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CAMBRIDGE A LEVEL PROGRAMME

A2 TRIAL EXAMINATION AUGUST/SEPTEMBER 2010

(June 2009 Intake)

Tueday 24 August 2010 8.30 am – 9.45 am

MATHEMATICS 9709/43

PAPER 4 Mechanics 1 (M1) 1 hour 15 minutes

Additional materials: Answer Booklet/Paper
List of formulae (MF9)

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
Write your name and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
Where a numerical value for the acceleration due to gravity is needed, use 10 ms^{-2}.
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total marks for this paper is 50.
Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

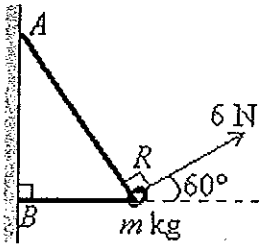
This document consists of 4 printed pages.

[Turn over

1

AB is a length of smooth wire. A bead of mass 100 grams is pushed gently from rest at A and it slides down the wire. If the vertical distance between A and B is 1 m, find the speed of the bead when it leaves the wire at B. [3]

2



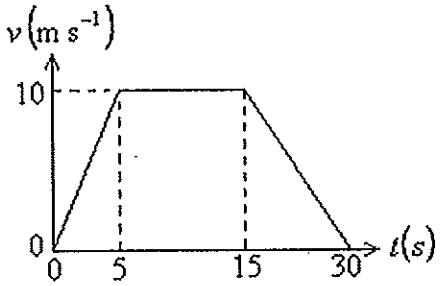
A light inextensible string has its ends attached to two fixed point A and B, A being vertically above B. A smooth ring R of mass m kg is threaded on the string and is pulled by a force of magnitude 6 N acting perpendicular to AR. Given that the ring is in equilibrium with BR horizontal (see diagram) and the string taut, find the tension in the string and the value of m. [5]

3 The engine of a lorry of mass 5 tonnes can develop a constant power of 80 kW.

(i) If its maximum speed on a flat road is 120 km h^{-1}, find the magnitude of the resistance to its motion. [3]

(ii) If this resistance is constant and the engine works at the same rate, find the acceleration of the lorry when it is traveling at a speed of 60 km h^{-1} [3]

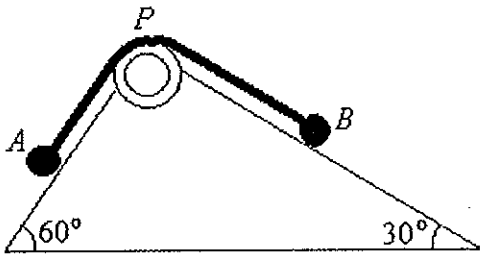
4



The diagram shows the (t, v) graph for the motion of a cyclist; the graph consists of three straight line segments. Use the information given on the graph to find the acceleration of the cyclist when $t = 2$ and the total distance traveled by the cyclist for $0 \leq t \leq 30$. [3]

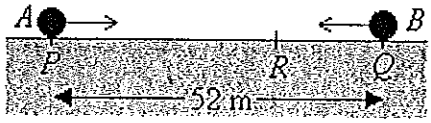
Without making any detailed calculations, sketch the (t, x) graph for this motion. [5]

5



The diagram shows particle A and B connected by a light inextensible string that passes over a small smooth pulley P. Pulley P is fixed at the top of a wedge which is fixed on a horizontal plane. Particle A is on the face of the wedge which makes an angle of $60°$ with the horizontal with the portion of the string AP parallel to the line of greatest slope of the face. Particle B is on the face of the wedge which makes an angle of $30°$ with the horizontal with the portion of string BP parallel to the line of greatest slope of the face. Given that the ratio of weight of particle A to that of particle B is $1 : 2$, and the coefficient of friction of each particle with the faces of the wedge is μ. Find the range of μ if the particle A moves towards P. [8]

6



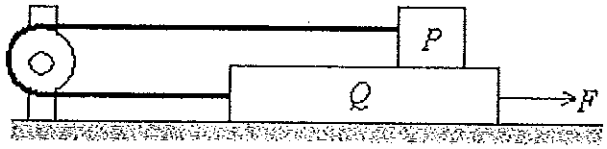
P and Q are two fixed points on the horizontal ground and are 52 m apart. A particle A travels at velocity v_A m s^{-1} given by $v_A = 8 + 6t - 2t^2$, where t is the time in s, after passing through point P and moving in the direction towards point Q. At the same instance, a particle B passes through point Q simultaneously and has a constant velocity of 3 m s^{-1} in the opposite direction. Particle A stops instantaneously at point R which is located in between points P and Q. By taking the direction from point P to point Q to be positive, find

(i) the maximum velocity of particle A. [3]

(ii) the total distance traveled by the particle A before it stops instantaneously at point R. [4]

(iii) the distance, in m, between the particles A and B when the particle A is at point R. [3]

7



Two blocks P and Q, each having mass 2 kg and 5 kg respectively, are connected with an inextensible string that passes through a smooth pulley, and block P is put on top of block Q. All the string portions not touching the pulley are parallel to the horizontal. Given that the coefficient of friction between the blocks is 0.2 and that between block P and the plane is 0.1. A horizontal force of F N acts on block P (see diagram). Find the value of F and the tension of the string if

(i) both blocks are about to slide. [5]

(ii) both blocks accelerate at 1 m s^{-2}, with block P remaining in contact with block Q. [5]