Ph 003

LEAVING CERTIFICATE EXAMINATION, SAMPLE PAPER

PHYSICS - HIGHER LEVEL

TIME: 3 HOURS

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) The work done in kJ, taking 'g' to be 10 ms^{-2}, when an object of mass 100 kg is dropped through a distance of 5 m is

A. 0·05
B. 5
C. 20
D. 105
E. 5000.

Answer ☐ (6)

(ii) Which of the following sources is associated with a line emission spectrum?

A. An electric fire.
B. A sodium street lamp.
C. A red traffic light.
D. A fluorescent lamp.
E. A tungsten filament lamp.

Answer ☐ (6)

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

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

Answer ☐ (6)

(iv) If the three kinds of nuclear radiation are arranged in decreasing order of penetrating power, the order is

A. alpha, beta, gamma
B. beta, alpha, gamma
C. gamma, beta, alpha
D. gamma, alpha, beta
E. alpha, gamma, beta.

Answer ☐ (6)

(v) Two capacitors, of 6 μF and 4 μF are connected across a 12 V supply as shown in Fig. 1. The potential difference across the 4 μF capacitor is

A. 4·8 V
B. 7·2 V
C. 12 V
D. 6 V
E. 4 V

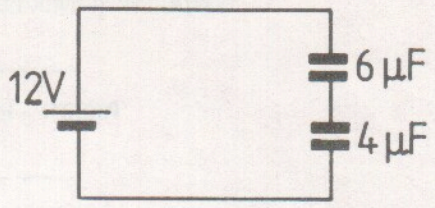

Fig. 1

Answer ☐ (6)

(vi) A transistor radio was placed in a glass container. When all the air was then removed from the container the radio was not heard because

A. radio waves cannot pass through a vacuum
B. sound waves require a medium
C. transistor circuits will not function in a vacuum
D. the lack of pressure prevented the loudspeaker of the radio from moving
E. the glass absorbed all the sound emitted.

Answer ☐ (6)

2. Answer **five** of the following.

(i) Give two of the basic assumptions of the kinetic theory of gases . . . . . .

. . . . . .

(6)

(ii) What property distinguishes transverse waves from longitudinal waves? . . . . . .

. . . . . .

(6)

(iii) As the source of a note moves towards an observer, the pitch of the note.....

(6)

(iv) Why does a charged particle, travelling at right angles to a magnetic field of uniform magnetic flux density, follow a circular path? . . . . . .

(6)

(v) In an n-channel field effect transistor the flow of current from source to drain is controlled by . .

. . . . . .

(6)

(vi) Complete the following nuclear reaction

$$^{3}_{1}H + ^{2}_{1}H \longrightarrow ^{4}_{2}He +$$

(6)

3. Answer **five** of the following.

(i) Give two properties of the electron. . . . . .

. . . . . .

(6)

(ii) Explain the term thermionic emission. . . . . .

. . . . . (6)

(iii) What happens when high speed electrons collide with a metal target? . . . . . .

. . . . . (6)

(iv) Give the function of the grid in a cathode ray tube. . . . . .

. . . . . (6)

(v) What is a photon? . . . . . (6)

(vi) When does light, incident on a metal surface cause electrons to be emitted? . . . . . .

. . . . . (6)

4. An induction coil is shown in Fig. 2. Answer five of the following.

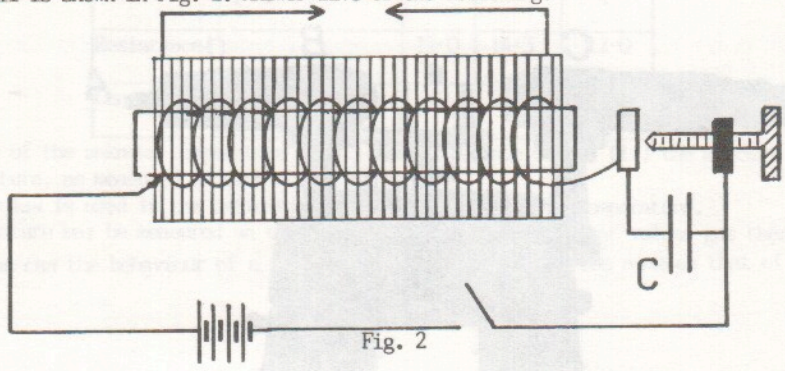

Fig. 2

(i) State the principle on which the induction coil is based. . . . . .

. . . . . (6)

(ii) Why is the core normally laminated? . . . . . .

. . . . . (6)

(iii) State one difference between the primary and secondary coils. . . . . .

. . . . . (6)

(iv) What is the purpose of the capacitor, C? . . . . . .

. . . . . (6)

(v) What is meant by "back e.m.f."? . . . . . .

. . . . . (6)

(vi) Name the Irish scientist who invented an induction coil. . . . . .

. . . . . (6)

SECTION B (80 marks)

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

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5. The following results were obtained by a student in an experiment to measure, g, the acceleration due to gravity using a simple pendulum.

Length/m	0·2	0·4	0·6	0·8	1·0	1·2	1·4	1·6
Time for 30 oscillations/s	27·0	37·8	46·5	53·7	60·6	66·0	70·8	76·4

Draw a suitable graph and hence determine the value of g. (24)
(i) Why should the amplitude of the oscillations be kept small? (6)
(ii) As the length of the pendulum was increased the number of oscillations timed could have been reduced. Explain. (9)

6. From the photograph of the spectrometer, Fig. 3, identify the parts labelled A, B and C. (9)

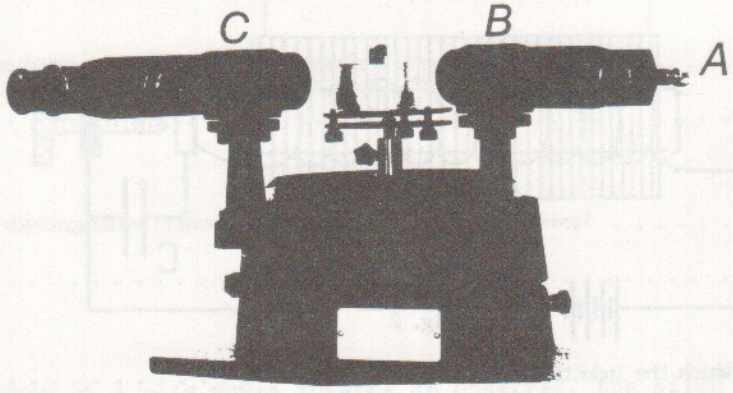

Fig. 3

If you were carrying out an experiment to measure the wavelength of monochromatic light using a spectrometer what step(s) would you take in each of the following cases ?

(a) If the images seen in the telescope were very faint. (3)
(b) If the cross wires were unclear. (3)
(c) If the images on one side were above the centre of the eyepiece. (3)
In using a spectrometer to measure the wavelength of sodium light with a diffraction grating which had 500 lines per mm the following readings were noted for the positions of the images – 243° 30'; 217° 15'; 200°; 182° 45' and 163° 30'.
(i) One of the angles was read wrongly. Which one was it? Give the reason for your answer. (9)
(ii) Calculate the wavelength of the light used. (12)

7. In an experiment to measure the resistivity of nichrome the following readings were obtained for a wire sample.

Resistance of wire/Ω	6				
Length of wire/cm	78·4				
Micrometer readings/mm	0·45	0·44	0·46	0·44	0·43

(i) If the reading on the micrometer when it was fully closed was 0·02 mm calculate the average diameter of the wire. (9)
(ii) Give two precautions which should have been taken when measuring the length of the wire. (6)
(iii) Use the data above to calculate the resistivity of nichrome. (12)
(iv) How can you tell from the data given in the table that the resistance measurement is the least precise? (6)
(v) Why should the current be kept low when measuring the resistance of the wire? (6)

SECTION C (200 marks)

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

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8. State Newton's second law of motion. (6)
What is meant by limiting friction? (9)
Describe an experiment to verify Newton's second law of motion. Explain how the effect of friction might be overcome in this experiment. (33)
A force of 6 N is applied to a block of mass 4·4 kg which is at rest. If the block starts off with an initial acceleration of 0·5 ms^{-2}, calculate the coefficient of static friction between the block and the surface on which it was at rest. (Take g = 9·8 ms^{-2}) (18)

9. What is meant by (i) thermometric property, (ii) ideal gas? (12)
How is temperature defined on a Celsius scale? (6)
Two methods were used to find the temperature of a liquid. The following table shows the readings obtained when a length of wire and a tube containing a column of mercury were inserted in (i) melting ice, (ii) steam, (iii) a liquid at an unknown temperature.

Thermometric property	ice	steam	liquid
Resistance/Ω	11·0	14·3	12·0
Length of mercury column/mm	40	240	100

Calculate the value of the unknown temperature on (i) the resistance scale, (ii) the mercury scale.
Why is the temperature, as measured on each scale, different? (18)
Explain how Boyle's law is used in the definition of the Kelvin scale of temperature. (12)
Describe how temperature may be measured on the Kelvin scale using a constant volume gas thermometer. (12)
Under what condition can the behaviour of a real gas be considered to be the same as that of the ideal gas? (6)

10. Explain the terms: refractive index; total internal reflection. (12)
Describe an experiment to measure the refractive index of a liquid. (15)
Use a ray diagram to show that light may be reflected through 180° by a triangular prism. Calculate the minimum value for the refractive index of the material of the prism for this to occur (18)

What are optical fibres? Explain how light is transmitted along such fibres and give two uses of them. (21)

11. Write a brief note on the part played by Ampere in showing the magnetic effect of an electric current. (9)
Describe, using a diagram, the structure and operation of a moving coil loudspeaker. (18)
What is the principle on which the moving-coil galvanometer is based? (9)
Show by means of a circuit diagram how a galvanometer can be converted to (i) an ammeter, (ii) a voltmeter. (12)
A galvanometer has a resistance of 100 Ω and gives a full scale deflection for a current of 50 uA.
Calculate the resistance required in order to convert it to (i) an ammeter reading up to 1 mA, (ii) a voltmeter reading up to 0·5 V. (18)

12. What is a semiconductor? (6)
Explain the terms: intrinsic conduction; doping. (12)
Fig. 4 represents a junction diode.
Describe what happens when a potential difference is applied across the junction, (i) when A is positive, (ii) when A is negative, with respect to B. (18)

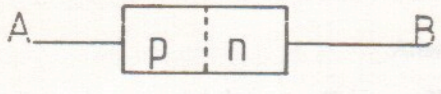

Fig. 4

Explain why P and Q in Fig. 5 are at approximately the same potential. (9)

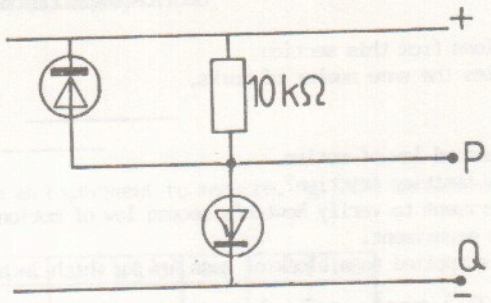

Fig. 5

When a relay is switched using a transistor, a diode is usually connected across the relay.
(i) Draw a circuit diagram to show the way in which the diode should be connected.
(ii) Explain the function of the diode in the circuit. (21)

13. Answer any **two** of the following.

(a) Define (i) specific heat capacity, (ii) specific latent heat of vaporisation. (12)
Assuming that 80% of the electrical energy is used to heat the water, calculate the time taken by a 2 kW kettle to convert 1 kg of water at 10° C into steam at 100° C. (Specific heat capacity of water = 4200 J kg^{-1} K^{-1}; specific latent heat of vaporisation of water = $2{\cdot}3 \times 10^6$ J kg^{-1}.) (21)

(b) What is an electric field? (12)
Describe a laboratory experiment to demonstrate the existence of an electric field.
Derive an expression for the electric field intensity at a point due to an isolated charge in terms of the charge and the distance from the charge. (9)
Show that the field outside a charged spherical conductor behaves as if the charge were concentrated at its centre. (12)

(c) State Kirchhoff's laws. (12)

Two batteries of e.m.f. 3 V and 6 V have internal resistances of 1 Ω and 2 Ω respectively **and are connected as shown in Fig. 6.** Calculate the current in the 10 Ω resistor. (21)

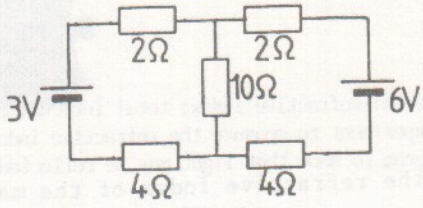

Fig. 6

(d) The following is an extract of a letter sent by Albert Einstein to President Roosevelt on August 2, 1939.

"Sir,
Some recent work by E. Fermi and L Szilard, which has been communicated to me in manuscript leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. . . . . .
In the course of the last four months it has been made probable - through the work of Joliot in France as well as Fermi and Szilard in America - that it may become possible to set up nuclear chain reactions in a large piece of uranium, by which vast amounts of power and large quantities of new radium-like elements would be generated. Now it appears almost certain that this could be achieved in the immediate future.
This new phenomenon would also lead....."

Having read the above paragraphs answer the following questions.

(i) What is the "new phenomenon" called? (6)
(ii) How would you account for the release of "vast amounts of power" from uranium? (12)
(iii) What is meant by "radium-like" elements? Describe briefly how a substance may be checked for the presence of "radium-like" elements. (15)