PAPER 2
ESSAY
[60 marks]

1½ hours

Answer **eight** *questions in* **all**, **five** *questions from Part* **I** *and three questions from Part* **II**.

PART I
[15 marks]

Answer any **five** *questions from this part.*

All *questions carry* **equal** *marks.*

1. Express **each** of the following S.I units in base units:
   (*a*) Pascal;
   (*b*) Joule;
   (*c*) Coulomb. [3 ma

2. (*a*) Define *force constant* of an elastic material.

   (*b*) A graph of tensile stress is plotted against tensile strain. What does the slope of the graph represent? [3 m

3. A stone is projected with an initial speed, u, at an angle, θ, to the horizontal. Show that the maximum height, H_{max} attained is given by $H_{max} = \frac{u^2 \, Sin^2 \, \theta}{2g}$, where g is the acceleration due to gravity. [3

4. (*a*) Explain the term *escape velocity* of satellites.

   (*b*) A satellite is launched with a speed greater than the escape velocity. What would be the shape of the orbit?

5. State the:
   (*a*) method of reducing the depletion layer in a p-n junction.

   (*b*) reason why diodes are used as rectifiers.

6. State **three** uses of magnets.

7. An object is thrown horizontally with a speed of 25 m s^{-1} from the roof of a tall building. If the object takes 5 s to hit the ground, calculate the height of the building. [g = 10 m s^{-2}]

PART II
[45 marks]

Answer **three** *questions from this part.*
All *questions carry* **equal** *marks.*

(a) Define *average velocity*. [2 marks]

(b) A body of mass 2.0 kg moving with a velocity of 10 m s^{-1} undergoes elastic collision with a stationary body of mass 4.0 kg. Calculate the velocities of the bodies after collision. [6 marks]

(c) A block of wood weighing 8 N is placed on a horizontal table. It is pulled by a spring balance attached to one of its ends. The block just begins to move when the spring balance records 5 N. Calculate the:
(i) co-efficient of static friction;
(ii) acceleration of the block when the spring balance records 12 N.
[g = 10 m s^{-2}]

[5 marks]

(d) When a bicycle tyre is inflated, its pressure increases, explain the reason for this observation. [2 marks]

(a) State **three** differences between *evaporation* and *melting*. [3 marks]

(b) Define **each** of the following terms:
(i) absolute zero temperature;
(ii) heat energy

[4 marks]

(c) A thermometer which was wrongly calibrated indicates −5 °C at the lower fixed point and 106 °C at the upper fixed point. Calculate the reading on the thermometer when the actual temperature is 60 °C. [3 marks]

(d) State **two** physical properties that are used in the measurement of temperature. [2 marks]

(e) Explain **briefly** how *conduction*, *convection* and *radiation* effects are minimized in a thermos flask. [3 marks]

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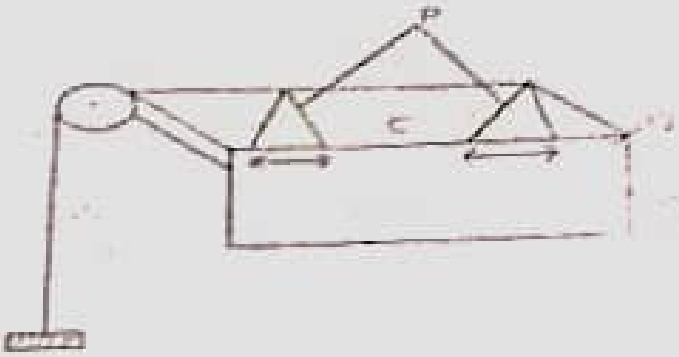
(a) State **one** law of vibration of stretched strings. [2 marks]

(b) (i) The diagram below illustrates a sonometer set up. Identify the parts labelled **P** and **Q**



(ii) State **two** functions of a sonometer.

(iii) A sonometer wire of length l vibrates at a frequency of 350 Hz. If the length of the wire is increased by 15 cm, the wire vibrates at 280 Hz under constant tension. Calculate the value of l

[7 marks]

Define **each** of the following terms:

(i) Fundamental note;

(ii) Overtone;

(iii) Harmonics.

[6 marks]

State the *laws of electromagnetic induction*. [4 marks]

Explain why a positively charged conductor placed near a candle flame causes the flame to spread out. [2 marks]

An alternating current 20 A flows through a pure inductor of inductance 30 mH. Calculate the energy stored in the inductor. [2 marks]

(i) Define **each** of the following terms:

(I) Electron volt;

(II) Resonant frequency of an a.c. series circuit.

(ii) Show that the resonant frequency, f_o of an L-C-R series a.c. circuit is given by $f_o = \frac{1}{2\pi\sqrt{LC}}$.

[7 marks]

12. (*a*) Light of wavelength 7.0×10^{-7} m is incident on a metal of work function 1.20 eV. Calculate the:

(i) energy of the photon;

(ii) energy of the most energetic photoelectrons.

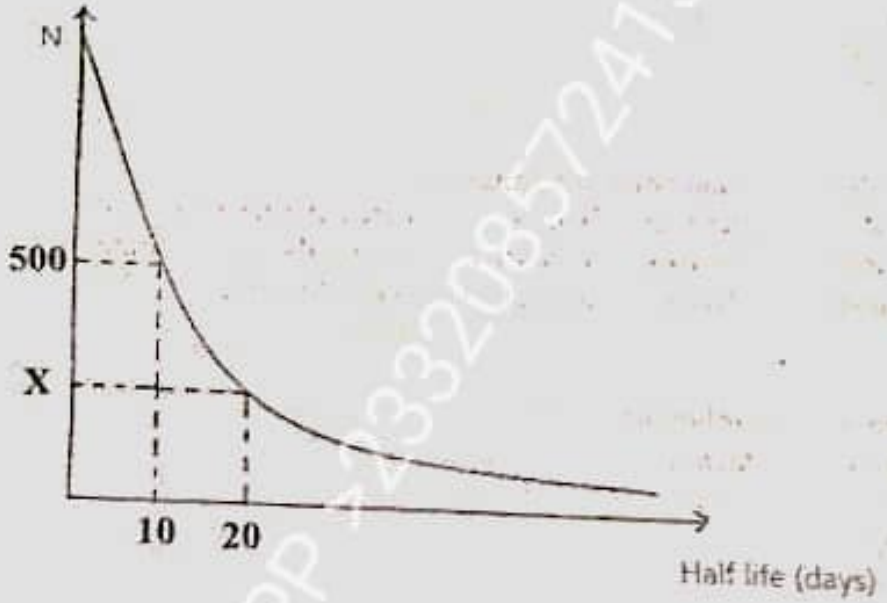
[Planck's constant, $h = 6.6 \times 10^{-34}$ J s ; $C = 3.0 \times 10^{8}$ m s^{-1}]

(*b*) Explain **each** of the following terms:

(i) Nuclear fusion;

(ii) Nuclear fission.

(*c*) The diagram below illustrates a decay curve for a radioactive sample of original number, N.



Using the graph, calculate the

(i) values of **X** and **N**;

(ii) number of samples disintegrated after 40 days.

(*d*) State **two** properties of alpha particles.

END OF ESSAY TEST

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FINAL MARKING SCHEME

PHYSICS 2

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THE WEST AFRICAN EXAMINATIONS COUNCIL

WASSCE FOR SCHOOL CANDIDATES, 2022

FINAL MARKING SCHEME

PHYSICS 2

SIERRA LEONE & LIBERIA

(Maximum Marks obtainable: 60)

PART I

[1[illegible]arks]

Rubrics: *Answer any* **five** *questions from this part*

1. **Expression in base units**
   (a) $kg\ m^{-1}\ s^{-2}$ (1)
   (b) $kg\ m^{2}\ s^{-2}$ (1)
   (c) As (1)

[3 marks]

2. (a) **Definition of force constant of an elastic materi[illegible]**
   The force per unit extension of the elastic material.
   OR
   The ratio of force to extension of the elastic [illegible]al

Any 1 x 2 = [2 marks]

(b) Modulus of elasticity / Young's Modu[illegible]us [1 mark]

3. **Proof of H_{max}**

For a projectile

$V_y^2 = U_y^2 - 2gh$ (1)

At maximum height, $V_y = 0$

$\therefore 0^2 = U_y^2 - 2gH_{max}$ (½)

$H_{max} = \frac{U_y^2}{2g}$ but $v_y = usin\,\theta$ (½)

$H_{max} = \frac{u^2 sin^2\theta}{2g}$ (1)

OR

$v_y = u_y - gt$ (1)

$u_y = usin\theta, v_y = 0, t = \frac{usin\theta}{g}$ (½)

$H_{max} = \left(\frac{u_{y+0}}{2}\right)t$

$H_{max} = \left(\frac{usin\theta}{2}\right)\left(\frac{usin\theta}{g}\right)$ (½)

$H_{max} = \frac{u^2 sin^2\theta}{2g}$ (1)

[3 marks]

4. (a) **Explanation of escape velocity of satellites** least / lowest speed escape
   The minimum speed (1) required to launch a satellite so as to leave the gravitational field region of a planet/Earth completely(1).

(b) **Shape of orbit when launched with speed greater than the escape velocity.**
   Hyperbolic (1)

[3 marks]

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5. (a) **Method of reducing the depletion layer in a p-n junction**

- Forward bias [1 mark]

(b) **Reason why diodes are used as rectifiers**

They allow current flow/conduct current in one direction. [2 marks or 0]

6. **Uses of magnets**

- Resetting the index in maximum/minimum thermometers.
- Used in doors of refrigerators/freezers.
- Picking up very small magnetic substances.
- Posting items on magnetic boards.
- Used as magnetic pin/needle in a compass.
- — ATM machines

Any 3 x 1= [3 marks]

7. **Calculation of height**

$h = ut + \frac{gt^2}{2}$ (1)

$h = 0 + \frac{1}{2} \times 10 \times 5^2$ (1)

$= 125$ m (1) no unit deduct $\frac{1}{2}$ mark

[3 marks]

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Part II

[45 marks]

Rubric: *Answer any* **three** *questions from this part.*

8. (a) **Definition of average velocity**
The ratio of total displacement of a body to the time taken. [2 marks]

A2

(b) **Calculation of the velocities of the bodies**
From the law of conservation of momentum; (1)

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$2 \times 10 + 0 = 2v_1 + 4v_2$ (1)

$20 = 2v_1 + 4v_2$ 1

From the law of conservation of energy;

$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$ (1)

$\frac{1}{2} \times 2 \times 10^2 + 0 = \frac{1}{2}2v_1^2 + \frac{1}{2}4v_2^2$

$100 = v_1^2 + 2v_2^2$ 2 (1)

solving eqns. 1 and 2 simultaneously

from eqn.1 $v_1 = 10 - 2v_2$

$\therefore v_1^2 = 100 - 40v_2 + 4v_2^2$ 3

from eqn.2 $v_1^2 = 100 - 2v_2^2$ 4

comparing equations 3 and 4

$100 - 2v_2^2 = 100 - 40v_2 + 4v_2^2$

$6v_2^2 - 40v_2 = 0$ (1)

$2v_2(3v_2 - 20) = 0$

If $v_2 = 6.67\ m\ s^{-1}$ then $v_1 = -3.33\ m\ s^{-1}$ (1)

B6

(c) (i) **Calculation of co-efficient static friction**
Limiting friction, F = 5 N
Normal reaction, R = 8 N

Co-efficient of static friction, $\mu = \frac{F}{R}$ (1)

$\mu = \frac{5}{8}$ (½)

$\mu = 0.625$ (½)

(ii) **Calculation of acceleration**

F-f = ma where F-f is the net force (1)

W = mg ; m = 0.8 kg

12 – 5 = 0.8 a

a = 8.75 m s^{-2} (1)

(1)

C5

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(d) **Physical properties used in measuring temperature**

- change in length.
- change in electrical resistance.
- change in pressure.
- change in electromotive force.
- differential expansion of metals.

Any 2 x 1 = [2 marks]

D2

(e) **Minimizing heat loss in a thermos flask**

Conduction : Use of plastic/glass materials /insulators/vacuum in making the flask. (1)

Convection: Vacuum between the walls of the flask. (1)

Radiation : Silvered walls /shiny metal surface. (1)

E3

10. (a) **Laws of vibration of stretched strings**

- The frequency of a vibrating string is inversely proportional to the length of the string, provided the tension and mass are constant; $f \propto \frac{1}{l}$.
- The frequency of a vibrating string is directly proportional to the square root of the tension in the string provided the length and mass are constant; $f \propto \sqrt{T}$
- The frequency of a vibrating wire is inversely proportional to the square root of its mass per unit length; $f \propto \frac{1}{\sqrt{m}}$ under constant tension.

Any 1 x 2 = [2 marks]

A2

(b) (i) **Identification of P and Q**

P - (moveable) bridges (1)

Q - (Box) (1)

(ii) **Functions of a sonometer**

- Used to determine unknown frequency of a given tuning fork. (1)
- Used to verify the laws of vibrating strings. (1)

(iii) From $f_1 l_1 = f_2 l_2$ OR $\frac{f_2}{f_1} = \frac{l_1}{l_2}$ (1)

$\frac{280}{350} = \frac{l}{(l+0.15)}$ (1)

$l = 0.6$ m (1)

B7

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(d) **Explanation of observation**

There are more air molecules introduced into the tyre. (1) Collision of air molecules with the walls of the tyre increases per unit time,(1) hence the pressure increases.

[2marks]

D2

9. (a) **Differences between evaporation and melting**

Evaporation	Melting
occurs at any temperature.	occurs at a particular temperature.
is affected by surface area of liquid exposed.	is not affected by the surface area of liquid exposed.
results in change of state from liquid to gas.	does not result in change of state from solid to liquid.
produces cooling effect.	does not produce cooling effect.

Any 3 x 1 = [3 marks]

A3

(b) **Definition of terms**

(i) **Absolute zero temperature**

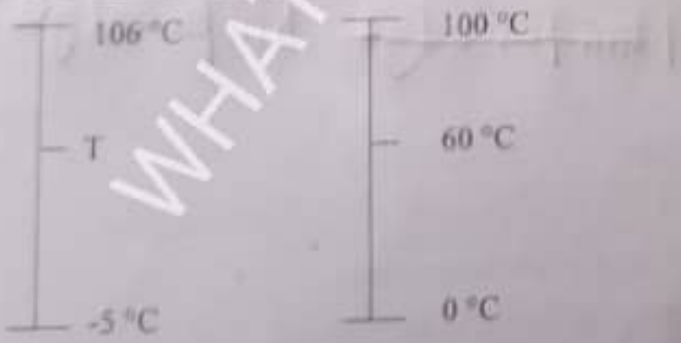
The lowest possible temperature on the thermodynamic scale at which the kinetic energy of all molecules is zero. [2 marks]

(ii) **Heat energy**

A form of energy resulting from the change in temperature of a body. [2 marks]

B4

(c) **Calculation of thermometer reading**



$\frac{T-T_0}{T_{100}-T_0} = \frac{\theta-\theta_0}{\theta_{100}-\theta_0}$ (1)

$\frac{T-(-5)}{106-(-5)} = \frac{60-0}{100-0}$ (1)

T= 61.6 °C (1)

C3

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(ii) At forty days = $4\ T_{1/2}$ ∴ n = 4

Number of atoms left = $\frac{N_0}{2^n}$

$= \frac{1000}{16} = 62.5$ g (½)

Number of samples disintegrated = $N_0 - N$
$= N_0 - 62.5$
$= 937.5$ atoms (1)

C5

(d) **Properties of alpha particles**. They:
- are positively charged.
- are helium nuclei.
- are shallow penetrators.
- ionize air.
- are deflected by electric/magnetic field.
- travel at low speed.

Any 2 x 1 = [2 marks]

B2

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