OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MATHEMATICS 2637

Mechanics 1

Friday **21 JANUARY 2005** Afternoon 1 hour 20 minutes

Additional materials:
Answer booklet
Graph paper
List of Formulae (MF8)

TIME 1 hour 20 minutes

INSTRUCTIONS TO CANDIDATES

- Write your Name, Centre Number and Candidate Number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- 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.
- Where a numerical value for the acceleration due to gravity is needed, use $9.8\,\mathrm{m\,s^{-2}}$.
- You are permitted to use a graphic calculator in this paper.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 60.
- Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.
- **You are reminded of the need for clear presentation in your answers.**

This question paper consists of 4 printed pages.

Registered Charity Number: 1066969
[Turn over

1 Two small spheres A and B, of masses 0.3 kg and 0.2 kg respectively, are moving on a smooth horizontal table and collide. Immediately before the collision A and B are moving directly towards each other with speeds $1.5\,\text{m s}^{-1}$ and $2\,\text{m s}^{-1}$ respectively. Immediately after the collision A and B move away from each other with speeds of $a\,\text{m s}^{-1}$ and $b\,\text{m s}^{-1}$ respectively.

(i) Show that $b = 0.25 + 1.5a$. [4]

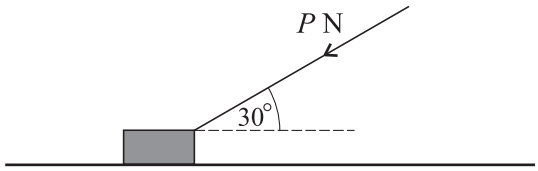
After the collision sphere A travels a distance of 2 m in 4 s.

(ii) Find the values of a and b. [2]

2 A block of mass 3 kg is at rest on a rough horizontal plane.

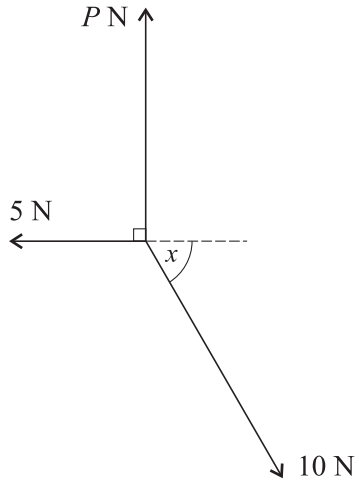
(i) The block is acted on by a horizontal force of magnitude 14.7 N. Given that the block is on the point of sliding, find the coefficient of friction between the block and the plane. [3]

(ii)



The horizontal force is now replaced by a force of magnitude P N acting downwards at 30° to the horizontal (see diagram). Given that the block is again on the point of sliding, find the value of P. [4]

3



The diagram shows the magnitudes and directions of three coplanar forces which act at a point.

(i) Find the value of P and the value of x in degrees for which the forces are in equilibrium. [4]

(ii) Find the magnitude of the resultant of the forces when $P = 12$ and $x = 45°$. [4]

4 A particle moves in a straight line. At time t s the acceleration of the particle is $3t^{\frac{1}{2}}$ m s^{-2}. When $t = 0$ the particle is at the point O, and when $t = 9$ the particle is at the point P and is moving with velocity 60 m s^{-1}. Find

(i) the velocity of the particle at O, [4]

(ii) the distance OP. [4]

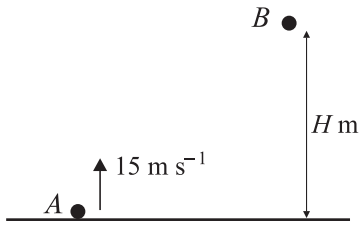
5 A cyclist travels along a straight road from the point O to the point A where he immediately turns round and returns directly to O. On the outward journey the cyclist starts from rest and accelerates uniformly for 20 s, reaching a speed of 9 m s^{-1}. He then cycles at a constant speed of 9 m s^{-1} for 82 s before decelerating uniformly for 8 s, coming to rest instantaneously at A. On the return journey the cyclist accelerates at 0.5 m s^{-2} until his speed reaches 8 m s^{-1}. He then cycles at a constant speed of 8 m s^{-1} until he reaches O.

(i) Sketch the (t, v) graph for the cyclist's whole journey (outward and return). [3]

(ii) Find the distance OA. [2]

(iii) Find the total time taken for the whole journey. [4]

6



A particle A is projected vertically upwards from horizontal ground with speed 15 m s^{-1}. At the same instant a particle B is released from rest at a height H m above the ground (see diagram).

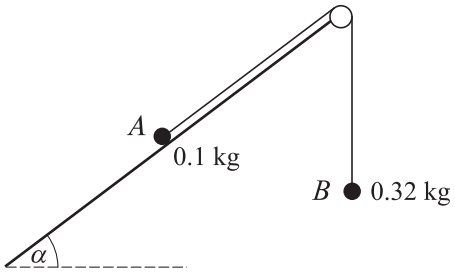
(i) Find the height of A after 0.8 s. [2]

(ii) Find the value of H, given that A and B are at the same height after 0.8 s. [2]

(iii) Show that the time interval between the instant that B reaches the ground and the instant that A returns to the ground is approximately 1.5 s. [5]

[Question 7 is printed overleaf.]

7



Particles A and B, of masses 0.1 kg and 0.32 kg respectively, are attached to the ends of a light inextensible string. The string passes over a fixed smooth pulley at the top of a rough plane which is inclined at an angle α to the horizontal. It is given that $\sin \alpha = 0.6$ and $\cos \alpha = 0.8$. Particle A is held in contact with the plane and particle B hangs vertically below the pulley (see diagram). The coefficient of friction between A and the plane is $\frac{1}{4}$. Particle A is released and the system starts to move. Find

(i) the acceleration of A, [7]

(ii) the distance travelled by A when its speed has reached $2.8\,\mathrm{m\,s^{-1}}$ (assuming that A has not reached the pulley). [2]

When the speed is $2.8\,\mathrm{m\,s^{-1}}$ the string breaks. Particle A continues to move up the plane without reaching the pulley.

(iii) Find the distance between the initial position of A and the highest point reached by A. [4]

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