Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2017

PHYSICS – ORDINARY LEVEL

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

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

Relevant data are listed in the *Formulae and Tables* booklet, which is available from the Superintendent.

SECTION A (120 MARKS)

Answer **three** questions from this section.
Each question carries 40 marks.

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1. An experiment was set up to measure *g*, the acceleration due to gravity.

   (*i*)   Draw a labelled diagram of the apparatus used in this experiment.   (12)

   (*ii*)   What measurements were taken to calculate *g*?

         How were these measurements taken?   (12)

   (*iii*) How were these measurements used to calculate *g*?   (9)

   (*iv*) State two precautions which the student might have taken
         to get an accurate result.   (7)

2. An experiment was set up to measure the specific heat capacity of a substance.

   (*i*)   Draw a labelled diagram of the apparatus used in this experiment.   (12)

   (*ii*)   What measurements were taken during this experiment?   (9)

   (*iii*) How was the mass of the substance determined?   (6)

   (*iv*) How was the specific heat capacity of the substance determined?   (9)

   (*v*)   State one precaution which the student might have taken
         to get an accurate result.   (4)

3. An experiment was set up to measure the focal length of a concave mirror.
The table shows the data recorded during the experiment.

u (cm)	15	25	45
v (cm)	30	17	13

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) How did the observer know that the apparatus was correctly arranged
to record the data? (6)

(*iii*) Indicate on your diagram the measurements that were taken. (6)

(*iv*) Calculate the value of the focal length f of the mirror, using the data above. (12)

(*v*) Why might it be an advantage to use a darkened room when carrying out
this experiment? (4)

4. An experiment was set up to investigate the variation of the resistance R
of a metallic conductor with its temperature θ.

(*i*) Draw a labelled diagram of the apparatus used in this experiment. (12)

(*ii*) How was the value of the resistance of the metallic conductor measured? (6)

The table shows the measurements obtained during the experiment.

θ (°C)	0	15	30	40	60	80	100
R (Ω)	19.6	20.6	21.6	22.2	23.5	24.8	26.1

(*iii*) Using the data in the table draw a graph, on graph paper, to show the variation of
the resistance of the metallic conductor with temperature. (12)

(*iv*) What does the graph tell you about the relationship between the resistance of
a metallic conductor and its temperature? (6)

(*v*) Use your graph to find the temperature of the metallic conductor when it has
a resistance of 22.8 Ω. (4)

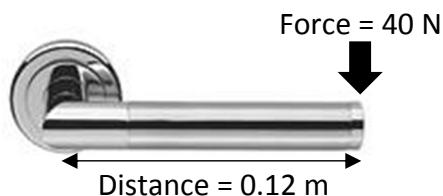# SECTION B (280 MARKS)

Answer **five** questions from this section.
Each question carries 56 marks.

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

(*a*)   Name an example of (*i*) a vector quantity and (*ii*) a scalar quantity.

(*b*)   A door handle is used to open a door.
Calculate the moment of the force applied in the diagram.

Force = 40 N

Distance = 0.12 m

(*c*)   Choose from the list below the instrument used to measure (*i*) electrical current and (*ii*) length.

ammeter   protractor   metre stick   barometer

(*d*)   Conduction is one method of heat transfer. Name the other two methods.

(*e*)   Name the instrument shown.

(*f*)   State one common use for a convex lens.

(*g*)   Resonance can cause a wine glass to shatter. What is resonance?

(*h*)   Name one source of voltage.

(*i*)   What sub-atomic particle is released by the photoelectric effect?

(*j*)   Name one method of detecting radiation.

(8 × 7)

6. A fairground sling-shot is shown below. Springs attached to the pod are used to store a form of potential energy. When the pod and springs are released, this potential energy is used to exert a <u>force</u> which gives the pod an upward <u>acceleration</u>. At the pod's highest point, the occupants experience apparent weightlessness for a short time, before <u>gravity</u> causes the pod to fall back towards the ground.

(*i*)	Explain the underlined terms.	(18)
(*ii*)	What form of energy does the pod have due to its motion?	(6)
(*iii*)	What form of energy does the pod have at its highest point?	(6)
(*iv*)	Why do the occupants experience apparent weightlessness at the pod's highest point?	(3)

The mass of the pod is 400 kg.

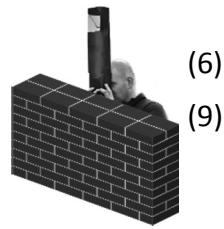It reaches a maximum height of 50 m above its point of release.

(*v*)	Calculate the potential energy stored in the springs before the pod is released.	(6)
(*vi*)	Draw a diagram to show the forces acting on the pod when it is released.	(6)
(*vii*)	Calculate the momentum of the pod when it has a speed of 8 m s^{-1}.	(6)
(*viii*)	State one energy loss that might prevent the pod from reaching its maximum height.	(5)

(*acceleration due to gravity, g = 9.8 m s^{-2}*)

7. A ray of light can undergo both reflection and refraction.

(*i*)   What is meant by reflection of light? (6)

(*ii*) State the laws of reflection. (9)

The periscope, like the one in the diagram, is an application of the reflection of light that allows a person to see over objects.

(*iii*) Draw a diagram to show how a periscope works. (9)

The diagram shows the word AMBULANCE written so that a driver can read it correctly in a car mirror.

(*iv*) Explain why the driver can read the word correctly in the mirror. (6)

Total internal reflection of light occurs in optical fibres which are used to transmit information.

(*v*)   Draw a labelled diagram to show how total internal reflection occurs. (9)

(*vi*) Draw a labelled diagram to show how an optical fibre transmits light along its length. (9)

(*vii*) An optical fibre cable has a refractive index of 1.5. Calculate the angle at which total internal reflection occurs. (8)

8. Frequency and wavelength are properties associated with waves.

(*i*)   What is meant by the frequency of a wave? (6)

(*ii*) State the relationship between the frequency of a wave and its wavelength. (6)

The diagram shows a person standing near an ambulance as it approaches with its siren on. As the ambulance passes, the person observes a change in the frequency of the siren.

(*iii*) What name is given to this effect? (6)

(*iv*) Explain, with the aid of a labelled diagram, how this phenomenon occurs. (12)

(*v*)   Name one practical application of this phenomenon. (5)

(*vi*) An electrical storm is seen before it is heard. What does this indicate about the difference between sound waves and light waves? (6)

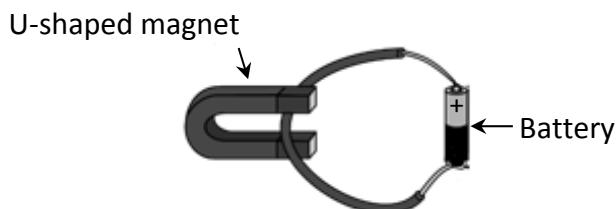(*vii*) State one other difference between sound waves and light waves. (6)

When timing a 100 m sprint, a person stands at the finishing line and starts the stopwatch when he hears the starting gun fired at the starting line.

(*viii*) Calculate the difference in time the runner would receive if the stopwatch was started at *exactly* the same time as the starting gun was fired, i.e. without any delay caused by the time taken for the sound to travel 100 m. (9)
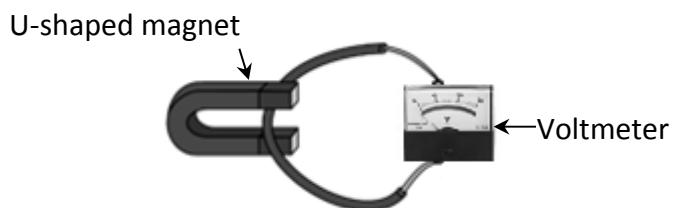
(*speed of sound in air = 330 m s^{-1}*)

9. Magnetic fields can be detected near a magnet or a current-carrying conductor.

(*i*)   What is a magnetic field? (6)

(*ii*)   State one example of a good conductor and one example of a good insulator. (6)

(*iii*)   Name the unit of voltage. (6)

The diagram below shows a wire placed between the poles of a U-shaped magnet.

U-shaped magnet

← Battery

(*iv*)   What happens to the wire when current flows through it? (6)

(*v*)   What happens when the direction of the current is reversed? (6)

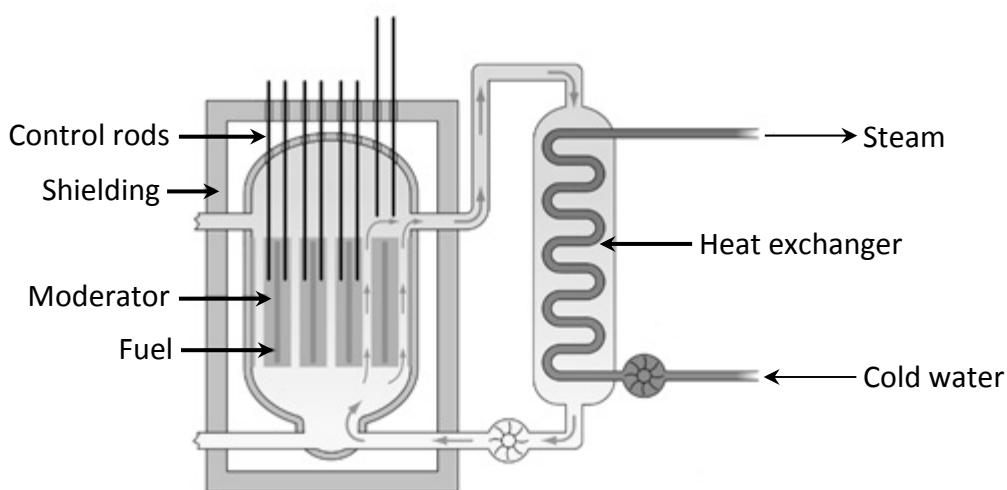(*vi*)   Name one device based on this effect. (6)

The wire is then disconnected from the battery and connected to a sensitive voltmeter.

U-shaped magnet

←Voltmeter

(*vii*)   What is observed on the voltmeter when neither the wire nor the magnet move? (4)

(*viii*)   What is observed on the voltmeter when either the wire or the magnet is moved? (4)

(*ix*)   Name a scientist whose law is associated with this phenomenon? (6)

(*x*)   Magnetism is one effect associated with an electric current.
Name one other effect. (6)

10. Radiation is released when radioactive elements decay.

(*i*) Name three types of radiation. (9)

(*ii*) Which type of radiation has no charge? (3)

(*iii*) Which type of radiation is the least penetrating? (3)

(*iv*) Which type of radiation is not deflected by magnetic fields? (3)

(*v*) State one danger associated with nuclear radiation. (6)

(*vi*) State one precaution that should be taken when handling
radioactive substances. (3)

Radioactive fuels are used to generate power in a nuclear fission reactor like the one
shown in the diagram.

(*vii*) What is nuclear fission? (6)

(*viii*) Name a fuel used in nuclear reactors. (5)

(*ix*) State the function of (*a*) the control rods and (*b*) the shielding in a reactor. (12)

(*x*) What is the purpose of the heat exchanger? (6)

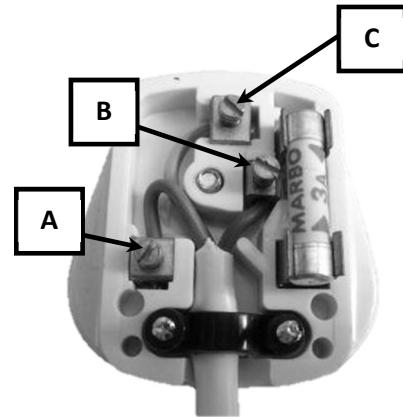**11.** Read the following passage and answer the questions below.

The Electricity Connection to your Home
The electricity connection to your home is an a.c. supply and comes through ESB Networks' main fuse and meter. The ordinary fuses or miniature circuit breakers in the distribution board respond to overloaded circuits by 'blowing' and switching off the flow of electricity in the circuit. Additional protection against electric shock or fire is provided by a Residual Current Device, RCD. In simple terms, an RCD detects an abnormal flow of electricity out of a circuit when, for instance, a cable is damaged or a fault develops in an appliance allowing electricity to 'leak' out. The RCD responds instantaneously to such 'leakage' and disconnects the supply from the circuit. All RCDs have a test button to check that the mechanism is working properly.

Making the Connection – Plugs and Cable Colours
Almost all new electric appliances now come complete with a fitted 13 A 3-pin plug. The first thing to know is the colour code for connecting the cables to the appropriate pin/terminal in the plug. When you connect each wire to the appropriate terminal, it is most important that no loose strands of wire are exposed and that all the screw connections are fully tightened. You should also leave a little extra slack on the green/yellow wire within the plug in order to avoid strain on this vital connection. The ordinary 13 A plug suits most of the commonly used 'non-fixed' appliances in the home – heaters, washing machines, dryers, microwave ovens, tools, entertainment equipment, etc. Appliances with a higher loading should be permanently connected to their own circuit through a switch. The most vulnerable parts of many appliances are the connecting flex and the plug. Most electrical accidents associated with electric appliances are caused either by damaged flexes or wrongly-wired plugs. For your own safety, keep electric appliances well maintained and don't abuse them.

(Adapted from *The Safe Use of Electricity in the Home*, ESB Networks)

(*a*)   What is the function of the electricity meter?

(*b*)   What is meant by the term a.c.?

(*c*)   Name three safety devices found in domestic circuits.

(*d*)   What is the cause of most accidents associated with electrical appliances?

(*e*)   What is the function of the test button on an RCD?

(*f*)   Name the pins labelled **A**, **B** and **C** in the diagram.

(*g*)   State one precaution that should be taken when wiring a plug.

(*h*)   What is the maximum power that an appliance with a 13 A plug can use when connected to a 220 V supply?

(8 × 7)

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

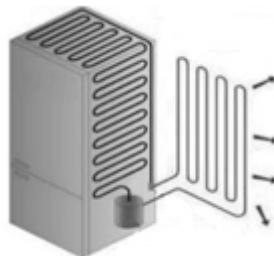(*a*) Define (*i*) velocity and (*ii*) friction. (9)

A car started from rest and accelerated at 0.4 m s^{-2} to reach a top speed of 28 m s^{-1}. It maintained this speed for 200 seconds.

When the car approached its destination, the driver applied the brakes uniformly to bring it to a stop in 30 s.

(*iii*) Draw a diagram indicating the main forces acting on the car when it was accelerating. (6)

(*iv*) Calculate how long it took the car to reach its top speed. (6)

(*v*) Sketch the velocity-time graph for the journey. (7)

(*b*) The heat pump in a fridge uses a fluid with a high specific latent heat.

(*i*) Explain the underlined terms. (12)

A fridge lowers the temperature of 2 kg of water from 30 °C to 5 °C in 840 s.

Calculate

(*ii*) the energy removed from the water (12)

(*iii*) the power of the fridge. (4)

(*specific heat capacity of water = 4200 J kg^{-1} K^{-1}*)

(*c*)   Mountain climbers encounter large changes in atmospheric pressure.

(*i*)   Define pressure and state its unit.   (10)

(*ii*) Describe an experiment to demonstrate that the atmosphere exerts
        pressure.   (9)

A weather balloon is released to test the weather at the height of Mount Everest,
where atmospheric pressure is only 3.0×10^4 Pa.

The balloon has a volume of 2 litres when it is released from sea level.

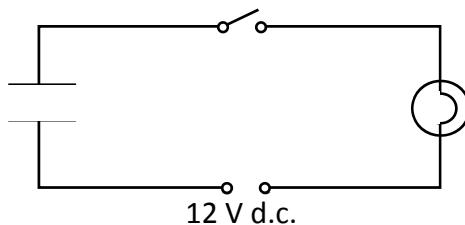(*iii*) Calculate the volume of the balloon when it reaches the height of
        Mount Everest.   (9)
        (*atmospheric pressure at sea level = 10.1×10^4 Pa*)

(*d*)   (*i*)   State Coulomb's law of force between electric charges.   (6)

A capacitor can be used to store electric charge.

A discharged capacitor with a capacitance of 6×10^{-2} F is connected in a circuit
with a bulb, a switch and a 12 V d.c. power supply as shown.

12 V d.c.

(*ii*) What is observed when the switch is closed?   (6)

(*iii*) What would be observed if a 12 V a.c. power supply had been used
        instead?   (4)

(*iv*) Calculate the charge stored on the capacitor when it is connected to the
        12 V d.c. power supply.   (9)

(*v*)   State one application of a capacitor.   (3)

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