$ oe |
| | 1.10 and –7.10 | **B1** | |
| 6(a)(iii) | 8.78 to 8.8[0] | **2** | **M1** for $\frac{1}{2}\times8\times2\times their\,1.10$ |

| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 6(b) | 5.63 to 5.64 nfww | **4** | **M1** for correct method to find $AB$ or $AC$<br>$\cos 35 = \frac{[AC]}{12}$ oe or $\cos(90-35) = \frac{[AB]}{12}$ oe<br><br>**M2** for $[\ ] = \textit{their } AC \times \sin 35$ oe<br>or $[\ ] = \textit{their } AB \times \sin(90-35)$ oe<br>or $[\ ] = \frac{\frac{1}{2}\times 12 \times \textit{their } AC \times \sin 35}{\frac{1}{2}\times 12}$ oe<br>or $[\ ] = \frac{\frac{1}{2}\times 12 \times \textit{their } AB \times \sin(90-35)}{\frac{1}{2}\times 12}$ oe<br>or **M1** for $\sin 35 = \frac{[\ ]}{\textit{their } AC}$ oe<br>or $\sin(90-35) = \frac{[\ ]}{\textit{their } AB}$ oe<br>or for $\frac{1}{2}\times d \times 12 = \frac{1}{2}\times 12 \times \textit{their}AC \times \sin 35$ oe<br>or<br>$\frac{1}{2}\times d \times 12 = \frac{1}{2}\times 12 \times \textit{their}AB \times \sin(90-35)$ oe |
| 7(a) | Correct smooth curve | **4** | **B3** for 4 or 5 correct points<br>or **B2** for 2 or more correct pairs of values soi<br>or **B1** for one correct pair of values soi |
| 7(b)(i) | Tangent drawn at $x = 0.5$ | **B1** | |
| | –5.5 to –2.8 | **B1** | Dependent on close attempt at tangent |
| 7(b)(ii) | –0.45 to –0.35 | **1** | |
| 7(b)(iii) | Line $y = 7 – x$ ruled | **M2** | **M1** for $\frac{1}{2x^2} + 3x = 7 - x$<br>or for line $y = k – x$ or $y = 7 + mx$ drawn, $m \neq 0$ |
| | –0.2 to –0.3<br>0.2 to 0.4<br>1.6 to 1.8 | **A2** | **A1dep** for one correct, dep on at least M1<br>After A0 scored **SC1** for all 3 correct with no or wrong working |

| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 8(a) | (1, 4) | **1** | |
| 8(b) | Gradient = $\frac{5-3}{4--2}$ oe | **M1** | |
| | $5=\left(their\frac{1}{3}\right)\times 4+c$ oe | **M1** | (4, 5), (–2, 3) or *their* midpoint substituted into $y=\left(their\frac{1}{3}\right)\times x+c$ oe |
| | Rearrangement to $c=\frac{11}{3}$<br><br>and hence showing $3y = x + 11$ | **A1** | or expansion to $3y – 15 = x – 4$ with completion<br>or expansion to $3y – 9 = x + 2$ with completion<br>or expansion to $3y – 12 = x – 1$ with completion<br>With no errors or omissions in working |
| 8(c) | $y = –3x + 7$ | **3** | **B1FT** for gradient = $-\frac{1}{their\text{ (b) gradient}}$<br>**M1** for substituting *their* (1, 4) into $y =$ *their* $(–3)x + c$ oe |
| 9(a) | 5 | **2** | **M1** for $3x = 7 + 8$ or better or $x-\frac{8}{3}=\frac{7}{3}$ |
| 9(b) | $x<\frac{3}{5}$ oe final answer | **2** | **M1** for $7x + 3x$ […] 6 or $\frac{7}{3}x+x[...]2$ |
| 9(c) | $\frac{25}{2}$ or $12\frac{1}{2}$ or 12.5 | **4** | **M2** for $3(x + 5) + x(x – 2) = (x – 2)(x + 5)$<br>or $\frac{3(x+5)+x(x-2)}{(x+5)(x-2)}=1$<br>or **M1** for $3(x + 5) + x(x – 2)$<br>or denominator $(x – 2)(x + 5)$ soi<br><br>**M1** for $3x + 15 + x^2 – 2x = x^2 – 2x + 5x – 10$ |
| 9(d) | $\frac{x+2y}{x+4}$ final answer | **4** | **B2** for $(x+2y)(2x+3)$<br>or **B1** for one correct partial factorisation seen<br>AND<br>**B1** for $(2x+3)(x+4)$ |
| 10(a) | 117.235 | **3** | **B1** for 6.25, 4.85 and 2.55 seen<br>or for 62.5, 48.5 and 25.5 seen<br><br>**M1** for (*their* 6.25 × *their* 4.85 + *their* 6.25 × *their* 2.55 + *their* 2.55 × *their* 4.85) [× 2]<br><br>or for (*their* 62.5 × *their* 48.5 + *their* 62.5 × *their* 25.5 + *their* 25.5 × *their* 48.5) [× 2] |

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 10(b)(i) | $XC^2 = 19^2 - 17^2$ oe | **M2** | **M1** for $19^2 = XC^2 + 17^2$ |
| | *their* $XC^2$ + *their* $XC^2$<br>or<br>$d^2 + d^2 = (2 \times \textit{their } XC)^2$ | **M1** | Dependent on use of Pythagoras for $XC$ |
| | $\sqrt{144} = 12$ | **A1** | |
| 10(b)(ii) | 816 | **2** | **M1** for $\frac{1}{3} \times 12^2 \times 17$ oe |
| 10(b)(iii) | 71.5 to 71.6 | **3** | **M2** for $\cos[\ ] = \frac{6}{19}$ oe or for<br>$\cos[\ ] = \frac{19^2 + 12^2 - 19^2}{2 \times 19 \times 12}$ oe<br>Or **M1** for<br>$19^2 = 12^2 + 19^2 - 2 \times 12 \times 19 \times \cos[\ ]$ |