OCR
RECOGNISING ACHIEVEMENT

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.

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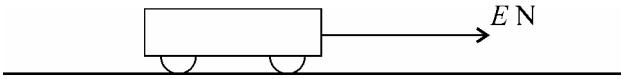
1



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 $0.2\,\mathrm{m\,s^{-2}}$. Find the value of E. [4]

2

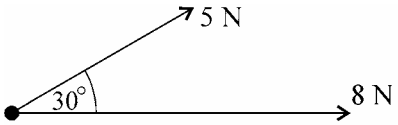


Fig. 1

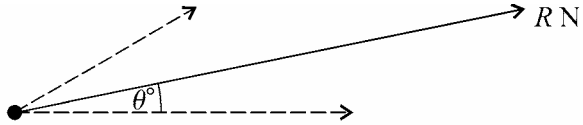


Fig. 2

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 $\theta°$ 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 $28\,\mathrm{m\,s^{-1}}$. 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

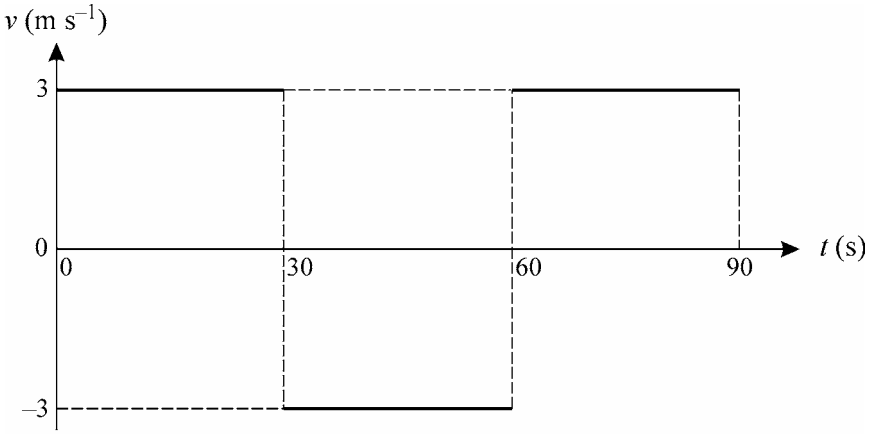


Fig. 1

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]

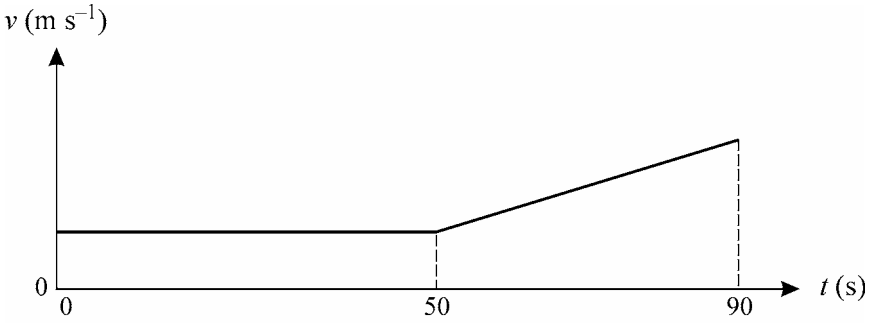


Fig. 2

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 $-\frac{1}{10}t$ m s^{-2}. At time $t = 0$, the velocity of *P* is *V* m s^{-1}.

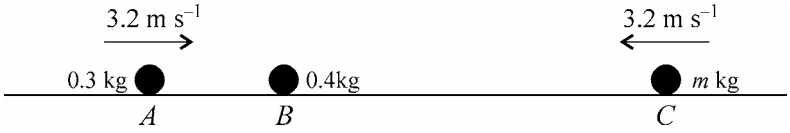
(i) Find, by integration, an expression in terms of *t* and *V* for the velocity of *P*. [4]

(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 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 $3.2\ \text{m s}^{-1}$ 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 $0.8\ \text{m s}^{-1}$. 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 $3.1\ \text{m s}^{-1}$ and $0.4\ \text{m s}^{-1}$ 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)

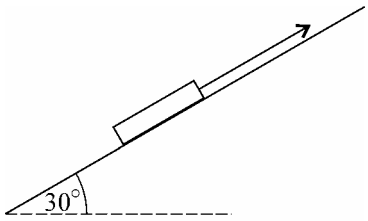


Fig. 1

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 $0.8\ \text{m s}^{-1}$ after being pulled for 10 s. Ignoring air resistance, find the tension in the cable. [6]

(ii)

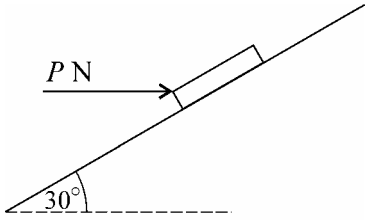


Fig. 2

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]