Mock Paper

Paper Reference 9MA0-32

Mathematics

Advanced
Paper 32: Mechanics

You must have:
Mathematical Formulae and Statistical Tables, calculator

Candidates may use any calculator allowed by Pearson regulations. 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.
- The total mark for this part of the examination is 50. There are 5 questions.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Unless otherwise stated, whenever a value of g is required, take $g = 9.8\ \text{m s}^{-2}$ and give your answer to either 2 significant figures or 3 significant figures.

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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Pearson

1. A car moves along a straight horizontal road.

The car starts from rest at a fixed point A on the road and moves with constant acceleration for 30 seconds, reaching a speed of 15 ms^{-1}.

This speed is then maintained.

When the car has been moving for 15 seconds a motorbike starts from rest at A and moves along the same road in the same direction as the car.

The motorbike accelerates at $1.5 ms^{-2}$ so that it catches up with the car when the car has been moving for T seconds.

(a) Using the same axes, sketch the speed-time graph of the car and the speed-time graph of the motorbike up to the time when the motorbike catches up with the car.

(3)

(b) Find the speed of the motorbike at the instant it catches up with the car.

(6)

Question 1 continued

Question 1 continued

Question 1 continued

(Total for Question 1 is 9 marks)

2.

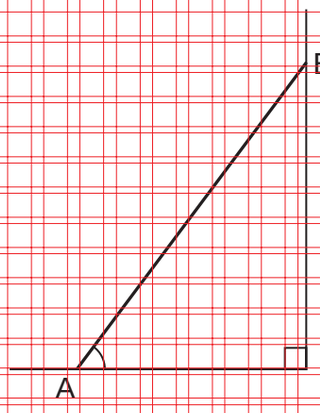

Figure 1

The ladder AB V K R Z Q L Q) L J X U H K D V O H Q J W K a and weight W.

The ladder rests in equilibrium with end A on rough horizontal ground and end B against a smooth vertical wall.

The ladder rests in a vertical plane perpendicular to the wall, and is inclined at an angle to the ground.

The coefficient of friction between the ladder and the ground is .

The ladder is on the point of slipping.

The ladder is modelled as a uniform rod.

(a) Show that $= \frac{1}{2\tan}$

(7)

(b) If the ladder were not modelled as uniform, state how this would affect the calculated value of . Explaining your answer carefully.

(2)

Question 2 continued

Question 2 continued

Question 2 continued

(Total for Question 2 is 9 marks)

3. [, Q W K L V T X H V W L R Q S R V L W L R Q Y H F W R U V D U H J L Y H Q U H O D W L

A particle P moves under the action of a single force F newtons.

At time W seconds, where W ≥ 0, the position vector of P, r metres, is given by

$$\mathbf{r} = (t^2 - 4t)\mathbf{i} + (5t - 6)\mathbf{j}$$

The mass of P is 0.5 kg.

At time T seconds, P is moving in the direction of the vector (i).

(a) Find the value of T.

(5)

(b) Find the magnitude of F when W

(4)

Question 3 continued

(Total for Question 3 is 9 marks)

4. [,Q WKLV TXHVWLRQ L DQG M DUH XQLW YHFWRUV ZLWK L KRUL]RQWDO DQG j EHLQJ YHUWLFDOO\ XSZDUG]

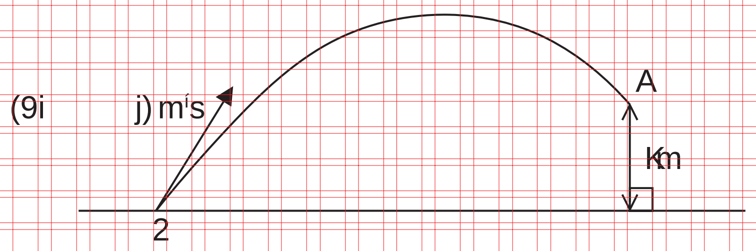

Figure 2

A small ball is projected from the fixed point 2 on horizontal ground with velocity (9i j) m s

The ball passes through the point A which is K metres vertically above the level of 2, DV VKRZQ LQ)LJXUH

The velocity of the ball at the instant it passes through the point A is (i j) m s, where is a positive constant.

The ball is modelled as a particle moving freely under gravity.

(a) Find the value of K.

(4)

(b) State the minimum speed of the ball as it moves from 2 to A.

(1)

F)LQG WKH OHQJWK RI WLPH IRU ZKLFK WKH VSHHG RI WKH E

(4)

The model could be refined by considering air resistance.

(d) Suggest one other refinement to the model that would make it more realistic.

(1)

(Total for Question 4 is 10 marks)

5.

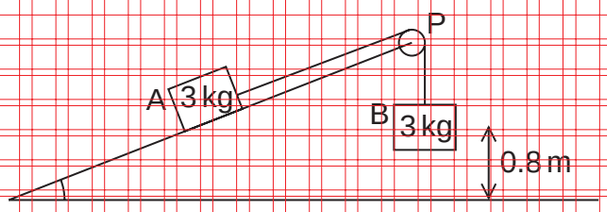

Figure 3

Two packages A and B, each of mass 3 kg, are attached to the ends of a rope.

Initially A is held at rest on a smooth fixed plane that is inclined at angle θ to the horizontal ground, where $\sin\theta = \frac{3}{5}$

The rope passes over a pulley, P, fixed at the top of the plane.

The pulley is modelled as small and smooth.

The part of the string from A to P is parallel to a line of greatest slope of the plane.

Package B hangs freely below P, as shown in Figure 3.

The packages are released from rest with the string taut and A moves up the plane.

In this model, the packages are modelled as particles and the rope as a light inextensible string.

The magnitude of the tension in the string immediately after the packages are released is T newtons.

(a) Find the value of T.

(6)

At the instant when the packages are released from rest, B is 0.8 m above the ground and A is at the point C on the plane.

When B reaches the ground, it is immediately brought to rest by the impact with the ground.

In the subsequent motion, A does not reach P and comes to instantaneous rest at the point D on the plane.

(b) Find the distance CD.

(5)

(c) State two limitations of the model that could affect the reliability of your answers.

(2)

Question 5 continued

(Total for Question 5 is 13 marks)

TOTAL FOR MECHANICS IS 50 MARKS