Pervil Malone

№ 8476

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Write your Examination Number here

AN ROINN OIDEACHAIS

LEAVING CERTIFICATE EXAMINATION, 1992

PHYSICS — HIGHER LEVEL

THURSDAY, 18 JUNE — AFTERNOON, 2.00 to 5.00

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.

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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) The unit of momentum may be written as

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

Answer ☐ (6)

(ii) The weight of a body on the moon is less than its weight on earth because

A. the radius of the moon is less than the radius of the earth
B. the mass of the body is less on the moon
C. the mass of the moon is less than the mass of the earth
D. there is no atmosphere on the moon
E. the density of the body is less on the moon.

Answer ☐ (6)

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

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

Answer ☐ (6)

(iv) A galvanometer may be converted to

A. a voltmeter by connecting a large resistance in parallel with it
B. an ammeter by connecting a small resistance in series with it
C. an ohmmeter by connecting a battery in parallel with it
D. a voltmeter by connecting a small resistance in series with it
E. an ammeter by connecting a small resistance in parallel with it.

Answer ☐ (6)

(v) Which of the following statements about a transformer is *not* correct?

A. The core is laminated to reduce energy losses.
B. The core is laminated to reduce induced e.m.f.s in the core.
C. The low voltage coil uses thicker wire to reduce energy losses.
D. The core is made of iron to reduce energy losses.
E. The core is laminated to reduce eddy currents.

Answer ☐ (6)

(vi) Fig. 1 shows a simple diagram of the structure of an n-channel unipolar (field effect) transistor. The source, S, is at 0 V. Which of the following statements is correct?

A. X is the drain and has a negative potential.
B. Y is the drain and has a positive potential.
C. X is the gate and has a positive potential.
D. X is the gate and has a negative potential.
E. Y is the gate and has a negative potential.

Answer ☐ (6)

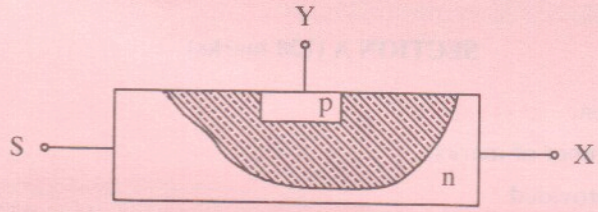

Fig. 1

2. Answer *five* of the following.

(i) What is meant by centripetal force? .....
.....
.....(6)

(ii) State Archimedes' Principle. .....
.....
.....(6)

(iii) The angle of dip is the angle between the .....
and the .....(6)

(iv) Give the principle on which the operation of an electromagnetic relay is based. .....
.....(6)

(v) Give one development with which Nicholas Callan was associated. .....
.....(6)

(vi) What is the function of the grid in a cathode ray oscilloscope? .....
.....(6)

3. Answer *five* of the following.

(i) What is meant by the period of a simple harmonic motion? .....

.....

.....(6)

(ii) The solar constant is 1.35 kW m^{-2}. What is the average amount of energy falling on each square metre of the earth's atmosphere in one year? (One year = 3.16×10^7 s.) .....

..... (6)

(iii) The unit of frequency is the ..... What is the relationship between this unit and the second? .....(6)

(iv) Give an expression for Joule's law. .....(6)

(v) Calculate the time taken by a constant current of 0.40 A to deposit 0.16 g of copper in a copper voltameter. (Electrochemical equivalent of copper = 3.3×10^{-7} kg C^{-1}.) .....

.....(6)

(vi) What is meant by the half-life of a radioactive isotope? .....

.....(6)

4. Answer *five* of the following.

(i) Define the unit of charge, i.e. the coulomb. .....

.....(6)

(ii) Give an expression for Coulomb's law of force between electric charges. .....

.....(6)

(iii) Define electric field intensity. .....

.....(6)

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

.....

.....(6)

(v) Give one practical application of point discharge. .....

.....

.....(6)

(vi) The equation $C = \varepsilon_0 A/d$ is an expression for .....

.....

ε_0 is called the .....(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. The following is part of a student's account of an experiment to verify the parallelogram law.

"The apparatus was set up as shown in the diagram. When the system was in equilibrium the magnitudes and directions of the three forces were noted. The magnitudes of the forces were 2.4 N, 2.9 N and 3.3 N. The angles between the forces were 103°, 121° and 136°, as shown in the diagram (Fig. 2)."

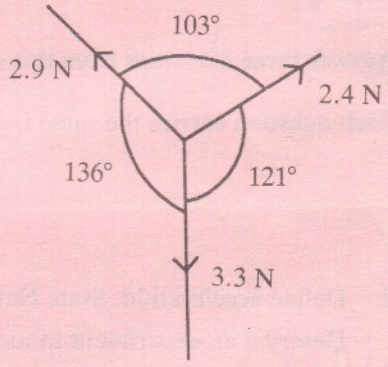

Fig. 2

Describe, with the aid of a diagram, the apparatus which might have been used in this experiment. (9)

Describe the procedure involved in obtaining the diagram shown in Fig. 2. (9)

Explain, either by drawing or by calculation, how the results obtained in this experiment verify the parallelogram law. (15)

Give one precaution which might have been taken to ensure a more accurate result. (6)

6. The following measurements were obtained in an experiment to compare the specific heat capacities of water and aluminium.

Mass of calorimeter	= 26.5 g
Mass of calorimeter + water	= 71.3 g
Temperature of calorimeter + cold water	= 16 °C
Mass of aluminium	= 14.7 g
Temperature of hot aluminium	= 100 °C
Final temperature of calorimeter + water + aluminium	= 21 °C

Given that the calorimeter was made of aluminium calculate the ratio of the specific heat capacity of water to that of aluminium. (21)

Describe how the aluminium might have been heated to 100 °C. (9)

Explain how using a larger mass of aluminium would have improved the accuracy of the final result. (9)

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7. In an experiment to investigate the variation of the resistance of a wire with temperature the following results were obtained.

θ/°C	20	30	40	50	60	70	80	90	100
R/Ω	4.4	4.6	4.7	4.8	5.0	5.1	5.3	5.6	5.7

Draw a suitable graph on graph paper to show how the resistance of the wire varies with its temperature. (12)

From the graph determine (i) the resistance of the wire at 0 °C, (ii) the change in resistance of the wire per degree rise in temperature. (12)

Explain how the resistance and temperature might have been measured. (9)

Why would it have been important to heat the wire slowly? (6)

SECTION C (200 marks)

Answer **three** questions from this section.

Each question carries the same number of marks.

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8. Define acceleration. State Newton's second law of motion. (9)

Describe an experiment to measure the acceleration of a body. (15)

A body starts with an initial velocity u and constant acceleration a. Derive an expression for its displacement after time t in terms of u and a. (12)

A body of mass 2.0 kg is thrown upwards with an initial velocity u from a point P which is 14 m above the ground. After 2.8 s it is at a point Q and its velocity is 18 m s^{-1} downwards. Find the value of u and the height of Q above the ground. (15)

A constant upward force, F, is applied to the body at Q and the body comes to rest just before it reaches the ground. Calculate the value of F. (Take g = 9.8 m s^{-2}.) (15)

9. What is meant by (i) thermometric property, (ii) ideal gas? (12)

Draw a labelled diagram of a constant volume gas thermometer. (12)

Name one type of thermometer, other than a gas thermometer, and describe an experiment to calibrate it. State clearly the thermometric property on which the thermometer is based. (18)

Explain why it is necessary to have a standard thermometer and state why the constant volume gas thermometer is used as the standard thermometer. (12)

Explain how Boyle's law is used in the definition of the Kelvin scale of temperature. (12)

David Malone

10. (*a*) State the laws of refraction of light. (6)

Describe an experiment to measure the refractive index of a liquid *or* a solid. (15)

Draw a ray diagram to show how the final image is formed in an astronomical telescope in normal adjustment. (12)

(*b*) Explain the terms (i) diffraction, (ii) interference. (12)

When a narrow beam of white light is passed normally through a diffraction grating a number of spectra are formed. Explain:

(i) how a spectrum is formed by a diffraction grating; (9)

(ii) why a number of spectra are formed; (6)

(iii) why no spectrum is formed directly opposite the grating. (6)

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

Outline the principles on which a potentiometer is based. (12)

Describe an experiment, using a potentiometer or otherwise, to measure the internal resistance of a cell. (18)

The current flowing from A to B through the 3 Ω resistor in the circuit shown in Fig. 3 is 0.125 A. Use Kirchhoff's laws to calculate the e.m.f., E, of the battery. Assume that the internal resistances of the batteries are negligible. (24)

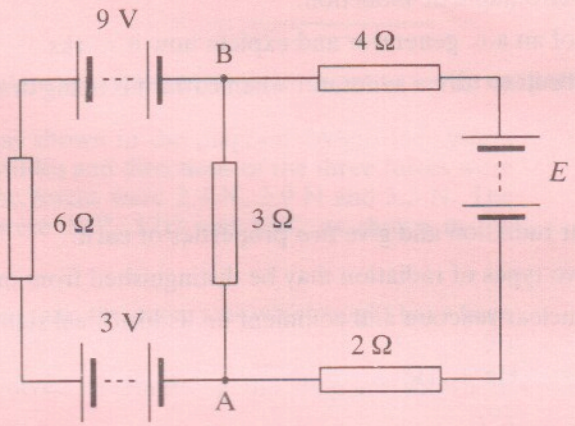

Fig. 3

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

Outline the principle of an experiment to determine the charge to mass ratio (e/m) for the electron. (12)

Discuss the role of electrons in (i) an X-ray tube, (ii) a photodiode. (15)

Fig. 4 shows a light controlled switch. While light falls on the CdS cell the light-emitting diode (LED) is off. While the CdS cell is in darkness the LED is on. Explain why the LED comes on when no light falls on the CdS cell and give one use of this type of circuit. (15)

Light of wavelength 420 nm falls on a metal which has a work function of 1.9 eV. What is the maximum kinetic energy of the electrons emitted from the metal? (Charge on electron, $e = 1.6 \times 10^{-19}$ C; Planck's constant, $h = 6.6 \times 10^{-34}$ J s; speed of light in vacuum, $c = 3.0 \times 10^{8}$ m s^{-1}.) (18)

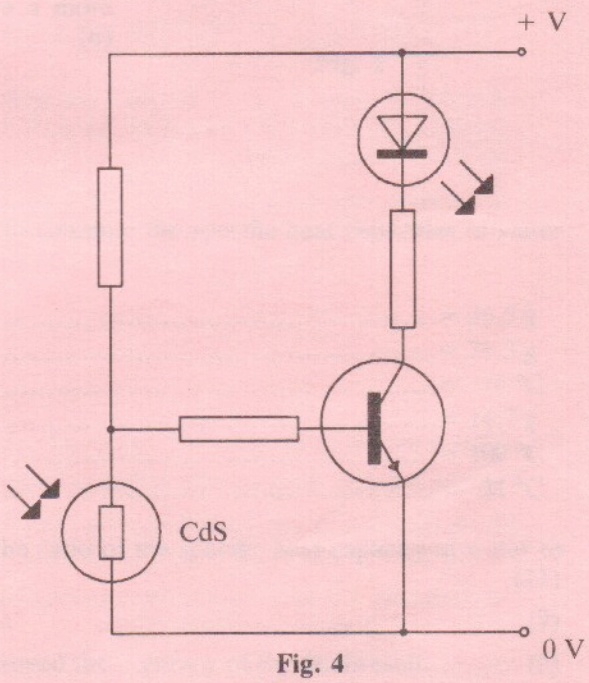

Fig. 4

13. Answer any *two* of the following.

(*a*) What is meant by the term limiting friction? (6)

Describe an experiment to measure the coefficient of dynamic friction. (15)

Discuss, with the use of two examples, the importance of friction in everyday life. Give one method of reducing friction between two surfaces. (12)

(*b*) Define the terms (i) sound intensity, (ii) threshold of hearing. (12)

Sound is emitted from a source, S (Fig. 5), at a rate of 2.6 W. Assuming that the sound is emitted equally in all directions and that no sound is absorbed or reflected, calculate the sound intensity at points a distance of 8.6 m from S. (12)

What is the intensity level at these points?
(Threshold of hearing = 1.0×10^{-12} W m^{-2}.) (9)

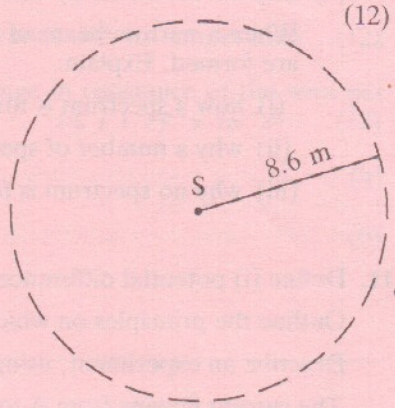

Fig. 5

(*c*) State Faraday's law of electromagnetic induction. (6)

Draw a labelled diagram of an a.c. generator and explain how it works. (21)

Explain why it is more difficult to turn a generator when current is being drawn from it than when no current is being drawn. (6)

(*d*) Name *two* types of nuclear radiation and give *two* properties of each. (12)

Outline briefly how the two types of radiation may be distinguished from one another experimentally. (9)

Complete the following nuclear reaction and comment on its historical significance.

$$^{7}_{3}\text{Li} + \quad \longrightarrow \quad ^{4}_{2}\text{He} + ^{4}_{2}\text{He}$$

(12)