

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

**Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education**

MATHEMATICS**4728**

Mechanics 1

Specimen Paper

Additional materials:
Answer booklet
Graph paper
List of Formulae (MF 1)

TIME 1 hour 30 minutes**INSTRUCTIONS TO CANDIDATES**

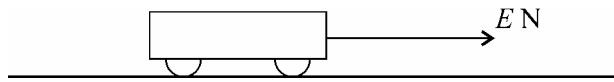
- Write your Name, Centre Number and Candidate Number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- Give non-exact numerical answers correct to 3 significant figures, unless a different degree of accuracy is specified in the question or is clearly appropriate.
- Where a numerical value for the acceleration due to gravity is needed, use 9.8 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 72.
- 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.

1



An engine pulls a truck of mass 6000 kg along a straight horizontal track, exerting a constant horizontal force of magnitude E newtons on the truck (see diagram). The resistance to motion of the truck has magnitude 400 N, and the acceleration of the truck is 0.2 m s^{-2} . Find the value of E . [4]

2

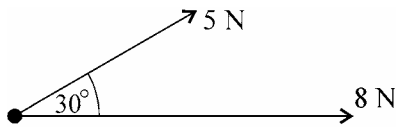


Fig. 1

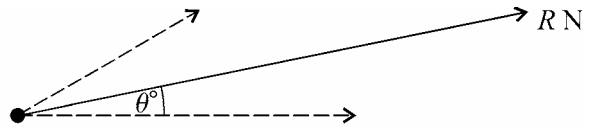


Fig. 2

Forces of magnitudes 8 N and 5 N act on a particle. The angle between the directions of the two forces is 30° , as shown in Fig. 1. The resultant of the two forces has magnitude R N and acts at an angle θ° to the force of magnitude 8 N, as shown in Fig. 2. Find R and θ . [7]

- 3 A particle is projected vertically upwards, from the ground, with a speed of 28 m s^{-1} . Ignoring air resistance, find
- (i) the maximum height reached by the particle, [2]
 - (ii) the speed of the particle when it is 30 m above the ground, [3]
 - (iii) the time taken for the particle to fall from its highest point to a height of 30 m, [3]
 - (iv) the length of time for which the particle is more than 30 m above the ground. [2]

4

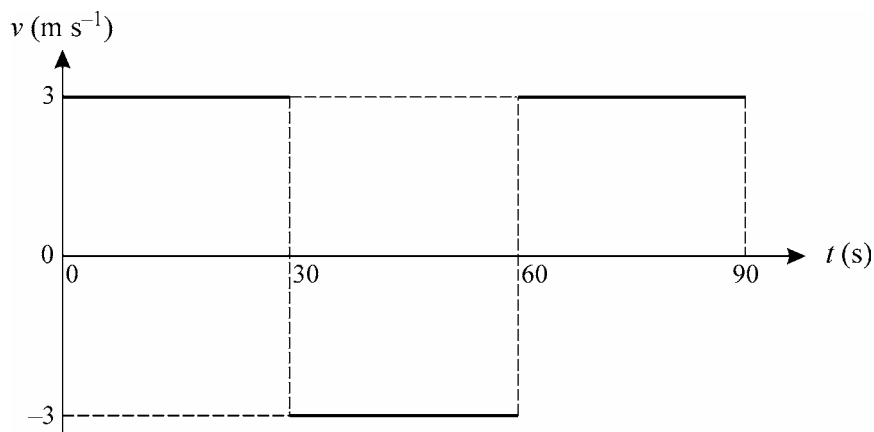


Fig. 1

A woman runs from A to B, then from B to A and then from A to B again, on a straight track, taking 90 s. The woman runs at a constant speed throughout. Fig. 1 shows the (t, v) graph for the woman.

- (i) Find the total distance run by the woman. [3]
- (ii) Find the distance of the woman from A when $t = 50$ and when $t = 80$, [3]

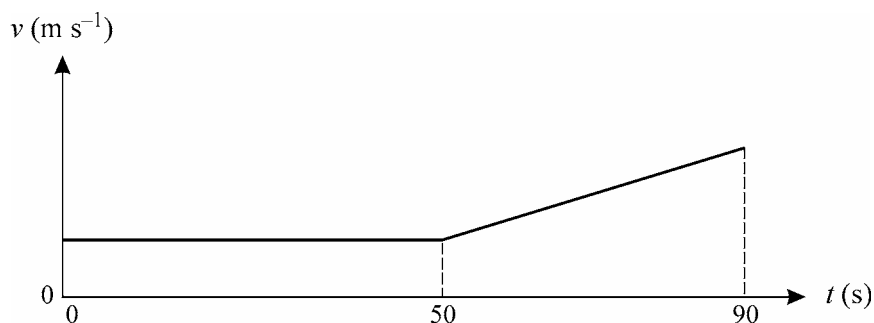


Fig. 2

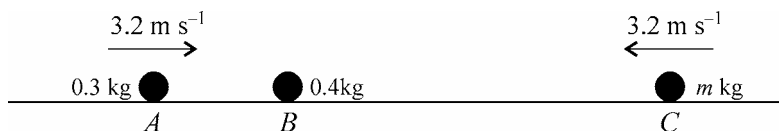
At time $t = 0$, a child also starts to move, from A, along AB. The child walks at a constant speed for the first 50 s and then at an increasing speed for the next 40 s. Fig. 2 shows the (t, v) graph for the child; it consists of two straight line segments.

- (iii) At time $t = 50$, the woman and the child pass each other, moving in opposite directions. Find the speed of the child during the first 50 s. [3]
- (iv) At time $t = 80$, the woman overtakes the child. Find the speed of the child at this instant. [3]

5 A particle P moves in a straight line so that, at time t seconds after leaving a fixed point O , its acceleration is $-\frac{1}{10}t \text{ m s}^{-2}$. At time $t = 0$, the velocity of P is $V \text{ m s}^{-1}$.

- (i) Find, by integration, an expression in terms of t and V for the velocity of P . [4]
- (ii) Find the value of V , given that P is instantaneously at rest when $t = 10$. [2]
- (iii) Find the displacement of P from O when $t = 10$. [4]
- (iv) Find the speed with which the particle returns to O . [3]

6



Three uniform spheres A , B and C have masses 0.3 kg , 0.4 kg and $m\text{ kg}$ respectively. The spheres lie in a smooth horizontal groove with B between A and C . Sphere B is at rest and spheres A and C are each moving with speed 3.2 m s^{-1} towards B (see diagram). Air resistance may be ignored.

- (i) A collides with B . After this collision A continues to move in the same direction as before, but with speed 0.8 m s^{-1} . Find the speed with which B starts to move. [4]
- (ii) B and C then collide, after which they both move towards A , with speeds of 3.1 m s^{-1} and 0.4 m s^{-1} respectively. Find the value of m . [4]
- (iii) The next collision is between A and B . Explain briefly how you can tell that, after this collision, A and B cannot both be moving towards C . [1]
- (iv) When the spheres have finished colliding, which direction is A moving in? What can you say about its speed? Justify your answers. [4]

7 A sledge of mass 25 kg is on a plane inclined at 30° to the horizontal. The coefficient of friction between the sledge and the plane is 0.2 .

(i)

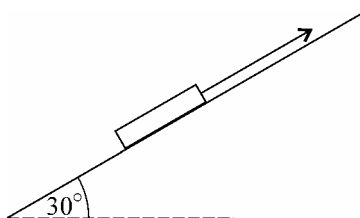


Fig. 1

The sledge is pulled up the plane, with constant acceleration, by means of a light cable which is parallel to a line of greatest slope (see Fig. 1). The sledge starts from rest and acquires a speed of 0.8 m s^{-1} after being pulled for 10 s . Ignoring air resistance, find the tension in the cable. [6]

(ii)

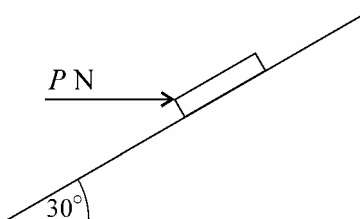


Fig. 2

On a subsequent occasion the cable is not in use and two people of total mass 150 kg are seated in the sledge. The sledge is held at rest by a horizontal force of magnitude P newtons, as shown in Fig. 2. Find the least value of P which will prevent the sledge from sliding down the plane. [7]