2

Answer **all** the questions in the spaces provided.

**1.** The length of a piece of paper is measured as 297 ± 1 mm. Its width is measured as 209 ± 1 mm.

**(a)** Calculate the fractional uncertainty of its length.

fractional uncertainty = ……………………………….. [1]

**(b)** Calculate the fractional uncertainty of its width.

fractional uncertainty = …………………………...….. [1]

**(c)** What is the area of one side of the piece of paper? State your answer with its uncertainty.

area = ………………..±….…….……. mm² [3]

3

**2.** The diagram below shows the velocity-time graph for a vertically bouncing ball. The ball is released at A and strikes the ground at B. The ball leaves the ground at D and reaches its maximum height at E. The effects of air resistance can be neglected.

A

Time

D

B

C

E

0

Velocity

**(a)** With reference to the diagram above, suggest:

**(i)** Why the gradient of the line AB is the same as the gradient of line DE?

……………………………………………………………………………………… [1]

**(ii)** What is represented by the area between the line AB and the time axis?

……………………………………………………………………………………… [1]

**(iii)** Why the area of triangle ABC is greater than the area of triangle CDE?

……………………………………………………………………………………… [1]

**(b)** The ball is dropped from rest from an initial height of 2.0 m. After hitting the ground the ball rebounds to a height of 1.6 m. The ball is in contact with the ground between B and D for a time of 0.16 s. Using acceleration of free fall, calculate:

**(i)** the speed of the ball immediately before hitting the ground.

speed = …………..….. ms-1 [2]

**(ii)** the speed of the ball immediately after hitting the ground.

speed = …………..….. ms-1 [2]

**[Turn over**

4

**(iii)** the acceleration of the ball while it is in contact with the ground. State the direction of this acceleration

acceleration = ……………..….. ms-2 [2]

direction = …………………..….. [1]

**3. (a)** Explain what is meant by the centre of gravity of an object.

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

**(b)** A flagpole of mass 25 kg and length *D* metres is held in a horizontal position by a cable as shown in the diagram below. The centre of gravity of the flagpole is at a distance of *R* metres from point **X**.

Tension, *T*

cable

**X**

30°

flagpole

*R*

Weight, *W*

*D*

**(i)** Using the symbols *W, R, T* and *D*, write an equation to represent the moments taken about point **X**.

……………………………………………………………………………………... [1]

5

**(ii)** If *R* = 1.0 m, *D* = 2.5 m, determine the tension, *T* in the cable.

*T* = ...…..….………..…N [2]

**(iii)** Determine the vertical component, Fy of the force exerted by point **X** on the flag pole.

Fy = …………………N [2]

**4. (a)** A spring has an initial length of 13.4 cm. When a load of 4.5 N is suspended from the spring, its length becomes 14.6 cm. Calculate:

**(i)** the elastic constant*, k* of the spring.

*k* = ...…..……….. Nm-1 [2]

**(ii)** the length of the spring for a load of 3.5 N.

length = …..……..….. cm [2]

**[Turn over**

6

**(b)** Distinguish between brittle material and ductile material. Name an example for each type.

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….…………………………………………………………………………...………………………………………………………………………………………….. [4]

**5. (a)** What is meant by a stationary wave?

.............................................................................................................................................. ………………………………………………………………………………………….. [1]

**(b)** A student sets up an experiment to determine the speed of sound in air. He scatters some dust along the lower side of a long glass tube. When the loudspeaker is switched on at frequency 512 Hz, the dust collects in small piles as shown in **Fig. 5.1.**

Glass tube

loudspeaker

Signal generator

Piles of dust

**Fig. 5.1**

**(i)** The length of the glass tube is 135 cm. Determine the wavelength of the sound waves.

*λ* = ………………………. m [2]

**(ii)** Calculate the speed of sound of air in the tube.

speed = ………………… ms-1 [1]

7

**(iii)** Mark with dots inside the tube on **Fig.5.1** for:

1. any two points (label them as P and Q) where the air particles are **vibrating** in phase with each other.

2. any two points (label them as R and S) where the air particles are **vibrating** in antiphase.

[2]

**(iv)** State and explain how the pattern of the piles of dust will change when the student increases the frequency of the sound to 1024 Hz.

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

**6. (a)** Define electric field strength at a point.

………………………………………………………………………………………………………………………………………………………………………………………….. [1]

**(b)** A high speed electron P enters the space between two charged, parallel plates, as shown in **Fig. 6.1.**

**+**

P

**Fig. 6. 1**

**-**

**(i)** Mark with an arrow labelled E, the direction of the electric field between the plates.

[1]

**[Turn over**

8

The electric force acting on the electron is 4.0 x 10-14 N.

**(ii)** Calculate the electric field strength.

E= ….......…………… N C-1  [2]

**(iii)** The two plates are separated by a distance of 2.0 cm. Show that the potential difference between the plates is 5 kV.

[1]

**(iv)** On **Fig. 6.1**, sketch the possible path of the electron inside the space between the plates.

[2]

**(c)** If the p.d. between the plates is being increased until to a high enough value so that the electric field strength exceeds 2 x 106 N C-1, electrical breakdown might occur.

Describe the cause for the electrical breakdown.

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

9

**7.** **Fig.7.1** shows a circuit in which a resistor R of resistance 2.0 Ω is connected to a fixed power supply of e.m.f. 2.2 V.

R

**Fig. 7.1**

**(a)** The p.d. across R is 2.0 V. A charge of 0.08 C passes through R. Calculate the energy dissipated in R during the time of current flow.

Energy=……..….………J [2]

**(b)** During the same period, determine the amount of energy supplied by the power supply.

Energy=……..…………J [2]

**(c)** Compare your answers in **(a)** and **(b)**, and account for the difference.

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

**[Turn over**

10

**8.** The decay of radioactive nuclei is *random* and *spontaneous*.

**(a) (i)** What is meant by *spontaneous*?

…………………………………………………………………………………………...…………………………………………………………………………………………...……………………………………………………………………………………… [1]

**(ii)** What is meant by *random*?

…………………………………………………………………………………………...…………………………………………………………………………………………...……………………………………………………………………………………… [1]

**(b)** A lead nuclide decays in three separate stages by one alpha- and two beta- emissions to become a nuclide .

**(i)** State the values of *A* and *Z*.

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

**(ii)** Identify nuclide *X*.

………………………………………………………………………………………. [1]

**(c)** Alpha-particles are described as ionising.

Explain why such particles can ionise the air.

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