Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2025

Mathematics

Assessment Unit AS 2

assessing

Applied Mathematics

[SMT21]

TUESDAY 27 MAY, AFTERNOON

MARK SCHEME

General Marking Instructions

GCE Advanced/Advanced Subsidiary (AS) Mathematics

Introduction

The mark scheme normally provides the most popular solution to each question. Other solutions given by candidates are evaluated and credit given as appropriate; these alternative methods are not usually illustrated in the published mark scheme.

The marks awarded for each question are shown in the right-hand column and they are prefixed by the letters M, W and MW as appropriate. The key to the mark scheme is given below:

M indicates marks for correct method.

W indicates marks for working.

MW indicates marks for combined method and working.

The solution to a question gains marks for correct method and marks for accurate working based on this method. Where the method is not correct no marks can be given.

A later part of a question may require a candidate to use an answer obtained from an earlier part of the same question. A candidate who gets the wrong answer to the earlier part and goes on to the later part is naturally unaware that the wrong data is being used and is actually undertaking the solution of a parallel problem from the point at which the error occurred. If such a candidate continues to apply correct method, then the candidate's individual working must be followed through from the error. If no further errors are made, then the candidate is penalised only for the initial error. Solutions containing two or more working or transcription errors are treated in the same way. This process is usually referred to as "follow-through marking" and allows a candidate to gain credit for that part of a solution which follows a working or transcription error.

Positive marking

It is our intention to reward candidates for any demonstration of relevant knowledge, skills or understanding. For this reason we adopt a policy of following through their answers, that is, having penalised a candidate for an error, we mark the succeeding parts of the question using the candidate's value or answers and award marks accordingly.

Some common examples of this occur in the following cases:

(a) a numerical error in one entry in a table of values might lead to several answers being incorrect, but these might not be essentially separate errors;

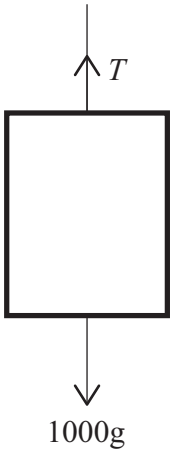
(b) readings taken from a candidate's inaccurate graphs may not agree with the answers expected but might be consistent with the graphs drawn.

When the candidate misreads a question in such a way as to make the question easier only a proportion of the marks will be available (based on the professional judgement of the examining team).

Section A : Mechanics

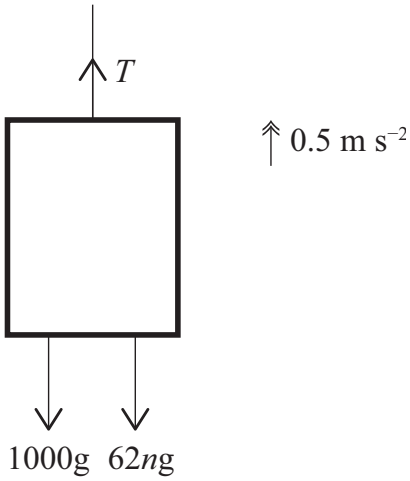
				AVAILABLE MARKS
1	**(i)**	$\mathbf{v} = \mathbf{u} + \mathbf{a}t$	M1	
		$\mathbf{v} = \mathbf{0} + 5(3\mathbf{i} + 4\mathbf{j})$	W1	
		$\mathbf{v} = (15\mathbf{i} + 20\mathbf{j})$ m s^{-1}	W1	
	(ii)	$\mathbf{s} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$	M1	
		$\mathbf{s} = \mathbf{0}(5) + \frac{1}{2}(3\mathbf{i} + 4\mathbf{j})\,5^2$	W1	
		$\mathbf{s} = \frac{25}{2}(3\mathbf{i} + 4\mathbf{j})$		
		$\mathbf{s} = \left(\frac{75}{2}\mathbf{i} + 50\mathbf{j}\right)$m	W1	
		Distance = $\lvert\mathbf{s}\rvert = \sqrt{\left(\frac{75}{2}\right)^2 + 50^2}$	M1	
		Distance = 62.5m	W1	
		Alternative Solution		
		$\mathbf{s} = \frac{1}{2}t\,(\mathbf{u} + \mathbf{v})$	M1	
		$\mathbf{s} = \frac{1}{2}(5)(\mathbf{0} + 15\mathbf{i} + 20\mathbf{j})$	W1	
		$\mathbf{s} = \frac{5}{2}(15\mathbf{i} + 20\mathbf{j})$		
		$\mathbf{s} = \left(\frac{75}{2}\mathbf{i} + 50\mathbf{j}\right)$m	W1	
		Distance = $\lvert\mathbf{s}\rvert = \sqrt{\left(\frac{75}{2}\right)^2 + 50^2}$	M1	
		Distance = 62.5 m	W1	
	(iii)	Displacement from O = $(-6\mathbf{i} + 2\mathbf{j}) + \left(\frac{75}{2}\mathbf{i} + 50\mathbf{j}\right)$	M1	
		Displacement from O = $\left(\frac{63}{2}\mathbf{i} + 52\mathbf{j}\right)$m	W1	10
2	**(i)**	Velocity $= \frac{6 - 8}{1 - 0.75}$	M1	
		Velocity $= -8$ km h^{-1}	W1	
	(ii)	Consider $t = 1.5$ to $t = 2$:		
		Velocity $= \frac{0 - 6}{2 - 1.5} = -12$ km h^{-1}	M1	
		Now consider $t = 2$ to $t = 2.3$:		
		Velocity $= \frac{s - 0}{2.3 - 2}$	MW1	
		$-12 = \frac{s}{0.3}$	MW1	
		$s = -3.6$ km	W1	6

3 (i)



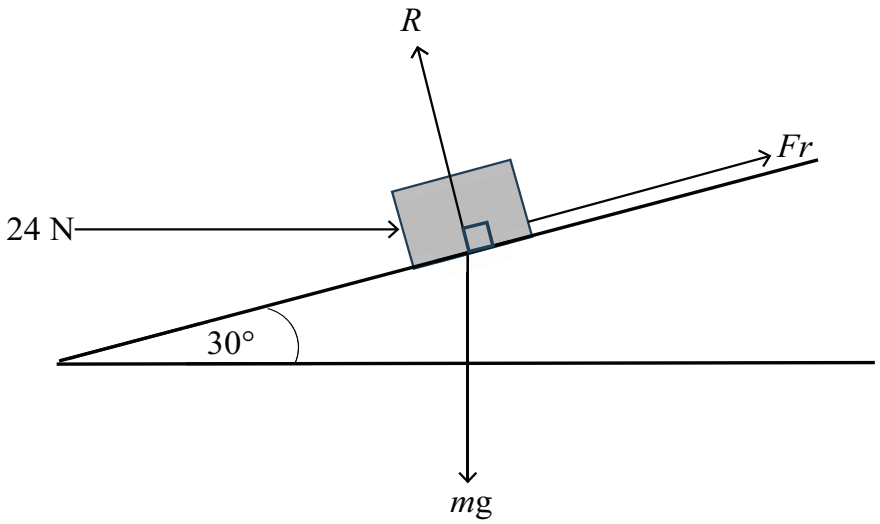
$T - 1000g = 1000(0)$	MW1	
$T = 9800$ N	W1	

(ii) Let n represent the maximum number of passengers the lift can safely carry.



$T - 1000g - 62ng = (1000 + 62n)0.5$	M1 MW2	
$T \leqslant 18000$		
$(1000 + 62n)0.5 + 1000g + 62ng \leqslant 18000$	W1	
$500 + 31n + 9800 + 607.6n \leqslant 18000$		
$638.6n \leqslant 7700$		
$n \leqslant 12.0576$	W1	
$n = 12$ passengers	MW1	8

AVAILABLE MARKS

			AVAILABLE MARKS
4	**(i)**		
		MW2	
	(ii)	Resolve (parallel to plane): $Fr + 24\cos 30° = mg\sin 30°$ M2 MW1	
		Resolve (perpendicular to plane): $R = mg\cos 30° + 24\sin 30°$ M1 MW1	
		$Fr = \mu R$	
		$Fr = \frac{2}{9}(mg\cos 30° + 24\sin 30°)$ M1	
		$24\cos 30° + \frac{2}{9}(mg\cos 30° + 24\sin 30°) = mg\sin 30°$ M1 W1	
		$12\sqrt{3} + \frac{\sqrt{3}}{9}mg + \frac{8}{3} = \frac{1}{2}mg$	
		$\left(\frac{1}{2} - \frac{\sqrt{3}}{9}\right)mg = 12\sqrt{3} + \frac{8}{3}$	
		$m = 7.7808...$	
		$m = 7.78$ kg W1	11
		Section A	**35**

Section B : Statistics

AVAILABLE MARKS

5 **(i)** Any **three** from:

- data may be missing
- there may be outliers
- some data may be in an incorrect format
- there may be errors in the data MW3

(ii) A histogram is not appropriate for displaying the nationality of visitors to NI as the data is not numerical. MW1

(iii) Joan's method is likely to give an inaccurate result as there are probably more visitors in July than most other months of the year. MW1 5

6 **(i)** $\bar{t} = \dfrac{28 \times 1.5 + 72 \times 4.5 + 7.5a + 8 \times 10.5}{28 + 72 + a + 8} = 5.1$ M1

$$\frac{7.5a + 450}{a + 108} = 5.1 \quad \text{MW1}$$

$$7.5a + 450 = 5.1a + 550.8$$

$$2.4a = 100.8$$

$$a = 42 \quad \text{W1}$$

(ii) $\Sigma ft^2 = 28 \times 1.5^2 + 72 \times 4.5^2 + 42 \times 7.5^2 + 8 \times 10.5^2 = 4765.5$ MW1

$$s^2 = \frac{4765.5}{150} - 5.1^2 \quad \text{M1}$$

$$s^2 = 5.76 \text{ hours}^2 \quad \text{W1}$$

(iii) The data collected may not be that accurate as people may not remember exactly how long they spent waiting.
Not all patients might have access to social media. MW1 7

				AVAILABLE MARKS
7	**(i)**	The Year 13 students who study Mathematics but not Spanish.	MW1	
		$61 + 13 = 74$	MW1	
	(ii) **(a)**	P(not (H or S)) $= \dfrac{61+9}{12+8+61+13+27+9}$	MW1	
		$= \dfrac{7}{13}$	W1	
	(ii) **(b)**	P(just one of H, M or S) $= \dfrac{12+61+27}{130}$		
		$= \dfrac{10}{13}$	MW1	
	(iii)	P(S) $= \dfrac{20}{130}$, P(H) $= \dfrac{40}{130}$	MW1	
		P($S \cap H$) $= 0$ but P(S) $\times$ P(H) $\neq 0$	W1	7
8	**(i)**	$S_{xy} = 1081.2 - \dfrac{214.5 \times 107.6}{20} = -72.81$	MW1	
		$S_{xx} = 2367.8 - \dfrac{214.5^2}{20} = 67.2875$	MW1	
		$S_{yy} = 665.3 - \dfrac{107.6^2}{20} = 86.412$	MW1	
		$r = \dfrac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$		
		$r = \dfrac{-72.81}{\sqrt{67.2875 \times 86.412}}$		
		$= -0.955$	MW1	
	(ii)	Values of air quality are higher in cities with lower rates of respiratory disease.	MW1	
	(iii)	$z = 76.8 + 0.703x$ $z = 76.8 + 0.703(10.5)$ $= 84.2$ years	MW1	
	(iv)	The gradient of the regression line indicates that life expectancy increases by 0.703 years when the air quality increases by 1 unit.	MW2	8

			AVAILABLE MARKS
9	**(i)**	State **three** conditions from: • there are only two outcomes: fraudulent and not fraudulent • transactions are independent of each other • the probability that a transaction is fraudulent remains the same for all transactions • fixed number of trials, i.e. 50 transactions MW3	
	(ii) **(a)**	Let X = number of fraudulent transactions so that $X \sim \text{Bin}(50, 0.15)$	
		$P(X = 8) = {}^{50}C_8 (0.15)^8 (0.85)^{42}$ M1	
		$= 0.149$ W1	
	(ii) **(b)**	$P(X \geqslant 10) = 1 - P(X \leqslant 9)$ M1	
		$= 1 - 0.79109\ldots$ MW1	
		$= 0.209$ W1	
			8
		Section B	**35**
		Total	**70**