

**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

**Tuesday 15 June 2010**  
**Morning**

**Duration:** 1 hour 30 minutes

**INSTRUCTIONS TO CANDIDATES**

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

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Printed Answer Book.
- **The questions are on the inserted Question Paper.**
- **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 and make sure that 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 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  $g = 9.8$ .

**INFORMATION FOR CANDIDATES**

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

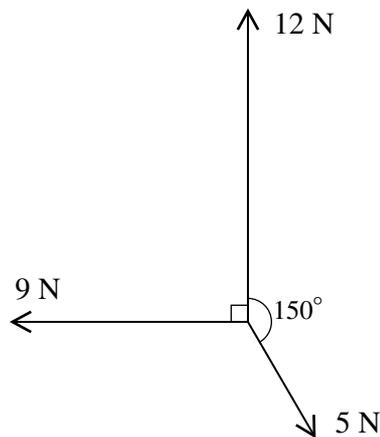
- The number of marks is given in brackets [ ] at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

**INSTRUCTION TO EXAMS OFFICER / INVIGILATOR**

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

- 1 A block  $B$  of mass  $3\text{ kg}$  moves with deceleration  $1.2\text{ m s}^{-2}$  in a straight line on a rough horizontal surface. The initial speed of  $B$  is  $5\text{ m s}^{-1}$ . Calculate
- (i) the time for which  $B$  is in motion, [2]
  - (ii) the distance travelled by  $B$  before it comes to rest, [2]
  - (iii) the coefficient of friction between  $B$  and the surface. [4]
- 2 Two particles  $P$  and  $Q$  are moving in opposite directions in the same straight line on a smooth horizontal surface when they collide.  $P$  has mass  $0.4\text{ kg}$  and speed  $3\text{ m s}^{-1}$ .  $Q$  has mass  $0.6\text{ kg}$  and speed  $1.5\text{ m s}^{-1}$ . Immediately after the collision, the speed of  $P$  is  $0.1\text{ m s}^{-1}$ .
- (i) Given that  $P$  and  $Q$  are moving in the same direction after the collision, find the speed of  $Q$ . [4]
  - (ii) Given instead that  $P$  and  $Q$  are moving in opposite directions after the collision, find the distance between them  $3\text{ s}$  after the collision. [5]

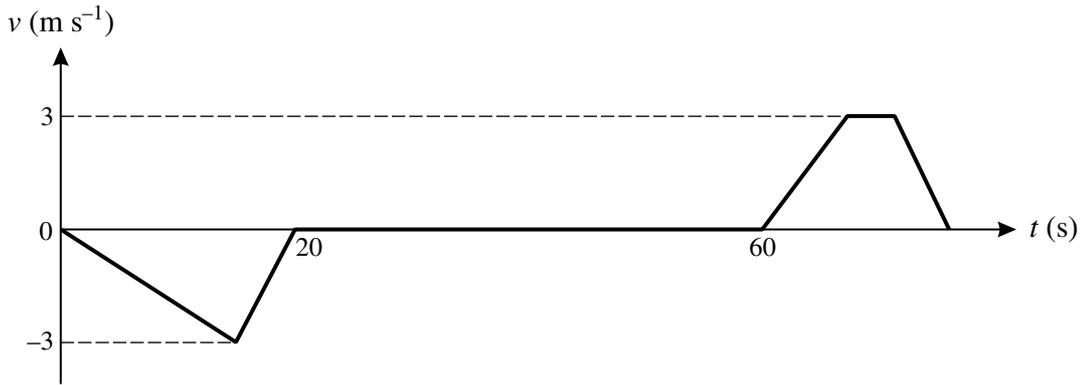
3



Three horizontal forces of magnitudes  $12\text{ N}$ ,  $5\text{ N}$ , and  $9\text{ N}$  act along bearings  $000^\circ$ ,  $150^\circ$  and  $270^\circ$  respectively (see diagram).

- (i) Show that the component of the resultant of the three forces along bearing  $270^\circ$  has magnitude  $6.5\text{ N}$ . [2]
  - (ii) Find the component of the resultant of the three forces along bearing  $000^\circ$ . [2]
  - (iii) Hence find the magnitude and bearing of the resultant of the three forces. [5]
- 4 A particle  $P$  moving in a straight line has velocity  $v\text{ m s}^{-1}$  at time  $t\text{ s}$  after passing through a fixed point  $O$ . It is given that  $v = 3.2 - 0.2t^2$  for  $0 \leq t \leq 5$ . Calculate
- (i) the value of  $t$  when  $P$  is at instantaneous rest, [2]
  - (ii) the acceleration of  $P$  when it is at instantaneous rest, [3]
  - (iii) the greatest distance of  $P$  from  $O$ . [5]

5



The diagram shows the  $(t, v)$  graph for a lorry delivering waste to a recycling centre. The graph consists of six straight line segments. The lorry reverses in a straight line from a stationary position on a weighbridge before coming to rest. It deposits its waste and then moves forwards in a straight line accelerating to a maximum speed of  $3 \text{ m s}^{-1}$ . It maintains this speed for 4 s and then decelerates, coming to rest at the weighbridge.

(i) Calculate the distance from the weighbridge to the point where the lorry deposits the waste. [2]

(ii) Calculate the time which elapses between the lorry leaving the weighbridge and returning to it. [4]

(iii) Given that the acceleration of the lorry when it is moving forwards is  $0.4 \text{ m s}^{-2}$ , calculate its final deceleration. [3]

6 A block  $B$  of mass  $0.85 \text{ kg}$  lies on a smooth slope inclined at  $30^\circ$  to the horizontal.  $B$  is attached to one end of a light inextensible string which is parallel to the slope. At the top of the slope, the string passes over a smooth pulley. The other end of the string hangs vertically and is attached to a particle  $P$  of mass  $0.55 \text{ kg}$ . The string is taut at the instant when  $P$  is projected vertically downwards.

(i) Calculate

(a) the acceleration of  $B$  and the tension in the string, [5]

(b) the magnitude of the force exerted by the string on the pulley. [2]

The initial speed of  $P$  is  $1.3 \text{ m s}^{-1}$  and after moving  $1.5 \text{ m}$   $P$  reaches the ground, where it remains at rest.  $B$  continues to move up the slope and does not reach the pulley.

(ii) Calculate the total distance  $B$  moves up the slope before coming instantaneously to rest. [6]

[Question 7 is printed overleaf.]

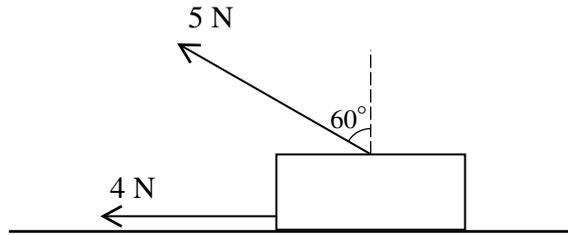


Fig. 1

A rectangular block  $B$  of weight  $12\text{ N}$  lies in limiting equilibrium on a horizontal surface. A horizontal force of  $4\text{ N}$  and a coplanar force of  $5\text{ N}$  inclined at  $60^\circ$  to the vertical act on  $B$  (see Fig. 1).

- (i) Find the coefficient of friction between  $B$  and the surface. [6]

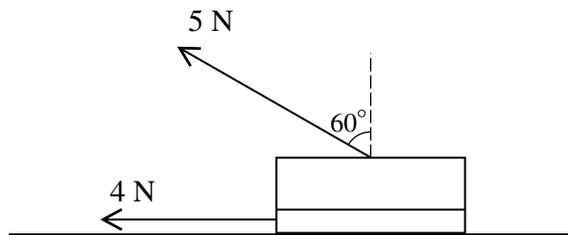


Fig. 2

$B$  is now cut horizontally into two smaller blocks. The upper block has weight  $9\text{ N}$  and the lower block has weight  $3\text{ N}$ . The  $5\text{ N}$  force now acts on the upper block and the  $4\text{ N}$  force now acts on the lower block (see Fig. 2). The coefficient of friction between the two blocks is  $\mu$ .

- (ii) Given that the upper block is in limiting equilibrium, find  $\mu$ . [2]
- (iii) Given instead that  $\mu = 0.1$ , find the accelerations of the two blocks. [6]

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Candidate Forename		Candidate Surname	
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<b>1 (i)</b>	
<b>1 (ii)</b>	
<b>1 (iii)</b>	



<b>3 (i)</b>	
<b>3 (ii)</b>	
<b>3 (iii)</b>	

<b>4 (i)</b>	
<b>4 (ii)</b>	
<b>4 (iii)</b>	

<b>5 (i)</b>	
<b>5 (ii)</b>	



<b>6 (i) (a)</b>	
<b>6 (i) (b)</b>	





<b>7 (ii)</b>	<b>(continued)</b>
<b>7 (iii)</b>	

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