

**ADVANCED SUBSIDIARY GCE
MATHEMATICS**

Mechanics 1

4728

Candidates answer on the Answer Booklet

OCR Supplied Materials:

- 8 page Answer Booklet
- List of Formulae (MF1)

Other Materials Required:

None

Monday 25 January 2010

Morning

Duration: 1 hour 30 minutes



* 4 7 2 8 *

INSTRUCTIONS TO CANDIDATES

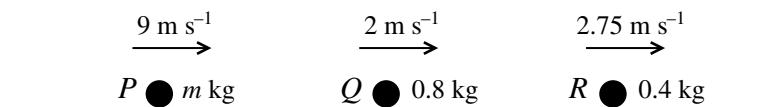
- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.
- The acceleration due to gravity is denoted by $g \text{ m s}^{-2}$. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$.
- You are permitted to use a graphical calculator in this paper.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- This document consists of **4** pages. Any blank pages are indicated.

- 1 A particle P is projected vertically downwards from a fixed point O with initial speed 4.2 m s^{-1} , and takes 1.5 s to reach the ground. Calculate
- the speed of P when it reaches the ground, [2]
 - the height of O above the ground, [2]
 - the speed of P when it is 5 m above the ground. [2]
- 2 Two horizontal forces of magnitudes 12 N and 19 N act at a point. Given that the angle between the two forces is 60° , calculate
- the magnitude of the resultant force, [5]
 - the angle between the resultant and the 12 N force. [3]

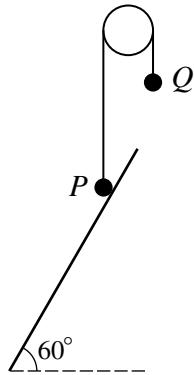
3



Three particles P , Q and R , are travelling in the same direction in the same straight line on a smooth horizontal surface. P has mass $m \text{ kg}$ and speed 9 m s^{-1} , Q has mass 0.8 kg and speed 2 m s^{-1} and R has mass 0.4 kg and speed 2.75 m s^{-1} (see diagram).

- A collision occurs between P and Q , after which P and Q move in opposite directions, each with speed 3.5 m s^{-1} . Calculate
 - the value of m , [4]
 - the change in the momentum of P . [2]
- When Q collides with R the two particles coalesce. Find their subsequent common speed. [3]

4



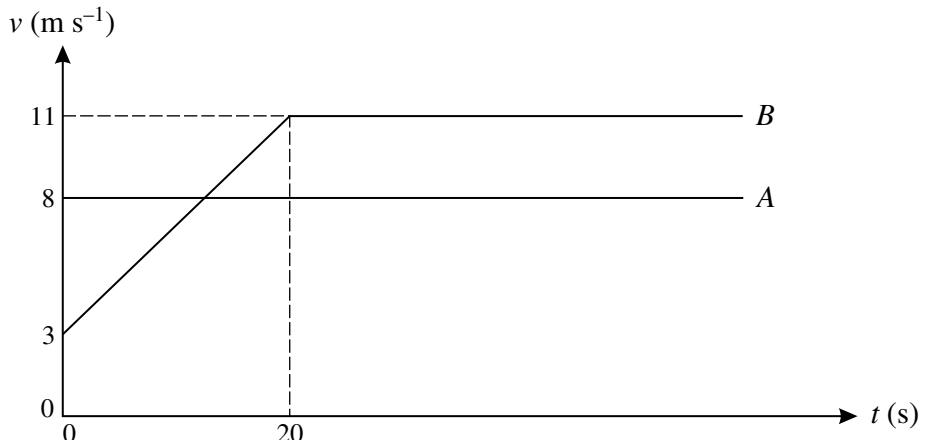
Particles P and Q , of masses 0.4 kg and 0.3 kg respectively, are attached to the ends of a light inextensible string. The string passes over a smooth fixed pulley and the sections of the string not in contact with the pulley are vertical. P rests in limiting equilibrium on a plane inclined at 60° to the horizontal (see diagram).

- (i) (a)** Calculate the components, parallel and perpendicular to the plane, of the contact force exerted by the plane on P . [4]
- (b)** Find the coefficient of friction between P and the plane. [2]

P is held stationary and a particle of mass 0.2 kg is attached to Q . With the string taut, P is released from rest.

- (ii)** Calculate the tension in the string and the acceleration of the particles. [4]

5



The (t, v) diagram represents the motion of two cyclists A and B who are travelling along a horizontal straight road. At time $t = 0$, A , who cycles with constant speed 8 m s^{-1} , overtakes B who has initial speed 3 m s^{-1} . From time $t = 0$ B cycles with constant acceleration for 20 s. When $t = 20$ her speed is 11 m s^{-1} , which she subsequently maintains.

- (i)** Find the value of t when A and B have the same speed. [3]
- (ii)** Calculate the value of t when B overtakes A . [5]
- (iii)** On a single diagram, sketch the (t, x) graphs for the two cyclists for the time from $t = 0$ until after B has overtaken A . [3]

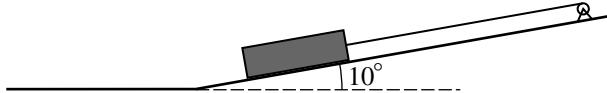
- 6 A swimmer C swims with velocity $v \text{ m s}^{-1}$ in a swimming pool. At time t s after starting, $v = 0.006t^2 - 0.18t + k$, where k is a constant. C swims from one end of the pool to the other in 28.4 s.

(i) Find the acceleration of C in terms of t . [2]

(ii) Given that the minimum speed of C is 0.65 m s^{-1} , show that $k = 2$. [5]

(iii) Express the distance travelled by C in terms of t , and calculate the length of the pool. [5]

7



A winch drags a log of mass 600 kg up a slope inclined at 10° to the horizontal by means of an inextensible cable of negligible mass parallel to the slope (see diagram). The coefficient of friction between the log and the slope is 0.15 , and the log is initially at rest at the foot of the slope. The acceleration of the log is 0.11 m s^{-2} .

(i) Calculate the tension in the cable. [5]

The cable suddenly breaks after dragging the log a distance of 10 m .

(ii) (a) Show that the deceleration of the log while continuing to move up the slope is 3.15 m s^{-2} , correct to 3 significant figures. [2]

(b) Calculate the time taken, after the cable breaks, for the log to return to its original position at the foot of the slope. [9]

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