



GCE A LEVEL

1300U40-1

THURSDAY, 12 JUNE 2025 – AFTERNOON

MATHEMATICS – A2 unit 4

APPLIED MATHEMATICS B

1 hour 45 minutes plus your additional time allowance

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 2 _____

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	4	
2	12	
3	8	
4	16	
5	7	
6	9	
7	8	
8	7	
9	9	
Total	80	

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- a Formula Booklet;
- a calculator;
- statistical tables (RND/WJEC Publications).

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball-point pen or your usual method.

Write your name, centre number and candidate number in the spaces provided on the front cover.

Answer ALL questions.

Take **g** as **9.8 ms^{-2}**

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

(Turn over)

INFORMATION FOR CANDIDATES

The maximum mark for this paper is 80.

The number of marks is given in brackets at the end of each question or part-question.

Sufficient working must be shown to demonstrate the MATHEMATICAL method employed.

Answers without working may not gain full credit.

Unless the degree of accuracy is stated in the question, answers should be rounded appropriately.

You are reminded of the necessity for good English and orderly presentation in your answers.

REMINDER: Sufficient working must be shown to demonstrate the MATHEMATICAL method employed.

SECTION A: STATISTICS

1. A continuous random variable X is uniformly distributed over the interval $[c, d]$

The mean and variance of X are 7.5 and 3 respectively. Find the values of c and d

[4 marks]

(Turn over)

[illegible]

(Turn over)

2. Selina is sitting two multiple-choice tests.
- (a) For each question in the first test, she classifies herself as 'very confident', 'confident' or 'not confident' with probabilities **0.2**, **0.5** and **0.3** respectively.

If she is 'very confident', the probability of getting a correct answer is **0.9**

If she is 'confident', the probability of getting a correct answer is **0.7**

If she is 'not confident', the probability of getting a correct answer is **0.25**

- (i) Calculate the probability that she will get the correct answer to a randomly selected question. [3 marks]
- (ii) Given that Selina gets a correct answer to a randomly selected question, calculate the probability that she was 'not confident'. [2 marks]
-
-

[illegible]

(Turn over)

[illegible]

(Turn over)

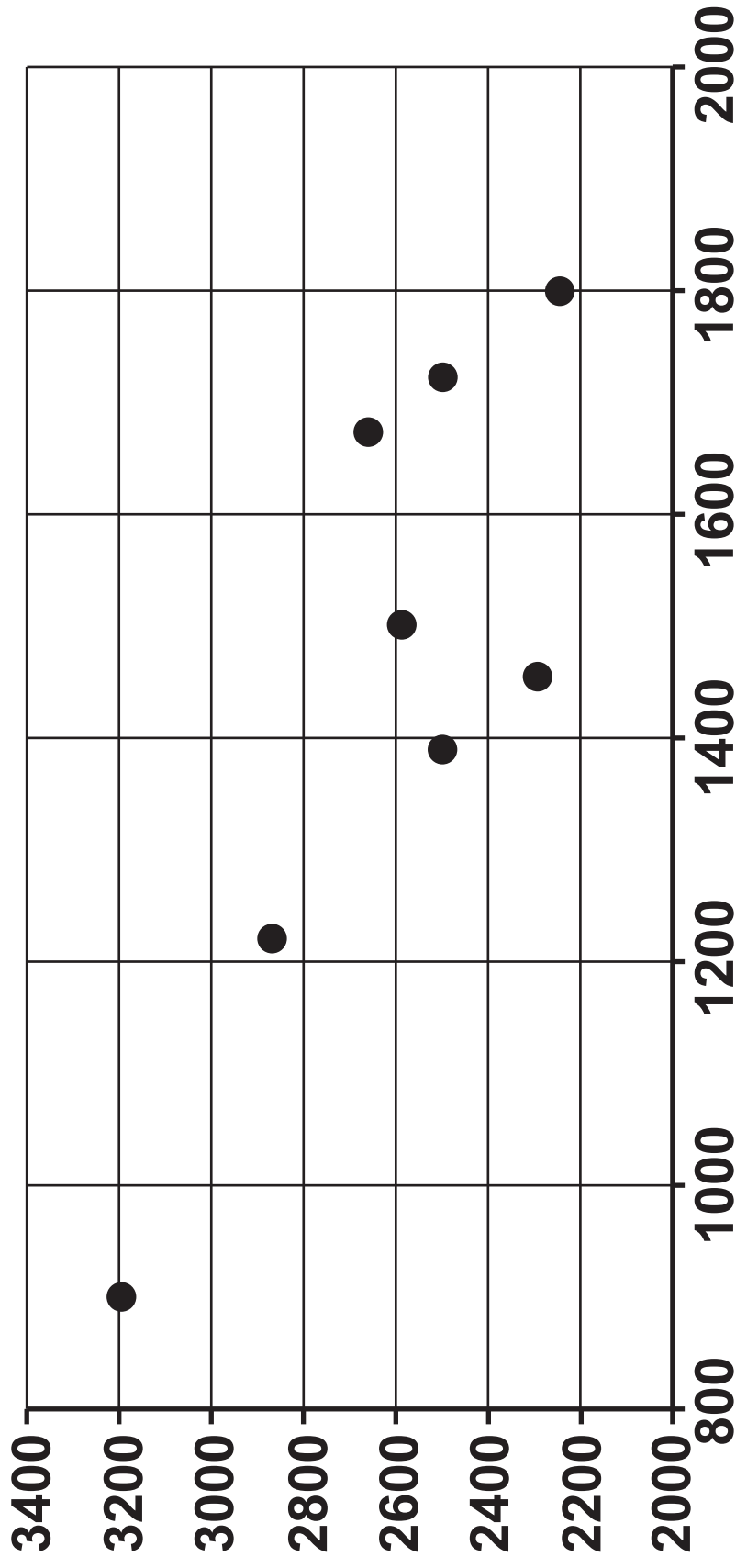
2 (b) The second test has **10** questions, each with **4** choices from which to select the answer. The probability that Selina knows the answer to a question is p , independently of any other question. If she knows the answer, she will select it. Otherwise, she will select one of the four choices at random, with equal probability for each.

(i) Calculate the smallest value of p that will give a probability of at least **0.7** of Selina getting the correct answer to a randomly selected question.
[4 marks]

(ii) At least **8** out of the **10** questions must be answered correctly to pass the test. Assuming that the probability of Selina getting the correct answer to a randomly selected question is **0.7** calculate the probability that she will pass the test.
[3 marks]

Number of delivery drivers versus Number of bus drivers

Number of delivery drivers



Number of bus drivers

3. A city councillor is investigating the decline in the number of bus drivers in the city. During her research, she finds an article claiming that delivery companies are actively recruiting bus drivers to work for them.

She collects data on the number of bus drivers and the number of delivery drivers from

8 randomly selected cities of a similar size to her city (see opposite). She calculates the correlation coefficient in order to carry out a hypothesis test.

- (a) Explain why a one-tailed test could be appropriate.

[1 mark]

(Turn over)

The product moment correlation coefficient for the data is **-0.8206**

3 (b) Carry out a one-tailed significance test at the 5% significance level. [5 marks]

[illegible]

(Turn over)

3 (c) (i)

Suggest a reason why the city councillor might conclude that there is a causal link between the number of delivery drivers and the number of bus drivers.

(ii) What can the city councillor conclude about the recruitment of bus drivers by delivery companies over time? [2 marks]

4. Collectable football cards come in packs. The masses, in grams, of the packs are normally distributed with mean **28.3** and standard deviation **0.3**
- (a) Calculate the probability that a randomly selected pack will have a mass less than **28 g** [2 marks]

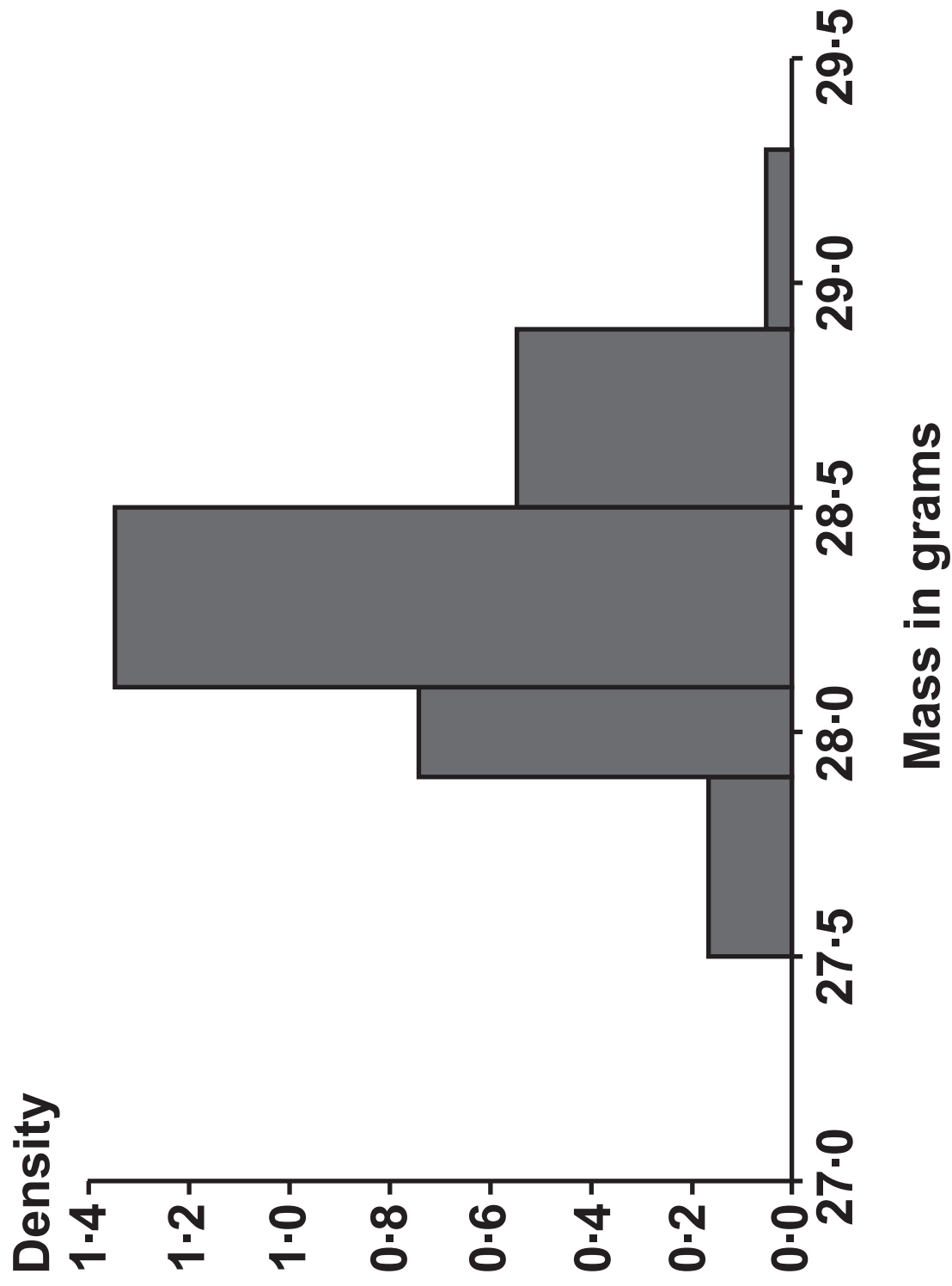
4 (b) Packs that have a mass more than 28.8 g are classed as 'heavy'. Andrei buys a randomly selected 'heavy' pack of cards.

Calculate the probability that this pack has a mass more than 29.1 g [6 marks]

[illegible]

(Turn over)

MASS OF PACKS OF CARDS

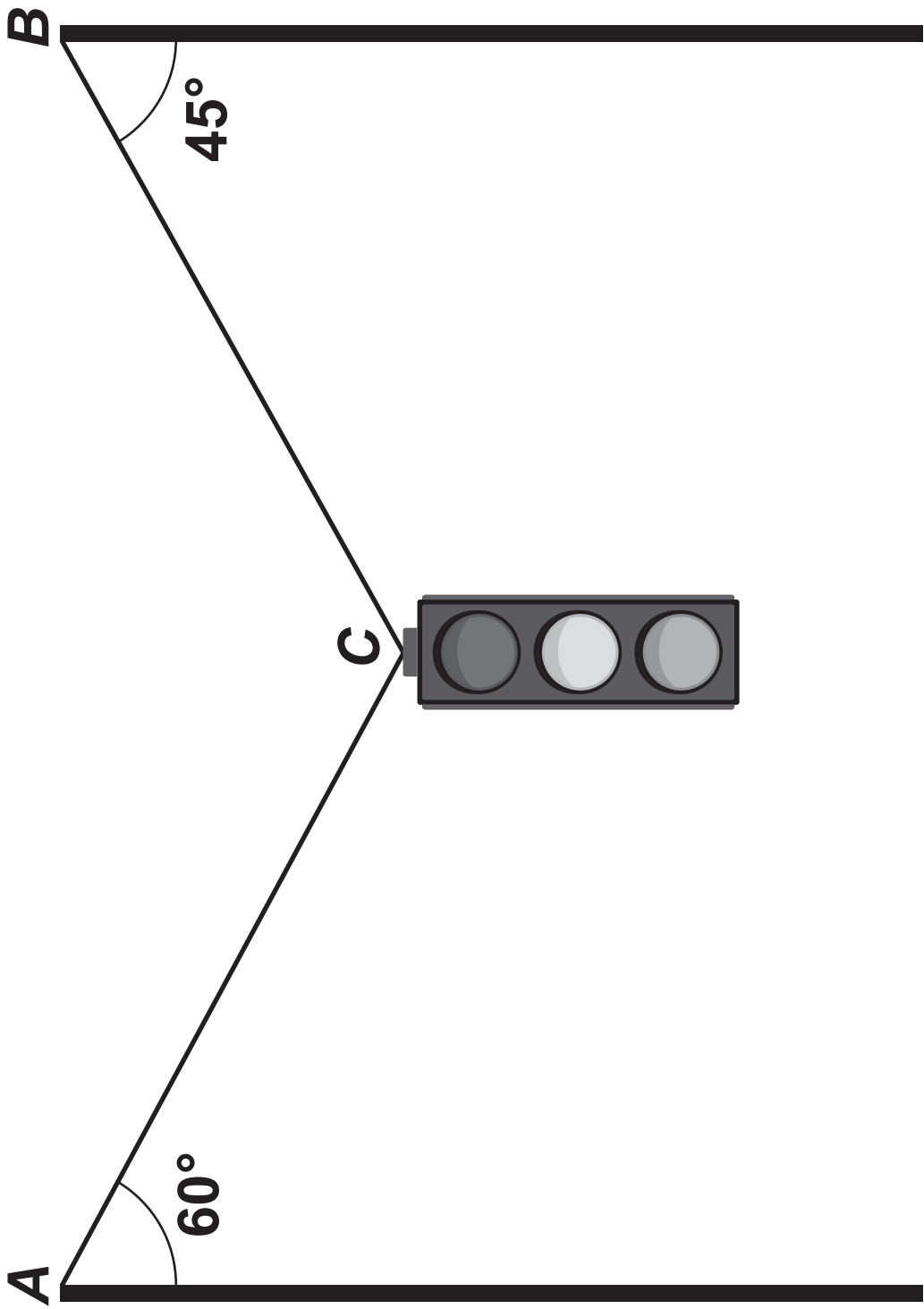


- 4 (c) Graham has a large number of packs of cards and wants to sell some to Andrei. Graham claims that the packs that he has to sell are, on average, heavier than **28.3 g**

Graham draws a histogram of the masses of his packs of cards, shown opposite.

Andrei randomly selects **10** packs from Graham to test Graham's claim. He finds that the total mass is **285 g**

- (i) What feature of the histogram supports conducting a significance test on the sample mean using Andrei's data? [1 mark]
- (ii) Given that the population standard deviation of the masses of Graham's packs is **0.32 g**, test Graham's claim at the **3%** level of significance. [7 marks]



SECTION B: DIFFERENTIAL EQUATIONS AND MECHANICS

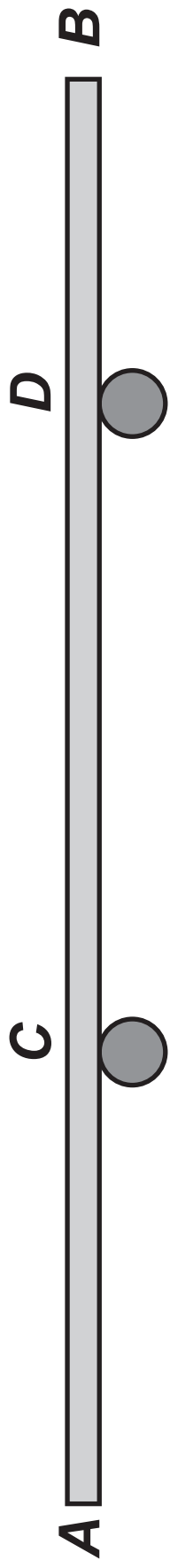
5. The diagram opposite shows a set of traffic lights suspended in equilibrium by means of two cables ***AC*** and ***BC***, inclined at angles of **60°** and **45°** to the vertical respectively. The set of traffic lights has a mass of **25 kg** and may be modelled as a single particle attached at ***C***

- (a) Show that the tension in ***AC*** is approximately **179 N** and calculate the tension in ***BC***

[6 marks]

(Turn over)

**5 (b) State a modelling assumption that you have made
in your solution. [1 mark]**



6. The diagram opposite shows a uniform rod AB , of length 3.8 m and weight 180 N . The rod is resting horizontally in equilibrium on two smooth supports at the points C and D , where $DB = 0.8\text{ m}$ and $CD = 1.8\text{ m}$.

An object of weight $W\text{ N}$ is placed at A .

- (a) Given that $W = 69$, find the magnitudes of the reaction at C and the reaction at D [6 marks]

6 (b) Determine the greatest value of W for which the rod remains in equilibrium. [3 marks]

[illegible]

(Turn over)

7. A particle of mass **1.2 kg** is moving in a straight line under the action of a variable force **F N**, where

$$F = \frac{30}{(t + 2)^2}$$

The speed of the particle at time **t** seconds is **$v \text{ ms}^{-1}$**

When **$t = 0.5$** , the speed of the particle is **20 ms^{-1}**

- (a) Find an expression for **V** in terms of **t** and hence write down the limiting value of **V** as **t** increases.
[6 marks]

(Turn over)

7 (b) Calculate the time taken for the particle to reach a speed of 29 ms^{-1} [2 marks]

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(Turn over)

8. An object, of mass **5 kg**, is projected up the line of greatest slope of a rough plane inclined at an angle of **30°** to the horizontal.
- (a) Given that the deceleration of the object up the plane is **6.3 ms^{-2}** , show that the coefficient of friction between the plane and the object is

$$\frac{2\sqrt{3}}{21}$$

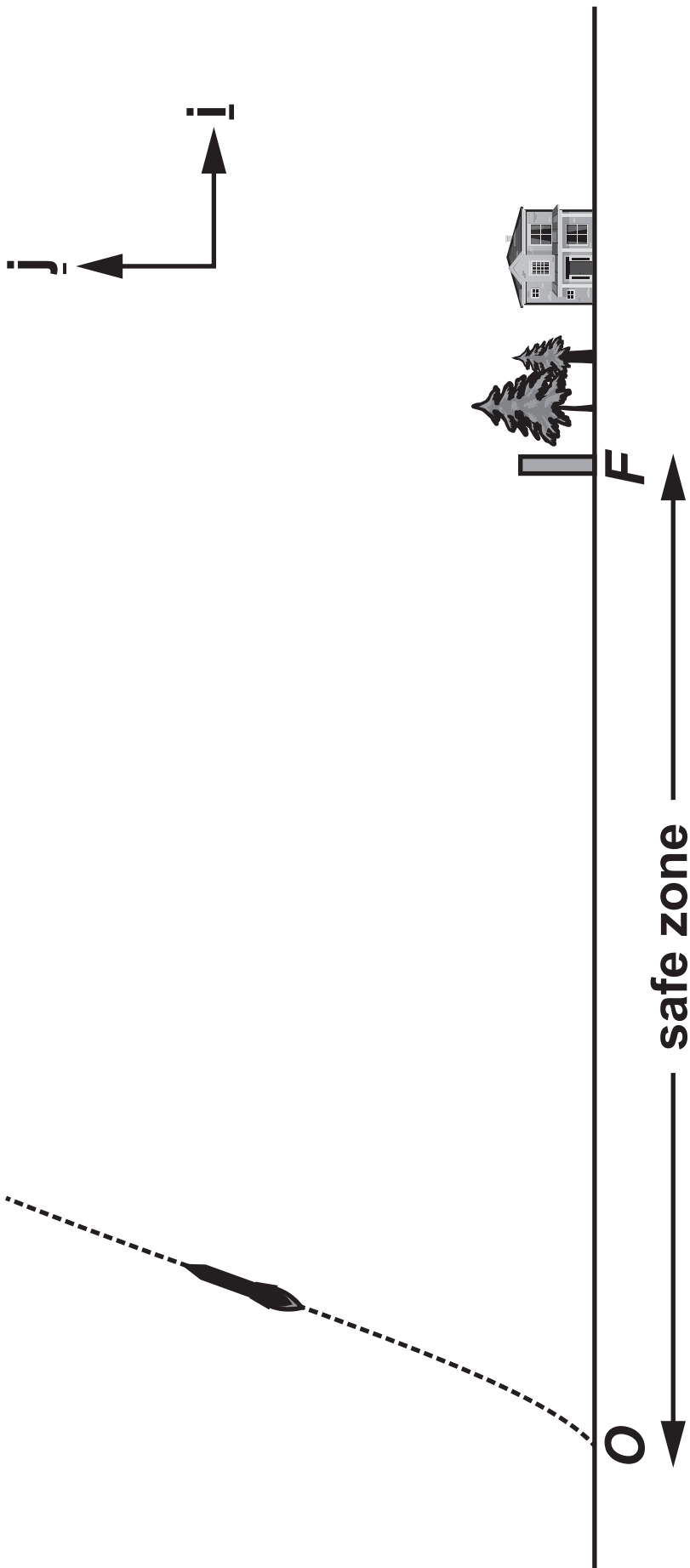
[5 marks]

(Turn over)

8 (b) Determine whether the object will remain stationary on the plane immediately after it comes to rest. [2 marks]

[illegible]

(Turn over)



9. A small rocket R is launched from a point O on horizontal ground so that it is moving in a vertical plane, where the unit vectors $\underline{i}$ and $\underline{j}$ are horizontal and vertical respectively.

The diagram opposite shows the path of R for the first 4 seconds of its motion.

The rocket R is required to land in a 'safe zone' which consists of the horizontal line from O to F

At time t seconds, the position vector $\underline{r}$ of R , relative to O , is modelled by

$$\underline{r} = 4t^2\underline{i} + \left(\frac{1}{4}t^4 + 6t^{\frac{3}{2}} \right)\underline{j}$$

for $0 \leq t \leq 4$

9 (a) Find an expression for the velocity vector of R at time t s, valid for $0 \leq t \leq 4$

Hence find the velocity vector of R when $t = 4$
[3 marks]

9 (b) At $t = 4$, R runs out of fuel. For $t > 4$, the motion of R can be modelled as a projectile.

(i) Show that R takes approximately **18** seconds to reach the ground after the fuel runs out. [4 marks]

(ii) Hence, determine whether R lands within the 'safe zone', given that $OF = 600$ m
[2 marks]

Question number	Additional page, if required. Write the question numbers in the left-hand margin.

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