

Markscheme

May 2026

**Mathematics: applications and
interpretation**

Standard level

Paper 2

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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) (i) attempt to find the number of rolls in a row (M1)
- $$\frac{8}{1.4} = 5.71428\dots \text{ round down to } 5$$
- attempt to find the number of rows (M1)
- $$\frac{4.8}{0.6} = 8$$
- $$5 \times 8$$
- 40 rolls A1

Note: Award **MOM0A0** for area of garden divided by area of a roll = 45. Use of area does not satisfy the given information

- (ii) 1×4.8
 4.8 m^2 A1
 [4 marks]
- (b) attempt to find the number of flats using their answer to a(ii) (M1)
- $$\frac{4.8}{0.6} = 8 \text{ and } \frac{4.8}{0.4} = 12 \text{ OR } \frac{4.8}{(0.4 \times 0.6)}$$
- 20 flats A1
 [2 marks]
- (c) $5(40) + 2(20)$ (M1)
 $\$240$ A1
 [2 marks]

continued...

Question 1 continued

- (d) attempting to arrange rolls and flats for phase two **M1**
 one column with 2 rolls and 5 flats, $2(1.4) + 5(0.4) = 4.8$
 one column with 8 flats, $8(0.6) = 4.8$
 2 rolls and 13 flats needed **A1**
- EITHER**
 $2(5) + 13(2) = 36$
 $36 < 40$ **R1**
- OR**
 $42(5) + 13(2) = 236$
 $236 < 240$ **R1**
- THEN**
 Ayden's claim is correct OR Ayden's plan is less expensive. **AG**

Note: A diagram is sufficient for **M1**, a correct diagram is sufficient for the **A1**. The diagram must identify the remaining space .

Award **M1** if a 4.8m x 1m space is identified and an attempt is made to cover this space with rolls and flats. Award **M1** for $0.84x + 0.24y = 4.8$ seen.

The inequality is not required but is sufficient for **R1**. If the working is present and the inequality is not seen, then the **AG** must be stated.

[3 marks]

- (e) attempt to find the perimeter **(M1)**
 $2(8) + 2(4.8) = 25.6\text{ m}$
 $\frac{2560}{40}$ OR $\frac{25.6}{0.4}$ **(M1)**
 64 lights **A1**

Note: Award **M1** for division by 40. Award **A0** if perimeter is incorrect

[3 marks]

Total [14 marks]

2. (a) (i) 0.002×6 (A1)
 0.012 (A1)
(ii) attempt to subtract sum of their probabilities from 1 (M1)
 $1 - (0.085 + 0.012 + 0.004 + 0.002 + 0.001)$
 0.896 (A1)
[4 marks]

- (b) attempt to multiply probabilities by prize values (M1)
 $(0.896 \times 0 +) 0.085 \times 2 + 0.012 \times 5 + 0.004 \times 10 + \dots$ (A1)
(expectation =) 0.97 or $E(X) = -0.03$ (A1)
 $0.97 \neq 1$ or $E(X) \neq 0$ therefore, the game is not fair (R1)

Note: Award **R1** only if their $0.97 \neq 1$ or $1 - 0.97 = 0.03$ or $E(X) = -0.03$ is seen.

[4 marks]

- (c) $\frac{48}{750} \left(\frac{8}{125}, 0.064 \right)$ (A1)
[1 mark]

- (d) (i) 0.064 is not the same as 0.085 (R1)
(ii) any of the following reasons or similar:
experimental probabilities often do not exactly equal theoretical probabilities
the results may be unreliable due to the small sample size
the sample may not be representative of the entire population (R1)

Note: Small sample size, on its own, is not sufficient. A statement similar to, “only 750 in the sample means that there is insufficient data to make claims” can be awarded **R1**.

0.064 and 0.085 do not need to be explicit. A written statement is sufficient

[2 marks]

continued...

Question 2 continued

- (e) (i) H_0 : The collected data follows the distribution described by the probabilities claimed by the lottery company
 H_1 : The collected data does not follow the distribution described by the probabilities claimed by the lottery company

A1

Note: **A1** can be awarded for null hypotheses similar to the following:

The probability of winning each prize matches the company's claim
 The observed data fits with the company's claim
 The distribution of prizes is consistent with the company's stated probabilities
 The (observed) data follows the given distribution

Do not award **A1** for statements such as;
 The prize probabilities are as expected
 The probability of winning a prize is proportional to the company's claim
 Any statement referring to just the \$2 prize probability
 Any statement referring to the probabilities being 'the same', 'not different', 'equal', or 'correct/incorrect'.
 Any statement with 'correlation', 'independence', 'association', or 'relationship'

- (ii) degrees of freedom = 3 seen
 evidence of finding expected frequencies

(A1)

(M1)

Prize (USD)	0	2	5	10, 100, 500
Expected Frequency	672	63.75	9	5.25

(p -value =) 0.117 (0.116824...)

A1

- (iii) 0.116824... > 0.10

R1

There is insufficient evidence to say that the collected data does not follow the distribution described by the probabilities claimed by the lottery company

A1

Note: Follow through from their p -value if > 0 .

Award the final A mark only if their conclusions are given in context.
 The following, on their own, are not sufficient to award this mark.
 Do not reject H_0 ; accept H_0 ; reject H_1 ,

The inequality needs to be seen to award the **R1**.
 Do not award **R0A1**.

[6 marks]

Total [17 marks]

- 3) (a) (i) $f'(x) = -\frac{1}{2}x + 1$ **A1**
 (ii) $(f'(0) =) 1$ **A1**
 (iii) $(\tan^{-1}(1) =) 45^\circ$ **A1**

Note: Accept answer in radians, $\frac{\pi}{4}$, 0.785 (0.785398...).

[3 marks]

- (b) (i) $\int_0^4 \left(-\frac{1}{4}x^2 + x + 2 \right) dx$ **A1A1**

Note: **A1** for correct limits, **A1** for fully correct integral including dx .
 Award **A1A0** if brackets are missing.

- (ii) 10.666666... OR $\frac{32}{3}$ seen **A1**

Note: Their 10.666666... may be seen in b(i)
 Award **A1** for rounded 10.666... (10.67 or 10.7) seen. Do not award the final **A** mark because their multiplication by 0.003 will not exactly = 0.032.

$$10.666666... \times 0.003 \left(\frac{32}{3} \times \frac{3}{1000} \right) \quad \text{A1}$$

$$0.032 \text{ m}^3 \quad \text{AG}$$

[4 marks]

- (c) multiplying 0.032 by 1000000 **OR** multiplying by 0.00119 **(M1)**
 $(0.032)(1000000)(0.00119)$
 38.08 kg **OR** 38.1 kg **A1**

Note: Incorrect conversion of 0.032 and/or 0.00119. Award **M1** for the attempt to multiply **their** converted numbers.

[2 marks]

continued...

Question 3 continued

(d) (i) $\int_0^4 \left(-\frac{1}{8}x^2 + \frac{1}{2}x + 2 \right) dx$ (M1)

9.333333...

9.33 m² seen

A1

Note: Their 9.33 may be seen in (ii)

(ii) attempting to find the percentage change

M1

$$\frac{10.6666... - 9.3333...}{10.6666...} = 0.125 \times 100 = 12.5\% \quad (12.6\%), (12.8\%)$$

OR

$$(9.3333...)\left(\frac{3}{1000}\right)(1000000)(0.00119) = 33.32$$

$$\frac{38.08 - 33.32}{38.08} = 0.125 \times 100 = 12.5\%$$

OR

$$10.6666... \times 0.85 = 9.0666... \quad 9.07 < 9.33 \text{ or } 9.07 \neq 9.33$$

A1

(He reduced the area by) less than 15%

Demarius is incorrect.

A1

[5 marks]

(e) (i) $g'(x) = -\frac{1}{4}x + \frac{1}{2}$ (A1)

$$\int_0^4 \left(\sqrt{1 + \left(-\frac{1}{4}x + \frac{1}{2} \right)^2} \right) dx$$
 (M1)

Note: Award **M1** for correct substitution of **their** $g'(x)$.

4.160915...

4.16 m

A1

(ii) 4.16 + 2 + 2 + 4

12.2 m (12.1609...)

A1

[4 marks]

Total [18 marks]

4. (a) attempt to find amount monthly salary OR multiply by 4% (M1)
 $60000 \div 12 \times 0.04$
 200 USD A1

[2 marks]

- (b) evidence of using finance app in GDC (M1)
 $N = 480$

$$I\% = 9.5$$

$$PV = 0$$

$$PMT = \pm 400$$

(A1)

$$P/Y = 12$$

$$C/Y = 12$$

$$2174517$$

A1

Note: Follow through from (a).

Final answer must be to nearest \$

[3 marks]

- (c) (i) any one of the following:
 the investment account increases at a rate less than 9.5%
 her salary decreases
 Waldron Industries stop matching her deposits
 she works there for less than 40 years/she loses her job R1

- (ii) any one of the following or any reasonable statement as long as a different assumption than the candidate's response for part (i):
 the investment account increases at a rate more than 9.5%
 her salary increases
 she works for more than 40 years R1

Note: Reasons must be explicitly tied to the assumptions in part (b).

Reason given in (c)(ii) must address a different assumption than the one addressed in (c)(i)

[2 marks]

continued...

Question 4 continued

(d) $N = 120$

$I\% = 9.5$

$PV = 0$

$PMT = \pm 400$

(M1)

$P/Y = 12$

$C/Y = 12$

79632.272... seen

(A1)

Note: Award **M1** for an attempt to find amount of the investment after 10 years, including attempts using the compound interest formula.

Follow through for incorrect PV seen in part (b)

79632.272 is an intermediate solution. Award **A1** for either unrounded value or rounded to nearest \$.

Do not accept 3sf answers. Follow through with 3sf working within this part.

evidence of subtracting 50000 from **their** 79632.272...

(M1)

$N = 360$

$I\% = 9.5$

$PV = \pm 29632.272...$

$PMT = \pm 400$

(A1)

$P/Y = 12$

$C/Y = 12$

1319773.676... (1319774) seen

(A1)

Note: Award first **A1** for correct list values, regardless of sign.

29632.272... and 1319773.676 are intermediate solutions. Award **A1** for either unrounded value or rounded to nearest \$. Do not accept 3sf answers.

If their answer in the first part of (d) is less than 50000, award **M0A0A0** for any intermediate answer and **A0** for the final mark.

If their answer to the first part of (d) is greater than 50000, award the final **A1** below for correct subtraction of **their** intermediate answer from **their** (b).

The final answer must be to nearest \$. Do not penalise the unrounded final answer if already penalised in (b)

FT can be awarded within the question part for the final three marks.

continued...

Question 4 continued

(Kelley will have) \$854743 (854748) less

A1
[6 marks]

(e) $N = 360$

$I\% = 9.5$

$PV = \pm 29\,632.272\dots$

$FV = \mp 2\,000\,000$

(A1)

$P/Y = 12$

$C/Y = 12$

734.586... (734.588...) seen

(A1)

(Kelley will need to increase her monthly deposits by) \$335

A1

Note: Award the first **A1** for correct values in the list, regardless of sign.

Award the final **A1** for deducting their original payment of 400 from **their** 734.586. Award **A1A0A1FT** for a final answer of \$833. Award **A0** for deducting 200.

Final answer must be to nearest \$. Do not penalise an unrounded final answer if already penalised in (b) or (d).

If their value after 10 years in part (d) was less than 50000, no marks can be awarded

[3 marks]

Total [16 marks]

5. (a) 12.5 (hours)

A1
[1 mark]

(b) $b = \frac{360}{12.5}$ **OR** $b = \frac{2\pi}{12.5}$ **(M1)**

$b = 28.8$ **OR** $b = 0.502654\dots$ **(A1)**

$d\left(\frac{57.5 + 50.5}{2}\right) = 54$ **(A1)**

$|a|\left(\frac{57.5 - 50.5}{2}\right) = 3.5$ **(A1)**

$w(t) = -3.5\cos(28.8t) + 54$ or $w(t) = -3.5\cos(0.502654t) + 54$ **A1**

Note: Condone use of $f(x)$ and x .

Award a maximum of **M1A1A1A1A0** for a positive 3.5

Award **A0A1FT** if the values for a and d are reversed.

[5 marks]

(c) setting their $w(t)$ equal to 53 **(M1)**

$53 = -3.5\cos(28.8x) + 54$

$(t =) 2.55 \text{ (2.54855...)} \text{ hours}$ **A1**

Note: For models where the a value is positive, or where the water level is above 53 feet at $t = 0$:

- Award at most **M1A0** for an answer of midnight or $t = 0$.
- Award at most **M1A1FT** for answers where the student has found the first time when the water rises above 53 again. For example, if $a = 3.5$ this would be $t = 8.79855\dots$

[2 marks]

continued...

Question 5 continued

- (d) 9.95144... – 2.54855... (M1)
 7.40 (7.40288...) hours A1

Note: For a function with a negative 3.5, award **M1** for subtraction of 2 values for $t < 12$, when $w(t) \geq 53$.

For a function with positive 3.5, award **M1** for the sum of 2 time periods when $w(t) \geq 53$.

[2 marks]

- (e) attempt to find out how many hours it will take the *Aimmika* to reach the port of Savannah (M1)
 $550 \div 21$
 26.1904... hours (A1)
 evidence of attempting to find $w(t) = 53$ when $t > 26.1904...$ (M1)
 $t = 27.5485...$ (A1)
 (the *Aimmika* must wait a minimum of) 1.36 (1.35808...) hours OR
 81.5 (81.4848...) minutes A1

Note: Award **M0A0A0** for the final 3 marks for any model where their $w(t) > 53$ at

[5 marks]

Total [15 marks]