



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION 2006

PHYSICS – ORDINARY LEVEL

MONDAY, 19 JUNE – MORNING 9:30 TO 12:30

Answer **three** questions from **section A** and **five** questions from **section B**.

SECTION A (120 marks)

Answer **three** questions from this section.

Each question carries 40 marks.

1. In a report of an experiment to verify the principle of conservation of momentum, a student wrote the following:

I assembled the apparatus needed for the experiment. During the experiment I recorded the mass of the trolleys and I took measurements to calculate their velocities. I then used this data to verify the principle of conservation of momentum.

- (i) Draw a labelled diagram of the apparatus used in the experiment. (12)
- (ii) How did the student measure the mass of the trolleys? (6)
- (iii) Explain how the student calculated the velocity of the trolleys. (9)
- (iv) How did the student determine the momentum of the trolleys? (6)
- (v) How did the student verify the principle of conservation of momentum? (7)

2. A student carried out an experiment to verify Snell's law of refraction by measuring the angle of incidence i and the angle of refraction r for a ray of light entering a glass block. The student repeated this procedure two more times. The data recorded by the student is shown in the table.

- (i) Draw a labelled diagram of the apparatus used in the experiment. (12)
- (ii) Describe how the student found the position of the refracted ray. (9)
- (iii) How did the student measure the angle of refraction? (4)
- (iv) Copy this table and complete it in your answerbook. (9)

angle of incidence i	angle of refraction r	$\sin i$	$\sin r$	$\frac{\sin i}{\sin r}$
30°	19°			
45°	28°			
65°	37°			

- (v) Use the data to verify Snell's law of refraction. (6)

3. A student carried out an experiment to investigate how the fundamental frequency of a stretched string varied with its length. The following is an extract from her report.

I set the string vibrating and adjusted its length until it was vibrating at its fundamental frequency. I then recorded the length of the vibrating string and its fundamental frequency. I repeated this procedure for different lengths of the stretched string. Finally, I plotted a graph of the fundamental frequency of the vibrating string against the inverse of its length.

- (i) Draw a labelled diagram of the apparatus used in the experiment. (12)
- (ii) Indicate on your diagram the length of the string that was measured. (6)
- (iii) Describe how the student set the string vibrating. (7)
- (iv) How did the student know that the string was vibrating at its fundamental frequency? (6)
- (v) Draw a sketch of the graph expected in this experiment. (9)

4. In an experiment to investigate the variation of resistance with temperature for a metallic conductor in the form of a wire, a student measured the resistance of the conductor at different temperatures. The table shows the measurements recorded by the student.

Temperature/ $^{\circ}\text{C}$	20	30	40	50	60	70	80
Resistance/ Ω	45.6	49.2	52.8	57.6	60.0	63.6	68.4

- (i) How did the student measure the resistance of the wire? (6)
 - (ii) Describe, with the aid of a diagram, how the student varied the temperature of the wire. (9)
 - (iii) Using the data in the table, draw a graph on graph paper of the resistance of the conductor against its temperature. Put temperature on the horizontal axis (X-axis). (12)
 - (iv) Use the graph to estimate the temperature of the conductor when its resistance is $50\ \Omega$. (7)
 - (v) What does your graph tell you about the relationship between the resistance of a metallic conductor and its temperature? (6)
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SECTION B (280 marks)

Answer **five** questions from this section.

Each question carries 56 marks.

5. Answer any **eight** of the following parts (a), (b), (c), etc.

- (a) A person pushed a car a distance of 15 m with a force of 500 N. Calculate the work done by the person. (7)

$$(W = Fs)$$

- (b) Which one of the following instruments can be used to measured the density of a liquid?

barometer

hydrometer

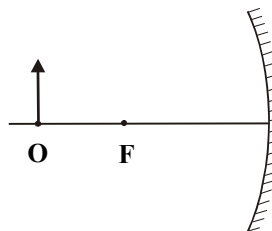
thermometer

(7)

- (c) What is friction? (7)

- (d) Give one example of a thermometric property. (7)

- (e) Copy and complete in your answerbook the following diagram to show how a concave mirror forms an image of an object O, which is placed outside the focus F of the mirror. (7)



- (f) Give one use of a spectrometer. (7)

- (g) Name the electrical component represented in the diagram.



(7)

- (h) State Ohm's law. (7)

- (i) Give one use of a capacitor. (7)

- (j) Give two properties of the electron. (7)

6. Define the term force and give the unit in which force is measured. (9)

Force is a vector quantity. Explain what this means. (6)

Newton's law of universal gravitation is used to calculate the force between two bodies such as the moon and the earth.

Give two factors which affect the size of the gravitational force between two bodies. (9)

Explain the term acceleration due to gravity, g . (9)

An astronaut carries out an experiment to measure the acceleration due to gravity on the surface of the moon. He drops an object from a height of 1.6 m above the surface of the moon and the object takes 1.4 s to fall. Use this data to show that the acceleration due to gravity on the surface of the moon is 1.6 m s^{-2} . (9)

The astronaut has a mass of 120 kg. Calculate his weight on the surface of the moon. (6)

Why is the astronaut's weight greater on earth than on the moon? (5)

The earth is surrounded by a layer of air, called its atmosphere. Explain why the moon does not have an atmosphere. (3)



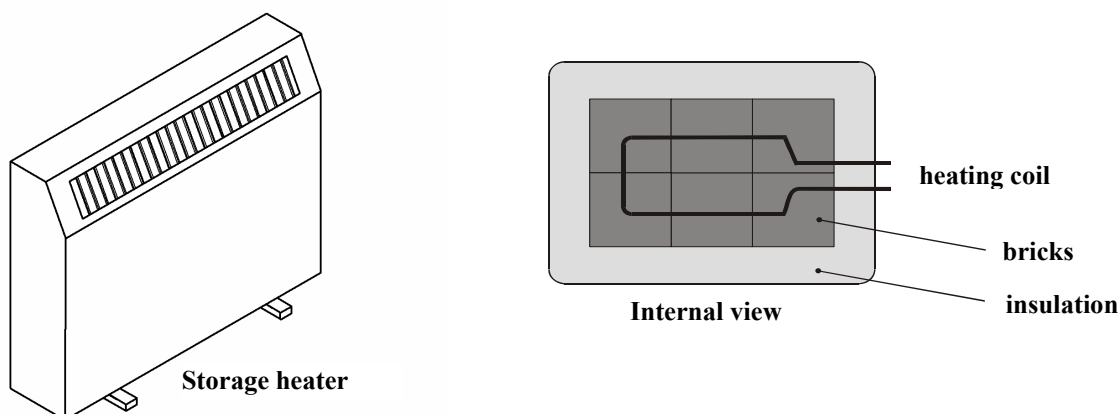
The moon

$$(W = mg, s = ut + \frac{1}{2}at^2)$$

7. Heat can be transferred in a room by convection.
What is convection? Name two other ways of transferring heat. (12)

Describe an experiment to demonstrate convection in a liquid. (12)

In an electric storage heater, bricks with a high specific heat capacity are heated overnight by passing an electric current through a heating coil in the bricks. The bricks are surrounded by insulation.



- Why is insulation used to surround the bricks?
Name a material that could be used as insulation. (12)

Explain how the storage heater heats the air in a room. (8)

The total mass of the bricks in the storage heater is 80 kg and their specific heat capacity is $1500 \text{ J kg}^{-1} \text{ K}^{-1}$. During a ten-hour period the temperature of the bricks rose from 15°C to 300°C .

Calculate:

- (i) the energy gained by the bricks;
(ii) the power of the heating coil. (12)

$$(Q = mc\Delta\theta, P = \frac{W}{t})$$

8. Describe, using diagrams, the difference between transverse waves and longitudinal waves. (12)

The speed of sound depends on the medium through which the sound is travelling.

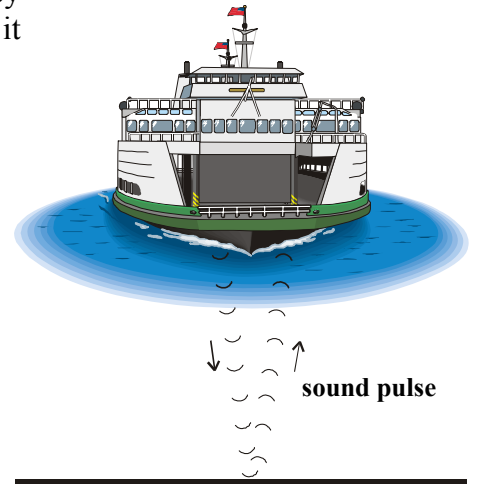
Explain how sound travels through a medium. (9)

Describe an experiment to demonstrate that sound requires a medium to travel. (15)

A ship detects the seabed by reflecting a pulse of high frequency sound from the seabed. The sound pulse is detected 0.4 s after it was sent out and the speed of sound in water is 1500 m s^{-1} .

Calculate

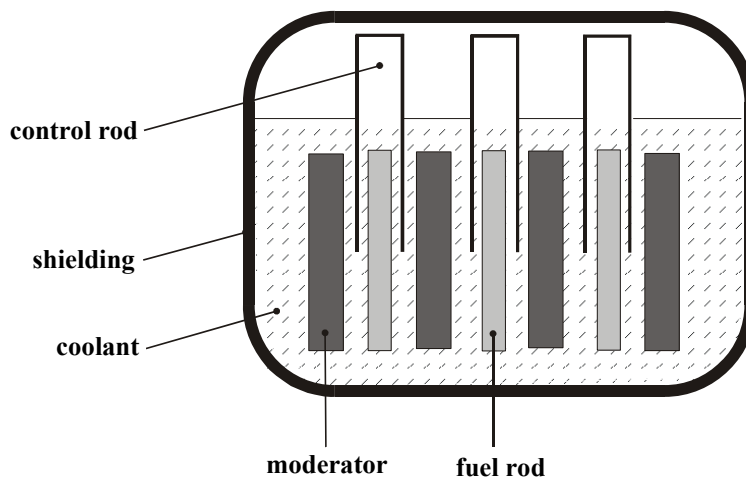
- (i) the time taken for the pulse to reach the seabed;
- (ii) the depth of water under the ship;
- (iii) the wavelength of the sound pulse when its frequency is 50 000 Hz. (15)



Why is the speed of sound greater in water than in air? (5)

$$(c = f\lambda, v = \frac{s}{t})$$

9. The diagram shows a simple nuclear fission reactor.

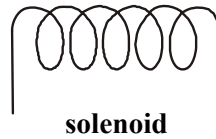


Energy is released in a fission reactor when a chain reaction occurs in the fuel rods.

- (i) What is meant by fission? Name a material in which fission occurs. (12)
- (ii) Describe how a chain reaction occurs in the fuel rods. (15)
Explain how the chain reaction is controlled.
- (iii) What is the purpose of the shielding? Name a material that is used as shielding. (12)
- (iv) Describe what happens to the coolant when the reactor is working. (5)
- (v) Give one effect of a nuclear fission reactor on the environment. (6)
- (vi) Give one precaution that should be taken when storing radioactive materials. (6)

10. What is a magnetic field?

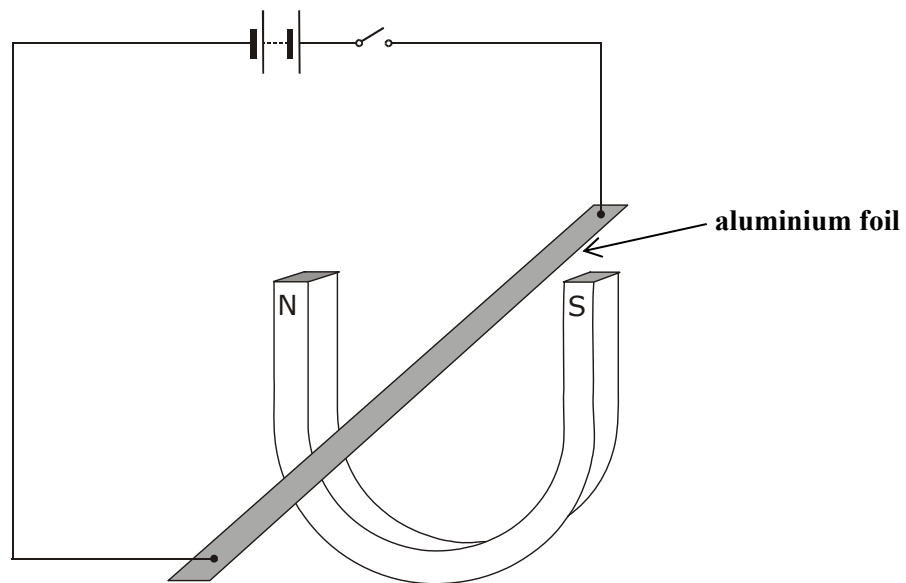
Describe an experiment to show the magnetic field due to a current in a solenoid. (18)



A solenoid carrying a current and containing an iron core is known as an electromagnet.

Give one use of an electromagnet. State one advantage of an electromagnet over an ordinary magnet. (9)

The diagram shows an experiment to demonstrate that a current-carrying conductor experiences a force in a magnetic field. A strip of aluminium foil is placed at right angles to a U-shaped magnet. The foil is connected in series with a battery and a switch.



When the switch is closed the aluminium foil experiences an upward force.

Name a device based on this effect. (6)

Describe what will happen if

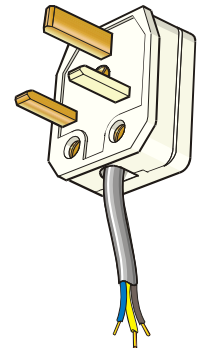
- (i) the current flows in the opposite direction;
- (ii) a larger current flows through the aluminium foil;
- (iii) the aluminium foil is placed parallel to the magnetic field. (15)

Calculate the force on the aluminium foil if its length is 10 cm and a current of 1.5 A flows through it when it is placed in a magnetic field of flux density 3.0 T. (8)

$$(F = I l B)$$

11. Read this passage and answer the questions below.

Electricity is so much part of modern living that we often take it for granted. It is a powerful and versatile energy of great use in the home but can be dangerous if not used properly. The electricity connection into your home comes through the ESB main fuse and the ESB meter. Almost all new electrical appliances now come complete with a fitted 13 Amp, 3-pin plug. Remember, a wrongly wired plug can result in a serious or fatal accident. The first thing to know is the colour code for connecting the cables to the appropriate pin/terminal in the plug. The cables consist of a metal conductor covered in coloured plastic.



When wiring a plug it is most important that all the screw connections are fully tightened. You should leave a little extra slack on the earth wire. You must also fit the correct size fuse. When an appliance is *double insulated* it does not need to be earthed. These appliances will only have two wires, the brown live and the blue neutral, they do not have an earth wire.

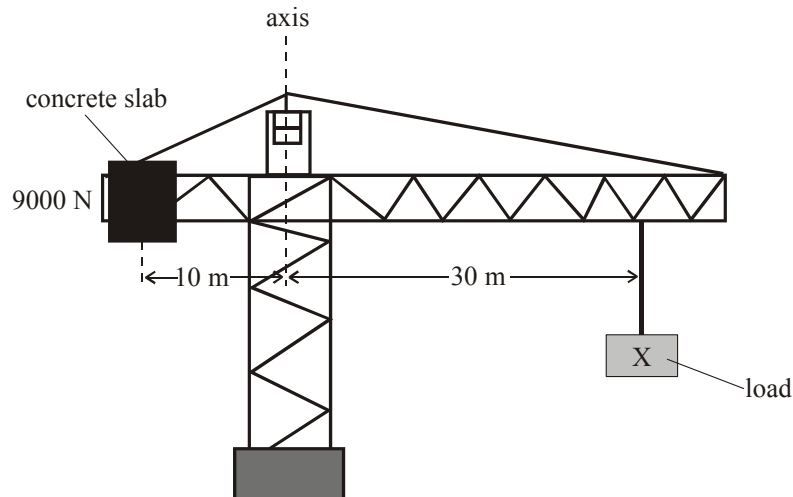
(Adapted from *The Safe Use Of Electricity In The Home* by The ESB.)

- (a) Give one use for electricity in the home. (7)
- (b) What is the function of the ESB meter? (7)
- (c) What will happen when a current of 20 A flows through a fuse marked 13 A? (7)
- (d) Give one safety precaution that should be taken when wiring a plug. (7)
- (e) What is the colour of the earth wire in an electric cable? (7)
- (f) Name a common material used to conduct electricity in electric cables. (7)
- (g) Why is the coating on electric cables made from plastic? (7)
- (h) Why are some appliances **not** earthed? (7)

12. Answer any **two** of the following parts (a), (b), (c), (d).

(a) Define the moment of a force. (6)

The diagram shows a crane in equilibrium.



Give one condition that is necessary for the crane to be in equilibrium. (6)

What is the moment of the 9000 N concrete slab about the axis of the crane? (6)

Calculate the value of the load marked X. (6)

A crane is an example of a lever. Give another example of a lever. (4)

(b) The diagram shows the relative positions of electromagnetic radiations in terms of their wavelength.

gamma rays	A	UV	light	IR	microwaves	B
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(i) Name the radiations marked **A** and **B**. (6)

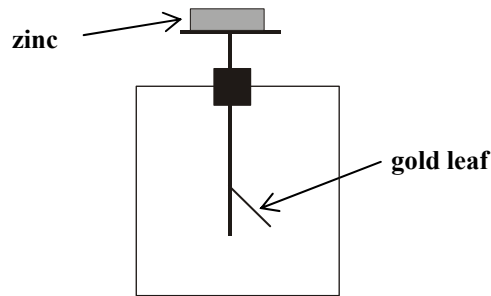
(ii) Give one property which is common to all electromagnetic radiations. (6)

(iii) Which one of the radiations has the shortest wavelength? (6)

(iv) Describe how IR radiation is detected. (6)

(v) Give one use for microwaves. (4)

- (c) In an experiment to demonstrate the photoelectric effect, a piece of zinc is placed on a gold leaf electroscope, as shown. The zinc is given a negative charge causing the gold leaf to deflect.



Explain why the gold leaf deflects when the zinc is given a negative charge. (9)

Ultraviolet radiation is then shone on the charged zinc and the gold leaf falls. Explain why. (9)

What is observed when the experiment is repeated using infrared radiation? (6)

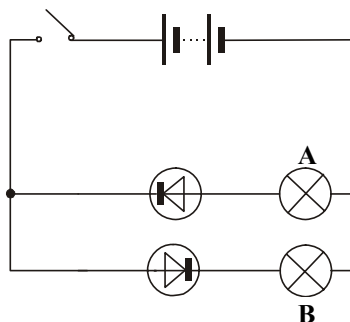
Give one application of the photoelectric effect. (4)

- (d) A semiconductor material can be doped to form a p-n junction (semiconductor diode).

Explain the underlined terms. (12)

Name a material used as a semiconductor. (6)

The circuit diagram shows 2 semiconductor diodes and 2 bulbs, labelled **A** and **B**, connected to a 6 V d.c. supply.



What is observed when the switch is closed? Explain why? (10)

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