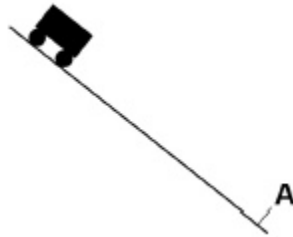


1

- (a) **Figure 1** shows a truck moving freely down a ramp inclined at an angle to the horizontal.

Figure 1



The truck starts from rest at the top of the ramp and reaches point **A**. Friction and air resistance are negligible.

As the truck moves down the ramp to point **A**, its centre of mass has a total vertical displacement of 8.0 m

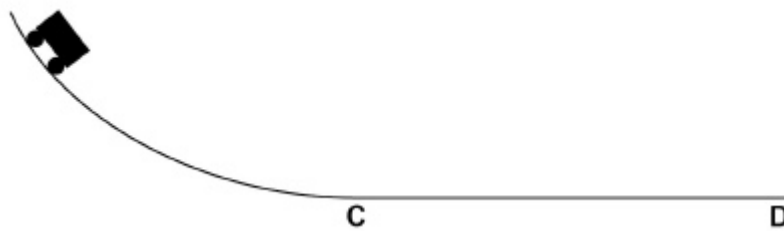
Calculate the speed of the truck at point **A**.

speed = _____ m s⁻¹

(2)

- (b) **Figure 2** shows the truck moving down a ramp with a varying slope.

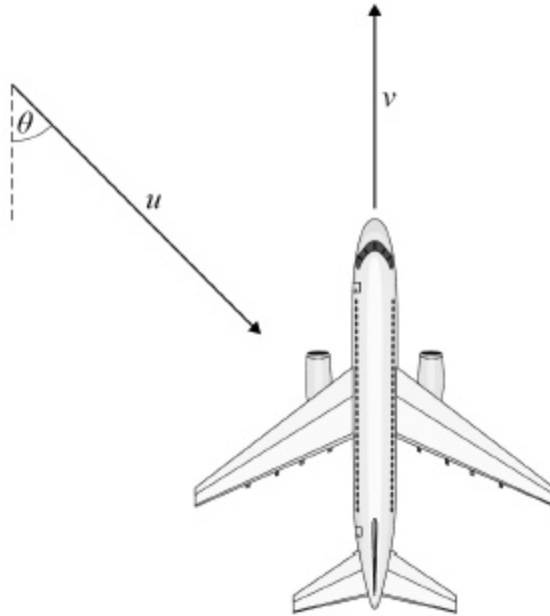
Figure 2



2

An aircraft is flying due north through still air with a speed v

The aircraft enters a region where the wind is blowing with a speed u from a direction which makes an angle of θ with due south.



What is the time taken for the aircraft to fly a distance D due north of its current position in this windy region?

A $\frac{D}{v - u \cos \theta}$

B $\frac{D}{v - u \sin \theta}$

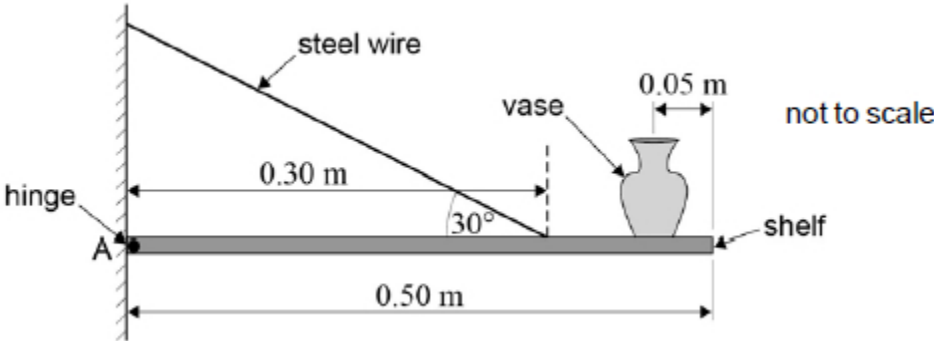
C $\frac{D}{v + u \cos \theta}$

D $\frac{D}{v + u \sin \theta}$

(Total 1 mark)

3

The diagram below shows a vase placed on a uniform shelf that is supported by a steel wire.



The mass of the vase is 0.65 kg and the mass of the shelf is 2.0 kg. The shelf is hinged at A. The steel wire is attached to the shelf 0.30 m from A and is at an angle of 30° to the shelf. The other end of the steel wire is attached to the wall.

(a) State the principle of moments.

(2)

(b) Show, by taking moments about A, that the tension in the steel wire is about 50 N.

(4)

- (c) The cross-sectional area of the steel wire is $7.8 \times 10^{-7} \text{ m}^2$. The steel has a Young modulus of 180 GPa.

Calculate the tensile strain of the steel wire when it is holding up the shelf and the vase.

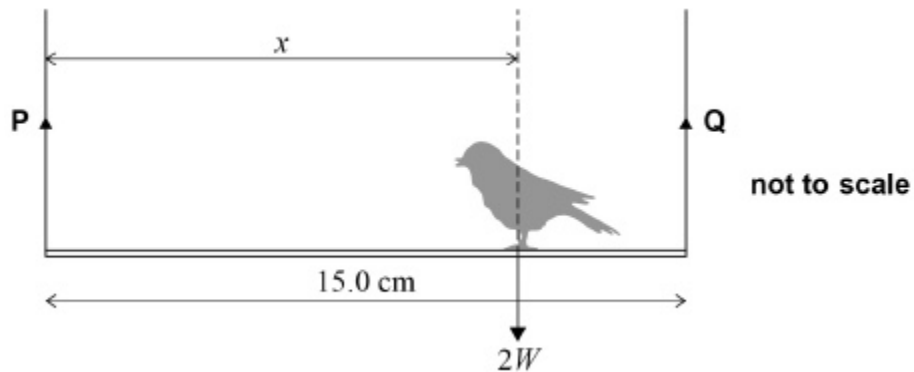
tensile strain = _____

(2)

(Total 8 marks)

4

A bird sits on a uniform rod suspended from vertical wires **P** and **Q**.



The rod has a weight W and is 15.0 cm long.

The weight of the bird is $2W$ and acts at a distance x from **P**.

What is the value of x when the tension in **P** is half the tension in **Q**?

- A 7.50 cm
- B 10.0 cm
- C 11.3 cm
- D 15.0 cm

(Total 1 mark)