



**First Year Entrance  
Examination  
English curriculum**

**Subject : Physics**  
**Duration : 2 Hours**  
**Session: JUNE 2023**

**Instruction : Answer All the questions**

- 1.) A dry cell delivers 0.18 A when connected to an  $8.0 \Omega$  resistor. When another identical resistor is connected in parallel to the first, the cell now delivers 0.33 A. Calculate the electromotive force (E) and the internal resistance (r) of this dry cell (5 marks)
- 2.) It can be shown that the pressure P, at a point in a fluid is related to its density  $\rho$  and a depth h by the equation:  $P + \alpha\rho + \beta\rho h = \omega$ .
  - a.) How can units be used to test the correctness of a physical equation
  - b.) Determine the base units of  $\alpha, \beta$  and  $\omega$  (7 marks)
- 3.) How do metals, semiconductors and insulators compare at room temperature with regards to
  - a.) Resistivity
  - b.) Effect of temperature on resistivity
  - c.) Number of charge carriers available for conduction (7 marks)
- 4.) Yellow light of wavelength 590 nm illuminates normally a diffraction grating with 500 lines per millimeter
  - a.) At what angle to the normal is the second order image obtained?
  - b.) What is the highest order in which an image may be obtained? (7 marks)
- 5.)
  - a.) A capacitor of capacitance C, a coil of Inductance L, a resistor of resistance R and a lamp are connected in series with an alternating source of voltage U. Keeping U constant and frequency of the source is varied from low to a high value. Describe and explain how the brightness of the lamp varies
  - b.) If in (a) the voltage  $U = 0.01 \text{ V}$  (r.m.s) and the capacitance  $C = 0.04 \mu\text{F}$  then the inductance  $L = 0.04 \text{ H}$  with  $R = 10\Omega$ . Calculate the voltage across C, at resonance (6 marks)
- 6.)
  - a.) Explain why a charged particle moving with constant speed in a uniform magnetic field describes a circular path if its initial velocity is perpendicular to the field lines. Explain
  - b.) An electron enters a uniform magnetic field of magnitude 0.8 T with a speed of  $4.0 \times 10^6 \text{ ms}^{-1}$ .
    - i.) Determine the centripetal force experienced by the electron.
    - ii.) If the electron is found to be losing speed, what would be the consequences to the path and environment of the electron (7marks)
- 7.) The Helium-Neon LASER is more popular than the gas discharge lamp for experiments in physics
  - i.) State the meaning of the acronym LASER
  - ii.) Why are LASERS more advantageous than the gas discharge lamp?
  - iii.) State and explain two applications of LASERS (7 marks)

- 8.) A mass defect of  $8.15 \times 10^{-30}$  kg is observed when Alpha particles and gamma rays are emitted from  $^{226}_{88}\text{Ra}$ .
- How can you identify the presence of  $\alpha$  – particles and  $\gamma$  – rays in this emission?
  - Determine energy released
- (5 marks)

- 9.) The figure below shows the circuit used with a photocell in a photo electricity experiment

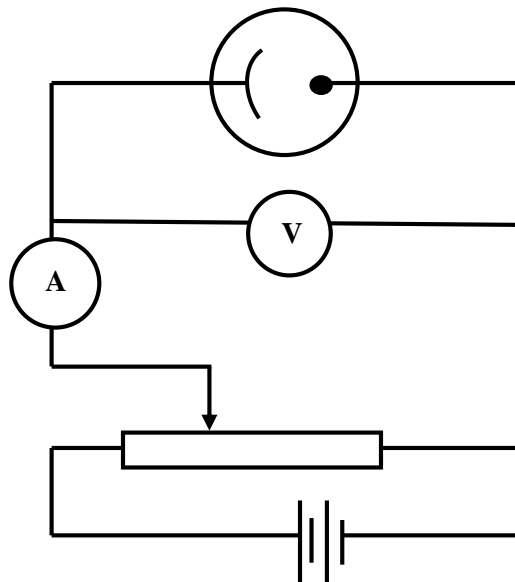


Figure 1

The current  $I$ , was measured for varying potential differences,  $V$  when the cell was illuminated by light.

- Sketch a graph of  $I$  against  $V$  for those results
  - What would be the effect on the graph of increasing the intensity of the illumination
  - What would be the effect on the graph of increasing the frequency of the light used
- (8 marks)
- 10.) A lead pellet fired from a gun hits an obstacle at  $20^\circ\text{C}$  and lead has a melting point of  $327^\circ\text{C}$ . Find the minimum speed the pellet must have if 60% of the kinetic energy of the pellet is used to heat it on impact. (Take the specific heat capacity of lead =  $1.3 \times 10^2 \text{ J kg}^{-1} \text{ K}^{-1}$  and the specific latent heat of fusion of lead =  $2.1 \times 10^4 \text{ J kg}^{-1}$ )
- (6 marks)
- 11.) a.) A 100 francs coin placed at the centre of the bottom of a cylindrical beaker of height 30.0 cm. A convex lens of focal length 20.0 cm attached to the beaker's rim forms an image coin when the beaker is illuminated from below. The coin has a diameter of 0.6 m. Determine the location of the coin's image
- b.) If the beaker is now filled to a height  $h$  cm with water, determine the size of the coin's image in terms of  $h$ , as  $h$  varies from zero to near the rim ( take refractive index of water as  $\frac{4}{3}$  )
- (9 marks)
- 12.) Temperature measurement depends on a specified property of a thermometric substance. Explain how it is possible on the Celsius scale. Propose the requirements which guide the choice of a thermometric property for the above and state an example
- (6 marks)