



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2025

Centre Number

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Candidate Number

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Mathematics

Assessment Unit AS 2

assessing

Applied Mathematics

MV24

[SMT21]

TUESDAY 27 MAY, AFTERNOON

Time

1 hour 15 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write on blank pages.

Complete in black ink only.

Do not write with a gel pen.

Questions which require drawing or sketching should be completed using an HB pencil.

Candidates must answer **all** questions from sections A and B.

Equal time should be spent on each section. Show clearly the full development of your answers.

Answers without working may not gain full credit.

Answers should be given to three significant figures unless otherwise stated.

You are permitted to use a graphic or scientific calculator in this paper.

Information for Candidates

The total mark for this paper is 70. The total available mark for each section of this paper is 35. Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

Answers should include diagrams where appropriate and marks may be awarded for them.

Take $g = 9.8 \text{ m s}^{-2}$, unless specified otherwise.

A copy of the **Mathematical Formulae and Tables booklet** is provided.

Throughout the paper the logarithmic notation used is $\ln z$ where it is noted that $\ln z \equiv \log_e z$

Answer all questions.

Section A

Mechanics

- 1** At time $t = 0$ seconds a particle is at rest at the point A.

The particle has a constant acceleration of $(3\mathbf{i} + 4\mathbf{j})\text{ms}^{-2}$

- (i)** Find the velocity of the particle when $t = 5$ [3 marks]

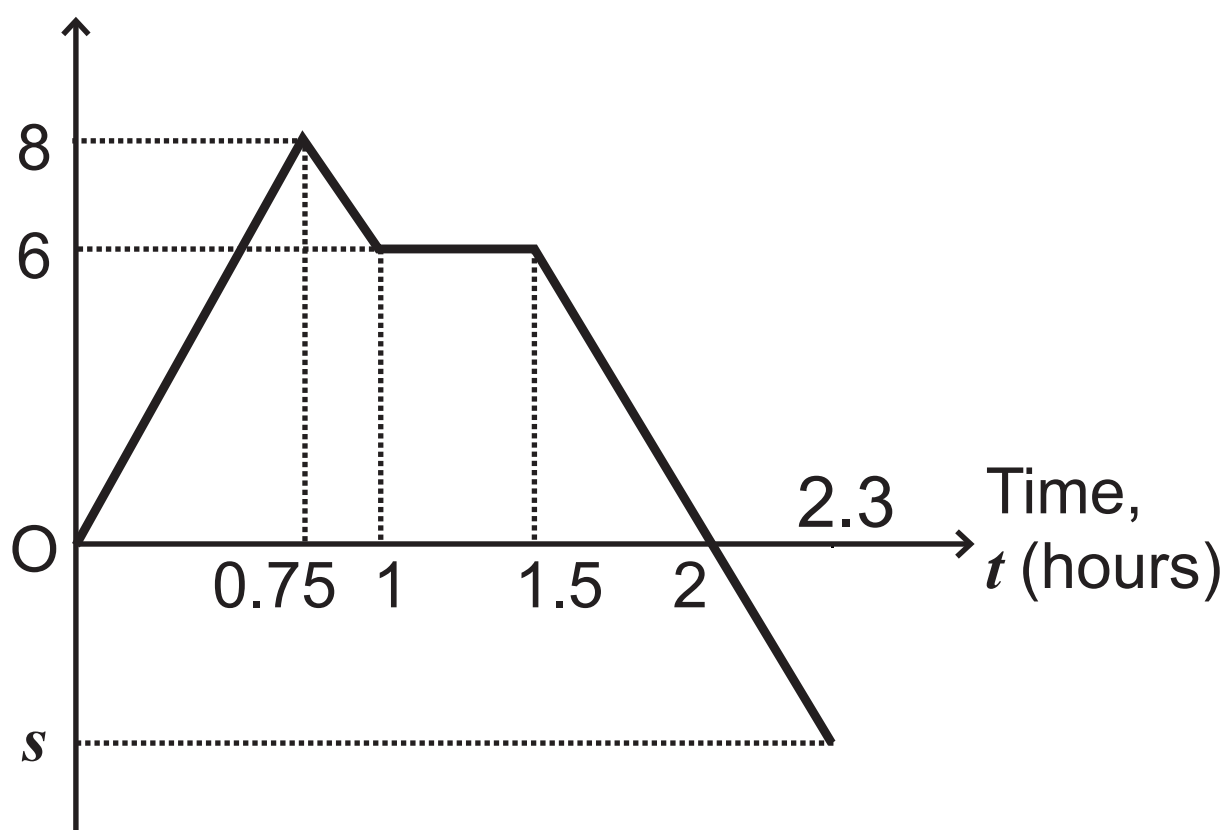
2 An athlete is training for a race.

During one of her training sessions, she runs along a horizontal path in a straight line.

Fig. 1 below shows the displacement (km) of the athlete at time t (hours) from her starting point O.

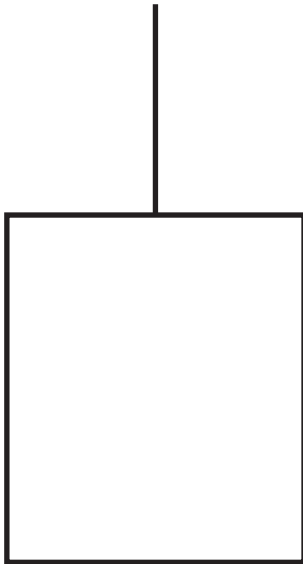
Fig. 1

Displacement
(km)



3 Fig. 2 below shows a lift of mass 1000 kg.

Fig. 2



A vertical cable attached to the top of the lift raises and lowers it.

- (i)** If the empty lift is travelling at constant speed, find the tension in the cable.
[2 marks]

Safety guidance recommends that the greatest tension the cable can withstand is 18 000 N.

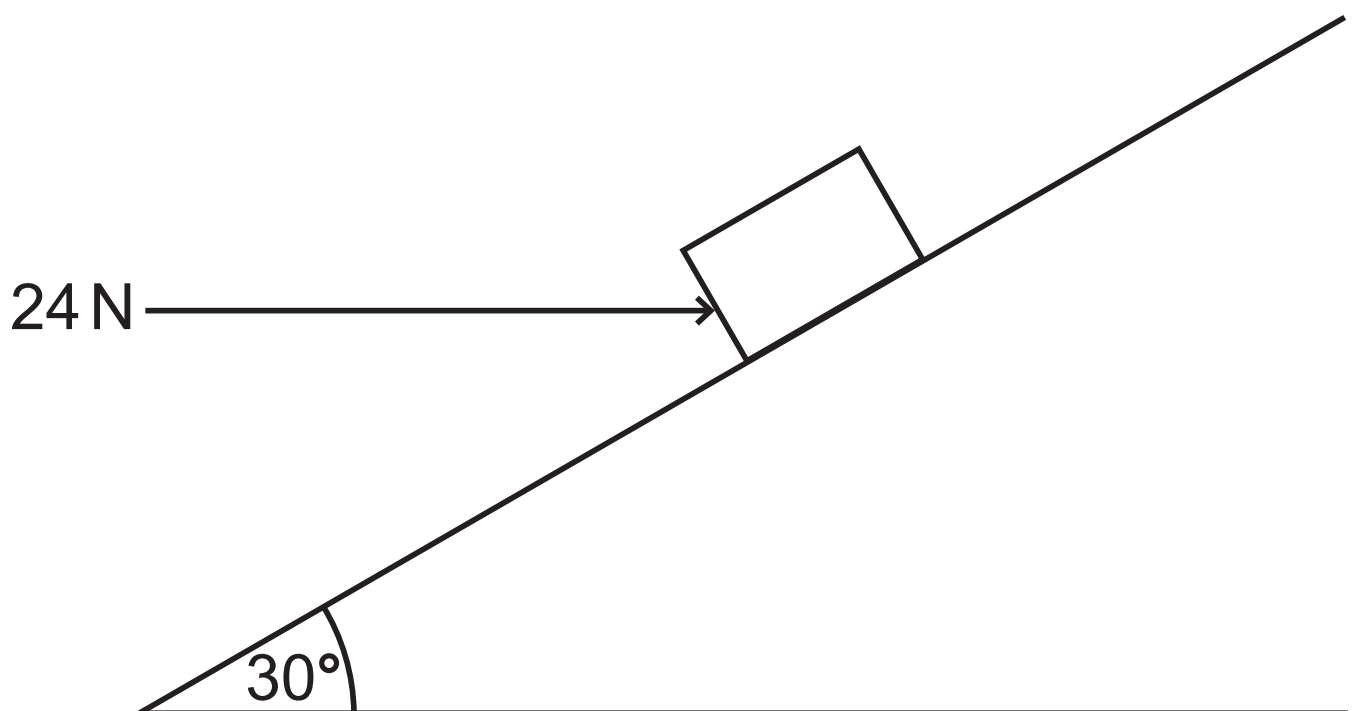
(ii) If the average mass of a passenger is 62 kg, find the maximum number of passengers that the lift can safely carry when it is accelerating upwards at 0.5 m s^{-2} [6 marks]

4 **Fig. 3** below shows a box at rest on a rough plane inclined at 30° to the horizontal.

The coefficient of friction between the box and the plane is $\frac{2}{9}$

When a horizontal force of magnitude 24 N is applied to the box, it is on the point of slipping down the plane.

Fig. 3



- (i) Complete the diagram above, showing all of the external forces acting on the box.
[2 marks]

- 6 The lengths of time, in hours, a number of patients waited at the emergency department of a hospital are shown in **Table 1** below.

Table 1

Time, t (hours)	Frequency
$0 < t \leq 3$	28
$3 < t \leq 6$	72
$6 < t \leq 9$	a
$9 < t \leq 12$	8
More than 12	0

An estimate of the mean waiting time is 5.1 hours.

- (i) Show that $a = 42$ [3 marks]

(ii) Calculate an estimate of the variance of their waiting times for these patients.
[3 marks]

These patients were asked to complete a questionnaire about their waiting times on one of the hospital's social media platforms.

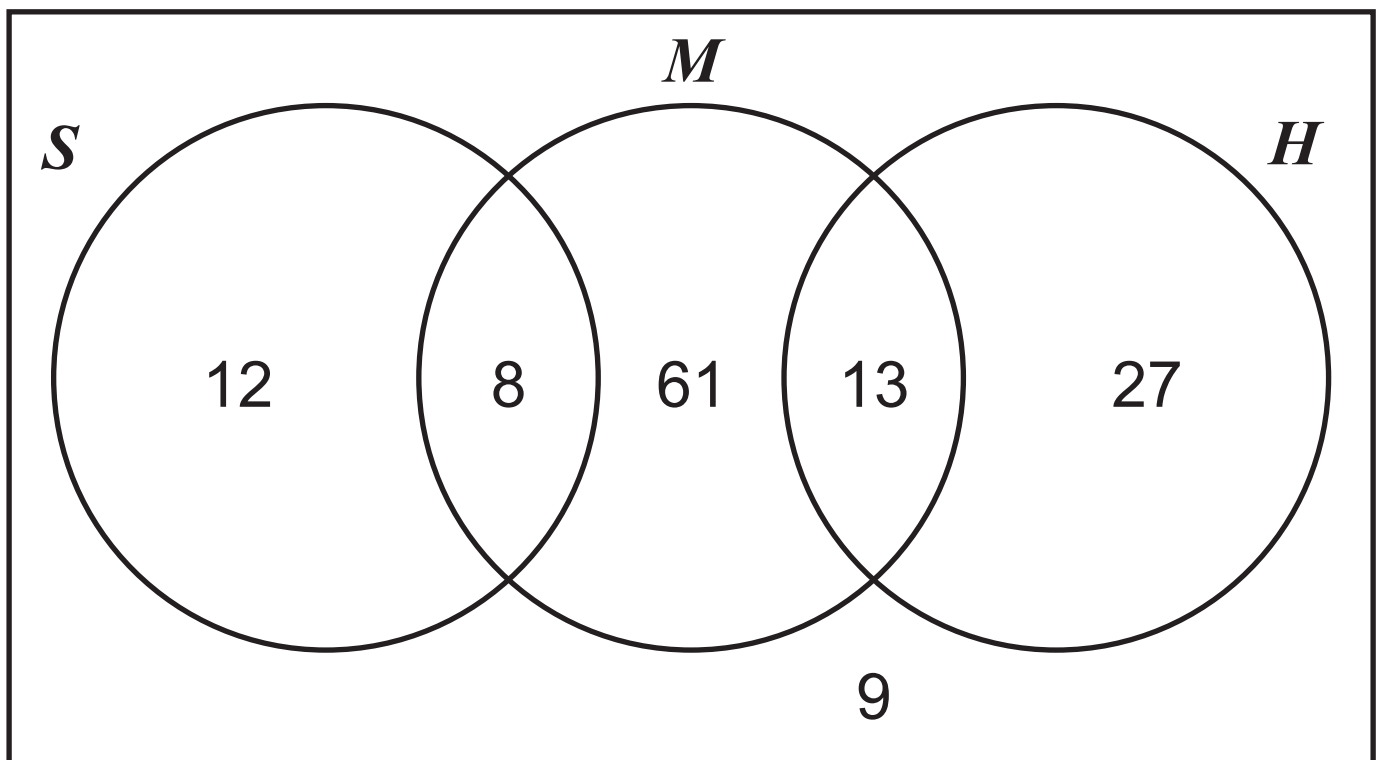
(iii) Give a critique of this method of data collection. [1 mark]

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(Questions continue overleaf)

7 The Venn diagram in **Fig. 4** below shows the number of students in Year 13 in a school who study Spanish (S), Mathematics (M) and History (H).

Fig. 4



(i) Explain the meaning of $\overline{S} \cap M$ in this context and state the number of students in this category. [2 marks]

One Year 13 student is selected at random from this school.

(ii) Find the probability that this student:

(a) does not study Spanish or History;
[2 marks]

(b) studies just one of the three subjects.
[1 mark]

(iii) Show why studying Spanish and studying History are not independent of each other. [2 marks]

- 8 David is researching a possible connection between the air quality, x , in 20 major cities and the rate of respiratory disease, y , among the population living there.

He calculates the following summary statistics:

$$\Sigma x = 214.5$$

$$\Sigma y = 107.6$$

$$\Sigma x^2 = 2367.8$$

$$\Sigma y^2 = 665.3$$

$$\Sigma xy = 1081.2$$

- (i) Calculate the product-moment correlation coefficient between the air quality and the rate of respiratory disease for these 20 cities. [4 marks]

In a different part of his research, for the same 20 cities, David obtains an equation for the line of regression of the average life expectancy, z years, on the air quality, x units.

The equation of his regression line is

$$z = 76.8 + 0.703x$$

(iii) Estimate the average life expectancy for the population of a city in which the air quality is 10.5 units. [1 mark]

(iv) Explain what is represented by the gradient of this regression line.
[2 marks]

9 Elaine runs a website selling second-hand furniture.

Over a period of time, Elaine estimates that 15% of all transactions on her website are fraudulent.

She takes a random sample of 50 transactions during one month and plans to use the binomial distribution to model the number of fraudulent transactions.

(i) State three conditions which must be satisfied for Elaine to use the binomial distribution as a model for the number of fraudulent transactions. [3 marks]

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SOURCES

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Question Number	Marks
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Total Marks	

Examiner Number

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