Rewarding Learning

General Certificate of Secondary Education
2006

Additional Mathematics

Paper 2
Mechanics and Statistics

[G0302]

THURSDAY 18 MAY, MORNING

G0302

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.

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Answer **all twelve** questions.

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

A package of mass 4 kg is initially at rest at the origin O on a smooth horizontal plane.

It is acted upon by two forces

$$\mathbf{P} = (4\mathbf{i} + 5\mathbf{j})\text{ N} \quad \text{and} \quad \mathbf{Q} = (2\mathbf{i} - 3\mathbf{j})\text{ N}$$

(i) Find the resultant of the two forces **P** and **Q**. [1]

The package moves from O with an acceleration $(a\mathbf{i} + b\mathbf{j})$ m/s^2

(ii) Find the values of a and b. [2]

After 4 seconds the package is at a point A.

(iii) Find the displacement vector **OA**. [1]

2 **(a)** One hundred visitors to a theme park were asked to estimate the height, in metres, of the Christmas tree. The mean of the estimates was calculated to be 9.77 m and the standard deviation was 1.8 m.

For analytical purposes each estimate was converted by multiplying by 3 and then subtracting 0.3

What is the mean and standard deviation of the converted estimates? [3]

(b) **Fig. 1** below shows distributions of the heights of three types of tree. Each distribution has the same mean.

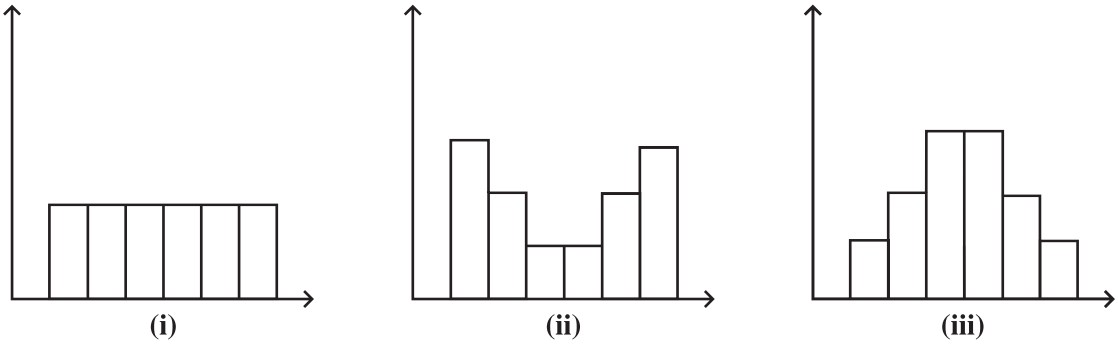

Fig. 1

State which distribution has the largest standard deviation, giving a reason for your answer. [2]

3 Last month a bricklayer recorded the number of bricks he laid each day. **Table 1** summarises the results.

Table 1

Number of bricks	500 –	600 –	700 –	800 –	900 –	1000 –
Number of days	1	3	6	10	3	0

Calculate an estimate of the median number of bricks he laid last month. [5]

4 A light fitting of mass 2 kg is held in equilibrium at a point C by two light chains CA and CB attached to the ceiling of a garage. The chains are inclined to the horizontal at 25° and 42° respectively as shown in **Fig. 2**.

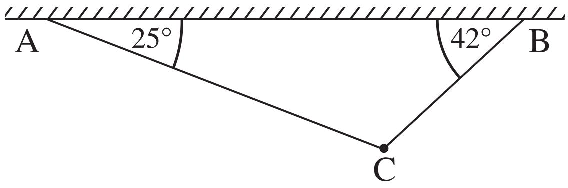

Fig. 2

(i) Copy **Fig. 2** showing clearly all the forces acting on the light fitting at the point C. [1]

(ii) Calculate the tensions in the chains CA and CB, giving each answer correct to 1 decimal place. [5]

5 A car starts from rest with uniform acceleration a m/s^2 in a straight line.

(i) Write down expressions in terms of a for the distances travelled by the car

(a) in the first 17 seconds,

(b) in the first 18 seconds. [2]

Given that the car travels 28 metres in the 18th second, calculate

(ii) the acceleration of the car, [3]

(iii) the speed of the car when it has travelled a distance of 80 metres from the start, [1]

(iv) the time it takes to travel this distance. [1]

6 A community support group has 36 members made up from representatives from three areas East, Central and West in the ratio 2:4:3 respectively.

(i) How many members are there from each area? [1]

(ii) One member is selected at random from the support group to act as secretary. What is the probability that this member is from Central? [1]

East has only one male member.

Central has the same number of male and female members.

West has twice as many female members as male.

(iii) One member is selected at random from the whole group of 36 to act as the group coordinator. What is the probability that this member is male? [2]

(iv) Two members from the whole group are selected at random to petition their local MP. What is the probability that they come from different areas? [3]

7 A hang gliding pilot recorded the duration of each of her flights last year correct to the nearest minute. **Fig. 3** in your Supplementary Answer Booklet shows part of the histogram summarising her results.

She made 55 flights, each lasting between 11 and 20 minutes. Using this information and the histogram in **Fig. 3** in your Supplementary Answer Booklet calculate how many flights she made lasting between

(i) 6 and 10 minutes, [2]

(ii) 31 and 50 minutes. [2]

(iii) At the beginning of the year she made 12 flights lasting between 2 and 5 minutes. She also made 20 flights lasting between 51 and 75 minutes. Use this information to complete the histogram in **Fig. 3** in your Supplementary Answer Booklet. [4]

8 A car is travelling at a constant speed of 18m/s. At the instant when it passes a stationary van the driver of the van gives chase.

The van accelerates uniformly for 25 seconds until it reaches a speed of 27 m/s. It then continues at this speed until it overtakes the car.

(i) On the axes drawn in **Fig. 4** in your Supplementary Answer Booklet sketch the speed–time graph for the van. [2]

Hence, or otherwise, calculate

(ii) the time taken for the van to overtake the car, [5]

(iii) the distance which the van has travelled in this time. [2]

9 A uniform plank AB of length 10 metres and mass 24 kg rests in equilibrium in a horizontal position on two supports at each end of the plank. A crate of mass 60 kg is placed on the plank at a point C where AC = 1 metre as shown in **Fig. 5**.

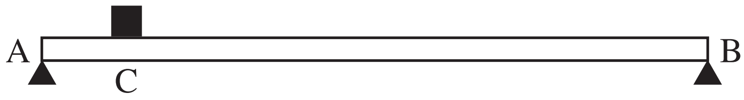

Fig. 5

Find

(i) the magnitude of the reaction at A, [4]

(ii) the magnitude of the reaction at B. [1]

One of the supports is now removed and the other is placed at a point D where AD = 4.5 metres. A boy of mass *M* kg stands on the plank at B and the plank again rests in equilibrium in a horizontal position as shown in **Fig. 6**.

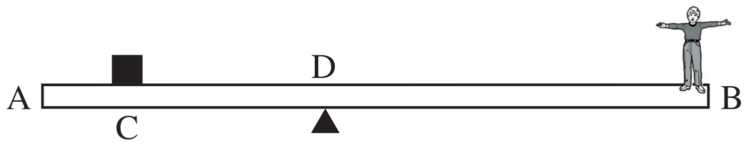

Fig. 6

Find

(iii) the mass *M* kg of the boy, [4]

(iv) the magnitude of the reaction at D. [1]

10 **Table 2** shows the number of customers attending a local hairdressing salon during the first 3 weeks in a particular month.

Table 2

	Tuesday	Wednesday	Thursday	Friday	Saturday
Week 1	52	54	58	53	49
Week 2	48	50	55	49	45
Week 3	44	47	51	44	43

These data have been plotted on the graph given in **Fig. 7** 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. [4]

(iii) Showing clearly where any reading is taken use the trend line to estimate the number of customers likely to attend on the next Tuesday in this month. [4]

(iv) Describe the secular trend these data illustrate. [1]

11 **Table 3** shows the marks obtained by 8 students in their Additional Maths Christmas test.

Table 3

Student	A	B	C	D	E	F	G	H
Paper 1	98	89	38	52	70	70	45	84
Paper 2	68	72	29	54	51	70	42	73

These data are plotted on the graph given in **Fig. 8** in your Supplementary Answer Booklet.

(i) Draw the line of best fit on this graph. [3]

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

(iii) Work out the rank orders for the marks on each paper. [2]

(iv) Calculate Spearman's coefficient of rank correlation. [4]

(v) What significance, if any, do you attach to the value you obtained in **(iv)**? [1]

12 (Throughout this question give your answers correct to 1 decimal place.)

A box of mass 2 kg is placed at a point X on a rough plane inclined at 35° to the horizontal as shown in **Fig. 9**.

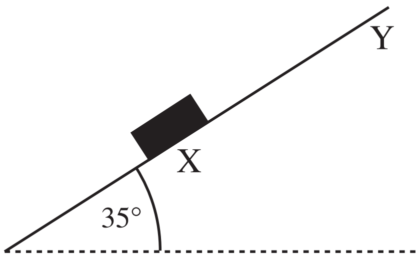

Fig. 9

The box is projected up the plane from X with an initial velocity of 6 m/s. It comes to instantaneous rest at a point Y on the plane.

The coefficient of friction between the box and the plane is 0.4

Find

(i) the total retarding force opposing the motion of the box up the plane, [4]

(ii) the retardation of the box, [2]

(iii) the distance XY. [2]

The box now slides down the plane from Y.

Find

(iv) the acceleration of the box down the plane, [5]

(v) the time taken by the box to slide from Y to X. [1]