



Thursday 12 June 2014 – Afternoon

AS GCE MATHEMATICS

4728/01 Mechanics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:

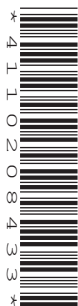
- Printed Answer Book 4728/01
- List of Formulae (MF1)

Other materials required:

- Scientific or graphical calculator

Duration: 1 hour 30 minutes

MODIFIED LANGUAGE



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 **8** 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 A particle P is projected vertically downwards with initial speed 3.5 m s^{-1} from a point A that is 5 m above horizontal ground.

(i) Find the speed of P immediately before it hits the ground. [2]

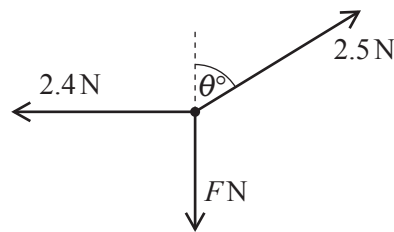
P hits the ground then rebounds and moves vertically upwards and 0.87 s after leaving the ground P passes through A .

(ii) Calculate the speed of P immediately after it leaves the ground. [3]

It is given that the mass of P is 0.2 kg.

(iii) Calculate the change in the momentum of P as a result of its collision with the ground. [2]

2



A particle rests on a smooth horizontal surface. Three horizontal forces of magnitudes 2.5 N, F N and 2.4 N act on the particle on bearings θ° , 180° and 270° respectively (see diagram). The particle is in equilibrium.

(i) Find θ and F . [4]

The 2.4 N force suddenly stops acting on the particle, that has mass 0.2 kg.

(ii) Find the magnitude and direction of the acceleration of the particle. [3]

- 3 A particle P travels in a straight line. The velocity of P at time t seconds after it passes through a fixed point A is given by $(0.6t^2 + 3) \text{ m s}^{-1}$.

Find

(i) the velocity of P when it passes through A , [1]

(ii) the displacement of P from A when $t = 1.5$, [4]

(iii) the velocity of P when it has acceleration 6 m s^{-2} . [3]

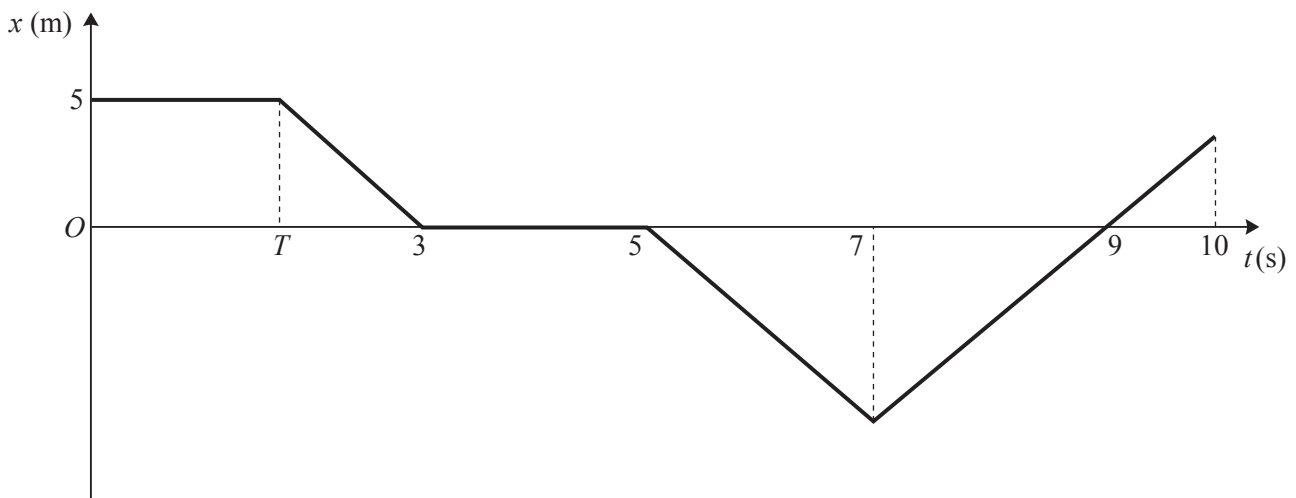
4



Particles P and Q are moving towards each other with constant speeds 4 m s^{-1} and 2 m s^{-1} along the same straight line on a smooth horizontal surface (see diagram). P has mass 0.2 kg . Q has mass 0.3 kg . The two particles collide.

- (i) Show that Q must change its direction of motion in the collision. [3]
- (ii) Given that P and Q move with equal speed after the collision, calculate both possible values for their speed after they collide. [5]

5



A particle P can move in a straight line on a horizontal surface. At time t seconds the displacement of P from a fixed point A on the line is x m. The diagram shows the (t, x) graph for P . In the interval $0 \leq t \leq 10$, either the speed of P is 4 m s^{-1} , or P is at rest.

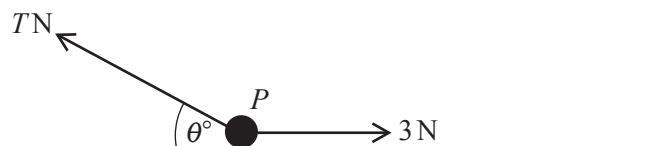
- (i) Show by calculation that $T = 1.75$. [2]
- (ii) State the velocity of P when
- (a) $t = 2$, [1]
- (b) $t = 8$, [1]
- (c) $t = 9$. [1]
- (iii) Calculate the distance travelled by P in the interval $0 \leq t \leq 10$. [3]
- For $t > 10$, the displacement of P from A is given by $x = 20t - t^2 - 96$.
- (iv) Calculate the value of t , where $t > 10$, for which the speed of P is 4 m s^{-1} . [4]

- 6 A particle P of weight 8 N rests on a horizontal surface. A horizontal force of magnitude 3 N acts on P , and P is in limiting equilibrium.

(i) Calculate the coefficient of friction between P and the surface. [2]

(ii) Find the magnitude and direction of the contact force exerted by the surface on P . [4]

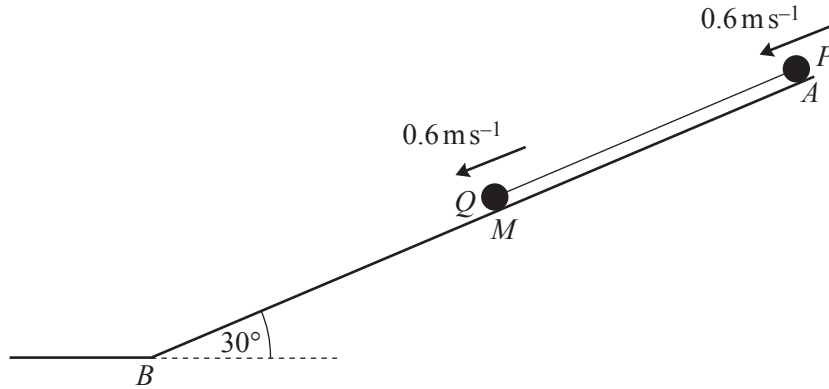
(iii)



The initial 3 N force continues to act on P in its original direction. An extra force of magnitude $T\text{ N}$, acting in the same vertical plane as the 3 N force, is now applied to P at an angle of θ° above the horizontal (see diagram). P is again in limiting equilibrium.

(a) Given that $\theta = 0$, find T . [2]

(b) Given instead that $\theta = 30$, calculate T . [6]



A and B are points at the upper and lower ends, respectively, of a line of greatest slope on a plane inclined at 30° to the horizontal. M is the mid-point of AB . Two particles P and Q , joined by a taut light inextensible string, are placed on the plane at A and M respectively. The particles are simultaneously projected with speed 0.6 m s^{-1} down the line of greatest slope (see diagram). The particles move down the plane with acceleration 0.9 m s^{-2} . At the instant 2 s after projection, P is at M and Q is at B . The particle Q then stays at rest at B .

- (i) Find the distance AB . [3]

The plane is rough between A and M , but the plane is smooth between M and B .

- (ii) Calculate the speed of P when it reaches B . [4]

P has mass 0.4 kg . Q has mass 0.3 kg .

- (iii) By considering the motion of Q , calculate the tension in the string as both particles move down the plane. [3]

- (iv) Calculate the coefficient of friction between P and the plane between A and M . [6]

END OF QUESTION PAPER

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