LEAVING CERTIFICATE EXAMINATION, 1968

PHYSICS - HONOURS

WEDNESDAY, 19th JUNE - MORNING, 10 to 12.30

Six questions to be answered

1. Define (i) energy, (ii) momentum.
State the principle of conservation of momentum and describe briefly how the principle may be illustrated experimentally.
A block of wood of mass 5 kgm. is suspended by a fine vertical wire of length 2 metres so that it is free to swing. A bullet of mass 40 gm. is fired horizontally into the wood and becomes embedded in it. If the impact of the bullet causes the wire to swing through an angle of 3° to the vertical, calculate the velocity of the bullet before impact. (Take g = 981 cm. per sec^2 , cos 3° = 0·9986).

(66 marks)

2. Give an account of the kinetic theory of gases. How does a perfect (ideal) gas differ from a real gas ?
Discuss how temperature is interpreted in the light of the kinetic theory of gases.
Explain how the physical properties of a suitable substance may be used to define a scale of temperature.
Describe a constant volume gas thermometer.

(66 marks)

3. Write a concise note on the nature of light.
Show how (i) refraction of light and the laws associated with it and (ii) interference of light, may be explained in terms of the wave theory.
How may the wavelength of monochromatic light be measured ?

(66 marks)

4. Describe a laboratory method of measuring the velocity of sound in air. Hence, or otherwise, show how the velocity of sound in a gas may be determined.
If the velocity of sound in a gas is expressed by the formula $V = \sqrt{\frac{\gamma p}{\rho}}$ where p is the pressure, ρ the density and γ a constant, show that $V \propto \sqrt{T}$, i.e. V is proportional to $\sqrt{T}$ where T is the absolute temperature.
Given that the velocity of sound in air is 330 metres per sec. at 0°C., calculate its velocity at 16°C.

(66 marks)

5. (a) Define electrical capacitance (capacity).
Establish the expression $\frac{A}{4\pi d}$ (C.G.S. system) or $\frac{\epsilon_0 A}{d}$ (M.K.S. system) for the capacitance of a parallel plate air condenser where A is the area of the plate, d is the distance between the plates, ϵ_0 is the absolute permittivity of air.
(b) Define electromotive force (e.m.f.) of a cell.
Describe, with relevant theory, a method of comparing the electromotive force of two cells.

(66 marks)

6. What is meant by the photoelectric effect ? Refer to the significance of (i) photons, (ii) work function, (iii) threshold frequency, in relation to this effect.
Calculate the energy of a photon of ultraviolet light of wavelength 2000Å. (Assume Planck's constant $h = 6{\cdot}62 \times 10^{-34}$ joule-sec., velocity of light = 3×10^8 metres per sec., 1Å = 10^{-10} metre.)
Indicate briefly a method by which Planck's constant, h, may be measured.
'The photoelectric effect may, in a sense, be regarded as the converse of X-ray production.' Discuss this statement.

(66 marks)

7. Discuss the relative merits of direct and alternating current.
Give an account of the principles underlying the operation of (a) a simple alternating current generator, (b) a thermionic diode.
Write a note on the rectification of alternating current.

(67 marks)

8. State Faraday's laws of electrolysis and describe how one of the laws may be tested by experiment.
A silver voltameter and an ammeter are in series and a steady current is passed through the circuit for 30 minutes. 2·35 gms. of silver are deposited in that time. If the ammeter reading is 1·2 amps calculate the error in the ammeter reading. (Assume electrochemical equivalent of silver = 0·001118 gm. per coulomb).
To what extent does Ohm's law apply to the conduction of electricity through (i) electrolytes, (ii) gases at reduced pressures ?

(67 marks)

9. Give a short account of (a) the discovery of the neutron, (b) the nuclear structure of the atom.
'Neutrons, especially slow neutrons, are generally very effective in inducing nuclear transmutations of the elements.' Comment on this statement.
A radioactive isotope, with a relatively short half-life (2 to 3 hours), disintegrates with the emission of beta particles and gamma rays. Indicate briefly how, in the case of this isotope, (i) the half-life may be measured, (ii) the nature of the radiations emitted may be confirmed.

(67 marks)

10. Write brief notes on any two of the following:-
(a) the earth's magnetism,
(b) the structure and optical principles of a telescope,
(c) the Compton effect and pair production,
(d) electromagnetic waves and the electromagnetic spectrum.

(67 marks)