

OCR

Oxford Cambridge and RSA

Friday 16 June 2017 – Afternoon

AS GCE MATHEMATICS

4728/01 Mechanics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

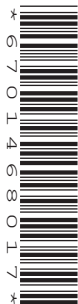
OCR supplied materials:

- 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.** If additional space is required, you should use the lined page(s) at the end of the Printed Answer Book. The question number(s) must be clearly shown.
- 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 barcodes.
- 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.

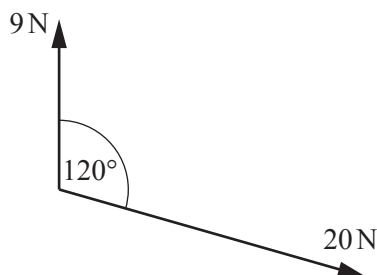
INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

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Answer **all** the questions.

- 1 AB is a line of greatest slope on a smooth plane inclined at 60° to the horizontal, with A above the level of B . A particle is projected down the plane with speed 3 m s^{-1} from A towards B . Given that 0.7 s after the instant of projection the particle passes through B , calculate the distance AB and the speed of the particle when it passes through B . [5]

2



Two horizontal forces of magnitudes 9 N and 20 N act along bearings 000° and 120° respectively. Calculate the magnitude and the bearing of their resultant. [6]

- 3 Two particles A and B are moving in the same direction along the same straight line on a smooth horizontal surface. A has mass 0.2 kg and velocity 6 m s^{-1} . B has mass 0.3 kg and velocity 4.2 m s^{-1} . The particles collide, and 2 seconds after they collide the distance AB is 1.6 m .

(i) Calculate the velocities of both particles after the collision. [6]

(ii) Find the change in the momentum of A as a result of the collision. [2]

- 4 A small ball is projected vertically upwards with speed 18 m s^{-1} from a point O on the ground. At the same instant a small object is released from rest at a point 27 m vertically above O .

(i) Verify that the ball and the object collide 1.5 s after they are set in motion. [4]

(ii) Find the velocities of the ball and the object immediately before they collide. [3]

The ball and the object have equal mass. When the ball and the object collide, they coalesce.

(iii) Find the time after their collision when they strike the ground at O . [5]

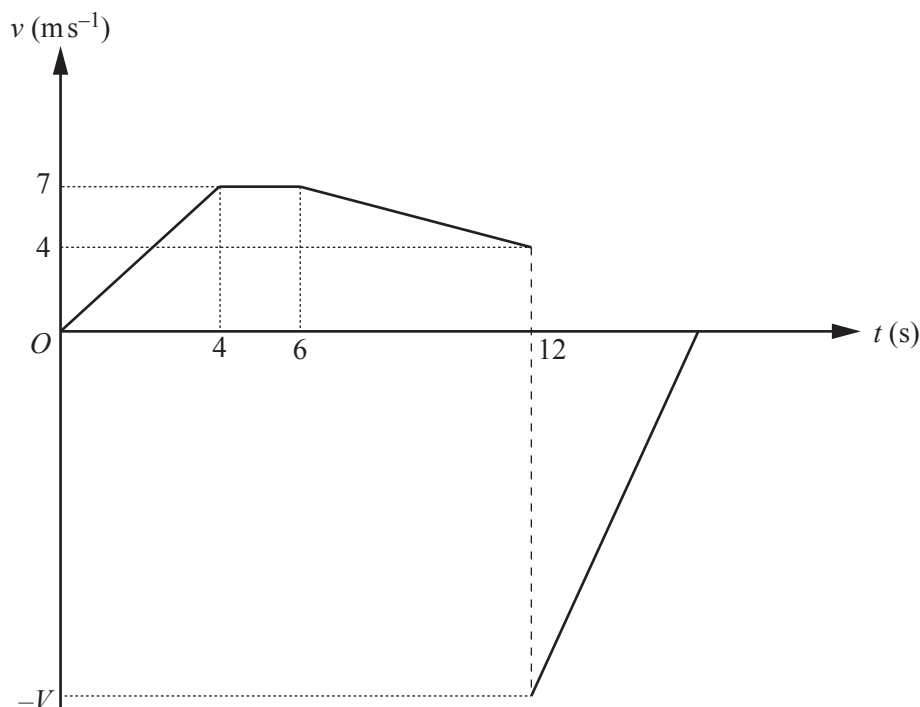
- 5 A particle moves in a straight line on a horizontal surface. At time $t \text{ s}$ after being released from rest at a point O on the line, the particle has a velocity $v \text{ m s}^{-1}$ and a displacement from O of $x \text{ m}$. It is given that

$$v = 0.8t^3 - 4t^2 + 5.6t.$$

(i) Find the positive values of t at which the particle has its maximum and minimum velocities, and calculate the values of these velocities. [5]

(ii) Express x in terms of t , and hence find the distance travelled by the particle while it is decelerating. [6]

6



A particle P is released from rest at a point A on an inclined plane with a variable coefficient of friction. P descends along a line of greatest slope $ABCD$. The velocity of P is $v \text{ m s}^{-1}$ at time t s after its release. The diagram shows the (t, v) graph for the motion of P . When $t = 4$, the particle passes through B with $v = 7$.

- (i) Find the constant acceleration of P during the first 4 seconds of its motion. [1]

P moves from B to C with constant velocity. P passes through C when $t = 6$. The particle P has mass 0.2 kg and the frictional force acting on P between B and C has magnitude 0.4 N .

- (ii) Find the inclination of the plane to the horizontal, and the magnitude of the normal component of the contact force exerted on P by the plane. [4]

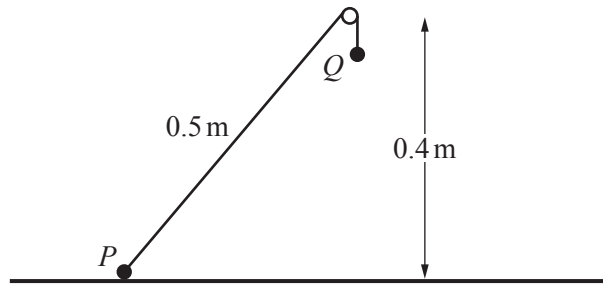
P moves from C to D with constant deceleration. P reaches D when $t = 12$ with $v = 4$.

- (iii) Show that the frictional force acting on P between C and D has magnitude 0.5 N . [3]

Immediately after reaching D at $t = 12$, the particle P is projected with speed $V \text{ m s}^{-1}$ from D back up the line of greatest slope, and comes to rest at C .

- (iv) Find V . [5]

Question 7 begins on page 4.



A particle P of mass 0.4 kg is attached to one end of a light inextensible string. The string passes over a small smooth fixed pulley, and a particle Q of mass 0.1 kg is attached to the other end of the string. P rests in limiting equilibrium on a horizontal surface which is 0.4 m below the pulley, with the string taut and in the same vertical plane as P , Q and the pulley. P is 0.5 m from the pulley (see diagram).

- (i) Calculate the coefficient of friction and the magnitude of the contact force exerted on P by the surface. [7]

Q is now moved to the position on the surface below the pulley such that the portion of the string attached to Q is vertical. P hangs freely below the pulley and the portion of the string attached to P is vertical. Both particles are at rest when Q is released.

- (ii) Find the acceleration of the particles and the tension in the string while P is descending. [5]

P strikes the surface and remains at rest. Q comes to instantaneous rest immediately before reaching the pulley.

- (iii) Find the length of the string. [5]

END OF QUESTION PAPER

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