

MARKING GUIDE
BUDAKA PROGRESSIVE HIGH SCHOOL
END OF TERM II EXAMS 2019
S.3 Physics Paper 2
Time: 2 hours 15 minutes

Instructions

- ❖ Attempt any **FIVE** questions from this paper.
- ❖ Assume where necessary;

Acceleration due to gravity, g , = 10ms^{-2}

Density of water = 1000kgm^{-3}

1. (a) Define the following terms

(i) Moment of force

(01 mark)

This is a product of the force and the perpendicular distance from the line of action of the force to a fixed point.

(ii) Centre of gravity.

(01 mark)

This is the point of application of the resultant force due to the earth's attraction on the body

(b) (i) State the principle of moments.

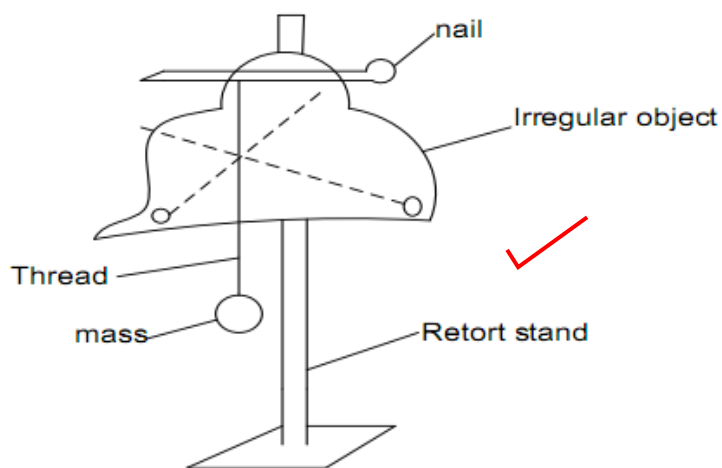
(01 mark)

It states that when a body is in equilibrium, the sum of clockwise moments about any point is equal to the sum of anti-clockwise moments about the same point.

(ii) Describe an experiment to locate the Centre of gravity of an irregular object.

(05 marks)

- ❖ Clamp a nail on the stand so that the pointed end is free.
- ❖ Make three holes at the edges of the object and hung it on the nail through one of the holes.
- ❖ Tie the thread on a mass to make a plumb line.
- ❖ Tie the plumb line on the nail and allow it to rest freely with the thread touching the object.
- ❖ Trace the thread using a pencil.
- ❖ Repeat the procedure when the object is suspended from the other holes.
- ❖ The point of intersection of the three lines is the centre of gravity of the board.



(c) A body of mass 50kg accelerates uniformly from rest and covers 40m in 8seconds. Calculate;

(i) The acceleration of the body

(02 marks)

$$m = 50\text{kg}$$

$$u = 0$$

$$s = 40\text{m}$$

$$t = 8\text{s}$$

$$\text{from } s = ut + \frac{1}{2}at^2$$

$$40 = 0 \times 8 + \frac{1}{2} \times a \times 8^2$$

$$\underline{a = 1.25\text{ms}^{-2}}$$

(ii) The momentum of the body after 8 seconds.

(02 marks)

$$\text{From } v = u + at,$$

$$v = 0 + 1.25 \times 8$$

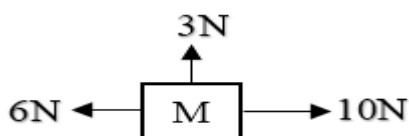
$$v = 10\text{ms}^{-1}$$

$$\text{Momentum} = \text{mass} \times \text{velocity}$$

$$= 50 \times 10$$

$$\underline{\text{Momentum} = 500\text{kgms}^{-1}}$$

(d) In the figure below, forces 3N, 6N and 10N act on a body M of mass 2kg initially at rest.



Find the magnitude of the resultant force and the acceleration with which the body moves.

(04 marks)

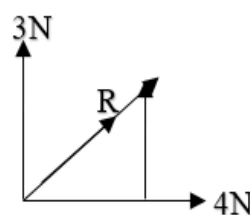
Resolving horizontally,

$$F_H = 10 - 6$$

$$= 4\text{N}$$

Resolving vertically,

$$F_V = 3\text{N}$$



Resultant force;

$$R^2 = 3^2 + 4^2$$

$$R = 5\text{N}$$

From $F = ma$,

$$5 = 2a$$

$$a = 2.5\text{ms}^{-2}$$

2. (a) (i) What is meant by reflection of light?

(01 mark)

Reflection of light is the bouncing of light when it falls on a reflection surface.

- (ii) State the laws of reflection of light.

(02 marks)

- ❖ The incident ray, the reflected ray and the normal at the point of incidence all lie in the same plane
- ❖ The angle of incidence is equal to the angle of reflection.

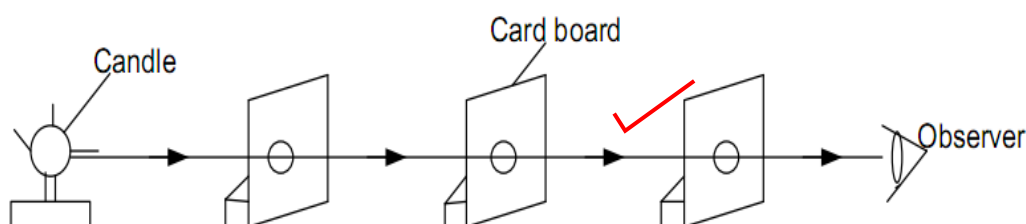
- (iii) Distinguish between diffuse and regular reflection of light

(02 marks)

Regular reflection	Diffuse reflection
❖ Takes place on a smooth surface	❖ Takes place on a rough surface
❖ A parallel incident beam is reflected as a parallel beam	❖ A parallel incident beam is reflected in different directions.

- (b) Describe an experiment to show that light travels in a straight line.

(05 marks)



- ❖ Three card boards with holes at their centre are mounted on wooden blocks.
- ❖ The boards are then arranged in a straight line
- ❖ A string is passed through the holes to ensure that they are in a straight line.
- ❖ A point source of light is placed on one side of the boards and observed at the other end.
- ❖ Observation: Light from the source is seen.
- ❖ The boards are then displaced such that the holes are not in a straight line and observed again
- ❖ Observation: The light from the source is not seen.
- ❖ Conclusion: Light travels in a straight line

- (c) An object 4cm high is placed at right angle to the principal axis of a concave mirror of focal length 10cm. If the object is 30cm from the pole, find the;

- (i) position of the image.

(02 marks)

$$h_0 = 4\text{cm}$$

$$u = 30\text{cm}$$

$$f = 10\text{cm}$$

$$\text{from } \frac{1}{f} = \frac{1}{u} + \frac{1}{v},$$

$$\frac{1}{10} = \frac{1}{30} + \frac{1}{v}$$

$$v = 15\text{cm}$$

(ii) Size of the image.

(02 marks)

$$\text{magnification, } m = \frac{v}{u} = \frac{15}{30}$$

$$m = 0.5$$

$$\text{but } m = \frac{h_1}{h_0}$$

$$0.5 = \frac{h_1}{4}$$

$$h_1 = 2\text{cm}$$

Alternatively, one can use graphical approach

(d) State two applications of a diverging mirror

(02 marks)

- ❖ They are used as driving mirrors.
- ❖ Used in super markets to observe the activities of customers
- ❖ Used in security check points to inspect under vehicles

3. (a) Define the following terms as applied to machines.

(i) Mechanical advantage

(01 mark)

This is the ratio of load to effort

(ii) Velocity ratio.

(01 mark)

This is the ratio of the distance moved by the effort to the distance moved by the load in the same time.

(iii) Efficiency.

(01 mark)

This is the ratio of work output to work input expressed as a percentage.

(b) A pulley system has an efficiency of 60% and velocity ratio of 4. Calculate;

(i) Its mechanical advantage.

(02 marks)

$$\text{Efficiency} = \frac{\text{mechanical advantage}}{\text{velocity ratio}} \times 100\%$$

$$60 = \frac{\text{mechanical advantage}}{4} \times 100\%$$

$$\text{Mechanical advantage} = 2.4$$

(ii) The effort required to raise a load of 150N.

(03 marks)

$$\text{From mechanical advantage} = \frac{\text{load}}{\text{effort}}$$

$$2.4 = \frac{150}{\text{effort}}$$

$$\text{Effort} = 62.5\text{N}$$

(iii) The distance moved by the load if the effort moves through a distance of 3m.

(02 marks)

From velocity ratio = $\frac{\text{effort distance}}{\text{load distance}}$

$$4 = \frac{3}{\text{load distance}}$$

$$\text{Load distance} = 0.75\text{m}$$

- (c) (i) Give two reasons why the efficiency of the pulley is never 100%. (02 marks)

- ❖ Some energy is wasted in overcoming frictional force in the moving parts
- ❖ Some energy is wasted in lifting useless weights like moveable parts of the machine

- (ii) Give two ways of improving the efficiency of a machine (02 marks)

- ❖ By oiling the movable parts.
- ❖ By using lightweight materials for movable parts.

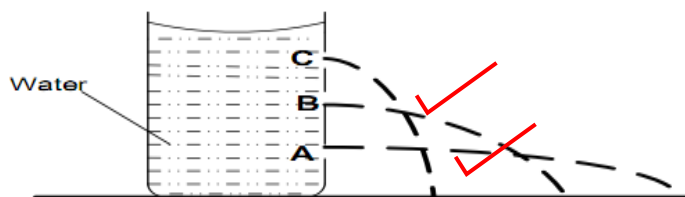
- (iii) Mention two applications of a pulley system in our daily life. (02 marks)

- ❖ Used by builders to lift construction materials
- ❖ It can also be used to raise a flag to the top of a flag pole.

4. (a) (i) Define pressure and state its S.I units. (02 marks)

Pressure is the force acting normally per unit area. Its SI unit is Pascal

- (ii) Describe a simple experiment to show that pressure in a liquid increases with depth. (05 marks)



- ❖ Make three holes, A, B, and C of the same diameter along a vertical line on one side of a tall can.
- ❖ Close the holes temporarily with cork and fill the can with water.
- ❖ Open the holes at the same time and observe

Observation

- ❖ Hole A shoots its water further followed by hole B and hole C shoots its water nearest.

Conclusion

- ❖ This shows that pressure in a liquid increases with depth.

- (iii) Calculate the pressure at the bottom of a swimming pool 1000cm deep. (density of water = 1000kgm^{-3}) (03 marks)

$$h = 1000\text{cm} = 10\text{m}$$

$$g = 10\text{ms}^{-2}$$

$$\rho = 1000\text{kgm}^{-3}$$

$$\text{Pressure} = h\rho g$$

$$= 10 \times 1000 \times 10$$

Pressure = 100000Pa

- (b) (i) State Pascal's principle (01 mark)
It states that pressure at a point in an enclosed fluid is transmitted equally throughout the fluid in all directions.

- (ii) Give two applications of Pascal's principle (02 marks)

It is applied in;

- ❖ Hydraulic press
- ❖ Hydraulic brake

- (c) (i) What is atmospheric pressure? (01 mark)

Atmospheric pressure is the pressure exerted by the atmosphere on the earth's surface due to weight of air

- (ii) Give two applications of atmospheric pressure. (02 marks)

It is applied in;

- ❖ Lift pump
- ❖ Force pump

5. (a) Differentiate between Kinetic energy and potential energy. (02 marks)

Kinetic energy is a form of energy possessed by a body due to its motion whereas potential energy is the energy possessed by a body due to its position in the field of force.

- (b) A ball of mass 100g falls from the top of a cliff 200cm high. Calculate the;

- (i) Potential energy possessed by the ball at the maximum height. (03 marks)

$$m = 100\text{g} = 0.1\text{kg}$$

$$u = 0 \text{ (falls from rest)}$$

$$h = 200\text{cm} = 2\text{m}$$

$$g = 10\text{ms}^{-2}$$

$$\text{Potential energy} = mgh$$

$$= 0.1 \times 10 \times 2$$

$$\text{Potential energy} = 2\text{J}$$

- (ii) Velocity with which the ball hits the ground (03 marks)

From the principle of conservation of energy;

Loss in potential energy = gain in kinetic energy

Therefore, kinetic energy = 2J

$$\text{But kinetic energy} = \frac{1}{2}mv^2$$

$$2 = \frac{1}{2} \times 0.1 \times v^2$$

$$v = 6.32\text{ms}^{-1}$$

(c) (i) What is meant by the term diffusion (01 mark)

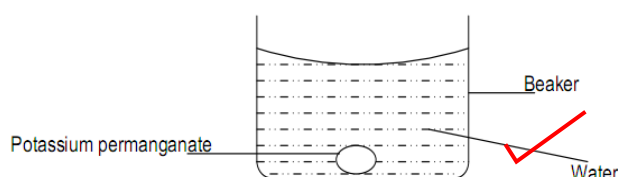
This is the movement of molecules of a substance from a region of their high concentration to region of their low concentration ✓

(ii) State two factors on which diffusion depends (02 marks)

- ❖ Temperature ✓
- ❖ Pressure ✓
- ❖ Density of diffusing molecules
- ❖ Size of the pores across which molecules diffuse

(iii) Describe an experiment to show diffusion in liquids. (05 marks)

Place a crystal of purple potassium permanganate at the bottom of a beaker containing clean water and leave the setup for some time. ✓



Observation

The crystal dissolves and spreads throughout the water forming a purple solution. ✓

Conclusion

This demonstrates diffusion in liquids ✓

6. (a) State Archimedes' principle. (01 mark)

Archimedes principle states that when a body is wholly or partially immersed in a fluid, it experiences an up thrust equal to the weight of fluid displaced ✓

(b) An object weighs 70N in air, 30N when fully immersed in water and 50N when wholly immersed in a certain liquid. Calculate the;

(i) relative density of the object (02 marks)

$$\begin{aligned}\text{Relative density of a solid} &= \frac{\text{weight in air}}{\text{Apparent loss in weight of the solid in water}} \\ &= \frac{70}{70-30} \\ &= 1.75\end{aligned}$$

(ii) relative density of the liquid (02 marks)

$$\begin{aligned}\text{Relative density of a liquid} &= \frac{\text{Apparent loss in weight of the solid in a liquid}}{\text{Apparent loss in weight of the solid in water}} \\ &= \frac{70-50}{70-30} \\ &= 0.5\end{aligned}$$

(iii) density of the liquid. (02 marks)

$$\begin{aligned}\text{Density of a liquid} &= \text{relative density} \times \text{density of water} \\ &= 0.5 \times 1000 \\ &= \underline{500 \text{ kg m}^{-3}}\end{aligned}$$

- (c) (i) Define momentum and state its SI unit (02 marks)

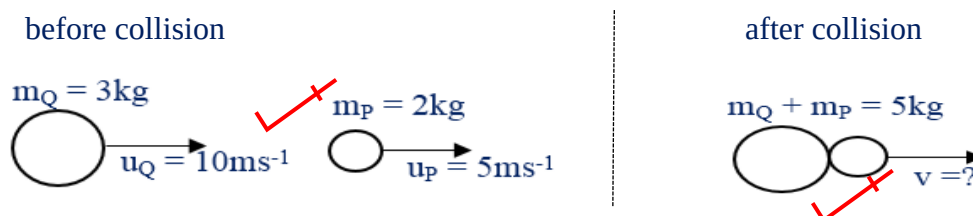
Momentum is a product of mass and velocity of a body. Its SI unit is kilogram metre per second (kg m s^{-1})

- (ii) State the principle of conservation of momentum. (01 mark)

It states that when two or more bodies act upon one another, their total momentum remains constant provided no external forces are acting.

- (d) A body **Q** of mass 3kg moving with a velocity of 10 m s^{-1} collides with another body **P** of mass 2kg moving with a velocity of 5 m s^{-1} in the same direction. If the two bodies move together after collision, calculate the;

- (i) Common velocity of the bodies after collision. (03 marks)



From the principle of conservation of momentum,

$$m_Q u_Q + m_P u_P = (m_Q + m_P) v$$

$$3 \times 10 + 2 \times 5 = (3 + 2) v$$

$$v = \underline{8 \text{ m s}^{-1}}$$

- (ii) Loss in kinetic energy. (03 marks)

$$\text{Kinetic energy before collision} = \frac{1}{2} m_Q u_Q^2 + \frac{1}{2} m_P u_P^2$$

$$= \frac{1}{2} \times 3 \times 10^2 + \frac{1}{2} \times 2 \times 5^2$$

$$= 175 \text{ J}$$

$$\text{Kinetic energy after collision} = \frac{1}{2} (m_Q + m_P) v^2$$

$$= \frac{1}{2} (3 + 2) \times 8^2$$

$$= 160 \text{ J}$$

$$\text{Loss in kinetic energy} = 175 - 160$$

$$= \underline{15 \text{ J}}$$

7. (a) (i) What is meant by thermionic emission? (01 mark)

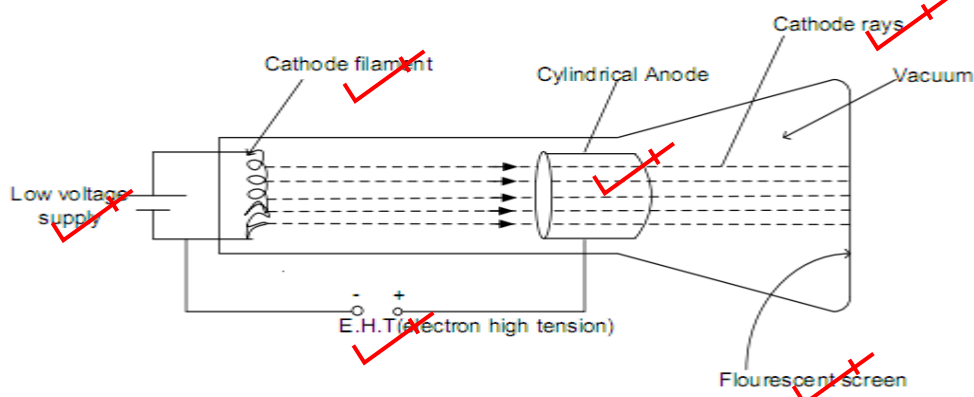
This is the process by which electrons are emitted from a heated metal surface

- (ii) State any two properties of cathode rays. (02 marks)

❖ They are negatively charged

❖ They travel in a straight line ✓

(b) Draw a labeled diagram showing the essential parts of a cathode ray tube. (03 marks)



(c) Define the following terms as applied to atomic physics

(i) Atomic number (01 mark)

Atomic number is the number of protons in the nucleus of an atom. ✓

(ii) Isotopes (01 mark)

Isotopes are atoms of the same element with the same atomic number but different atomic mass. ✓

(d) The half-life of a radioactive substance is 24 hours. Find the time it will take 32g of the substance to reduce to 4g. (03 marks)

$$N_0 = 32g$$

$$N = 4g$$

$$T_{1/2} = 24 \text{ hours}$$

$$t = ?$$

$$\text{using } N = \frac{N_0}{2^n} \quad \checkmark$$

$$4 = \frac{32}{2^n} \quad \checkmark$$

$$n = 3 \quad \checkmark$$

$$\text{using } n = \frac{t}{T_{1/2}} \quad \checkmark$$

$$3 = \frac{t}{24}$$

$$t = 8 \text{ hours} \quad \checkmark$$

(e) (i) State any one use of X-rays. (01 mark)

- ❖ Used to detect fractures in bones ✓
- ❖ Used to destroy cancer cell
- ❖ Used in detection of lung tuber culosis
- ❖ Used for sterilization of medical equipment.

Any one

(ii) State two health hazards caused by X-rays (02 marks)

- ❖ They cause genetic damage and mutation ✓
- ❖ They can burn the skin and other body tissues ✓

(iii) Give two differences between X-rays and cathode rays. (02 marks)

x-rays	Cathode rays
❖ Carry no charge ✓	❖ Carry a negative charge ✓
❖ Cannot be deflected by both electric and magnetic fields ✓	❖ Can be deflected by both electric and magnetic fields ✓

8. (a) Distinguish between primary and secondary cells and give one example of each. **(04 marks)**

Primary Cell	Secondary Cell
Current is produced as a result of irreversible chemical change. ✓	Current is produced as a result of reversible chemical change ✓
Cannot be recharged.	Can be recharged
Provide a lower e.m.f	Provide a higher e.m.f
Works for a shorter time	Works for a longer time.
Higher internal resistance	Low internal resistance
Examples include, dry cell, simple cell ✓	Examples include, lead acid cell, nickel iron cell, nickel cadmium cell ✓

- (b) State two precautions one has to undertake to prolong the life of a lead- acid accumulator

(02 marks)

- ❖ It should be charged regularly. ✓
- ❖ Avoid shorting (connecting wires across the terminals). ✓
- ❖ Over charging should be avoided.
- ❖ It should not be left in discharge state for a long time.

Any two

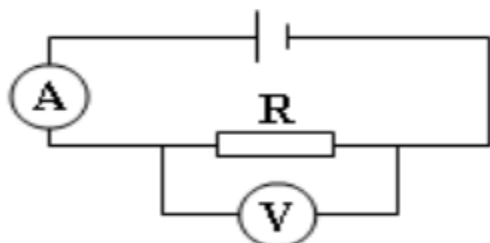
- (c) (i) Define the term internal resistance of a cell

(01 mark)

This is the opposition to the flow of current within a cell. ✓

- (ii) With the aid of a circuit diagram, describe how you can determine the internal resistance of a cell. **(05 marks)**

- ❖ A high resistance voltmeter is connected across the terminals of the cell and the voltmeter reading, E is noted. ✓
- ❖ A standard resistor, R and the ammeter are connected in series with the cell terminals. ✓
- ❖ The voltmeter is then connected across the resistor as shown below. ✓

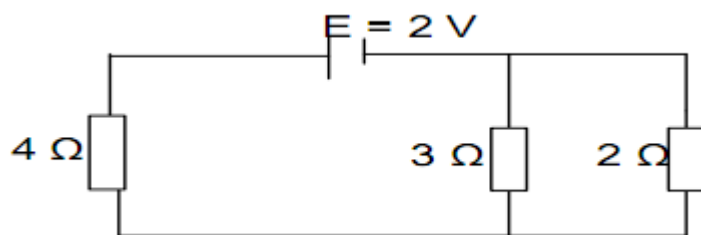


- ❖ Read and record the voltmeter reading, V and the corresponding ammeter reading, I . ✓
- ❖ Calculate the internal resistance of the cell, r from;

$$r = \frac{E - V}{I}$$

- ❖ Repeat the procedure using other resistors of different resistances and calculate the average value of internal resistance

(d) The figure below shows a cell of e.m.f 2V and negligible internal resistance connected to three resistors of resistances 4Ω , 3Ω and 2Ω .



Calculate the current supplied by the cell

(04 marks)

$$R = \frac{3 \times 2}{3 + 2} + 4$$

$$R = 5.2\Omega$$

$$\text{Using } E = I(R + r)$$

$$2 = I(5.2 + 0)$$

$$I = 0.3846A$$