Rewarding Learning

General Certificate of Secondary Education
2009

Additional Mathematics

Paper 2
Mechanics and Statistics

[G0302]

G0302

FRIDAY 15 MAY, MORNING

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 m/s^2 when required.

Answer **all twelve** questions

1 (Throughout this question **i** and **j** denote unit vectors parallel to a set of standard x–y axes.)

A body of mass 5 kg is acted on by a force $\boldsymbol{F}$ newtons. The body moves in a straight line with initial velocity ($2\mathbf{i} + 3\mathbf{j}$) m/s. After 2 seconds its velocity is ($5\mathbf{i} - \mathbf{j}$) m/s.

Find

(i) the acceleration of the body as a vector in terms of **i** and **j**, [2]

(ii) the force $\boldsymbol{F}$ as a vector in terms of **i** and **j**, [1]

(iii) the magnitude of the force $\boldsymbol{F}$. [1]

2 As part of a quality control programme, Isaac measured the mass of each apple in a consignment delivered to his store. Each reading was rounded to the nearest gram and the results are summarised in **Table 1**.

Table 1

Mass of apple (g)	51–100	101–150	151–180	181–210	211–260
Number of apples	74	104	117	96	22

Using **Fig. 1** in your Supplementary Answer Booklet, draw a histogram to represent this information. **Label each axis clearly.** [5]

3 A car accelerates uniformly from rest to a speed V m/s in 16 seconds. It continues to move with this speed for 40 seconds. The brakes are then applied and the car retards uniformly to rest.

The total time for this journey is 60 seconds.

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

The total distance travelled by the car in the 60 seconds is 900 metres.

(ii) Calculate the value of V. [4]

4 For each of the following classes write down

(a) the lower class boundary,

(b) the upper class limit,

(c) the class width.

(i) 15 kg to 18 kg, measured correct to the nearest kg.

(ii) 5.5 cm to 8.5 cm, measured correct to the nearest mm.

(iii) –4 °C to 2 °C, measured correct to the nearest °C. [6]

5 A librarian counted the number of books on each shelf in a school library. The results are summarised in **Table 2**.

Table 2

Number of books	11–25	26–35	36–45	46–55	56–65
Number of shelves	14	18	21	5	2

(i) Calculate an estimate of the mean number of books per shelf. [2]

(ii) Calculate an estimate of the median number of books per shelf. [4]

6 A box of mass m kg is suspended from a fixed point O by a light inextensible string. The box is pulled aside by a force of 20.7 N which acts at 45° with the horizontal as shown in **Fig. 3**.

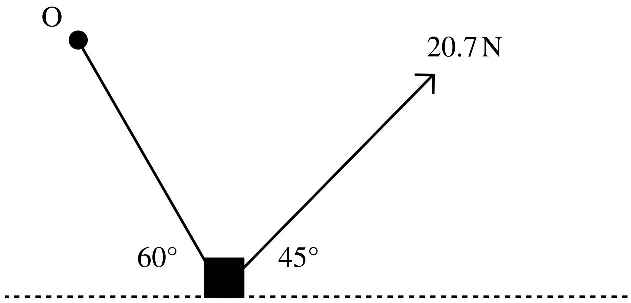

Fig. 3

The box hangs in equilibrium with the string making an angle of 60° with the horizontal.

Find

(i) the tension T newtons in the string, [3]

(ii) the mass m kg of the box. [4]

7 During the first 3 weeks in September, Dolly recorded how much money she received each day by selling snacks from the mobile refreshment service she operated. Each amount was rounded to the nearest pound and the results are summarised in **Table 3**.

Table 3

	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1	247	244	245	249	255
Week 2	250	248	249	253	258
Week 3	254	252	252	257	263

These data have been plotted on the graph given in **Fig. 4** in your Supplementary Answer Booklet.

(i) Calculate appropriate moving averages to smooth the data. [2]

(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 how much money she will receive on the fourth Monday in September. [4]

8 A **non-uniform** plank AB of length 8 metres rests horizontally in equilibrium on two supports, one at A and the other at B. The reactions at A and B are 180 N and 420 N respectively.

(i) Calculate the mass of the plank. [2]

The centre of mass of the plank is at a point G, x metres from the end A as shown in **Fig. 5**.

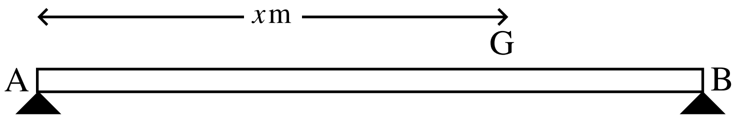

Fig. 5

(ii) Find the value of x. [3]

The two supports are removed and replaced by a single support placed at the mid-point of the plank.

A child of mass m kg stands on the plank at the end A.

The plank is now in equilibrium in a horizontal position as shown in **Fig. 6**.

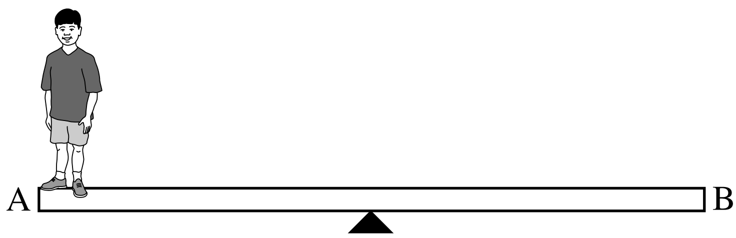

Fig. 6

(iii) Copy **Fig. 6** and mark clearly on your diagram **all** the forces acting on the plank. [3]

(iv) Calculate the mass m kg of the child. [2]

 [Turn over

9 Each Wednesday Maeve plays a hockey match, either for her club, or for her county, but not both.

If on a given Wednesday she plays a club match, the probability that she will play a county match on the following Wednesday is 0.65

If on a given Wednesday she plays a county match, the probability that she will play a club match on the following Wednesday is 0.8

(i) On Wednesday Maeve plays a match for her club. Draw a clearly labelled tree diagram to show the probabilities of playing club and county matches for the following three Wednesdays. [3]

Using the tree diagram, or otherwise, calculate the probability that on these three Wednesdays she will play

(ii) 3 county matches, [2]

(iii) only 1 county match, [3]

(iv) at least 1 county match. [3]

10 A large concrete block of mass 45 kg is lying on a rough horizontal floor. A rope is attached to the block to pull it along the floor. The rope makes an angle of 50° with the horizontal as shown in **Fig. 7**.

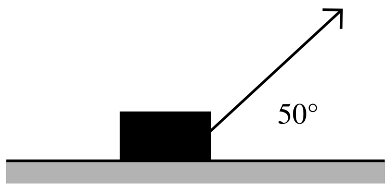

Fig. 7

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

When the tension T in the rope is 175 N, the block is on the point of moving along the floor.

(ii) Calculate, correct to 2 decimal places, the normal reaction between the block and the floor. [2]

(iii) Show that the coefficient of friction between the block and the floor is 0.356, correct to 3 decimal places. [3]

The angle that the rope makes with the horizontal is reduced to 35°.

Assume that the tension in the rope and the coefficient of friction remain unaltered.

(iv) Calculate, correct to 2 decimal places, the acceleration of the block. [4]

11 Two small particles A and B of masses 0.6 kg and 0.4 kg respectively are connected by a light inextensible string which passes over a smooth fixed pulley as shown in **Fig. 8**.

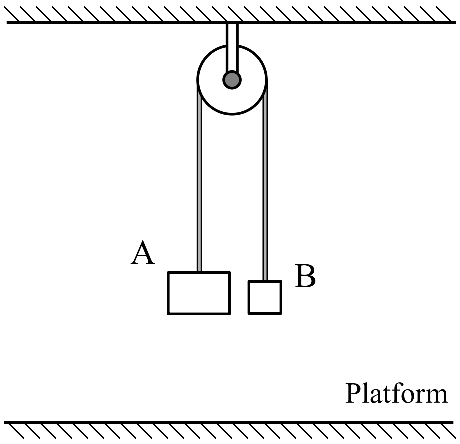

Fig. 8

The system is released from rest with the particles hanging vertically.

Calculate

(i) the acceleration of the system, [3]

(ii) the tension in the string, [1]

(iii) the force exerted by the string on the pulley when the particles are in motion. [1]

When the particles have been in motion for 1.5 seconds, A strikes a fixed horizontal platform. The string becomes slack and B initially continues to rise. Assuming that B does not reach the pulley, calculate

(iv) the speed of the particles at the instant A strikes the platform, [2]

(v) the **additional** distance through which B rises after A strikes the platform, [3]

(vi) the time which elapses between A striking the platform and the string becoming taut again. [2]

12 Mr Caldwell asked each pupil in his Year 13 class to record the total length of time spent watching television in a week. He wanted to compare these times with the marks they achieved in a test at the end of the week. The results are shown in **Table 4**.

Table 4

Student	Grainne	Nicole	Declan	Marlene	Charlotte	Jerry	Rosanna	Tom	Jack	Luc
Times (to the nearest hour)	5	14	9	8	18	12	14	11	10	16
Mark (%)	91	34	70	87	54	36	75	55	70	44

(i) Determine the rank orders for the times and for the marks. [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]

The data from **Table 4** are plotted on the graph given in **Fig. 9** in your Supplementary Answer Booklet.

(iv) Calculate the mean time and the mean mark. [1]

(v) Draw your line of best fit on the graph in the Supplementary Answer Booklet. [2]

(vi) Determine the equation of the line of best fit which you have drawn. [3]

THIS IS THE END OF THE QUESTION PAPER

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Centre Number

71	

Candidate Number

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FRIDAY 15 MAY, MORNING

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SUPPLEMENTARY ANSWER BOOKLET

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

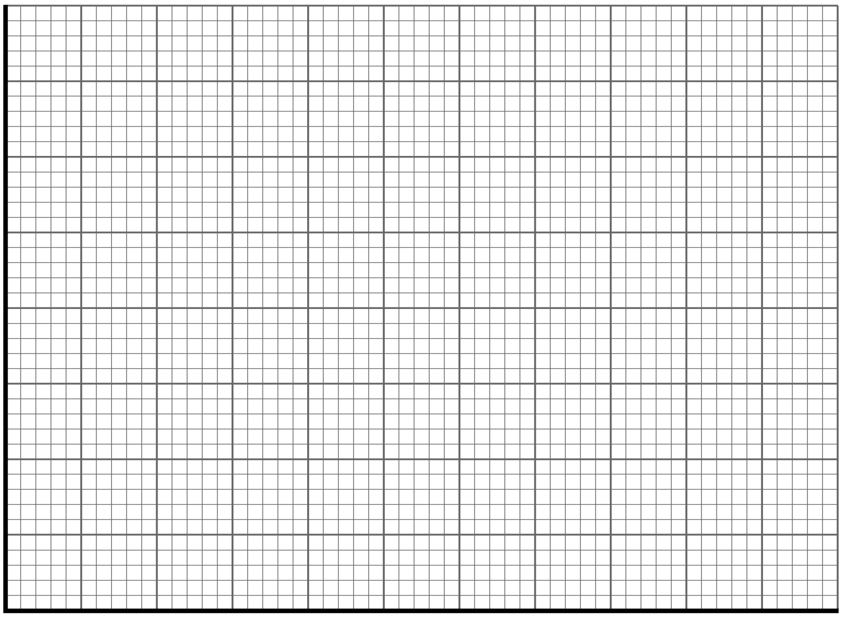

Fig. 1

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

Fig. 2

 [Turn over

7 Plot the moving averages in **Fig. 4** and draw the trend line.

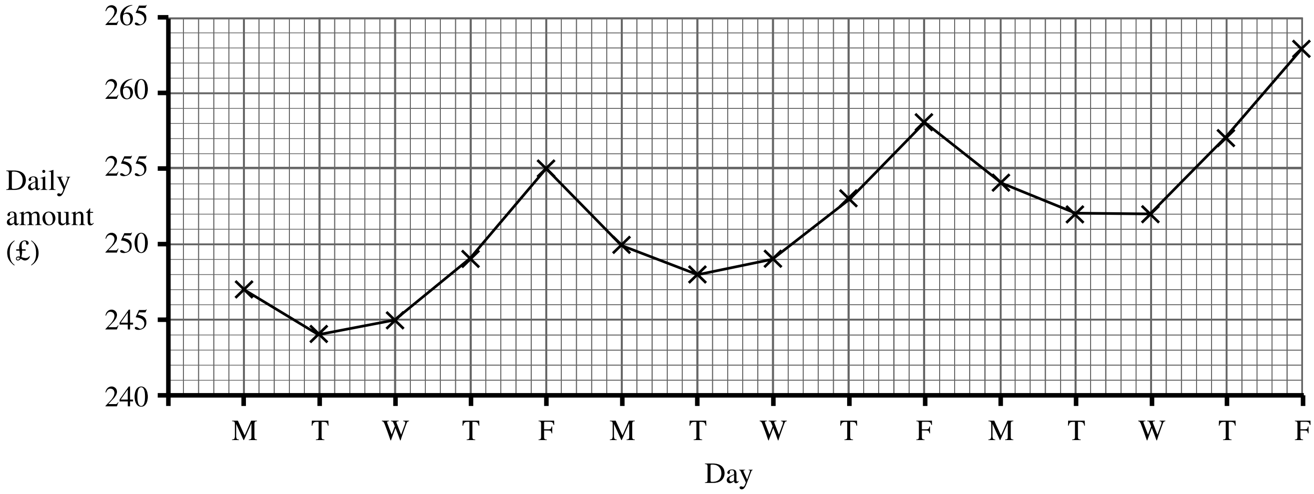

Fig. 4

12 Draw the line of best fit through the data points shown in **Fig. 9**.

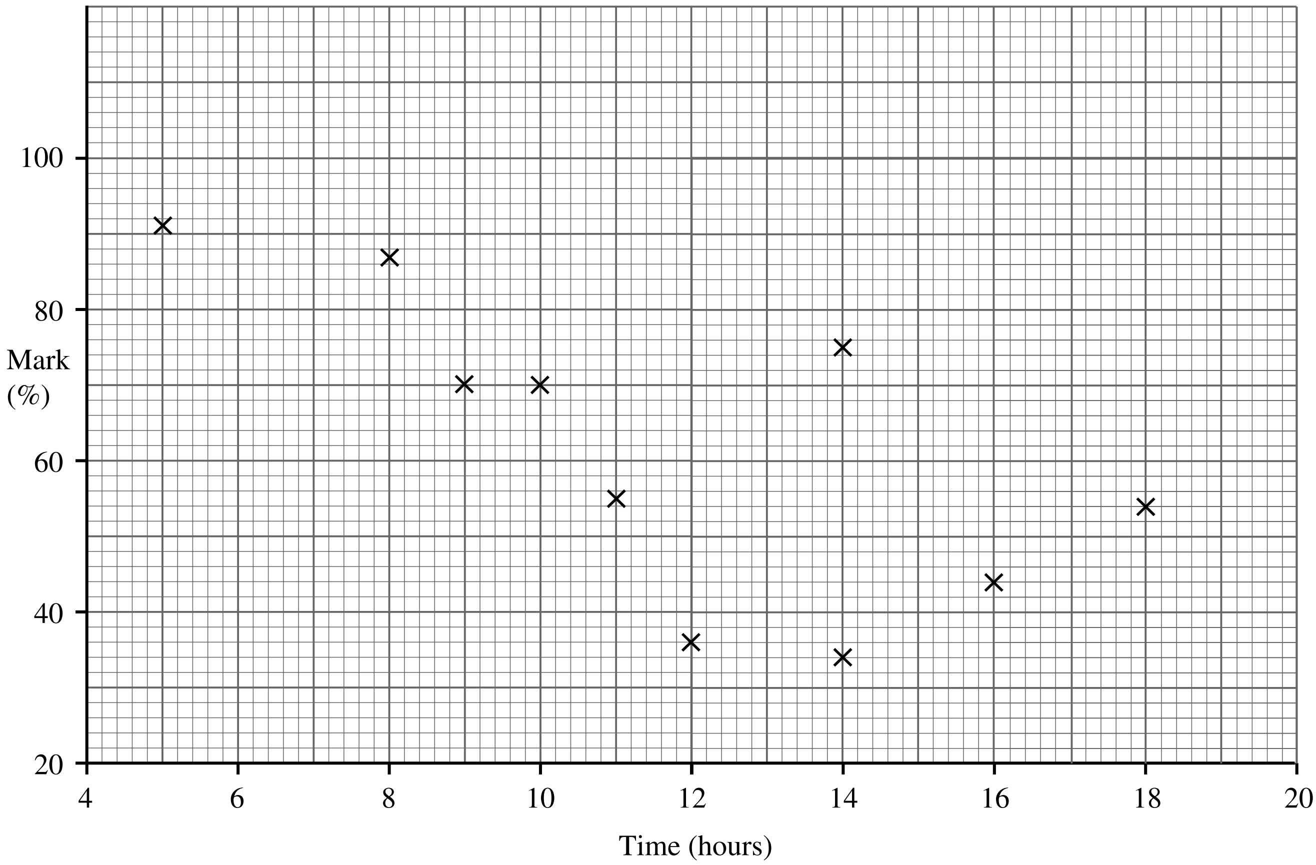

Fig. 9