

Markscheme

May 2026

**Mathematics:
applications and interpretation**

Standard level

Paper 1

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Instructions to Examiners

Abbreviations

- M** Marks awarded for attempting to use a correct **Method**.
- A** Marks awarded for an **Answer** or for **Accuracy**; often dependent on preceding **M** marks.
- R** Marks awarded for clear **Reasoning**.
- AG** Answer given in the question and so no marks are awarded.
- FT** Follow through. The practice of awarding marks, despite student errors in previous parts, for their correct methods/answers using incorrect results.

Using the markscheme

1 General

Award marks using the annotations as noted in the markscheme *eg M1, A2*.

2 Method and Answer/Accuracy marks

- Do **not** automatically award full marks for a correct answer; all working **must** be checked, and marks awarded according to the markscheme.
- It is generally not possible to award **M0** followed by **A1**, as **A** mark(s) depend on the preceding **M** mark(s), if any.
- Where **M** and **A** marks are noted on the same line, *e.g. M1A1*, this usually means **M1** for an **attempt** to use an appropriate method (*e.g.* substitution into a formula) and **A1** for using the **correct** values.
- Where there are two or more **A** marks on the same line, they may be awarded independently; so if the first value is incorrect, but the next two are correct, award **A0A1A1**.
- Where the markscheme specifies **A3**, **M2** *etc.*, do **not** split the marks, unless there is a note.
- The response to a “show that” question does not need to restate the **AG** line, unless a **Note** makes this explicit in the markscheme.
- Once a correct answer to a question or part question is seen, ignore further working even if this working is incorrect and/or suggests a misunderstanding of the question. This will encourage a uniform approach to marking, with less examiner discretion. Although some students may be advantaged for that specific question item, it is likely that these students will lose marks elsewhere too.
- An exception to the previous rule is when an incorrect answer from further working is used **in a subsequent part**. For example, when a correct exact value is followed by an incorrect decimal approximation in the first part and this approximation is then used in the second part. In this situation, award **FT** marks as appropriate but do not award the final **A1** in the first part.

Examples:

	Correct answer seen	Further working seen	Any FT issues?	Action
1.	$8\sqrt{2}$	5.65685... (incorrect decimal value)	No. Last part in question.	Award A1 for the final mark (condone the incorrect further working)
2.	$\frac{35}{72}$	0.468111... (incorrect decimal value)	Yes. Value is used in subsequent parts.	Award A0 for the final mark (and full FT is available in subsequent parts)

3 Implied marks

Implied marks appear in **brackets e.g. (M1)**, and can only be awarded if **correct** work is seen or implied by subsequent working/answer.

4 Follow through marks (only applied after an error is made)

Follow through (**FT**) marks are awarded where an incorrect answer from one **part** of a question is used correctly in **subsequent** part(s) (e.g. incorrect value from part (a) used in part (d) or incorrect value from part (c)(i) used in part (c)(ii)). Usually, to award **FT** marks, **there must be working present** and not just a final answer based on an incorrect answer to a previous part. However, if all the marks awarded in a subsequent part are for the answer or are implied, then **FT** marks should be awarded for *their* correct answer, even when working is not present.

For example: following an incorrect answer to part (a) that is used in subsequent parts, where the markscheme for the subsequent part is **(M1)A1**, it is possible to award full marks for *their* correct answer, **without working being seen**. For longer questions where all but the answer marks are implied this rule applies but may be overwritten by a **Note** in the Markscheme.

- Within a question part, once an **error** is made, no further **A** marks can be awarded for work which uses the error, but **M** marks may be awarded if appropriate.
- If the question becomes much simpler because of an error then use discretion to award fewer **FT** marks, by reflecting on what each mark is for and how that maps to the simplified version.
- If the error leads to an inappropriate value (e.g. probability greater than 1, $\sin \theta = 1.5$, non-integer value where integer required), do not award the mark(s) for the final answer(s).
- The markscheme may use the word “their” in a description, to indicate that students may be using an incorrect value.
- If the student’s answer to the initial question clearly contradicts information given in the question, it is not appropriate to award any **FT** marks in the subsequent parts. This includes when students fail to complete a “show that” question correctly, and then in subsequent parts use their incorrect answer rather than the given value.
- Exceptions to these **FT** rules will be explicitly noted on the markscheme.
- If a student makes an error in one part but gets the correct answer(s) to subsequent part(s), award marks as appropriate, unless the command term was “Hence”.

5 Mis-read

If a student incorrectly copies values or information from the question, this is a mis-read (**MR**). A student should be penalized only once for a particular misread. Use the **MR** stamp to indicate that this has been a misread and do not award the first mark, even if this is an **M** mark, but award all others as appropriate.

- If the question becomes much simpler because of the **MR**, then use discretion to award fewer marks.
- If the **MR** leads to an inappropriate value (e.g. probability greater than 1, $\sin \theta = 1.5$, non-integer value where integer required), do not award the mark(s) for the final answer(s).
- Miscopying of students' own work does **not** constitute a misread, it is an error.
- If a student uses a correct answer, to a "show that" question, to a higher degree of accuracy than given in the question, this is NOT a misread and full marks may be scored in the subsequent part.
- **MR** can only be applied when work is seen. For calculator questions with no working and incorrect answers, examiners should **not** infer that values were read incorrectly.

6 Alternative methods

Students will sometimes use methods other than those in the markscheme. Unless the question specifies a method, other correct methods should be marked in line with the markscheme. If the command term is 'Hence' and not 'Hence or otherwise' then alternative methods are not permitted unless covered by a note in the mark scheme.

- Alternative methods for complete questions are indicated by **METHOD 1**, **METHOD 2**, etc.
- Alternative solutions for parts of questions are indicated by **EITHER . . . OR**.

7 Alternative forms

Unless the question specifies otherwise, **accept** equivalent forms.

- As this is an international examination, accept all alternative forms of **notation** for example 1.9 and 1,9 or 1000 and 1,000 and 1.000.
- Do not accept final answers written using calculator notation. However, **M** marks and intermediate **A** marks can be scored, when presented using calculator notation, provided the evidence clearly reflects the demand of the mark.
- In the markscheme, equivalent **numerical** and **algebraic** forms will generally be written in brackets immediately following the answer.
- In the markscheme, some **equivalent** answers will generally appear in brackets. Not all equivalent notations/answers/methods will be presented in the markscheme and examiners are asked to apply appropriate discretion to judge if the student work is equivalent.

8 Format and accuracy of answers

If the level of accuracy is specified in the question, a mark will be linked to giving the answer to the required accuracy. If the level of accuracy is not stated in the question, the general rule applies to final answers: *unless otherwise stated in the question all numerical answers must be given exactly or correct to three significant figures*.

Where values are used in subsequent parts, the markscheme will generally use the exact value, however students may also use the correct answer to 3 sf in subsequent parts. The markscheme will often explicitly include the subsequent values that come “*from the use of 3 sf values*”.

Simplification of final answers: Students are advised to give final answers using good mathematical form. In general, for an **A** mark to be awarded, arithmetic should be completed, and any

values that lead to integers should be simplified; for example, $\sqrt{\frac{25}{4}}$ should be written as $\frac{5}{2}$. An

exception to this is simplifying fractions, where lowest form is not required (although the numerator and the denominator must be integers); for example, $\frac{10}{4}$ may be left in this form or written as $\frac{5}{2}$.

However, $\frac{10}{5}$ should be written as 2, as it simplifies to an integer.

Algebraic expressions should be simplified by completing any operations such as addition and multiplication, e.g. $4e^{2x} \times e^{3x}$ should be simplified to $4e^{5x}$, and $4e^{2x} \times e^{3x} - e^{4x} \times e^x$ should be simplified to $3e^{5x}$. Unless specified in the question, expressions do not need to be factorized, nor do factorized expressions need to be expanded, so $x(x+1)$ and $x^2 + x$ are both acceptable.

Please note: intermediate **A** marks do NOT need to be simplified.

9 Calculators

A GDC is required for this paper, but if you see work that suggests a student has used any calculator not approved for IB DP examinations (eg CAS enabled devices), please follow the procedures for malpractice.

10 Presentation of student work

Crossed out work: If a student has drawn a line through work on their examination script, or in some other way crossed out their work, do not award any marks for that work unless an explicit note from the student indicates that they would like the work to be marked.

More than one solution: Where a student offers two or more different answers to the same question, an examiner should only mark the first response unless the student indicates otherwise. If the layout of the responses makes it difficult to judge, examiners should apply appropriate discretion to judge which is “first”.

1. (a) $4 \times \pi \times 6371^2$ (A1)
 $= 510000000 (510064471.9..., 510 \text{ million}, 5.1 \times 10^8, 162000000\pi) \text{ km}^2$ A1
 [2 marks]

- (b) EITHER

$$\frac{510064471.9 - 148900000}{510064471.9} \times 100$$
 (A1)(M1)

Note: Award **A1** for subtracting 148.9 million from their answer to (a), and **M1** for attempt to find a percentage.

OR

$$100 - \frac{148900000}{510064471.9} \times 100$$
 (A1)(M1)

Note: Award **A1** for calculating the percentage of land and **M1** for subtracting their percentage from 100 or their decimal answer from 1.

THEN

$$70.8 (70.8076...) \%$$
 A1
 [3 marks]
 Total [5 marks]

2. (a) attempt to use sine rule with given measurements (M1)

$$\frac{29}{\sin \hat{CAB}} = \frac{35}{\sin 40} \quad (A1)$$

$$(\hat{CAB} =) 32.2^\circ (32.1809\dots) \quad A1$$

[3 marks]

- (b) angle B = 108 (107.819...) seen anywhere (A1)

Note: This **A1** can be awarded for a correct AC value seen (51.8382...).

attempt to substitute into $\frac{1}{2}ab\sin C$ with values from triangle (M1)

$$\frac{1}{2} \times 35 \times 29 \times \sin 107.819\dots$$

$$483 (483.154\dots) \text{ m}^2 \quad A1$$

[3 marks]

Total [6 marks]

3. (a) $120 < n \leq 140$ A1

[1 mark]

- (b) correct GDC work leading to at least one correct value or attempt to substitute into formula for mean of a data set (both a numerator and a denominator must be shown) (M1)

(i) 120 (120.1) grams A1

(ii) 18.1 (18.1104...) grams A1

[3 marks]

Note: Award **A0** for an answer of 18.2 (18.1559...) from using the sample standard deviation.

- (c) you do not know every number guessed (only that it is somewhere between each pair of limits) / only ranges of guesses are given R1

OR

the data is grouped / the middle value of the group is used (instead of the guesses) / averages (or medians) of each group are used R1

[1 mark]

Total [5 marks]

4. (a) (i) $r = 0.773$ (0.773178...) **A1**

(ii) $n = 1.99T - 14.3$ ($n = 1.99429...T - 14.2680...$) **A2**

[3 marks]

Note: Award **A1A0** for any one of these errors; award **A0A0** if two or more apply:

- One of the values is incorrect
- Both values are correct, but not written as an equation
- Values are switched
- Variables are switched
- Either value rounded to a lower degree of accuracy, e.g. $n = 1.99T - 14, n = 2T - 14$

(b) (i) $1.99429... \times 30 - 14.2680...$ **(A1)**

Note: Award **(A1)** for substituting 30 into their equation.

$= 45.6$ (45.5608...) **A1**

(ii) any of the following: (this list is not exhaustive)

- 30 degrees is greater than the highest temperature in the table (or any reason that communicates “extrapolation”)
- calculated value is not an integer / number of children must be a whole number
- correlation is not that strong
- a statement about another reasonable factor that could affect the number of children such as “there could be more children if it is a weekend” / “it could be raining” / “children may not go out when the temperature is that high”, etc.)

R1

Note: Do not accept a generic criticism of any mathematical model such as “models are never accurate”, “there are assumptions being made”, “the data only represents 8 days and cannot be generalized”, etc.

[3 marks]

Total [6 marks]

5. (a) $(a =) 104\,000$ **A1**
[1 mark]

- (b) $105\,144 = 104\,000 \times b^1$ **(A1)**
 $(b =) 1.011$ **A1**

Note: Answer must be exact; a 3sf answer earns **A0** if the exact answer is not seen.

[2 marks]

- (c) $f(10) = 104\,000 \times 1.011^{10}$ **(A1)**
 $116\,023 \quad (116\,023.2\dots)$ **A1**

[2 marks]

Note: Answer must be given to the nearest integer for the final **A1** to be awarded.
 Award **A0** for an unrealistic **FT** answer that is greater than the Earth's population
 (8.3 billion or 8.3×10^9).

Total [5 marks]

6. (a) $(20, 30, 240)$ **A1A1**
[2 marks]

Note: Award **A1** for a coordinate triple that includes at least one correct coordinate. Award **A1A0** for 20, 30, 240 (i.e. no parentheses).

- (b) **METHOD 1 – Distance formula in 3D**
 recognition that distance between two points in 3D is required **(M1)**

$$\sqrt{(20-40)^2 + (30-0)^2 + (240-160)^2}$$
 (A1)
 $= 87.7 \quad (87.7496\dots, \sqrt{7700}, 10\sqrt{77}) \text{ cm}$ **A1**

METHOD 2 – Using Pythagoras theorem twice

- (FB =) $\sqrt{(40-20)^2 + (0-30)^2} (= 36.0555\dots)$ **AND** (SB =) $240-160 (= 80)$ **(A1)**
 (FS =) $\sqrt{36.0555^2 + 80^2}$ **(A1)**
 (FS =) $87.7 \quad (87.7496\dots, \sqrt{7700}, 10\sqrt{77}) \text{ cm}$ **A1**

[3 marks]

Total [5 marks]

7. (a) $\frac{62}{180} \left(\frac{31}{90}, 0.344444\dots, 34.4\% \right)$ **A1**
[1 mark]

- (b) $\frac{19}{53} (0.358490\dots, 35.8\%)$ **A2**
[2 marks]

Note: Award **A1A0** for correct denominator seen if numerator is incorrect.

- (c) $(H_0 :)$ age is independent of (preferred type of) drink **A1**
[1 mark]

Note: Do not accept “correlated” or “related”.

- (d) GDC work leading to at least one correct answer **(M1)**

- (i) $(\chi^2 =) 3.66 (3.65997\dots)$ **A1**

- (ii) $(p\text{-value} =) 0.160 (0.160415\dots)$ **A1**
[3 marks]

- (e) $3.65997\dots < 9.210$ **OR** $0.160415\dots > 0.01$ **R1**

Note: To award FT marks for a comparison using their p -value, p must be between 0 and 1 inclusive.

- so, insufficient evidence / fail to reject null hypothesis **A1**
 (age is independent of preferred type of drink)

Note: Do not award **R0A1**. Their conclusion must be consistent with their χ^2 or their p -value and their hypothesis.

[2 marks]

Total [9 marks]

8. (a) recognizing that sequence is geometric (M1)
 $3 \times 1.14^{10-1}$ (A1)
 $= 9.76 \text{ (9.75584...) cm}$ A1

[3 marks]

Note: If a list of terms is shown, award **M1** for a list of at least three terms that form a geometric sequence (not necessarily correct), **A1** for a list of at least three correct terms and evidence that 10th term is required, **A1** for a correct answer.

(b) **METHOD 1**

190(cm) seen (or 1.9×100) (A1)

attempt to write an inequality using their 190 or 1.9 or 19 (M1)

$$3 \times 1.14^{n-1} > 190$$

$$n > 32.6604...$$

(n =) 32.7 (32.6604...) A1

Note: Accept a 2sf answer of 33.

METHOD 2

$n = 32$ then height is 174(174.249...), $n = 33$ then height is 199(198.644...) (M1)(A1)

(n =) 33 A1

Note: Award **M1** for attempting to find both values, **A1** for both correct answers, **A1** for a clearly stated final answer.
 Accept an equivalent method to a greater degree of accuracy, e.g. 32.6 and 32.7 .

[3 marks]

Total [6 marks]

9. (a) **EITHER**

$$N = 60$$

$$I\% = 1.8$$

$$PV = (\pm)2000$$

$$(PMT = 0)$$

$$P / Y = 12$$

$$C / Y = 12$$

(M1)(A1)

Note: Award **M1** for attempt to use financial app with at least three entries (not necessarily correct) and **A1** for all entries correct.

OR

$$N = 5$$

$$I\% = 1.8$$

$$PV = (\pm)2000$$

$$(PMT = 0)$$

$$P / Y = 1$$

$$C / Y = 12$$

(M1)(A1)

Note: Award **M1** for attempt to use financial app with at least three entries (not necessarily correct) and **A1** for all entries correct.

OR

attempt to substitute given values into compound interest formula

(M1)

$$(FV =) 2000 \times \left(1 + \frac{1.8}{100 \times 12} \right)^{12 \times 5}$$

(A1)

THEN

$$(FV =) \$2188.20$$

A1

Note: Answer must be correct to two decimal places for the final **A1** to be awarded.
Award at most **(M1)(A1)A0** for a final answer of $-\$2188.20$.

[3 marks]

(b) **EITHER**

$$I\% = 1.8$$

$$PV = (\pm) 2000$$

$$(PMT = 0)$$

$$FV = (\mp) 5000$$

$$P / Y = 12$$

$$C / Y = 12$$

(A1)

Note: Award **A1** for all entries correct.

OR

$$I\% = 1.8$$

$$PV = (\pm) 2000$$

$$(PMT = 0)$$

$$FV = (\mp) 5000$$

$$P / Y = 1$$

$$C / Y = 12$$

(A1)

Note: Award **A1** for all entries correct.

OR

$$5000 = 2000 \times \left(1 + \frac{1.8}{100 \times 12} \right)^{12 \times n}$$

(A1)

THEN

$$N = 611.318... \text{ months, } N = 50.9 \text{ years}$$

$$51 \text{ years}$$

A1

Note: Answer must be an integer for the final **A1** to be awarded, unless rounding was already penalized in part (a).

[2 marks]

(c) $N = 24$

$I\% = 3.8$

$PV = (-)2600$

$FV = 0$

$P/Y = 12$

$C/Y = 12$

(A1)(A1)

Note: Award **A1** for 2600 , **A1** for all other entries correct.

$(PMT =) \$112.67$

A1

Note: Answer must be correct to two decimal places for the final **A1** to be awarded, unless rounding was already penalized in part (a) or part (b).
Accept an answer \$112.68 given the context.

[3 marks]

Total [8 marks]

10. (a) H_0 : the results follow a uniform distribution / the spinner is unbiased
/ the results match the expected frequencies

- H_1 : the results do not follow a uniform distribution / the spinner is biased
/ the results do not match the expected frequencies

A1

[1 mark]

- (b) 15

A1

[1 mark]

- (c) (i) 0.112 (0.111610...)

A2

- (ii) $0.111610... > 0.10$

R1

Note: Award FT marks only if their p -value is between 0 and 1 inclusive.

(insufficient evidence to reject the null hypothesis)

(there is sufficient evidence that) the spinner is unbiased / the results follow a uniform distribution / the results match the expected frequencies

A1

Note: Do not award **R0A1**. The conclusion must be contextual to award **A1**.
Their conclusion must be consistent with their p -value and their hypothesis.

[4 marks]

Total [6 marks]

11. (a) attempt to use the formula for nth term of arithmetic sequence with the given values (M1)

$$(u_{42} =) 18 + (42 - 1)7$$

$$= 305$$

A1

[2 marks]

(b) $9475 = \frac{n}{2}(2 \times 18 + (n - 1) \times 7)$ (A1)

$$3.5n^2 + 14.5n - 9475 = 0 \quad \text{OR} \quad 7n^2 + 29n - 18950 = 0 \quad \text{A2}$$

Note: Award **A1** for at least one correct term (with the exception of -9475) and equating to 0.

[3 marks]

- (c) an attempt to solve the quadratic equation found in (b). (M1)

e.g. $(n - 50)(7n + 379)$, sketch

$$(n =) 50$$

A1

Note: Award **M1A0** if final answer is “50 or -54.1428...” i.e. both answers given. The final **A1ft** is awarded only if n is an integer due to the context.

[2 marks]

Total [7 marks]

12. recognition of need to integrate (e.g. reverse power rule or integral symbol or integrating at least one term correctly) (M1)

$$f(x) = 2x^3 - x^2 + 3x (+c) \quad \text{(A1)(A1)}$$

Note: Award **A1A1** if all three x terms correct (condone omission of +c), **A1A0** if only one or two correct terms or if additional terms are seen, **A0A0** otherwise.

substituting (2,12) into their $f(x)$ (must include constant of integration) (M1)

$$12 = 2(2)^3 - 2^2 + 3(2) + c$$

Note: Award **M0** for substituting (2, 12) into the given derivative.

$$c = -6$$

$$(f(x) =) 2x^3 - x^2 + 3x - 6 \quad \text{A1}$$

Total [5 marks]

13. attempt to find gradient between any two given points (M1)

(gradient of AB =) $\frac{10-2}{1-5}$ (A1)

= -2

(equation of AB is) $y-10 = -2(x-1)$ OR $y-2 = -2(x-5)$ OR $y = -2x+12$ A1

EITHER

attempt to find the negative reciprocal of their gradient (M1)

(gradient of CD =) 0.5

(equation of CD is) $y-5 = 0.5(x-4)$ OR $y = 0.5x+3$ A1

Note: A1 can be awarded for a correct equation for CD even if A0 was previously awarded for an incorrect or missing equation of AB.

equating the expressions of their two equations to find intersection point or a sketch of the graph of the simultaneous equations (M1)

OR

attempt to find an expression for CX where X is any point (x,y) on (AB) (M1)

$CX = \sqrt{(4-x)^2 + (5-y)^2} = \sqrt{(4-x)^2 + (-7+2x)^2}$ A1

attempt to use GDC to find minimum value of CX (M1)

$x = 3.6$

THEN

(3.6,4.8) A1

Total [7 marks]