AN ROINN OIDEACHAIS. M.56.

LEAVING CERTIFICATE EXAMINATION, 1964.

PHYSICS—HONOURS

WEDNESDAY, 10th JUNE—Afternoon, 3 to 5.30.

Not more than six questions to be attempted.

1. Define Newton's gravitational constant, G, and describe any method by which it has been measured.

Taking 980 cm. per sec². as the value for the acceleration due to gravity on the earth's surface, calculate the corresponding value for gravity on the surface of a certain planet if the $\frac{\text{radius of earth}}{\text{radius of planet}} = 3$; and if the $\frac{\text{mean density of earth}}{\text{mean density of planet}} = \frac{5}{3}$.

(66 marks.)

OR

1. State the law of conservation of momentum.

A railway truck of mass 10 tons travelling along a horizontal track at 8 ft. per sec. strikes another truck which is travelling at 4 ft. per sec. in the same direction. After coalescing both trucks travel together with a common velocity of 7 ft. per sec. Find (i) the mass of the second truck, (ii) the loss of kinetic energy, in ft. lbs., on impact. If the two trucks experience a resistance to motion of 30 lb. wt. per ton after impact, what distance will the trucks travel before coming to rest ?

(66 marks.)

2. Outline the Kinetic Theory of Gases.

(a) Show how the theory may be used to deduce an expression for the pressure of a gas.

(b) Using the expression deduced in (a), calculate the root mean square velocity of hydrogen molecules at N.T.P. given that the density of hydrogen at N.T.P. is 0·09 gm. per litre, density of mercury = 13·6 gm. per c.c. and g = 980 cm. per sec².

(66 marks.)

3. Give a brief account of the wave nature of sound.

Describe fully how you would measure (i) the wavelength of the sound emitted by a tuning fork, (ii) the velocity of sound in air.

Describe, also, how the velocity of sound in a gaseous medium other than air may be measured.

(66 marks.)

4. Write a note on the electromagnetic spectrum.

Give an account of the propagation of energy by waves, illustrating your answer by particular reference to experiments which demonstrate energy propagation by infra-red radiations and by visible light.

(66 marks.)

OR

4. (a) Derive a formula which expresses the focal length of a convex lens in terms of u, v where u and v represent the distances of object and image from the lens, respectively.

(b) Outline how you would measure the focal length of a thin concave lens using a thin convex lens of greater power.

(c) When an object is placed 15 cm. from a convex lens a real image is formed four times the size of the object. What distance from the lens must the object be placed to give a virtual image three times the size of the object ?

(66 marks.)

5. Define (i) index of refraction, (ii) critical angle.

If the refractive index for air-glass is $\frac{3}{2}$ and for air-water $\frac{4}{3}$, find the critical angle for glass-water.

Derive an expression for the refractive index of glass in terms of the wave theory of light.

Given that the speed of light in air is 3×10^8 metres per sec., calculate the speed of light in glass.

(66 marks.)

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6. Outline the theory and experimental procedure of an interference or diffraction method for measuring the wavelength of sodium light.

Monochromatic light falls normally on a diffraction grating of 6,000 lines per cm. Find the wavelength of the light if the second order diffracted image appears at an angle of 44° 58′ to the incident light. Explain why the third order spectrum of this particular wavelength cannot be observed with this grating.

(66 marks.)

OR

6. (a) Describe, with the aid of a ray-diagram, a simple telescope. Establish an expression for its magnifying power.

(b) Write a note on the dispersion of light by a prism.

(66 marks.)

7. Discuss the process of conduction of an electric current through (a) a metal, (b) an electrolyte, (c) a gas.

Describe how the current varies with the applied potential in each case. Show how the relationship between current and applied potential may be verified experimentally in the case of (a).

(67 marks.)

8. What is a photon ?

Give an account of a photoelectric cell and describe how it works.

What is the relation between photoelectric emission and (i) the frequency, (ii) the intensity, of the incident light ?

How may these relations be justified ?

(67 marks.)

OR

8. Define (a) electric potential, (b) the capacity of a condenser.

Derive an expression for the capacity of a condenser which consists of two concentric spheres, the outer sphere being earthed.

A parallel-plate air condenser consists of two circular plates 1 mm. apart, each 10 cm. in diameter. Calculate (i) the capacity of the condenser, (ii) the energy stored in the condenser when a battery of 200 volts is connected to it.

(In the C.G.S. system 300 volts = 1 e.s.u.; in the M.K.S. system $\epsilon_o = 8{\cdot}85 \times 10^{-12}$)

(67 marks.)

9. Show how X-rays may be produced and state their principal properties.

Distinguish between X-rays and cathode rays.

Calculate the velocity acquired by an electron in a discharge tube when a potential difference of 12,000 volts is applied across the electrodes. (1 e.s.u.= 300 volts; ratio of the charge of an electron to its mass is $5{\cdot}3 \times 10^{17}$ e.s.u.)

(67 marks.)

OR

9. (a) Describe a method for measuring the internal resistance of a cell and give the theory associated with the method.

(b) Two cells each of e.m.f. 1·4 volts and internal resistance of 2 ohms are connected (i) in series, (ii) in parallel. Calculate the current flowing in each case if the external resistance in the circuit is 1 ohm.

(67 marks.)

10. Define (a) magnetic field strength at a point, (b) magnetic meridian.

Establish an expression for (i) the intensity of the magnetic field due to a bar magnet at a point on its axis produced, (ii) the moment of the couple on a magnet in a uniform field.

A magnet of length 10 cm. and pole strength 20 C.G.S. units is free to turn about a vertical axis through its centre. Calculate the couple required to maintain the magnet in a position in which its magnetic axis makes an angle of 30° with the magnetic meridian.

(Horizontal component of the earth's magnetic field = 0·18 oersted.)

(67 marks.)

OR

10. Write brief notes on two of the following:-

(a) Radioactivity and radioactive isotopes,

(b) An alternating current generator,

(c) The determination of $\frac{e}{m}$ for an electron (the ratio of the charge of an electron to its mass).

(67 marks.)