

Centre No.							Paper Reference	Surname		Initial(s)
Candidate No.							6 6 7 7 / 0 1	Signature		

Paper Reference(s)

# 6677/01

# Edexcel GCE

## Mechanics M1

### Advanced/Advanced Subsidiary

Wednesday 16 May 2012 – Morning

Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
Total	

Materials required for examination

Mathematical Formulae (Pink)

Items included with question papers

Nil

**Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation or symbolic differentiation/integration, or have retrievable mathematical formulae stored in them.**

### Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature. Check that you have the correct question paper.

Answer ALL the questions.

You must write your answer to each question in the space following the question.

Whenever a numerical value of *g* is required, take  $g = 9.8 \text{ m s}^{-2}$ .

When a calculator is used, the answer should be given to an appropriate degree of accuracy.

### Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.

Full marks may be obtained for answers to ALL questions.

The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2).

There are 7 questions in this question paper. The total mark for this paper is 75.

There are 28 pages in this question paper. Any blank pages are indicated.

### Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.

You should show sufficient working to make your methods clear to the Examiner.

Answers without working may not gain full credit.

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W850/R6677/57570 6/5/3



*Turn over*

1. Two particles *A* and *B*, of mass  $5m$  kg and  $2m$  kg respectively, are moving in opposite directions along the same straight horizontal line. The particles collide directly. Immediately before the collision, the speeds of *A* and *B* are  $3\text{ m s}^{-1}$  and  $4\text{ m s}^{-1}$  respectively. The direction of motion of *A* is unchanged by the collision. Immediately after the collision, the speed of *A* is  $0.8\text{ m s}^{-1}$ .

(a) Find the speed of *B* immediately after the collision.

**(3)**

In the collision, the magnitude of the impulse exerted on *A* by *B* is  $3.3\text{ N s}$ .

(b) Find the value of  $m$ .

**(3)**

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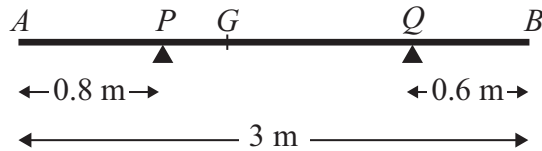
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2.

**Figure 1**

A non-uniform rod  $AB$  has length 3 m and mass 4.5 kg. The rod rests in equilibrium, in a horizontal position, on two smooth supports at  $P$  and at  $Q$ , where  $AP = 0.8$  m and  $QB = 0.6$  m, as shown in Figure 1. The centre of mass of the rod is at  $G$ . Given that the magnitude of the reaction of the support at  $P$  on the rod is twice the magnitude of the reaction of the support at  $Q$  on the rod, find

(a) the magnitude of the reaction of the support at  $Q$  on the rod, **(3)**

(b) the distance  $AG$ . **(4)**

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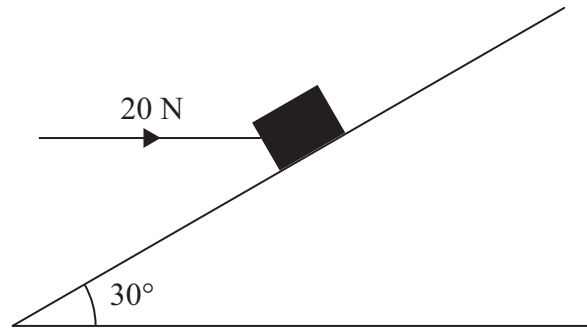
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3.



**Figure 2**

A box of mass 5 kg lies on a rough plane inclined at  $30^\circ$  to the horizontal. The box is held in equilibrium by a horizontal force of magnitude 20 N, as shown in Figure 2. The force acts in a vertical plane containing a line of greatest slope of the inclined plane. The box is in equilibrium and on the point of moving down the plane. The box is modelled as a particle.

Find

(a) the magnitude of the normal reaction of the plane on the box, (4)

(b) the coefficient of friction between the box and the plane. (5)

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Question 3 continued

Lined area for writing the answer to Question 3.



4. A car is moving on a straight horizontal road. At time  $t = 0$ , the car is moving with speed  $20 \text{ m s}^{-1}$  and is at the point  $A$ . The car maintains the speed of  $20 \text{ m s}^{-1}$  for 25 s. The car then moves with constant deceleration  $0.4 \text{ m s}^{-2}$ , reducing its speed from  $20 \text{ m s}^{-1}$  to  $8 \text{ m s}^{-1}$ . The car then moves with constant speed  $8 \text{ m s}^{-1}$  for 60 s. The car then moves with constant acceleration until it is moving with speed  $20 \text{ m s}^{-1}$  at the point  $B$ .

(a) Sketch a speed-time graph to represent the motion of the car from  $A$  to  $B$ . (3)

(b) Find the time for which the car is decelerating. (2)

Given that the distance from  $A$  to  $B$  is 1960 m,

(c) find the time taken for the car to move from  $A$  to  $B$ . (8)









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blank

**Question 5 continued**

A series of horizontal lines for writing the answer to Question 5 continued.



P 4 0 6 8 9 A 0 1 5 2 8

6. [In this question  $\mathbf{i}$  and  $\mathbf{j}$  are horizontal unit vectors due east and due north respectively and position vectors are given with respect to a fixed origin.]

A ship  $S$  is moving with constant velocity  $(-12\mathbf{i} + 7.5\mathbf{j}) \text{ km h}^{-1}$ .

- (a) Find the direction in which  $S$  is moving, giving your answer as a bearing. (3)

At time  $t$  hours after noon, the position vector of  $S$  is  $\mathbf{s}$  km. When  $t = 0$ ,  $\mathbf{s} = 40\mathbf{i} - 6\mathbf{j}$ .

- (b) Write down  $\mathbf{s}$  in terms of  $t$ . (2)

A fixed beacon  $B$  is at the point with position vector  $(7\mathbf{i} + 12.5\mathbf{j}) \text{ km}$ .

- (c) Find the distance of  $S$  from  $B$  when  $t = 3$  (4)

- (d) Find the distance of  $S$  from  $B$  when  $S$  is due north of  $B$ . (4)

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**Question 6 continued**

Handwriting practice lines for Question 6 continued.



P 4 0 6 8 9 A 0 1 9 2 8

7.



Figure 3

Two particles  $P$  and  $Q$ , of mass  $0.3\text{ kg}$  and  $0.5\text{ kg}$  respectively, are joined by a light horizontal rod. The system of the particles and the rod is at rest on a horizontal plane. At time  $t = 0$ , a constant force  $\mathbf{F}$  of magnitude  $4\text{ N}$  is applied to  $Q$  in the direction  $PQ$ , as shown in Figure 3. The system moves under the action of this force until  $t = 6\text{ s}$ . During the motion, the resistance to the motion of  $P$  has constant magnitude  $1\text{ N}$  and the resistance to the motion of  $Q$  has constant magnitude  $2\text{ N}$ .

Find

- (a) the acceleration of the particles as the system moves under the action of  $\mathbf{F}$ , (3)
  - (b) the speed of the particles at  $t = 6\text{ s}$ , (2)
  - (c) the tension in the rod as the system moves under the action of  $\mathbf{F}$ . (3)
- At  $t = 6\text{ s}$ ,  $\mathbf{F}$  is removed and the system decelerates to rest. The resistances to motion are unchanged. Find
- (d) the distance moved by  $P$  as the system decelerates, (4)
  - (e) the thrust in the rod as the system decelerates. (3)

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**Question 7 continued**

A series of horizontal lines for writing.

**(Total 15 marks)**

**Q7**

**TOTAL FOR PAPER: 75 MARKS**

**END**

