

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

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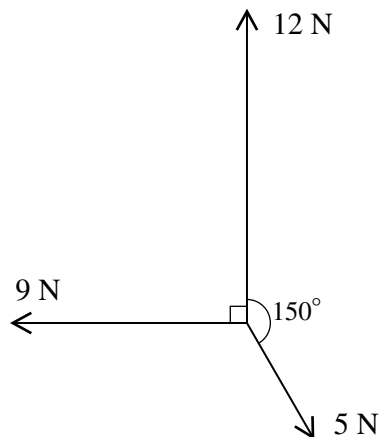
- The number of marks is given in brackets [] at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question 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 A block B of mass 3 kg moves with deceleration 1.2 m s^{-2} in a straight line on a rough horizontal surface. The initial speed of B is 5 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 kg and speed 3 m s^{-1} . Q has mass 0.6 kg and speed 1.5 m s^{-1} . Immediately after the collision, the speed of P is 0.1 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 s after the collision. [5]

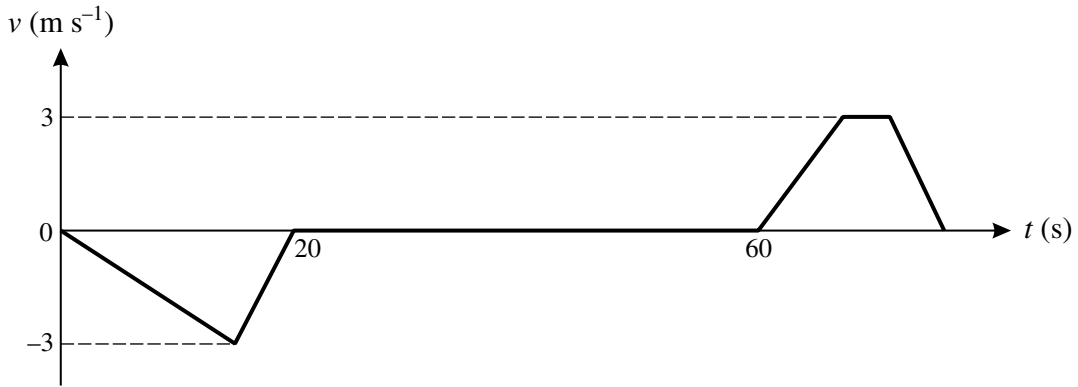
3



Three horizontal forces of magnitudes 12 N , 5 N , and 9 N act along bearings 000° , 150° and 270° respectively (see diagram).

- (i) Show that the component of the resultant of the three forces along bearing 270° has magnitude 6.5 N . [2]
 - (ii) Find the component of the resultant of the three forces along bearing 000° . [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 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 m s^{-2} , calculate its final deceleration. [3]

6 A block B of mass 0.85 kg lies on a smooth slope inclined at 30° 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 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 m s^{-1} and after moving 1.5 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.]

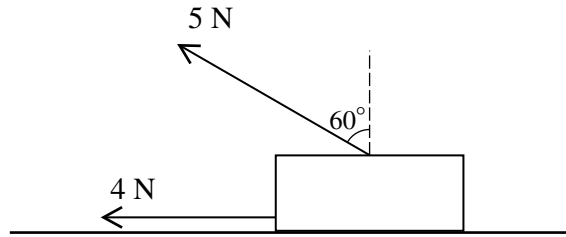


Fig. 1

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

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

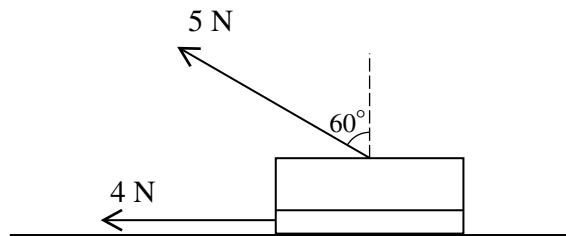


Fig. 2

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

- (ii) Given that the upper block is in limiting equilibrium, find μ . [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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Centre Number						Candidate Number				
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1 (i)	
1 (ii)	
1 (iii)	

3 (i)	
3 (ii)	
3 (iii)	

4 (i)	
4 (ii)	
4 (iii)	

5 (i)	
5 (ii)	

6 (i) (a)	
6 (i) (b)	

7 (ii)	(continued)
7 (iii)	

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