

#### READ THESE INSTRUCTIONS FIRST

Write your name, class and student number in the spaces at the top of this page.

Write in dark blue or black pen in the spaces provided on the Question Paper.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **both** questions.

##### At the end of the examination, fasten all your work securely together.

##### The number of marks is given in brackets [ ] at the end of each question or part question.

# CAMBRIDGE A LEVEL PROGRAMME

AS TRIAL EXAMINATION AUGUST 2011

**(January / March 2011 Intakes)**

Monday 15 August 2011 9.45am – 10.45am

## PHYSICS 9702/2

**PAPER 2 1 hour**

Candidates answer on the Question Paper

Data Booklet

|  |  |  |
| --- | --- | --- |
| Class | Student Number | Name |

This document consists of 10 printed pages.

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| **Total** |  |

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.

**ΔL / L = (1 / 297)**

**= 3.4 x 10-3  --- (A1)**

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

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

**ΔW / W = (1 / 209)**

**= 4.8 x 10-3  --- (A1)**

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

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

**A =W x L**

**= 297 x 209 = 62073 mm --- (C1)**

**ΔA = [(ΔL / L) + (ΔW / W)] (WxL)**

**= (3.4 x 10-3 + 4.8 x 10-3)(297 x 209)**

**= 500 mm --- (C1)**

**Area = 62100 ± 500 mm --- (A1)**

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?

**In both cases the ball is accelerating due to gravity only/ same acceleration --- (B1)**

……………………………………………………………………………………… [1]

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

**Initial height of the ball above the ground/fallen distance --- (B1)**

……………………………………………………………………………………… [1]

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

**Ball does not bounce as high as initial position / some k.e is lost during the bounce --- (B1)**

……………………………………………………………………………………… [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.

v2 = u2 + 2as; u = 0

**v2 = 2 (9.81) (2.0) --- (C1)**

**v = 6.26 ms-1 --- (A1)**

speed = …………..….. ms-1 [2]

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

v2 = u2 + 2as; v = 0

**u2 = 2 (9.81) (1.6) --- (C1)**

**u = 5.60 ms-1 --- (A1)**

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

a = change in velocity / time taken

**a = [(5.60) - (-6.26)] / 0.16 --- (C1)**

**a = 74.1 ms-2 --- (A1)**

**Upwards direction --- (B1)**

acceleration = ……………..….. ms-2 [2]

direction = …………………..….. [1]

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

Point at which the **whole weight** --- **(B1)**

is **considered to act --- (B1)**

………………………………………………………………………………………………………………………………………………………………………………………….. [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**.

**(W) (R) = (T) (D sin30°) --- (B1)**

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

**No ecf for question 3 from part (i) to part (ii) because there’s no value involved but the expression. However, ecf is allowed from part (ii) to part (iii).**

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

Sum of clockwise moments = sum of anti-clockwise moments

**(25 x 9.81) (1.0) = (T) (2.5 sin30°) --- (C1)**

**T = 196 N --- (A1)**

*T* = ...…..….………..…N [2]

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

Net vertical force = 0

Vertical component of force at left-hand end + vertical component of T = W

**Vertical component of force at left-hand end + (196.2 sin30°) = (25 x 9.81) --- (C1)**

**Vertical component of force at left-hand end = 147 N --- (A1)**

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.

F = kx

4.5 = k (0l.146 – 0.134) --- **(C1)**

k = **375 Nm-1 --- (A1)**

*k* = ...…..……….. Nm-1 [2]

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

F = kx

3.5 = 375 (x)

x = 0.0093 m / 0.93 cm --- **(C1)**

length = 13.4 + 0.93 = **14.3 cm / 0.143 m--- (A1)**

length = …..……..….. cm [2]

**[Turn over**

6

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

Ductile material **experience plastic deformation** before fracture.--- **(B1)**

Example of ductile material - copper --- **(B1)**

Brittle material **does not (little) experience plastic deformation** before fracture.--- **(B1)**

Example of brittle material - glass --- **(B1)**

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

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

One where the **wave profile does not advance/ energy is not transferred along the propagation of waves**. --- **(B1)**

.............................................................................................................................................. ………………………………………………………………………………………….. [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.

2 λ = 135 cm --- **(C1)**

λ = 67.5 cm = 0.675 m --- **(A1)**

*λ* = ………………………. m [2]

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

v = f λ

v = (512)(0.675) = 346 ms-1 --- **(A1)**

speed = ………………… ms-1 [1]

n7

**(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. **Refer diagram/**

**P**

**Q**

**two points between two successive nodes --- (B1)**

2. any two points (label them as R and S) where the air particles are **vibrating** in antiphase. **Refer diagram --- (B1)**

**R**

**S**

**two points in adjacent ‘loops’**

[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.

Wavelength becomes halved. --- **(B1)**

There will be twice the number of piles of dust formed. --- **(B1)**

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

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

Electric force per unit positive charge. --- **(B1)**

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

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

**+**

P

E --- **(B1)**

**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.

F = qE

E = (4 x 10-14) / (1.6 x 10-19) --- **(C1)**

E = 2.5 x 105 NC-1 --- **(A1)**

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.

E = V / d

V = (2.5 x 10-5)(0.02) --- **(B1)**

V = 5000 V = 5 kV--- **(A0)**

[1]

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

Upwards --- **(B1)**

Parabolic --- **(B1)**

**Can be within the plate or beyond**

**+**

P

[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.

The electric force pulls the electron (outermost) in the air molecules in one direction. --- **(B1)**

While the force pulls the positive ion in the opposite direction. The force is strong enough to

detach the electron from the molecule. --- **(B1)**

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………….. [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**0** C passes through R. Calculate the energy dissipated in R during the time of current flow.

W = QV

W = (0.08) (2) --- **(C1)**

W = **0.16 J**--- **(A1)**

Energy=……..….………J [2]

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

W = QV

W = (0.08) (2.2) --- **(C1)**

W = **0.176 J**--- **(A1)**

Energy=……..…………J [2]

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

Part of the energy from the power supply ( or 0.016 J) --- **(B1)**

is dissipated in the internal resistance of the source/ resistance due to connecting wires --- **(B1)**

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

**[Turn over**

10

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

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

Rate of decay is unaffected by external physical factors. (e.g. air pressure, temperature)

--- **(B1)**

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

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

It is impossible to predict which nucleus will be the next to decay. --- **(B1)**

Or it is impossible to predict when the next decay will occur.

Constant probability of decay for individual nucleus (per unit time)

…………………………………………………………………………………………...…………………………………………………………………………………………...……………………………………………………………………………………… [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*.

A = 206 --- **(B1);** Z = 82 --- **(B1)**

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

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

Lead --- **(B1)**

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

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

Explain why such particles can ionise the air.

Alpha particle has higher K.E./larger mass --- **(M1)**

When colliding with an air molecule. It knocks off an electron from the molecule. --- **(B1)**

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