

Pearson Edexcel
Level 3 GCE
Mathematics

Advanced
Paper 3: Statistics and Mechanics

Friday 15 June 2018 – Afternoon
Time: 2 hours

9MA0/03

You must have:
Mathematical Formulae and Statistical Tables, calculator

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – there may be more space than you need
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 10 questions in this question paper. The total mark for this paper is 100.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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4. Charlie is studying the time it takes members of his company to travel to the office. He stands by the door to the office from 08 to 0850 one morning and asks workers, as they arrive, how long their journey was.

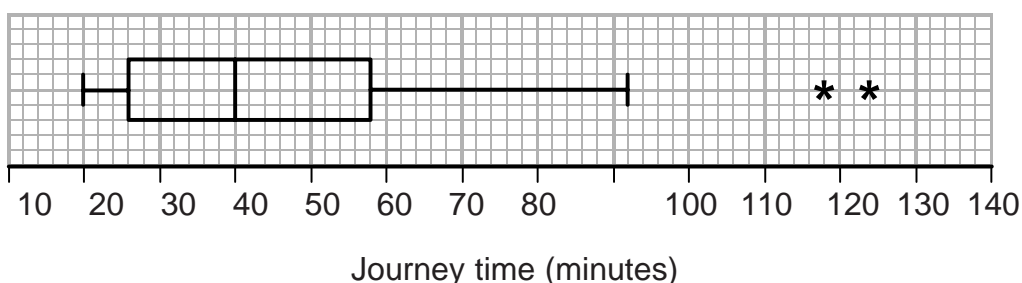
(a) State the sampling method Charlie used. (1)

(b) State and briefly describe an alternative method of non-random sampling Charlie could have used to obtain a sample of 40 workers. (2)

Taruni decided to ask every member of the company the time it takes them to travel to the office.

(c) State the data selection process Taruni used. (1)

Taruni's results are summarised by the box plot and summary statistics below



$n = 133$ $\bar{x} = 41.33$ $s = 20$

(d) Write down the interquartile range for these data. (1)

(e) Calculate the mean and the standard deviation for these data. (3)

(f) State, giving a reason, whether you would recommend using the mean and standard deviation or the median and interquartile range to describe these data. (2)

Rana and David both work for the company and have both moved house since Taruni collected her data.

Rana's journey to work has changed from 75 minutes to 35 minutes and David's journey to work has changed from 60 minutes to 33 minutes.

Taruni drew her box plot again and only had to change two values.

(g) Explain which two values Taruni must have changed and whether each of these values has increased or decreased. (3)

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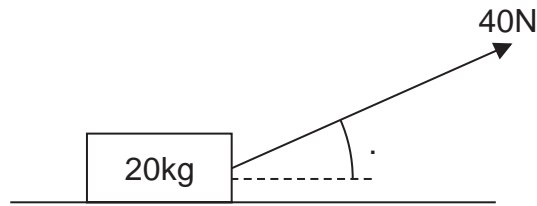


Figure 1

A wooden crate of mass ~~20~~ is pulled in a straight line along a rough horizontal floor using a handle attached to the crate.

The handle is inclined at an angle to the floor, as shown in Figure 1, where $\tan \frac{3}{4}$

The tension in the handle is ~~40~~

The coefficient of friction between the crate and the floor is 0.14

The crate is modelled as a particle and the handle is modelled as a ~~rod~~

Using the model,

(a) find the acceleration of the crate.

(6)

The crate is now pushed along the same floor using the handle. The handle is again inclined at the same angle to the floor, and the thrust in the handle is ~~40~~ as shown in Figure 2 below.

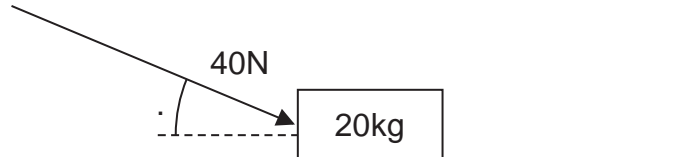


Figure 2

(b) Explain briefly why the acceleration of the crate would now be less than the acceleration of the crate found in part (a).

(2)

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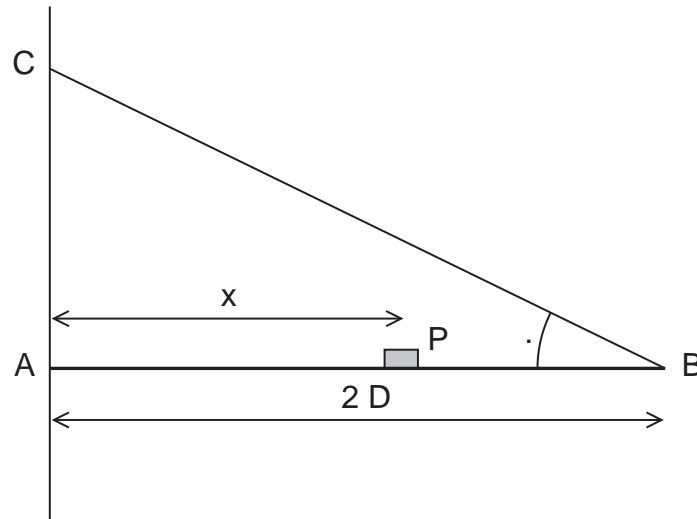


Figure 3

A plank, AB, of mass M and length $2D$, rests with its end A against a rough vertical wall. The plank is held in a horizontal position by a rope. One end of the rope is attached to the plank at B and the other end is attached to the wall at the point C, which is vertically above A.

A small block of mass $3M$ is placed on the plank at the point P, where $AP = x$. The plank is in equilibrium in a vertical plane which is perpendicular to the wall.

The angle between the rope and the plank is θ , where $\tan \theta = \frac{3}{4}$, as shown in Figure 3.

The plank is modelled as a uniform rod, the block is modelled as a particle and the rope is modelled as a light inextensible string.

(a) Using the model, show that the tension in the rope is $\frac{5Mg(3 + 4\theta)}{6D}$. (3)

The magnitude of the horizontal component of the force exerted on the plank at the wall is $\frac{2}{3}Mg$.

(b) Find x in terms of D . (2)

The force exerted on the plank at A by the wall acts in a direction which makes an angle ϕ with the horizontal.

(c) Find the value of $\tan \phi$. (5)

The rope will break if the tension in it exceeds $14Mg$.

(d) Explain how this will restrict the possible positions of P. You must justify your answer carefully. (3)

