

**ADVANCED SUBSIDIARY GCE
MATHEMATICS**

Mechanics 1

4728

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:

- Printed answer book 4728
- List of Formulae (MF1)

Other materials required:

- Scientific or graphical calculator

**Monday 24 January 2011
Morning**

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. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- 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 $g \text{ m s}^{-2}$. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$.

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- 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

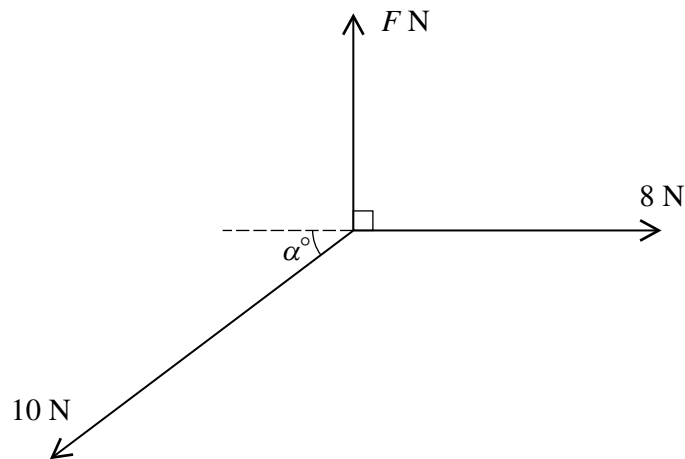
- Do not send this question paper for marking; it should be retained in the centre or destroyed.

- 1 Two particles P and Q are projected directly towards each other on a smooth horizontal surface. P has mass 0.5 kg and initial speed 2.4 m s^{-1} , and Q has mass 0.8 kg and initial speed 1.5 m s^{-1} . After a collision between P and Q , the speed of P is 0.2 m s^{-1} and the direction of its motion is reversed. Calculate

(i) the change in the momentum of P , [2]

(ii) the speed of Q after the collision. [4]

2



Three horizontal forces of magnitudes $F \text{ N}$, 8 N and 10 N act at a point and are in equilibrium. The $F \text{ N}$ and 8 N forces are perpendicular to each other, and the 10 N force acts at an obtuse angle $(90 + \alpha)^\circ$ to the $F \text{ N}$ force (see diagram). Calculate

(i) α , [3]

(ii) F . [3]

- 3 A particle is projected vertically upwards with velocity 5 m s^{-1} from a point 2.5 m above the ground.

(i) Calculate the speed of the particle when it strikes the ground. [3]

(ii) Calculate the time after projection when the particle reaches the ground. [3]

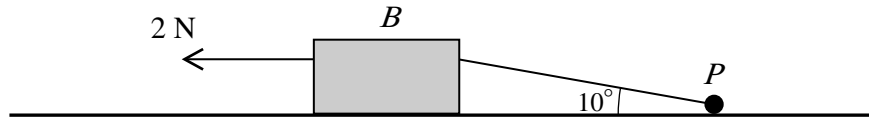
(iii) Sketch on separate diagrams

(a) the (t, v) graph,

(b) the (t, x) graph,

representing the motion of the particle. [4]

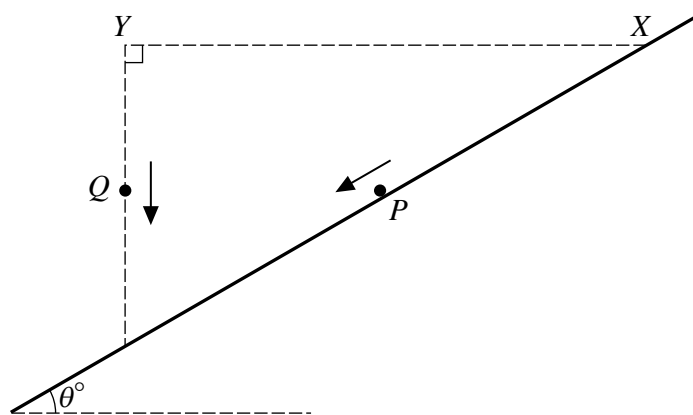
4



A block B of mass 0.8 kg and a particle P of mass 0.3 kg are connected by a light inextensible string inclined at 10° to the horizontal. They are pulled across a horizontal surface with acceleration 0.2 m s^{-2} , by a horizontal force of 2 N applied to B (see diagram).

- (i) Given that contact between B and the surface is smooth, calculate the tension in the string. [3]
- (ii) Calculate the coefficient of friction between P and the surface. [7]

5



X is a point on a smooth plane inclined at θ° to the horizontal. Y is a point directly above the line of greatest slope passing through X , and XY is horizontal. A particle P is projected from X with initial speed 4.9 m s^{-1} down the line of greatest slope, and simultaneously a particle Q is released from rest at Y . P moves with acceleration 4.9 m s^{-2} , and Q descends freely under gravity (see diagram). The two particles collide at the point on the plane directly below Y at time T s after being set in motion.

- (i) (a) Express in terms of T the distances travelled by the particles before the collision. [3]
- (b) Calculate θ . [2]
- (c) Using the answers to parts (a) and (b), show that $T = \frac{2}{3}$. [3]
- (ii) Calculate the speeds of the particles immediately before they collide. [3]
- 6 The velocity $v\text{ m s}^{-1}$ of a particle at time t s is given by $v = t^2 - 9$. The particle travels in a straight line and passes through a fixed point O when $t = 2$.
- (i) Find the displacement of the particle from O when $t = 0$. [4]
- (ii) Calculate the distance the particle travels from its position at $t = 0$ until it changes its direction of motion. [6]
- (iii) Calculate the distance of the particle from O when the acceleration of the particle is 10 m s^{-2} . [5]

[Question 7 is printed overleaf.]

- 7 A particle P of mass 0.6 kg is projected up a line of greatest slope of a plane inclined at 30° to the horizontal. P moves with deceleration 10 m s^{-2} and comes to rest before reaching the top of the plane.
- (i) Calculate the frictional force acting on P , and the coefficient of friction between P and the plane. [7]
- (ii) Find the magnitude of the contact force exerted on P by the plane and the angle between the contact force and the upward direction of the line of greatest slope,
- (a) when P is in motion, [5]
- (b) when P is at rest. [2]

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Candidate forename		Candidate surname	
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Centre number						Candidate number				
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1 (i)	
1 (ii)	

2 (i)	
2 (ii)	
3 (i)	

3 (ii)	
3 (iii) (a)	
3 (iii) (b)	
4 (i)	

4 (i)	(continued)
4 (ii)	

5(i)(a)	
5(i)(b)	

5(i)(c)	
5(ii)	

6 (i)	
6 (ii)	

6 (ii)	(continued)
6 (iii)	

7 (ii) (b)	



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