

OCR

Oxford Cambridge and RSA

Tuesday 9 June 2015 – 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 inside 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 $g \text{ ms}^{-2}$. 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 **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

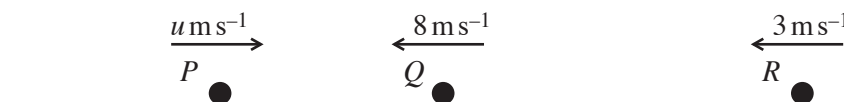
INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

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- 1 A particle P is projected vertically downwards with speed 14 m s^{-1} from a point 30 m above the ground.
- (i) Calculate the speed of P when it reaches the ground. [2]
 - (ii) Find the distance travelled by P in the first 0.4 s of its motion. [2]
 - (iii) Calculate the time taken for P to travel the final 15 m of its descent. [3]

2



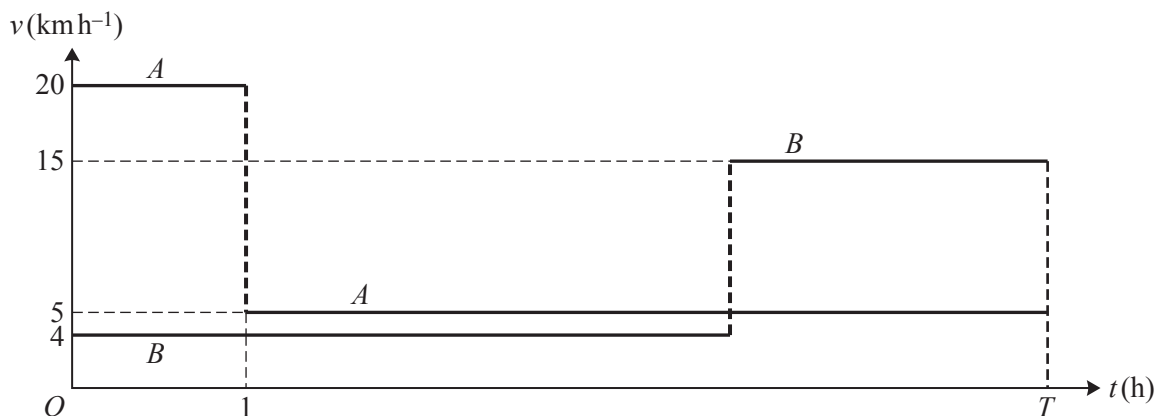
Three particles P, Q and R with masses 0.4 kg , 0.3 kg and $m \text{ kg}$ are moving along the same straight line on a smooth horizontal surface. P and Q are moving towards each other with speeds $u \text{ m s}^{-1}$ and 8 m s^{-1} respectively. R has speed 3 m s^{-1} and is moving in the same direction as Q (see diagram).

- (i) Immediately after the collision between P and Q their directions of motion have been reversed, but their speeds are unchanged. Calculate u . [4]

The next collision is between Q and R . After the collision between Q and R , particle Q is at rest and R has speed 9 m s^{-1} .

- (ii) Calculate m . [4]

3

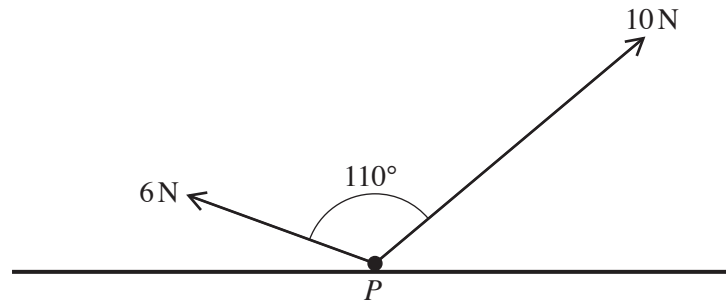


Two travellers A and B make the same journey on a long straight road. Each traveller walks for part of the journey and rides a bicycle for part of the journey. They start their journeys at the same instant, and they end their journeys simultaneously after travelling for T hours. A starts the journey cycling at a steady 20 km h^{-1} for 1 hour. A then leaves the bicycle at the side of the road, and completes the journey walking at 5 km h^{-1} . B begins the journey walking at a steady 4 km h^{-1} . When B finds the bicycle where A left it, B cycles at 15 km h^{-1} to complete the journey (see diagram).

- (i) Calculate the distance A cycles, and hence find the period of time for which B walks before finding the bicycle. [3]
- (ii) Find T . [3]
- (iii) Calculate the distance A and B each travel. [2]

3

4



Two forces of magnitudes 6 N and 10 N separated by an angle of 110° act on a particle P , which rests on a horizontal surface (see diagram).

- (i) Find the magnitude of the resultant of the 6 N and 10 N forces, and the angle between the resultant and the 10 N force. [6]

The two forces act in the same vertical plane. The particle P has weight 20 N and rests in equilibrium on the surface. Given that the surface is smooth, find

- (ii) the magnitude of the force exerted on P by the surface, [1]
 (iii) the angle between the surface and the 10 N force. [2]

- 5 A particle P of mass 0.4 kg is at rest on a horizontal surface. The coefficient of friction between P and the surface is 0.2. A force of magnitude 1.2 N acting at an angle of θ° above the horizontal is then applied to P . Find the acceleration of P in each of the following cases:

- (i) $\theta = 0$; [3]
 (ii) $\theta = 20$; [3]
 (iii) $\theta = 70$; [3]
 (iv) $\theta = 90$. [2]

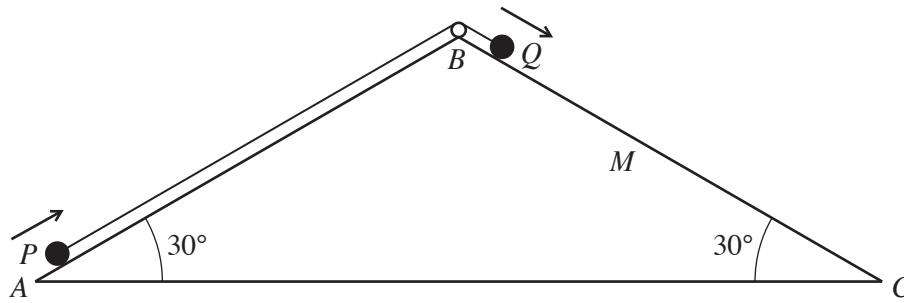
- 6 A particle P moves in a straight line on a horizontal surface. P passes through a fixed point O on the line with velocity 2 m s^{-1} . At time t s after passing through O , the acceleration of P is $(4 + 12t) \text{ m s}^{-2}$.

- (i) Calculate the velocity of P when $t = 3$. [4]
 (ii) Find the distance OP when $t = 3$. [4]

A second particle Q , having the same mass as P , moves along the same straight line. The displacement of Q from O is $(k - 2t^3) \text{ m}$, where k is a constant. When $t = 3$ the particles collide and coalesce.

- (iii) Find the value of k . [1]
 (iv) Find the common velocity of the particles immediately after their collision. [5]

Question 7 begins on page 4.



AB and BC are lines of greatest slope on a fixed triangular prism, and M is the mid-point of BC . AB and BC are inclined at 30° to the horizontal. The surface of the prism is smooth between A and B , and between B and M . Between M and C the surface of the prism is rough. A small smooth pulley is fixed to the prism at B . A light inextensible string passes over the pulley. Particle P of mass 0.3 kg is fixed to one end of the string, and is placed at A . Particle Q of mass 0.4 kg is fixed to the other end of the string and is placed next to the pulley on BC . The particles are released from rest with the string taut. P begins to move towards the pulley, and Q begins to move towards M (see diagram).

- (i) Show that the initial acceleration of the particles is 0.7 ms^{-2} , and find the tension in the string. [5]

The particle Q reaches M 1.8 s after being released from rest.

- (ii) Find the speed of the particles when Q reaches M . [2]

After Q passes through M , the string remains taut and the particles decelerate uniformly. Q comes to rest between M and C 1.4 s after passing through M .

- (iii) Find the deceleration of the particles while Q is moving from M towards C . [2]

- (iv) (a) By considering the motion of P , find the tension in the string while Q is moving from M towards C . [3]

- (b) Calculate the magnitude of the frictional force which acts on Q while it is moving from M towards C . [3]

END OF QUESTION PAPER

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