

1. A railway truck P , of mass m kg, is moving along a straight horizontal track with speed 15 m s^{-1} . Truck P collides with a truck Q of mass 3000 kg , which is at rest on the same track. Immediately after the collision the speed of P is 3 m s^{-1} and the speed of Q is 9 m s^{-1} . The direction of motion of P is reversed by the collision.

Modelling the trucks as particles, find

- (a) the magnitude of the impulse exerted by P on Q , **(2)**

- (b) the value of m . **(3)**



2. A car of mass 1000 kg is towing a caravan of mass 750 kg along a straight horizontal road. The caravan is connected to the car by a tow-bar which is parallel to the direction of motion of the car and the caravan. The tow-bar is modelled as a light rod. The engine of the car provides a constant driving force of 3200 N. The resistances to the motion of the car and the caravan are modelled as constant forces of magnitude 800 newtons and R newtons respectively.

Given that the acceleration of the car and the caravan is 0.88 ms^{-2} ,

(a) show that $R = 860$, (3)

(b) find the tension in the tow-bar. (3)



Question 2 continued

Lined area for writing the answer to Question 2.

(Total 6 marks)

Q2



4.

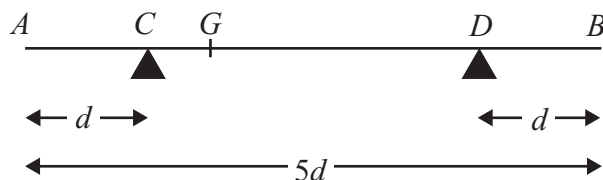


Figure 1

A non-uniform rod AB , of mass m and length $5d$, rests horizontally in equilibrium on two supports at C and D , where $AC = DB = d$, as shown in Figure 1. The centre of mass of the rod is at the point G . A particle of mass $\frac{5}{2}m$ is placed on the rod at B and the rod is on the point of tipping about D .

(a) Show that $GD = \frac{5}{2}d$. (4)

The particle is moved from B to the mid-point of the rod and the rod remains in equilibrium.

(b) Find the magnitude of the normal reaction between the support at D and the rod. (5)



Question 4 continued

Blank lined area for writing the answer to Question 4.



Question 6 continued

Handwriting practice area with 30 horizontal lines.



7. [In this question, the unit vectors \mathbf{i} and \mathbf{j} are due east and due north respectively. Position vectors are relative to a fixed origin O .]

A boat P is moving with constant velocity $(-4\mathbf{i} + 8\mathbf{j}) \text{ km h}^{-1}$.

(a) Calculate the speed of P . (2)

When $t = 0$, the boat P has position vector $(2\mathbf{i} - 8\mathbf{j}) \text{ km}$. At time t hours, the position vector of P is $\mathbf{p} \text{ km}$.

(b) Write down \mathbf{p} in terms of t . (1)

A second boat Q is also moving with constant velocity. At time t hours, the position vector of Q is $\mathbf{q} \text{ km}$, where

$$\mathbf{q} = 18\mathbf{i} + 12\mathbf{j} - t(6\mathbf{i} + 8\mathbf{j})$$

Find

(c) the value of t when P is due west of Q , (3)

(d) the distance between P and Q when P is due west of Q . (3)



Question 7 continued

Lined area for writing the answer to Question 7.

Q7

(Total 9 marks)



8.

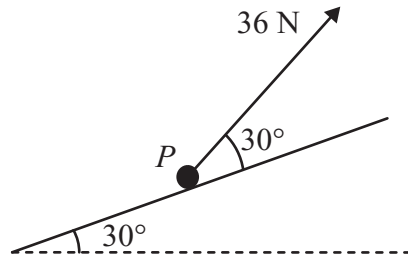


Figure 2

A particle P of mass 4 kg is moving up a fixed rough plane at a constant speed of 16 m s^{-1} under the action of a force of magnitude 36 N . The plane is inclined at 30° to the horizontal. The force acts in the vertical plane containing the line of greatest slope of the plane through P , and acts at 30° to the inclined plane, as shown in Figure 2. The coefficient of friction between P and the plane is μ . Find

- (a) the magnitude of the normal reaction between P and the plane, (4)
- (b) the value of μ . (5)

The force of magnitude 36 N is removed.

- (c) Find the distance that P travels between the instant when the force is removed and the instant when it comes to rest. (5)



Question 8 continued

Lined area for writing the answer to Question 8 continued.

Q8

--	--

(Total 14 marks)

TOTAL FOR PAPER: 75 MARKS

END

