Forces

SCAN ME

REVISE THIS TOPIC

CHECK YOUR ANSWERS

SCAN ME

1 A particle P has mass 4 kg.

The particle is pulled along a rough horizontal surface by a horizontal force of magnitude 30 N against a constant friction force of magnitude 8 N.

(a) Find

(i) the weight of P. **(1)**

(ii) the magnitude of the normal reaction force between P and the surface. **(1)**

(iii) the acceleration of P. **(2)**

(b) Given that P starts from rest, find

(i) the distance travelled by P in the first 4 seconds. **(2)**

(ii) the speed of P after 4 seconds. **(1)**

(Total for Question 1 is 7 marks)

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2 The mass of particle P is h kg and the mass of particle Q is $5h$ kg, where h is a constant.

Particle P moves on a smooth horizontal surface under the action of a single horizontal force of magnitude 12 N.

Particle Q moves on a rough horizontal surface under the action of a horizontal force of magnitude 25 N and a frictional force of magnitude 4 N.

(a) Given that the acceleration of Q is 1.4 ms^{-2}, find

(i) the value of h. **(2)**

(ii) the acceleration of P. **(2)**

At the instant when the force of magnitude 12 N is first applied to P, P is moving with speed 5 ms^{-1}, in the direction of the force.

(b) Find the distance travelled by P in the first 3 seconds after the force is applied. **(2)**

(Total for Question 2 is 6 marks)

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3 A particle P, of mass 6 kg is moving along a rough horizontal surface.

A horizontal force of magnitude 33 N acts on P in the direction of motion.

(a) Given that P accelerates at 4 ms^{-2}, find the magnitude of the frictional force acting on P. **(2)**

When P reaches a speed of 12 ms^{-1}, the horizontal force of magnitude 33 N is removed.

(b) Assuming that the frictional force remains constant, find the time taken for P to come to rest. **(3)**

(Total for Question 3 is 5 marks)

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4 A particle P is moving horizontally at a constant speed of 8 ms^{-1}.

A horizontal force of magnitude 90 N acts on P in the direction of motion.
A constant resistance force of magnitude k N also acts on P.

(a) Find the value of k. **(1)**

The horizontal force is then increased to 150 N while the resistance force remains constant.
P accelerates uniformly and reaches a speed of 14 ms^{-1} after 3 seconds.

(b) Find the acceleration of P. **(2)**

(c) Find the mass of P. **(2)**

(Total for Question 4 is 5 marks)

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5 A lift of mass 800 kg is attached to a vertical cable.

The lift starts from rest and accelerates vertically upwards at 1.5 ms^{-2} for 4 seconds.

(a) Find the tension in the cable during these 4 seconds. **(2)**

(b) Find the speed of the lift after 4 seconds. **(1)**

The lift then continues to move vertically upwards but decelerates uniformly, coming to rest 3 seconds later.

(c) Find the tension in the cable during the 3 seconds when the lift decelerates. **(3)**

(Total for Question 5 is 6 marks)

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6 A car of mass 1200 kg is travelling at 10 ms^{-1} along a straight horizontal road.

The car accelerates uniformly and reaches a speed of 22 ms^{-1} after travelling 96 m.

A constant resistance of 500 N acts on the car.

(a) Find the acceleration of the car. **(2)**

(b) Find the driving force acting on the car. **(2)**

The driver applies the brakes. The driving force is removed and the brakes exert an additional force of 2500 N opposing the motion of the car. The resistance force remains constant at 500 N.

(c) Find the magnitude of the deceleration of the car. **(2)**

(d) Find the distance travelled by the car before it comes to rest. **(2)**

(Total for Question 6 is 8 marks)

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7 A particle P, of mass 5 kg is moving along a rough horizontal surface.

A horizontal force of magnitude $4x$ N acts on P in the direction of motion. The frictional force acting on P has magnitude $2y$ N, where x and y are constants.

The magnitude of the normal reaction on P is $(3x + 7y)$ N.

Given that P accelerates at 4 ms^{-2}, find the values of x and y.

(Total for Question 7 is 4 marks)

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Solutions

8 A ball is falling vertically.

When $t = 3$,

- the weight of the ball is $2c^2$ N, where c is a constant
- the air resistance has magnitude $(17c - 30)$ N
- the acceleration of the ball is 0 ms^{-2}
- the speed of the ball is 30 ms^{-1}
- the ball is 18 m above the ground.

(a) Find two possible values of c. **(3)**

(b) Given that the mass of the ball is less than 2 kg, find the mass of the ball. **(2)**

After $t = 3$, the acceleration of the ball remains 0 ms^{-2}

(c) find the value of t when the ball hits the ground. **(2)**

(Total for Question 8 is 7 marks)

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