OCR
RECOGNISING ACHIEVEMENT

Thursday 6 June 2013 – Morning

AS GCE MATHEMATICS

4728/01 Mechanics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4728/01
- List of Formulae (MF1)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found in the centre of the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book**. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- 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 m s^{-2}. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$.

INFORMATION FOR CANDIDATES

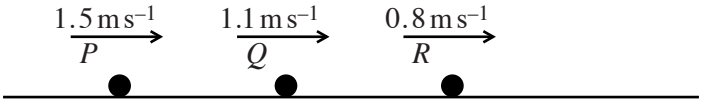
This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **16** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

1



Three particles P, Q and R have masses 0.1 kg, 0.3 kg and 0.6 kg respectively. The particles travel along the same straight line on a smooth horizontal table and have velocities $1.5\,\text{m s}^{-1}$, $1.1\,\text{m s}^{-1}$ and $0.8\,\text{m s}^{-1}$ respectively (see diagram). P collides with Q and then Q collides with R. In the second collision Q and R coalesce and subsequently move with a velocity of $1\,\text{m s}^{-1}$.

(i) Find the speed of Q immediately before the second collision. **[3]**

(ii) Calculate the change in momentum of P in the first collision. **[3]**

2 A particle P is projected vertically upwards and reaches its greatest height 0.5 s after the instant of projection. Calculate

(i) the speed of projection of P, **[2]**

(ii) the greatest height of P above the point of projection. **[3]**

It is given that the point of projection is 0.539 m above the ground.

(iii) Find the speed of P immediately before it strikes the ground. **[3]**

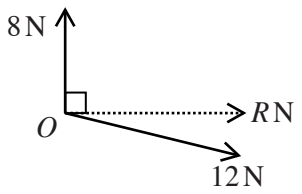
3 Two forces of magnitudes 8 N and 12 N act at a point O.

(i) Given that the two forces are perpendicular to each other, find

(a) the angle between the resultant and the 12 N force, **[2]**

(b) the magnitude of the resultant. **[2]**

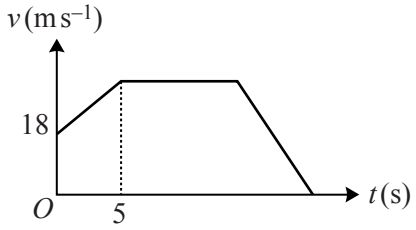
(ii) It is given instead that the resultant of the two forces has magnitude R N and acts in a direction perpendicular to the 8 N force (see diagram).



(a) Calculate the angle between the resultant and the 12 N force. **[3]**

(b) Find R. **[2]**

4



The diagram shows the (t, v) graph of a car moving along a straight road, where $v\,\text{m s}^{-1}$ is the velocity of the car at time t s after it passes through the point A. The car passes through A with velocity $18\,\text{m s}^{-1}$, and moves with constant acceleration $2.4\,\text{m s}^{-2}$ until $t = 5$. The car subsequently moves with constant velocity until it is 300 m from A. When the car is more than 300 m from A, it has constant deceleration $6\,\text{m s}^{-2}$, until it comes to rest.

(i) Find the greatest speed of the car. **[2]**

(ii) Calculate the value of t for the instant when the car begins to decelerate. **[5]**

(iii) Calculate the distance from A of the car when it is at rest. **[3]**

5 A particle P is projected with speed $u\,\text{m s}^{-1}$ from the top of a smooth inclined plane of length $2d$ metres. After its projection P moves downwards along a line of greatest slope with acceleration $4\,\text{m s}^{-2}$. At the instant 3 s after projection P has moved half way down the plane. P reaches the foot of the plane 5 s after the instant of projection.

(i) Form two simultaneous equations in u and d, and hence calculate the speed of projection of P and the length of the plane. **[6]**

(ii) Find the inclination of the plane to the horizontal. **[2]**

(iii) Given that the contact force exerted on P by the plane has magnitude 6 N, calculate the mass of P. **[2]**

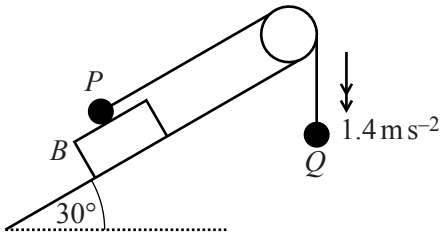
6 A particle P moves in a straight line. At time t s after passing through a point O of the line, the displacement of P from O is x m. Given that $x = 0.06t^3 - 0.45t^2 - 0.24t$, find

(i) the velocity and the acceleration of P when $t = 0$, **[6]**

(ii) the value of x when P has its minimum velocity, and the speed of P at this instant, **[5]**

(iii) the positive value of t when the direction of motion of P changes. **[3]**

7



A block B is placed on a plane inclined at 30° to the horizontal. A particle P of mass 0.6 kg is placed on the upper surface of B. The particle P is attached to one end of a light inextensible string which passes over a smooth pulley fixed to the top of the plane. A particle Q of mass 0.5 kg is attached to the other end of the string. The portion of the string attached to P is parallel to a line of greatest slope of the plane, the portion of the string attached to Q is vertical and the string is taut. The particles are released from rest and start to move with acceleration $1.4\,\text{m s}^{-2}$ (see diagram). It is given that B is in equilibrium while P moves on its upper surface.

(i) Find the tension in the string while P and B are in contact. **[3]**

(ii) Calculate the coefficient of friction between P and B. **[5]**

(iii) Given that the weight of B is 7 N, calculate the set of possible values of the coefficient of friction between B and the plane. **[7]**