WARNING: You must return this section with your answer-book otherwise marks will be lost.

Write Your Examination Number here

AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA

LEAVING CERTIFICATE EXAMINATION, 1999

PHYSICS — ORDINARY LEVEL

MONDAY, 21 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) A train travels from Galway to Dublin in a time of 2.5 hours. If the distance between Galway and Dublin is 215 kilometres, what is the average speed of the train in kilometres per hour?

A. 21.5
B. 53
C. 86
D. 215
E. 537.5

Answer ☐ (6)

(ii) The diagram (Fig. 1) shows a uniform metre stick which is balanced with a body of mass 2 kg at the 20 cm position. What is the position of the body of mass 4 kg?

A. 55 cm
B. 65 cm
C. 70 cm
D. 85 cm
E. 90 cm

Answer ☐ (6)

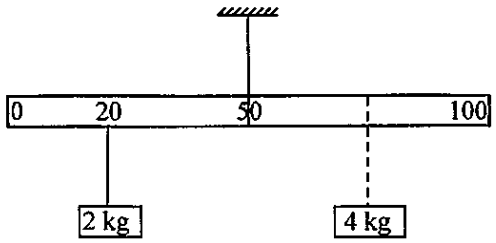

Fig. 1

(iii) Fig. 2 shows a ray of light being reflected by a plane mirror. What is the angle of reflection?

A. 30°
B. 60°
C. 90°
D. 120°
E. 150°

Answer ☐ (6)

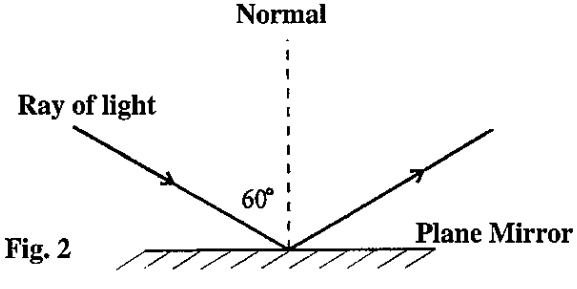

Fig. 2

(iv) Three beams of light are incident on a white screen (Fig. 3). What colour will be seen at X?

A. magenta
B. cyan
C. white
D. yellow
E. green.

Answer ☐ (6)

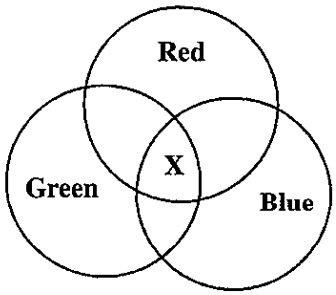

Fig. 3

(v) What is the effective resistance of the three resistors shown in Fig. 4?

A. ⅙ Ω
B. ⅓ Ω
C. ½ Ω
D. 2 Ω
E. 6 Ω

Answer ☐ (6)

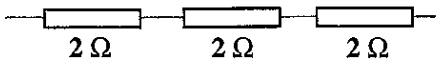

Fig. 4

(vi) Isotopes are atoms which

A. have the same number of protons and neutrons
B. have the same number of protons but different numbers of neutrons
C. have the same number of neutrons and protons but different numbers of electrons
D. have the same number of neutrons and electrons but different numbers of protons
E. have the same number of electrons but different numbers of neutrons and protons.

Answer ☐ (6)

2. Answer *five* of the following.

(i) Give an example of a thermometric property ..... (6)

(ii) Give a reason why the atmospheric pressure is less on top of a mountain than at sea level.

.....

..... (6)

(iii) Give an everyday example of friction ..... (6)

(iv) State a factor on which the capacitance of a parallel-plate capacitor depends.

..... (6)

(v) On the Kelvin temperature scale 273 K is equal to .....on the Celsius scale. (6)

(vi) Ohm's law states that the ..... in a conductor is proportional to the

..... between the ends of the conductor provided that the temperature of the conductor does not change. (6)

3. Answer *five* of the following.

(i) Reflection is a phenomenon shown by waves. Give two other phenomena shown by waves.

(*a*) .....

(*b*) ..... (6)

(ii) Give an equation to show the relationship between the velocity, the frequency and the wavelength, of a wave.

..... (6)

(iii) Show on the diagram, Fig. 5, the amplitude of the wave. (6)

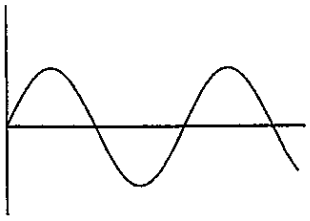

Fig. 5

(iv) State one difference between sound waves and light waves.

..... (6)

(v) Give an example of resonance.

.....

..... (6)

(vi) Give an example of the Doppler effect.

..... (6)

4. Answer *five* of the following.

(i) Give two properties of electrons.

(*a*) .....

(*b*) ..... (6)

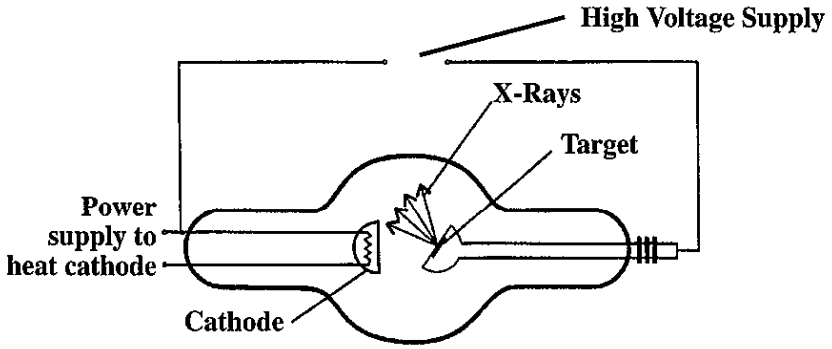

Fig. 6: X-Ray Tube

(ii) Name the process by which the electrons are produced at the cathode in Fig. 6.

..... (6)

(iii) Why does the target in Fig. 6 get hot when the X-ray tube is in operation?

..... (6)

(iv) What is the function of the high voltage supply in Fig. 6?

..... (6)

(v) Give one use of X-rays.

.....(6)

(vi) Name another piece of apparatus which uses a beam of electrons.

.....(6)

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PHYSICS — ORDINARY 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 (82 marks)

Answer **two** of the questions from this section.

Each question carries the same number of marks.

5. In an experiment to investigate Snell's law of refraction a student measured the angles of incidence and of refraction.

(i) Explain, with the help of a diagram, how the incident ray and the refracted ray could have been obtained in the experiment. (15)

(ii) Show in the diagram the angle of incidence and the angle of refraction. (8)

(iii) In order to verify Snell's law the student plotted a graph similar to the one shown in Fig. 7.

(*a*) Name the two quantities which the student plotted on the graph. (12)

(*b*) What does this graph tell you about the relationship between the two quantities? (6)

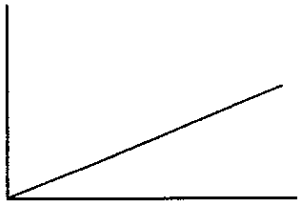

Fig. 7

6. In a report of an experiment to compare the specific heat capacities of water and of copper a student wrote the following.

"The test-tube containing copper rivets at a temperature of 100 °C was emptied into the cold water in the copper calorimeter and the highest temperature reached by the water was noted. The following were the measurements obtained in the experiment."

Mass of copper rivets...	9.8 g
Mass of empty calorimeter	60 g
Mass of calorimeter and cold water	98.6 g
Initial temperature of hot copper rivets	100 °C
Initial temperature of calorimeter and cold water	16.2 °C
Final temperature of calorimeter, rivets and water... ...	23.8 °C

(i) How might the rivets have been heated to 100 °C? (9)

(ii) Calculate: (*a*) the mass of the cold water;
(*b*) the fall in temperature of the copper rivets;
(*c*) the rise in temperature of the water and the calorimeter. (9)

(iii) State one possible source of error in the experiment. (6)

The specific heat capacity of copper is 3.9×10^2 J kg^{-1} K^{-1}, and the specific heat capacity of water is 4.2×10^3 J kg^{-1} K^{-1}. Calculate the quantity of heat

(i) lost by the copper rivets; (9)

(ii) gained by the cold water. (8)

7. The apparatus shown in Fig. 8 was used in an experiment to investigate how the resistance of a length of wire varied with temperature.

(i) Name the part labelled **X**. What is measured with **X**? (6)

(ii) Name the part labelled **Y**. (6)

(iii) Name a liquid which could be used as the liquid **Z**. (5)

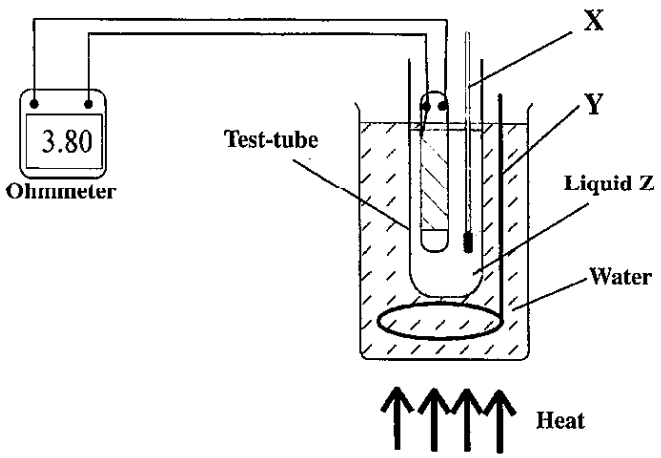

Fig. 8

(iv) The table below shows how the resistance of the wire varied with temperature.

Temperature in °C	20	40	60	80	100
Resistance in ohms	3.5	4.3	5.0	5.9	6.8

Use the data in the table to draw a graph of resistance against temperature. (18)

Use the graph to estimate the temperature of the wire when the reading on the ohmmeter is as shown in Fig. 8. (6)

SECTION C (198 marks)

Answer **three** questions from this section.

Each question carries the same number of marks.

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8. State Newton's Universal Law of Gravitation. (9)

The acceleration due to gravity at the surface of the earth is given by $g = GM/r^2$, where G is the universal constant of gravitation. What do the letters M and r represent in the equation? (12)

Describe an experiment to measure the acceleration due to gravity, g. (24)

An object is dropped from a height of 12 metres above the ground. If the object is initially at rest calculate

(i) the time which the object will take to reach the ground; (12)

(ii) the speed of the object just before it hits the ground. (9)

(Take $g = 9.8\ \text{m s}^{-2}$.)

9. Draw a ray diagram to show the formation of (i) a real image, (ii) a virtual image, by a concave mirror. (18)

Describe an experiment to measure the focal length of a concave mirror. (21)

An object is placed 35 cm in front of a concave mirror of focal length 20 cm. Find (i) the position, (ii) the magnification, of the image formed. (15)

Give a use of (i) a concave mirror, (ii) a convex mirror. (12)

10. (*a*) Draw a labelled diagram of an electroscope and give a use which can be made of the electroscope. (12)

Describe an experiment to show that like charges repel each other. (15)

Fig. 9 shows a positively charged sphere and a negatively charged sphere.

Copy the diagram and show on it the electric field pattern, including the direction of the field, around the spheres. (6)

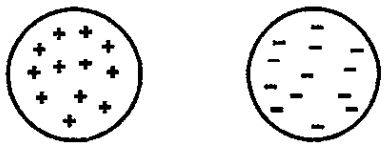

Fig. 9

(*b*) What is an electrolyte? (6)

Describe an experiment to measure the electrochemical equivalent of an element, e.g. copper. (21)

Give one application of electrolysis. (6)

11. What is meant by electromagnetic induction? (9)

State Faraday's law of electromagnetic induction. (9)

Explain how you would use the apparatus shown in Fig. 10 to demonstrate Faraday's law of electromagnetic induction. (12)

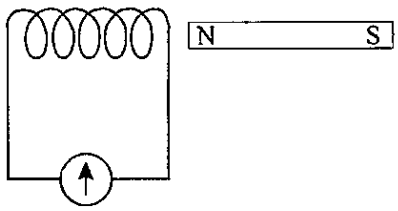

Fig. 10

The induction coil (Fig. 11) is based on electromagnetic induction.

(i) State the purpose for which an induction coil is used. (6)

(ii) Coil **A** is connected to the battery. Name coil **A**. (6)

(iii) Coil **B** is connected to **D**. Name coil **B**. (6)

(iv) Name part **C**. (6)

(v) What happens at **D** when the induction coil is working? (6)

Name another device which is based on electromagnetic induction. (6)

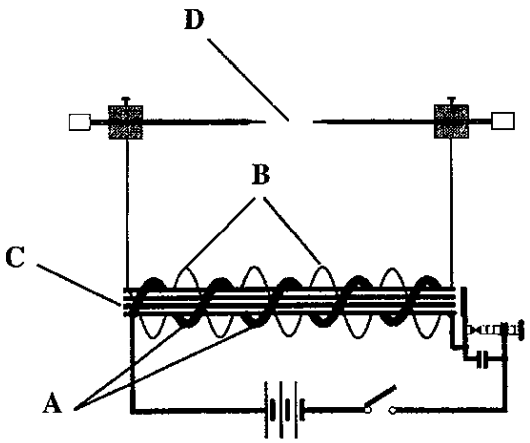

Fig. 11

12. (*a*) What is a semiconductor? (9)

Fig. 12 shows the circuit symbols for two semiconductor devices, A and B.

Name each of the devices in Fig. 12. (12)

State the function of each of the devices. (12)

Fig. 12

(*b*) What is meant by radioactivity? (6)

Name three types of radiation emitted by radioactive substances.

State the nature of each of the radiations. (18)

Which of the three radiations:

(i) causes most ionisation;

(ii) causes least ionisation;

(iii) has the greatest range in air? (9)

13. Answer any *two* of the following.

(*a*) State what is meant by (i) energy, (ii) power. Give the unit in which each is measured. (18)

A car of mass 1000 kg, starting from rest, increases its velocity to 15 m s^{-1} over a time of 5 seconds. Calculate:

(i) the kinetic energy of the car at the end of the 5 seconds; (9)

(ii) the average power generated in giving the car this velocity over this time. (6)

(*b*) According to Boyle's law, the pressure of a fixed mass of a gas is inversely proportional to its volume, provided that the temperature of the gas remains constant. Write down an equation for this law. (6)

Draw a labelled diagram of the apparatus which you would use to verify Boyle's law. (9)

What measurements would you take in an experiment to verify Boyle's law? (9)

How would you use these measurements to verify Boyle's law? (9)

(*c*) The natural frequency of vibration of a stretched string depends on the tension in the string and also the length of the string.

(i) How would you change the tension in the string? (6)

(ii) How would you expect the natural frequency of vibration of the string to change as you increase the tension, while keeping the length the same? (6)

(iii) How would you expect the natural frequency of vibration of the string to change as you increase the length, while keeping the tension the same? (6)

(iv) Give an everyday example of vibration in a string. (6)

(v) Explain how you would find the natural frequency of vibration of the string. (9)

(*d*) Fig. 13 shows a loudspeaker.

(i) Name the parts labelled A, B, C. (18)

(ii) Explain how the loudspeaker produces sound when a changing current is passed through B. (15)

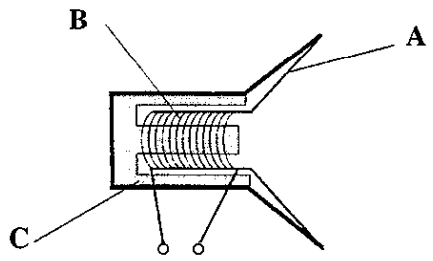

Fig. 13