13509

Write your Examination Number here

AN ROINN OIDEACHAIS

LEAVING CERTIFICATE EXAMINATION, 1991

PHYSICS—HIGHER LEVEL

FRIDAY, 14 JUNE—MORNING, 9.30 to 12.30

Answer **all** questions in Section A.

Answer **two** questions from Section B and **three** questions from Section C.

SECTION A (120 marks)

Answer each question in this section.

Each question carries the same number of marks.

Write your answers in the spaces provided.

Write your examination number at the top.

Be sure to return this section of the examination paper, enclosing it in the answer book you use in answering Sections B and C.

1. Answer *five* of the following items, (i), (ii), (iii), etc. In the case of each item write the letter corresponding to the correct answer in the box provided.

(i) When a body is floating partially immersed in a fluid, which of the following statements is *not* correct?

A. The upthrust is equal to the weight of fluid displaced.
B. The density of the fluid is greater than the density of the body.
C. The upthrust is greater than the weight of the body.
D. The volume of the body is greater than the volume of fluid displaced.
E. The weight of the body is equal to the weight of fluid displaced.

Answer ☐ (6)

(ii) When a particle is executing simple harmonic motion its

A. velocity increases as its displacement increases
B. acceleration increases as its velocity increases
C. acceleration increases as its displacement increases
D. velocity is zero when its displacement is zero
E. acceleration is zero when its velocity is zero.

Answer ☐ (6)

(iii) When a small object is placed on the principal axis of a convex mirror the image formed is

A. erect, magnified and virtual
B. inverted, magnified and real
C. inverted, diminished and real
D. erect, magnified and real
E. erect, diminished and virtual.

Answer ☐ (6)

(iv) Monochromatic light falls normally on a diffraction grating. The separation of the images formed by the grating would be decreased by

A. increasing the number of lines/mm on the grating
B. decreasing the wavelength of the light
C. decreasing the distance between the lines on the grating
D. increasing the distance between the grating and the light source
E. decreasing the frequency of the light.

Answer ☐ (6)

(v) The unit of electrochemical equivalent is

A. $C\ kg^{-1}$
B. $A\ s^{-1}\ kg^{-1}$
C. $kg\ A\ s^{-1}$
D. $kg\ A^{-1}\ s$
E. $kg\ C^{-1}$

Answer ☐ (6)

(vi) The peak value of an a.c. voltage is 12 V. The r.m.s. value is

A. $12\sqrt{2}$
B. $\sqrt{12}/2$
C. $12/\sqrt{2}$
D. $\sqrt{6}/2$
E. $6/\sqrt{2}$.

Answer ☐ (6)

2. Answer *five* of the following.

(i) When a satellite is in a circular orbit of radius r about a body of mass M its period is proportional to .... and inversely proportional to .... (6)

(ii) State Avogadro's law. ....

....

.... (6)

(iii) What is the Doppler effect? ....

....

.... (6)

(iv) Fig. 1 shows how the resistance of a certain device varies with its temperature. What type of device is it?

.... (6)

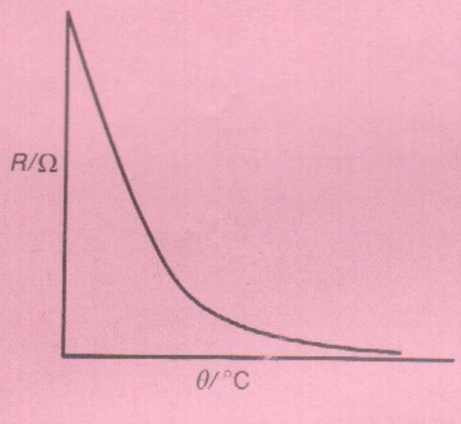

Fig. 1

(v) In a bipolar transistor the .... current is controlled by the .... current. (6)

(vi) The photoelectric effect was discovered by .... in 1887 and was explained by .... in a paper published in 1905. (6)

3. Answer *five* of the following.

(i) Define the unit of energy, i.e. the joule. ....

.... (6)

(ii) A body of mass 4 kg falls through a distance of 5 m. What is the gain in its kinetic energy?

(Take $g = 9{\cdot}8\ \mathrm{m\ s^{-2}}$.) .... (6)

(iii) Give an expression for the relationship between the temperature of a gas and the average kinetic energy

of its molecules. .... (6)

(iv) The energy stored in a charged parallel plate capacitor is equal to half of the product of

.... and .... (6)

(v) What is the energy of an X-ray photon of wavelength $2{\cdot}2 \times 10^{-10}$ m?
(Planck's constant, $h = 6{\cdot}6 \times 10^{-34}$ J s; speed of light in vacuum, $c = 3{\cdot}0 \times 10^{8}\ \mathrm{m\ s^{-1}}$.)

.... (6)

(vi) What is meant by mass-energy conservation in relation to nuclear reactions? ....

....

.... (6)

4. Fig. 2 shows a simple diagram of the structure of a semiconductor diode.
Answer *five* of the following.

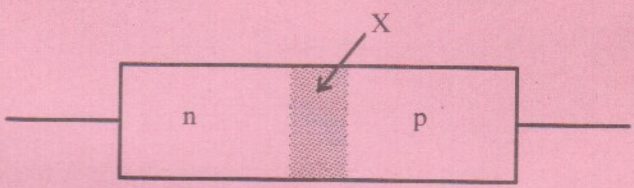

Fig. 2

(i) Indicate on the diagram how a battery would be connected to the diode in order to reverse bias it. (6)

(ii) What is the name given to the area labelled X on the diagram? ....(6)

(iii) How is the area labelled X formed? ....

....

.... (6)

(iv) What is meant by the junction voltage? ....

.... (6)

(v) Indicate on the diagram an area of the diode which has (a) a net positive charge, (b) a net negative charge. (6)

(vi) Give two differences between a light emitting diode (LED) and a photodiode. ....

....

.... (6)

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PHYSICS—HIGHER LEVEL

Section A is on a separate sheet which provides spaces for your answers. The completed sheet should be enclosed in your answer book.
Write your answers to Sections B and C in your answer book.

SECTION B (80 marks)

Answer **two** of the questions from this section.
Each question carries the same number of marks.

5. In an experiment to measure the specific latent heat of vaporisation of water, steam was passed into cold water in a copper calorimeter. The following results were obtained.

Mass of calorimeter	=	52·6 g
Mass of calorimeter + water	=	114·4 g
Temperature of cold water	=	18 °C
Temperature of steam	=	100 °C
Mass of calorimeter + water + steam	=	115·6 g
Final temperature of water	=	29 °C

Given that the specific heat capacity of copper is 390 J kg^{-1} K^{-1} and that the specific heat capacity of water is 4180 J kg^{-1} K^{-1}, calculate the specific latent heat of vaporisation of water. (21)

Draw a labelled diagram of an apparatus which could have been used in this experiment. (9)

Explain why passing more steam into the water might have improved the accuracy of the result. (9)

6. In an experiment to verify Snell's law a block of glass was placed on a sheet of paper as shown in Fig. 3. The angles of incidence, *i*, and refraction, *r*, for a ray of light entering the block were measured and the following results were obtained.

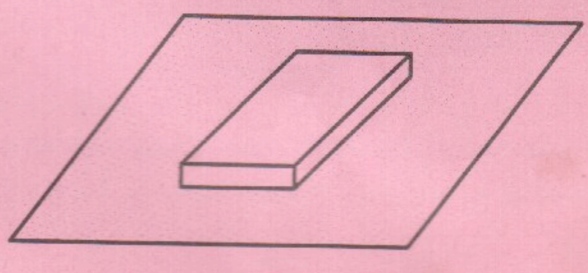

Fig. 3

i/degrees	10	20	30	40	50	60	70	80
r/degrees	8	13	19	26	29	34	39	41

Draw a suitable graph on graph paper and explain how this verifies Snell's law. (18)

From the graph determine the refractive index of the glass. (9)

Describe how the position of the refracted ray might have been determined. (6)

Explain why placing the block on its edge would have given a less accurate result. (6)

7. The following is a student's account of an experiment to determine the resistivity of nichrome.

"The length of the wire was measured and found to be 68·5 cm. The diameter of the wire was measured at five places and the values found were 0·20 mm, 0·21 mm, 0·19 mm, 0·22 mm and 0·21 mm. The resistance of the wire was found to be 26·4 Ω."

Present the measurements given in this account in the form of a table. (6)

Name the instrument normally used to find the diameter of the wire and explain how it is used. (12)

Mention two precautions which should be taken, when determining the length of the wire, to ensure a more accurate result. (6)

Use the data given to calculate the resistivity of nichrome. (15)

SECTION C (200 marks)

Answer **three** questions from this section.

Each question carries the same number of marks.

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8. Define the term coefficient of static friction. (6)

Describe an experiment to verify Newton's second law. (21)

Fig. 4 shows a body of mass 8·4 kg acted on by a force of 48 N at an angle of 25° to the horizontal. The body starts to move over a horizontal surface with an initial acceleration of 2·5 m s^{-2} in the direction shown. Draw a diagram to show all the forces acting on the body. (9)

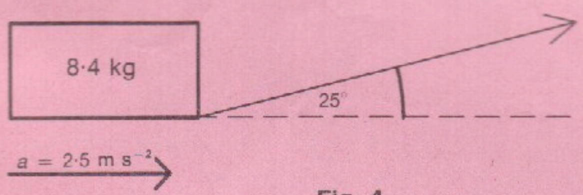

Fig. 4

Calculate the magnitude of (i) the resultant force, (ii) the frictional force, on the body. (15)

Find the value of the coefficient of static friction between the body and the surface. (Take g = 9·8 m s^{-2}.) (15)

9. Explain the term resonance. (6)

Give two characteristics of a musical note. (6)

Describe an experiment to investigate the relationship between the natural frequency of a stretched string and its tension. (18)

Name one other factor, in addition to tension, which determines the natural frequency of a stretched string and give the relationship between the natural frequency and this factor. (9)

What is meant by (i) frequency limits of audibility, (ii) threshold of hearing? (12)

Given that the threshold of hearing at a frequency of 1 kHz is 1×10^{-12} W m^{-2} calculate the intensity level of a sound which has an intensity of 4×10^{-6} W m^{-2}. (15)

10. Define (i) potential difference, (ii) e.m.f. (electromotive force). (12)

Define the ampere, and describe an experiment to illustrate the principle on which this definition is based. (21)

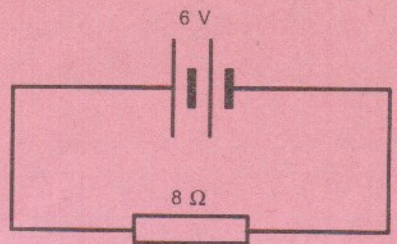

Fig. 5

Fig. 5 shows a circuit consisting of a battery of e.m.f. 6 V and a resistor of resistance 8 Ω. If 80% of the work done by the battery appears as heat in the resistor what is the potential difference across the resistor? (Assume that no forms of energy, other than heat, are involved and that the resistance of the connecting wires is negligible.) (9)

Calculate (i) the current flowing in the circuit, (ii) the internal resistance of the battery, (iii) the rate at which heat is produced in the resistor. (24)

11. Explain what is meant by electromagnetic induction and describe an experiment to demonstrate this phenomenon. (15)

Draw a labelled diagram of an a.c. generator and explain how it works. (18)

Explain the physical principles involved in each of the following.

(i) When a magnet is moved past a sheet of aluminium, the aluminium tends to follow the magnet. (12)

(ii) In a simple d.c. motor the slower the coil turns the larger is the current which flows in it. (9)

(iii) The efficiency of a transformer is improved by laminating the core. (12)

12. Explain the terms (i) radioactivity, (ii) half-life. (12)

Describe an experiment to measure the half-life of a short-lived radioactive isotope. (18)

Explain how the detector used in the experiment works. (9)

A sample of a radioactive gas in a container is found to emit α-particles and to have a half-life of 11·2 days. After a period of several hours the gas in the container is tested and found to contain radon-219.

Write an equation to represent the reaction taking place in the container. (Refer to the Periodic Table of the Elements in the Mathematics Tables, p. 44.) (9)

How might it have been confirmed that the radiation emitted by the substance in the container was α-particles rather than β-particles or γ-rays? (9)

Calculate the decay constant for the isotope. (9)

P.T.O. →

13. Answer any *two* of the following.

(*a*) State the principle of conservation of momentum. (6)

Describe an experiment to verify this principle. (18)

Discuss the application of the principle of conservation of momentum to the collision between a tennis ball and a racquet. (9)

(*b*) Fig. 6 shows a simple diagram representing the electromagnetic spectrum. Name the radiations represented by the regions labelled A, B, C and D. What property is common to all these forms of electromagnetic radiation? (9)

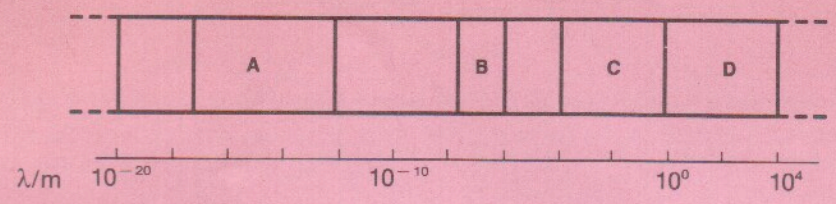

Fig. 6

Outline a terrestrial method for measuring the speed of light. (15)

Name an American physicist who carried out a number of experiments to measure the speed of light and state why it is important that the speed of light be known accurately. (9)

(*c*) Define electric flux. (6)

What is meant by conservation of total electric flux? (6)

Using conservation of flux, or otherwise, show that all the charge on an insulated conductor is on the surface of the conductor and hence that there can be no electric field inside an empty hollow conductor. (18)

Give one practical application of the fact that there can be no electric field inside an empty hollow conductor. (3)

(*d*) Give *two* properties of the electron. (6)

Explain how a beam of electrons may be produced. (12)

A beam of electrons travelling with a speed of $2{\cdot}5 \times 10^{7}$ m s^{-1} enters a magnetic field of uniform magnetic flux density 5·0 mT at right angles to the direction in which the electrons were travelling. Calculate the force on each electron and explain why the electrons follow a circular path in the magnetic field.
(Charge on electron, $e = 1{\cdot}6 \times 10^{-19}$ C.) (15)