



General Certificate of Secondary Education
2007

Additional Mathematics

Paper 2
Mechanics and Statistics

[G0302]



MONDAY 21 MAY, AFTERNOON

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet and the Supplementary Answer Booklet provided.

Answer **all twelve** questions.

At the conclusion of the examination attach the Supplementary Answer Booklet to your Answer Booklet using the treasury tag supplied.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Figures in brackets printed down the right-hand side of pages indicate the approximate marks awarded to each question or part question.

You may use your calculator.

A copy of the formulae list is provided.

Take $g = 10 \text{ m/s}^2$ when required.

Answer **all twelve** questions.

- 1 Two packages A and B, of masses 4 kg and M kg respectively, where $M < 4$, are connected by a light inextensible string passing over a smooth fixed pulley as shown in **Fig. 1**.

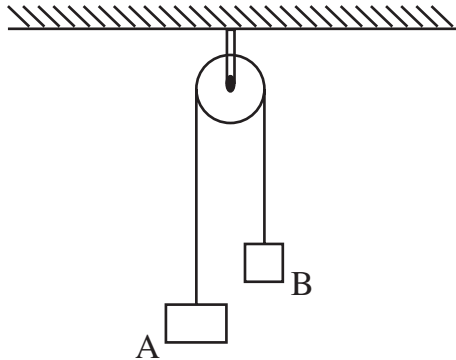


Fig. 1

When the packages are released from rest with the string taut the magnitude of the acceleration of each package is 2.5 m/s^2 .

Calculate

- (i) the tension in the string, [2]
- (ii) the value of M . [2]
- 2 An internet information channel surveyed 180 users to determine what age-groups were accessing its site during the first week in September. **Table 1** summarises the results.

Table 1

Age (years)	0–9	10–14	15–19	20–24	25–34	35–59	60–
Number using site	8	34	29	27	54	28	0

Use the graph paper in **Fig. 2** in your Supplementary Answer Booklet to draw a histogram to represent this information. [5]

3 (Throughout this question \mathbf{i} and \mathbf{j} denote unit vectors parallel to a set of standard x - y axes)

Three vectors \mathbf{a} , \mathbf{b} and \mathbf{c} are defined as follows

$$\mathbf{a} = 4\mathbf{i} + \mathbf{j} \quad \mathbf{b} = 2\mathbf{i} - 3\mathbf{j} \quad \mathbf{c} = 5\mathbf{i} - 4\mathbf{j}$$

Calculate

(i) the values of the scalar quantities p and q such that $p\mathbf{a} + q\mathbf{b} = \mathbf{c}$, [3]

(ii) the magnitude of the single vector represented by $3\mathbf{a} - 3\mathbf{b} + 2\mathbf{c}$ giving your answer correct to 1 decimal place, [2]

(iii) the angle that this vector makes with the positive x -axis. [1]

4 A car which is initially at rest accelerates uniformly on a straight road for t seconds until it reaches a speed of 16 m/s. The car then travels at this speed for 40 seconds. The brakes are then applied and the car retards uniformly to rest. The **magnitude** of the retardation is three times the **magnitude** of the acceleration.

(i) On the axes drawn in **Fig. 3** of your Supplementary Answer Booklet **sketch** the speed–time graph for this journey. [2]

The total time taken by the car for this journey is 56 seconds.

Calculate

(ii) the value of t , [2]

(iii) the total distance travelled. [3]

- 5 A group of friends was debating which extra features were more popular on their mobile phones. Over a 4-week period they each recorded how many photographs they took and how often they listened to music using their mobile phones. The results are summarised in **Table 2**.

Table 2

Name	Derek	Kevin	Tom	Lucy	Rachel	Rosanna	Armelle
Time listening to music (to nearest hour)	15	18	5	9	4	15	0
Number of photographs taken	15	8	12	23	18	3	3

- (i) Work out the rank orders for the times spent listening to music and for the number of photographs taken. [2]
- (ii) Calculate Spearman's coefficient of rank correlation. [4]
- (iii) What significance, if any, do you attach to the value you obtained in (ii)? [1]
- 6 Tony achieved the following marks in each section of his last music exam.

24, 15, 6, 18, 12

- (i) Calculate the standard deviation of these marks. [3]

He needs to scale his marks so that the mean mark is 40 and the standard deviation is doubled. He does this by multiplying each score by a constant a and adding a constant b .

- (ii) Calculate a and b . [4]

- 7 A uniform plank AB of length 8 metres and mass 20 kg rests horizontally in equilibrium on two supports placed at points C and D on the plank where $AC = 1$ m and $DB = 2$ m as shown in Fig. 4.

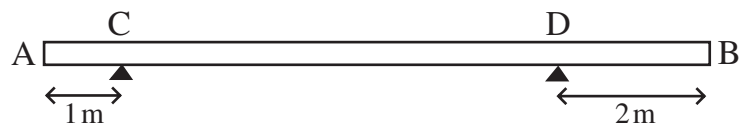


Fig. 4

Calculate

- (i) the magnitude of the reaction at C, [2]
- (ii) the magnitude of the reaction at D. [1]

A box of mass M kg is placed on the plank at A. The plank remains horizontal but is on the point of tilting about the support at C.

- (iii) State the reaction at D when the plank is on the point of tilting. [1]
- (iv) Calculate the mass M kg of the box. [2]

The box is now moved from A and placed at a point on the plank x metres from B. The plank remains horizontal but is now on the point of tilting about D.

- (v) Find the value of x . [3]

- 8 At a basketball training session the coach recorded the number of 'lay-ups' scored by each member of the class. **Table 3** summarises their scores.

Table 3

Pupil	Beth	Lara	Hannah	Aidan	Ward	Larry	Erin	Peter	Daniel	Niamh
Number of right-hand 'lay-ups' scored	57	49	25	15	20	45	37	57	38	30
Number of left-hand 'lay-ups' scored	39	38	30	21	26	31	28	33	35	25

- (a) These data are plotted on the graph given in **Fig. 5** in the Supplementary Answer Booklet.
- (i) Calculate the mean number of right-hand 'lay-ups' scored and the mean number of left-hand 'lay-ups' scored. [1]
- (ii) Draw your line of best fit on the graph in the Supplementary Answer Booklet. [2]
- (iii) Determine the equation of the line of best fit which you have drawn. [4]
- (iv) Estimate the number of left-hand 'lay-ups' likely to be scored by a player who scored 50 right-hand 'lay-ups' during the session. [1]
- (b) What is the median number of left-hand 'lay-ups'? [1]

- 9 The practice manager at a local surgery recorded the number of patients treated in the surgery by the doctors over the past 3 years. **Table 4** summarises the results.

Table 4

	Jan–Mar	Apr–Jun	Jul–Sep	Oct–Dec
2004	1003	841	728	900
2005	1055	905	784	968
2006	1111	965	836	1036

These data have been plotted on the graph given in **Fig. 6** in your Supplementary Answer Booklet.

- (i) Calculate appropriate moving averages to smooth the data. [3]
- (ii) Plot these averages on the graph and draw the trend line. [3]
- (iii) Showing clearly where any reading is taken, use the trend line to calculate an estimate of the number of patients likely to be treated in the period January to March 2007. [4]
- 10 A boy is standing at the edge of the flat roof of a building. He is 10 metres above the pavement. He throws a ball vertically upwards with a speed of 8 m/s.

- (i) Find the maximum height above the pavement reached by the ball. [3]

The boy fails to catch the ball as it falls back down again towards the pavement.

Calculate

- (ii) the speed of the ball, in m/s, at the instant when it strikes the pavement, giving your answer correct to 1 decimal place. [2]
- (iii) the time, in seconds, which elapses from the instant the ball leaves the boy's hand until it strikes the pavement, giving your answer correct to 1 decimal place. [4]

The ball rebounds with half the speed with which it strikes the pavement.

- (iv) Calculate the height to which the ball rebounds after the first bounce, giving your answer correct to 1 decimal place. [2]

- 11** A child throws a red die and a blue die. The red die is numbered 1 to 6 and the blue die is numbered 1, 2, 2, 3, 3, 3.

Using a probability space diagram or otherwise calculate the probability that

- (i) both dice show prime numbers, [2]
- (ii) the sum of the scores on both dice is prime, [2]
- (iii) both dice show the number 1 given that the sum of the scores is prime, [3]
- (iv) the score on the blue die is greater than the score on the red die. [2]

A double occurs when both dice show the same score.

Both dice are thrown 6 times.

- (v) Calculate the probability of getting no doubles. [2]
- (vi) Hence calculate the probability of scoring at least one double. [1]

- 12 A crate of mass 20 kg slides down a rough chute in a warehouse. The chute is inclined at 25° to the horizontal as shown in **Fig. 7**.

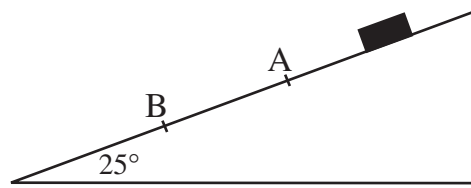


Fig. 7

The frictional resistance to the motion is constant throughout.

- (i) Copy **Fig. 7** and mark on it the forces acting on the crate. [2]

The crate passes two markers A and B, 4 metres apart on the chute, with speeds of 2 m/s and 4 m/s respectively.

Calculate

- (ii) the acceleration of the crate, [2]
- (iii) the magnitude of the frictional resistance, giving your answer correct to 1 decimal place, [4]
- (iv) the coefficient of friction between the crate and the surface of the chute, giving your answer correct to 1 decimal place. [3]

The crate reaches the bottom of the chute 2 seconds after passing A.

Calculate

- (v) the speed of the crate when it reaches the bottom of the chute, [1]
- (vi) the distance of the bottom of the chute from A. [1]

THIS IS THE END OF THE QUESTION PAPER



Centre Number

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Candidate Number

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**SUPPLEMENTARY
ANSWER BOOKLET**

2 Using the information from **Table 1** draw a histogram in **Fig. 2**. Label each axis clearly.

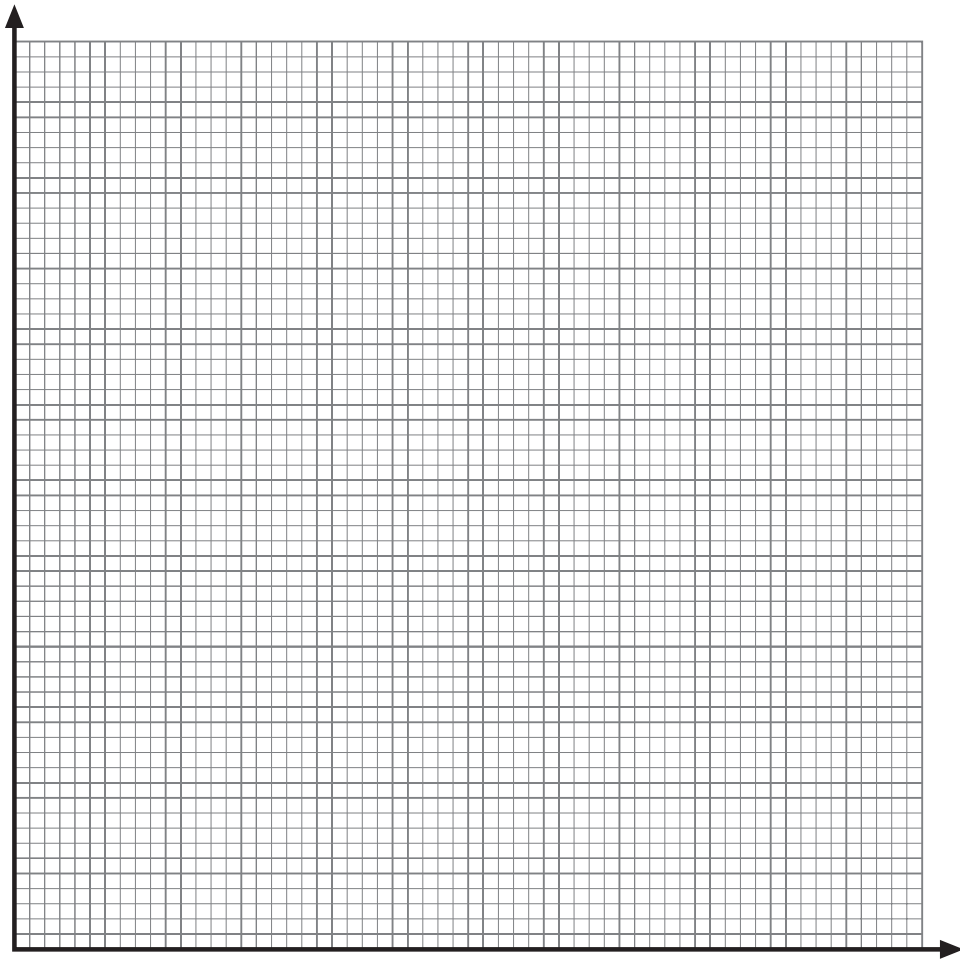


Fig. 2

4 On the axes below **sketch** the speed–time graph for the journey.



Fig. 3

8 Draw your line of best fit through the data points shown in **Fig. 5**.

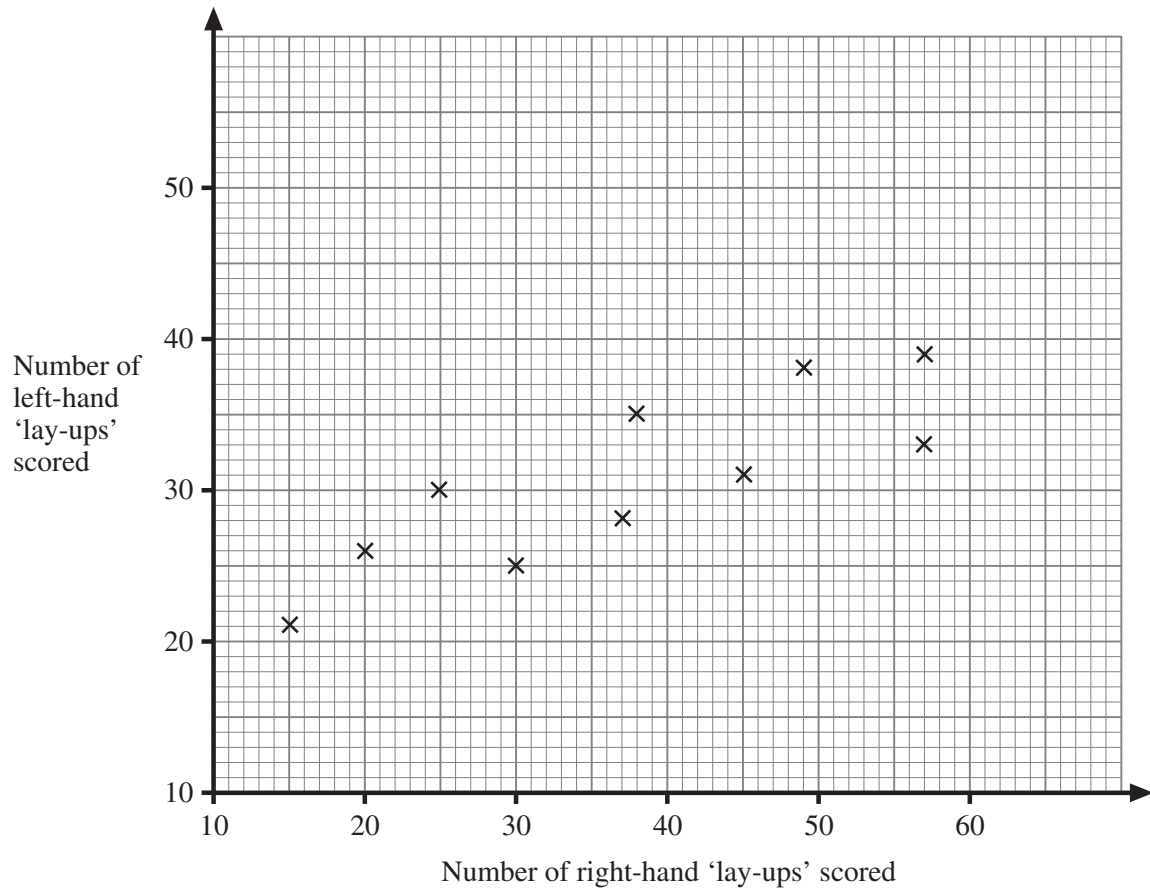


Fig. 5

9 Plot the moving averages in **Fig. 6** and draw the trend line.

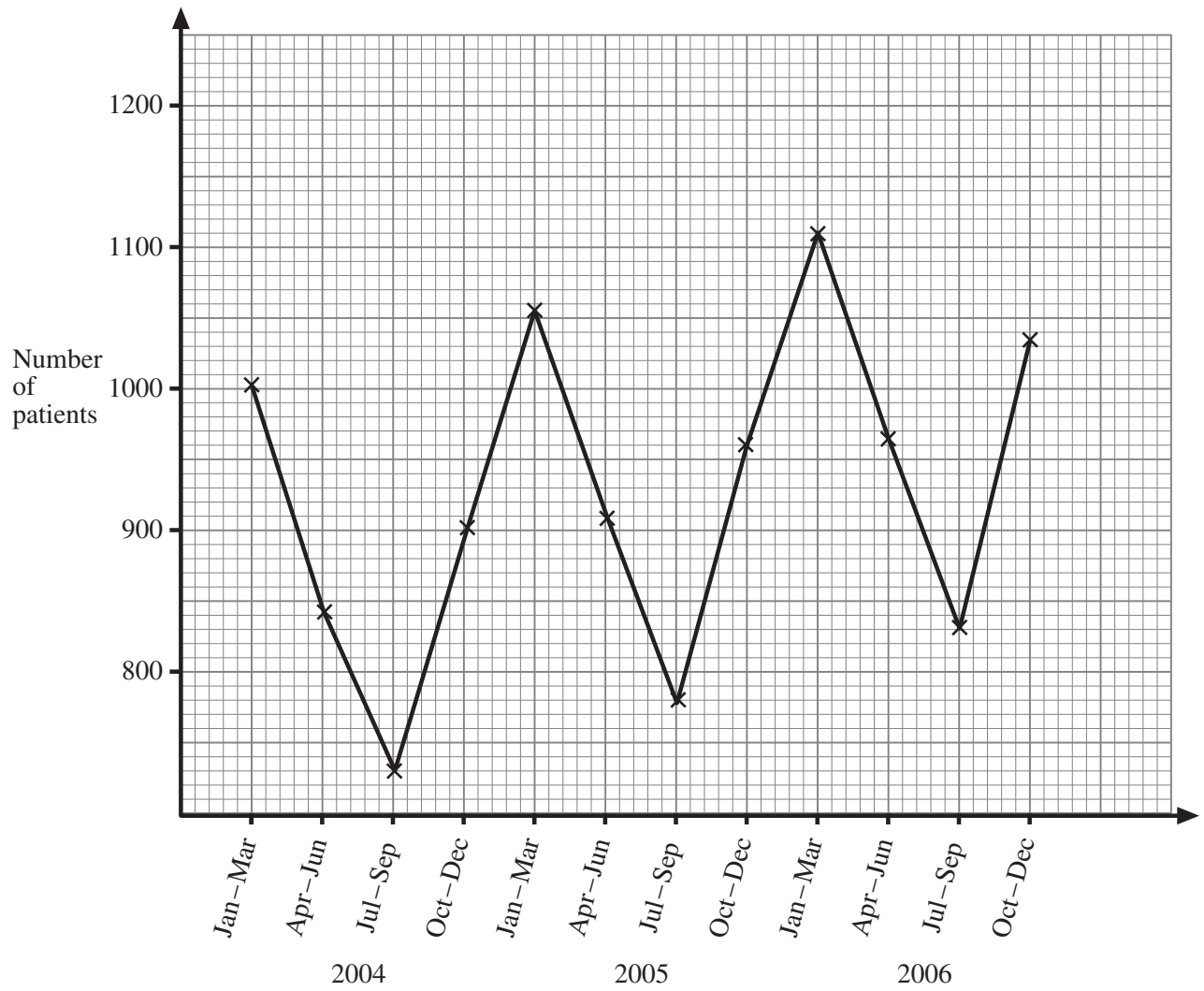


Fig. 6

