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DUNMAN HIGH SCHOOL
Holiday Home Revision Set A
Year 5

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1 The speed v of a transverse wave on a uniform string is given by the expression

$$v = \sqrt{\frac{Tl}{m}}$$

where T is the tension in the string, l is its length and m is its mass. An experiment is performed to determine the speed v of the wave. The measurements are shown in Fig. 1.

Quantity	Measurement	Percentage Uncertainty
T	20 N	± 5%
l	150 cm	± 1%
m	9.5 g	± 2%

Fig. 1

(a) Use the data in Fig. 1 to calculate v.

v = ……………. m s^{-1} [2]

(b) Express v with its appropriate uncertainty.

v = ………………. ± ……………. m s^{-1} [3]

2 An archer shoots an arrow with a velocity of 45.0 m s^{-1} at an angle of 50.0° with the horizontal. An assistant standing on the level ground 150 m away from the launch point, throws an apple straight up with the ***minimum*** initial speed such that the arrow hits the apple. Air resistance is negligible.

(a) Show that the time taken by the arrow to be exactly above the assistant is 5.19 s.

[1]

(b) Hence, or otherwise, determine the vertical height of the arrow when it is exactly above the assistant.

vertical height of the arrow = …………… m [2]

(c) Determine the minimum initial speed of the apple.

minimum initial speed = ……………m s^{-1} [2]

(d) The apple is thrown at time t after the arrow is launched.

Determine t if the arrow is to hit the apple.

t = ………….s [3]

3 Fig. 2 shows three boxes A, B and C which are initially stationary. Box A of mass 1.5 kg is placed in front of a light spring which is compressed 15 cm. The spring is then released and box A collides with box B of mass 1.5 kg on the smooth horizontal surface in a straight line. After the collision, boxes A and B continue to move and collide with box C which has half the mass of box A. All three boxes stick together and move at a common velocity.

The three boxes then move up a rough plane inclined at 30° with the horizontal. The boxes experience a frictional force of 8.5 N through a distance *s* before coming instantaneously to rest.

The spring has a spring constant of 1.33 kN m^{-1}.

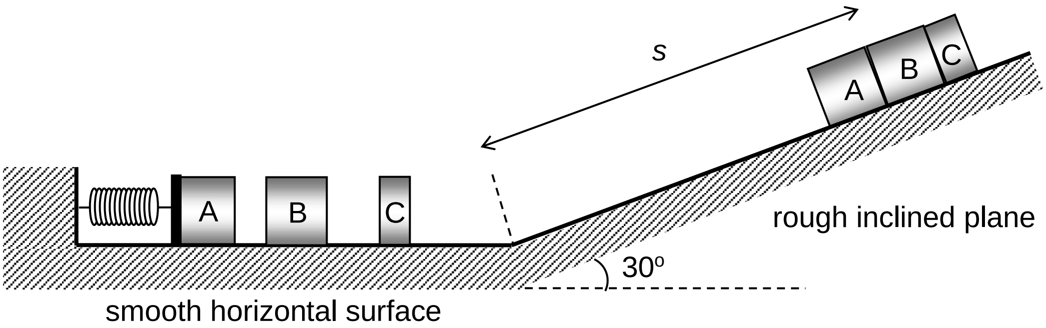

Fig. 2

(a) State the *principle of conservation of momentum*.

……………………………………………………………………………………………………

…………………………………………………………………………………………… [2]

(b) Determine the velocity of box A when it just loses contact with the spring.

velocity = …………………………….. m s^{-1} [2]

(c) Calculate the common velocity of the three boxes on the horizontal plane.

velocity = ……………….…….. m s^{-1} [2]

(d) Determine the distance *s*.

s = …….……….………….. m [3]

4 **(a)** State the two conditions necessary for the equilibrium of a body acted upon by a number of forces.

……

……

………………………………………………………………………………………………… [2]

(b) A ***non-uniform*** beam of mass 20 kg and length 5.0 m is supported by a cable and hinged to the wall as shown in Fig. 4.1. The beam supports a load of 5.0 kg at one end and is in equilibrium.

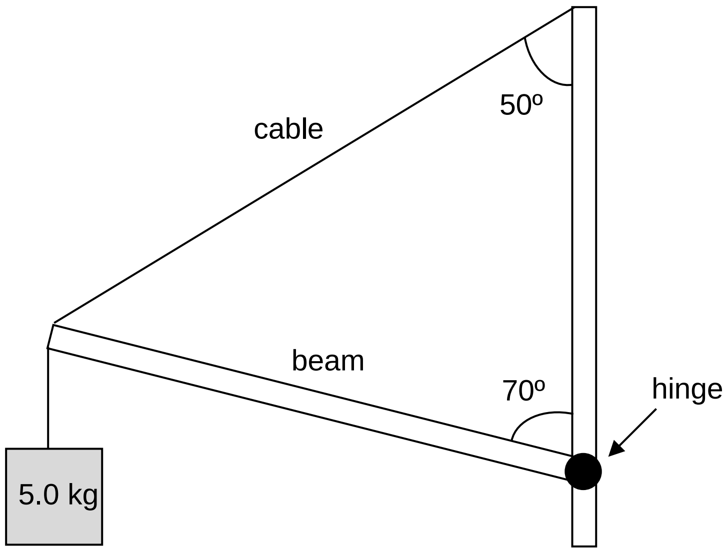

Fig. 4.1

(i) In the space below, draw a free body diagram of the forces acting on the beam. [2]

(ii) If the tension in the cable is 120 N, calculate the position of the centre of gravity of the beam from the hinge.

centre of gravity = ………….………… m [2]

(iii) Calculate the magnitude and direction of the force acting by the wall on the beam.

force = …………….…………….. N

direction = ……………….…….………………… [3]

(c) A solid iron sphere of density 8000 kg m^{-3} and volume 4.50×10^{-4} m^3 is completely submerged in a liquid of density 800 kg m^{-3}. The iron sphere is resting on a spring, as shown in Fig. 4.2. The spring is compressed by 10.2 cm.

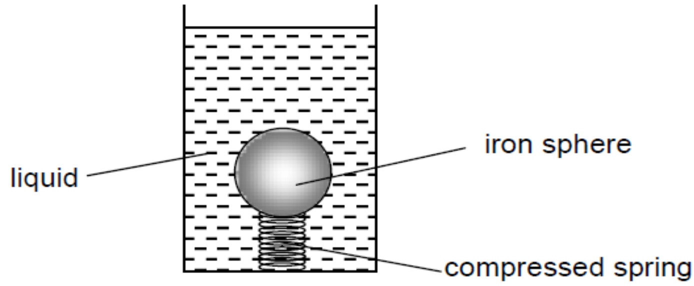

Fig. 4.2

(i) Show that the upthrust on the iron sphere is 3.53 N.

[1]

(ii) Hence, calculate the spring constant of the spring.

spring constant = ... N m^{-1} [2]

(iii) A string of breaking strength 32.0 N is used to lift the iron sphere vertically upwards, as shown in Fig. 4.3. The iron sphere is then lifted partially out of the liquid as shown in Fig. 4.4.

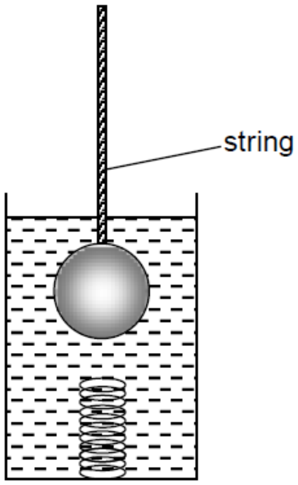

Fig. 4.3

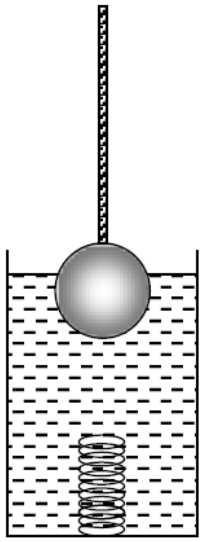

Fig. 4.4

1. Explain why the string breaks.

....

....

.... [1]

2. Calculate the volume of the fluid displaced at the instant when the string breaks.

volume = ... m^3 [2]

5 A car of mass 1450 kg travels at a constant speed of 90.0 km h^{-1} in a circle of radius *r* along a banked track, which is inclined at an angle of 20^0 to the horizontal as shown in Fig. 5.

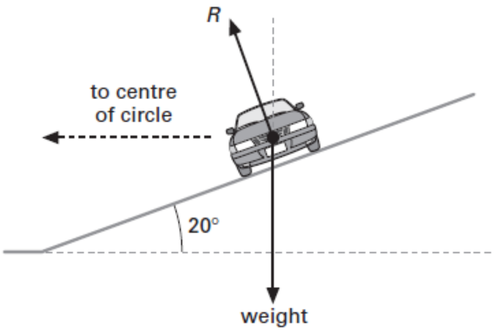

Fig. 5

(a) The net vertical force on the car is zero. Hence, or otherwise, show that the normal contact force *R* on the car is 15.1 kN. [2]

(b) Use the answer from **(a)** to calculate *r*.

r = ………….. m [4]

6 A 8.00 kg point mass and a 15.0 kg point mass are held in place 50.0 cm apart. A particle of mass m is released from a point between the two masses 20.0 cm from the 8.00 kg mass along the line connecting the two fixed masses.

Detemine the magnitude and direction of the acceleration of the particle.

magnitude of acceleration = ... m s^{-2}

direction of acceleration = ...[3]

7 A simple pendulum consists of a light incompressible string in which is attached a bob of mass 150 g. The variation of the kinetic energy E_k of the bob with the horizontal displacement x of the bob is shown in Fig. 7.

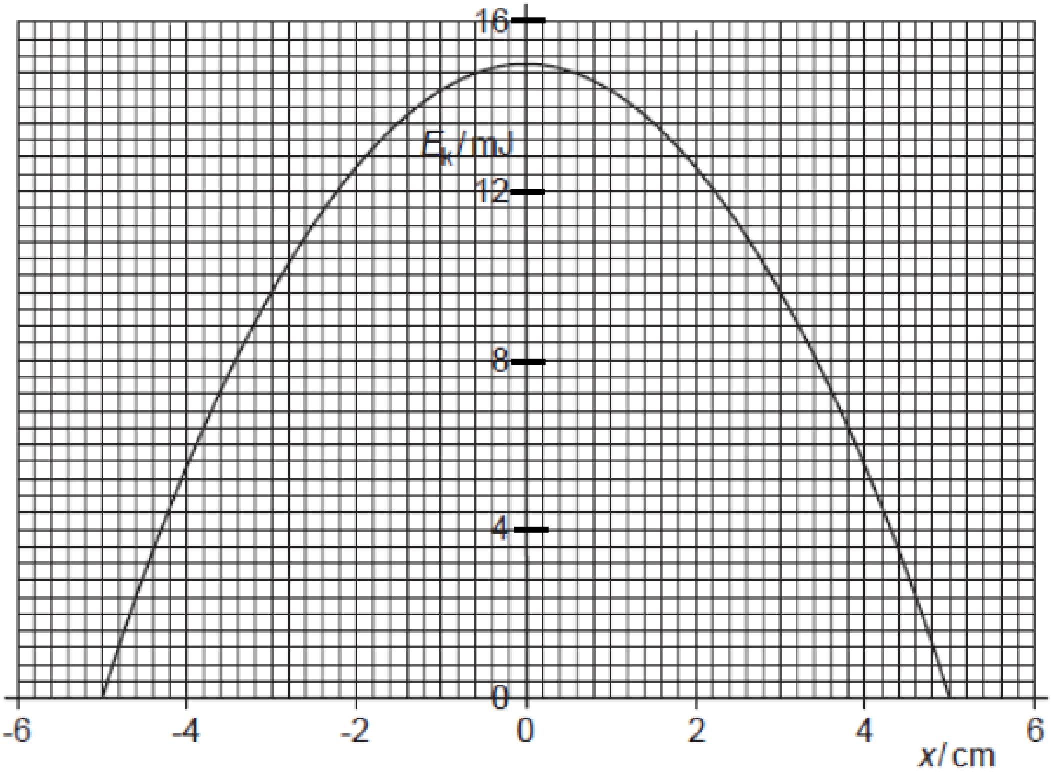

Fig. 7

(a) On Fig. 7, draw lines to represent the variation with horizontal displacement x of

(i) the potential energy of the bob (label this line P)

(ii) the total energy of the bob (label this line T) [2]

(b) **(i)** Calculate the frequency of the oscillation of the bob.

frequency = …………………… Hz [2]

(ii) Determine the acceleration of the bob for a displacement x of 2.0 cm.

acceleration = ……………………… m s^{-2} [2]

(c) The oscillations are now subjected to damping.

(i) Explain what is meant by *damping*.

……………………………………………………………………………………

…………………………………………………………………………………… [2]

(ii) The bob loses 20% of its energy. Use Fig. 7 to determine the new amplitude of oscillation of the bob.

amplitude = …………………… cm [2]

8 **(a)** A torch is rated as '2.5 V, 0.030 A'.

(i) How much charge flows through the bulb in 1.0 hour when it is operating at its rated current?

charge = ………………………………… C [1]

(ii) At what rate is electrical energy dissipated in the bulb when it is operating at its rated voltage?

rate = ………………………………… W [1]

(iii) What is its resistance under these operating conditions?

resistance = ………………………………… Ω [1]

(b) **(i)** A constantan wire of length 15 m is to carry a current of 25 A with a potential drop of no more than 5.0 V along its length. What is the minimum acceptable diameter of this cable?

diameter = ………………………………… m [3]

(ii) The resistivity of constantan is 4.8×10^{-7} Ω m. Calculate

1. the resistance per metre of constantan wire of diameter 0.35 mm,

resistance per metre = ………………………………… [2]

2. the length of this wire needed to make a '12 V, 30 W' heater filament.

length = ………………………………… m [2]

End of Holiday Home Revision Set A