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

Friday 12 January 2007 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

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

Materials required for examination	Items included with question papers
Mathematical Formulae (Green)	Nil

Candidates may use any calculator EXCEPT those with the facility for symbolic algebra, differentiation and/or integration. Thus candidates may NOT use calculators such as the Texas Instruments TI 89, TI 92, Casio CFX 9970G, Hewlett Packard HP 48G.

Instructions to Candidates
In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
You must write your answer for 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 16 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 must show sufficient working to make your methods clear to the Examiner. Answers without working may gain no credit.

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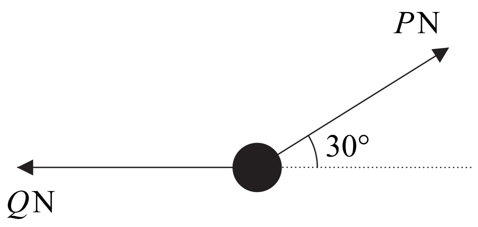
1. **Figure 1**



A particle of weight 24 N is held in equilibrium by two light inextensible strings. One string is horizontal. The other string is inclined at an angle of 30° to the horizontal, as shown in Figure 1. The tension in the horizontal string is Q newtons and the tension in the other string is P newtons. Find

(a) the value of P,

(3)

(b) the value of Q.

(3)

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Question 1 continued

Q1

(Total 6 marks)

N 2 3 5 6 0 A 0 3 1 6

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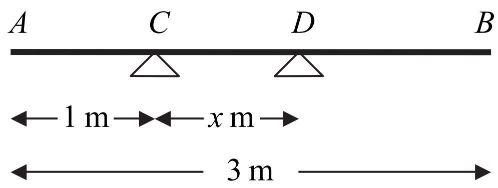
2.

Figure 2



A uniform plank AB has weight 120 N and length 3 m. The plank rests horizontally in equilibrium on two smooth supports C and D, where $AC = 1$ m and $CD = x$ m, as shown in Figure 2. The reaction of the support on the plank at D has magnitude 80 N. Modelling the plank as a rod,

(a) show that $x = 0.75$

(3)

A rock is now placed at B and the plank is on the point of tilting about D.
Modelling the rock as a particle, find

(b) the weight of the rock,

(4)

(c) the magnitude of the reaction of the support on the plank at D.

(2)

(d) State how you have used the model of the rock as a particle.

(1)

N 2 3 5 6 0 A 0 4 1 6

Leave blank

Question 2 continued

Q2

(Total 10 marks)

N 2 3 5 6 0 A 0 5 1 6

Turn over

Leave blank

3. A particle P of mass 2 kg is moving under the action of a constant force $\mathbf{F}$ newtons. When $t = 0$, P has velocity $(3\mathbf{i} + 2\mathbf{j})$ m s^{-1} and at time $t = 4$ s, P has velocity $(15\mathbf{i} - 4\mathbf{j})$ m s^{-1}. Find

(a) the acceleration of P in terms of $\mathbf{i}$ and $\mathbf{j}$,

(2)

(b) the magnitude of $\mathbf{F}$,

(4)

(c) the velocity of P at time $t = 6$ s.

(3)

Leave blank

Question 3 continued

(Total 9 marks)

Q3

Leave blank

4. A particle P of mass 0.3 kg is moving with speed $u \text{ m s}^{-1}$ in a straight line on a smooth horizontal table. The particle P collides directly with a particle Q of mass 0.6 kg, which is at rest on the table. Immediately after the particles collide, P has speed 2 m s^{-1} and Q has speed 5 m s^{-1}. The direction of motion of P is reversed by the collision. Find

(a) the value of u,

(4)

(b) the magnitude of the impulse exerted by P on Q.

(2)

Immediately after the collision, a constant force of magnitude R newtons is applied to Q in the direction directly opposite to the direction of motion of Q. As a result Q is brought to rest in 1.5 s.

(c) Find the value of R.

(4)

Leave blank

Question 4 continued

Q4

(Total 10 marks)

N 2 3 5 6 0 A 0 9 1 6

Leave blank

5. A ball is projected vertically upwards with speed 21 m s^{-1} from a point A, which is 1.5 m above the ground. After projection, the ball moves freely under gravity until it reaches the ground. Modelling the ball as a particle, find

(a) the greatest height above A reached by the ball,

(3)

(b) the speed of the ball as it reaches the ground,

(3)

(c) the time between the instant when the ball is projected from A and the instant when the ball reaches the ground.

(4)

N 2 3 5 6 0 A 0 1 0 1 6

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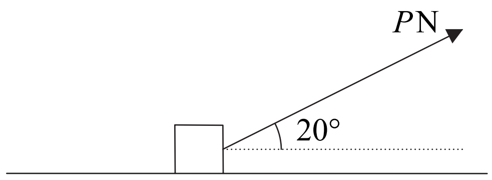
Question 5 continued

(Total 10 marks)

Q5

6.

Figure 3



A box of mass 30 kg is being pulled along rough horizontal ground at a constant speed using a rope. The rope makes an angle of 20° with the ground, as shown in Figure 3. The coefficient of friction between the box and the ground is 0.4. The box is modelled as a particle and the rope as a light, inextensible string. The tension in the rope is P newtons.

(a) Find the value of P.

(8)

The tension in the rope is now increased to 150 N.

(b) Find the acceleration of the box.

(6)

Leave blank

Question 6 continued

Q6

(Total 14 marks)

Leave blank

7.

Figure 4

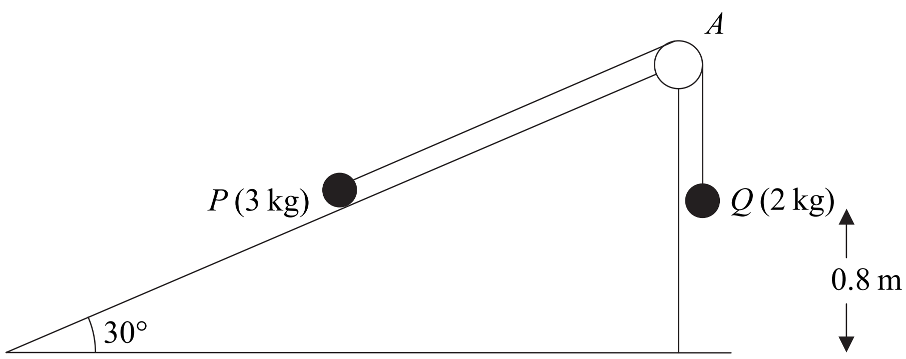


Figure 4 shows two particles P and Q, of mass 3 kg and 2 kg respectively, connected by a light inextensible string. Initially P is held at rest on a fixed smooth plane inclined at 30° to the horizontal. The string passes over a small smooth light pulley A fixed at the top of the plane. The part of the string from P to A is parallel to a line of greatest slope of the plane. The particle Q hangs freely below A. The system is released from rest with the string taut.

(a) Write down an equation of motion for P and an equation of motion for Q.
(4)

(b) Hence show that the acceleration of Q is 0.98 m s^{-2}.
(2)

(c) Find the tension in the string.
(2)

(d) State where in your calculations you have used the information that the string is inextensible.
(1)

On release, Q is at a height of 0.8 m above the ground. When Q reaches the ground, it is brought to rest immediately by the impact with the ground and does not rebound. The initial distance of P from A is such that in the subsequent motion P does not reach A. Find

(e) the speed of Q as it reaches the ground,
(2)

(f) the time between the instant when Q reaches the ground and the instant when the string becomes taut again.
(5)

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Question 7 continued

Leave blank

Question 7 continued

Q7

(Total 16 marks)

TOTAL FOR PAPER: 75 MARKS

END