



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION, 2013

PHYSICS – ORDINARY LEVEL

MONDAY, 17 JUNE – MORNING, 9:30 TO 12:30

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

N.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.

1. You carried out an experiment to measure g , the acceleration due to gravity.
- (i) Draw a labelled diagram of the apparatus you used. (12)
 - (ii) State the measurements you took during the experiment. (6)
 - (iii) Describe how you took these measurements. (9)
 - (iv) How did you calculate a value for g from your measurements? (9)
 - (v) Give one precaution that you took to get an accurate result. (4)
2. A student carried out an experiment to measure the specific latent heat of fusion of ice. The following is an extract from her report.
- “I first set up the apparatus for this experiment. I prepared the ice. I added the ice which was at $0\text{ }^{\circ}\text{C}$ to the warm water. I found the mass of the ice. When all the ice was melted I took a temperature reading. I was then able to calculate the specific latent heat of fusion of ice.”
- (i) Draw a labelled diagram of the apparatus used in the experiment. (12)
 - (ii) How did the student prepare the ice for the experiment? (6)
 - (iii) How did the student know that the ice was at $0\text{ }^{\circ}\text{C}$? (3)
 - (iv) How did the student find the mass of the ice? (9)
 - (v) Why did the student use warm water in the experiment? (6)
 - (vi) What precaution did the student take when adding the ice to the water? (4)

3. An experiment to measure the refractive index of a substance was carried out by a student. When the apparatus had been set up the student made a series of measurements. The student repeated the experiment a number of times.
- (i) Draw a labelled diagram of the apparatus that the student used in the experiment. (12)
 - (ii) What measurements did the student take? (12)
 - (iii) How were these measurements used to calculate the refractive index of the substance? (10)
 - (iv) Why did the student repeat the experiment? (6)

4. In an experiment to investigate the variation of the resistance R of a thermistor with temperature θ a student measured the resistance of a thermistor at different temperatures.
- (i) Draw a labelled diagram of the apparatus used in the experiment. (12)
 - (ii) How did the student measure the resistance of the thermistor? (6)

The table shows the measurements recorded by the student.

$\theta/^\circ\text{C}$	10	20	30	40	50	60	70
R/Ω	1800	1200	750	400	190	90	40

- (iii) Plot a graph on graph paper to show the relationship between resistance R of the thermistor and the temperature θ . (Put θ on the X -axis.) (12)
- (iv) Use the graph to estimate the temperature of the thermistor when its resistance is $500\ \Omega$. (4)
- (v) What can you tell from the graph about the relationship between the resistance of a thermistor and its temperature? (6)

SECTION B (280 marks)

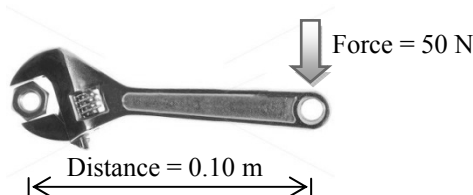
Answer **five** questions from this section.

Each question carries 56 marks.

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

(a) Give an example of (i) a vector quantity, (ii) a scalar quantity.

(b) The spanner shown in the diagram is used to turn a nut. Calculate the moment of the force applied by the spanner to the nut.



(c) Which of the following scientists is associated with the discovery of the structure of the atom?

Einstein Rutherford Faraday Coulomb

(d) What is meant by the threshold of hearing?

(e) How does light travel through an optical fibre?

(f) Give a common use for a convex lens.

(g) What colour is the wire that is connected to the fuse in a standard three-pin plug?

(h) Give a common use for a capacitor.

(i) What is the photoelectric effect?

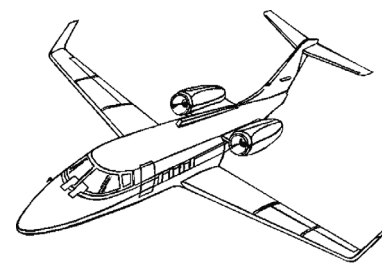
(j) Name one method for detecting radioactive particles.

(8 × 7)

6. Define (a) momentum, (b) force. (12)

State the principle of conservation of momentum.

Explain how the principle of conservation of momentum applies in the case of a jet engine moving an aircraft. (12)



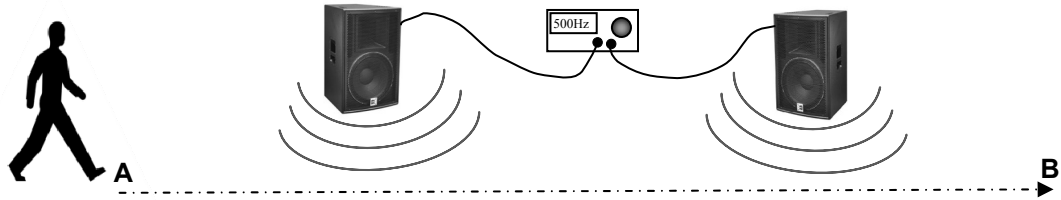
A truck of mass 5000 kg is moving with a velocity 10 m s^{-1} when it collides with a stationary car with a mass of 1000 kg. The truck and the car then move off together.



- (i) Calculate the momentum of the truck and the car before the collision. (6)
- (ii) What is the momentum of the combined vehicles after the collision? (4)
- (iii) Calculate the velocity of the combined vehicles after the collision. (6)
- (iv) What is the momentum of the truck after the collision? (4)
- (v) If the collision between the truck and the car takes 0.3 seconds, calculate the force exerted by the truck on the car. (6)
- (vi) When the truck hits the back of the car the driver's airbag inflates. The airbag deflates when it is hit by the driver's head. Explain why the airbag reduces the risk of injury to the driver. (6)

7. (a) What is meant by the frequency of a wave?
Give the relationship between the frequency and the wavelength of a wave. (12)

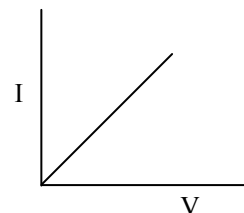
The diagram shows a student walking in front of two loudspeakers along the path between **A** and **B**. A signal generator set at 500 Hz is connected to the loudspeakers.



- (i) What will the student notice as he moves from **A** to **B**? (6)
- (ii) Name this phenomenon. (4)
- (iii) Explain with the aid of a diagram how this phenomenon occurs. (9)
- (iv) Why should this phenomenon be taken into account in the placing of speakers in theatres or auditoriums? (6)
- (b) The note produced by a guitar string depends on the fundamental frequency of the string. The quality of the note depends on the number of overtones produced. The loudness of a note is increased by resonance in the body of a guitar.
- (i) Explain the underlined terms. (9)
- (ii) How can the note produced by a guitar string be changed? (4)
- (iii) What is resonance? (6)



8. (a) An electric current is the flow of charge in a conductor when there is a potential difference between its ends.
- (i) Name the unit of current. (6)
 - (ii) Give an example of a conductor. (3)
 - (iii) Name a source of potential difference. (6)
 - (iv) What are the charge carriers in semiconductors? (8)
 - (v) What type of conductor does the I-V graph in the diagram represent? (6)



- (b) A magnetic field exists about a current-carrying conductor.
- (i) What is a magnetic field? (6)
 - (ii) Describe an experiment to show that a long straight wire carrying a current has a magnetic field. Sketch the magnetic field. (15)
 - (iii) Give an application of the magnetic field due to a current. (6)

9. When heat is transferred to or from an object the temperature of the object changes.
- (i) What is heat? (6)
 - (ii) Name the three ways in which heat can be transferred. (9)
 - (iii) Describe an experiment to show how heat is transferred in a liquid. (9)

The water in an electric kettle is heated by the element and its handle is made from an insulating material.

- (iv) How does the method of heat transfer in a liquid affect the positioning of the heating element in a kettle? (6)
- (v) Why is the handle of a kettle made of an insulating material? (4)
- (vi) Name an insulator suitable for use in the handle of a kettle. (4)



A kettle contains 1.3 kg of water with a specific heat capacity of $4200 \text{ J kg}^{-1} \text{ K}^{-1}$. The temperature of the water rises from 10°C to 80°C during a three-minute period.

Calculate

- (vii) the energy gained by the water (9)
- (viii) the power rating of the kettle, assuming all of the electrical energy is used to heat the water. (9)

10. X-rays are used to diagnose and treat medical conditions. The image shows an X-ray photograph.

(i) What are X-rays?

(ii) State a property of X-rays that makes them suitable for medical use.

(iii) Give a use, other than medical, for X-rays.



(6)

(6)

(6)

In an X-ray tube a beam of electrons is used to produce X-rays.

(iv) Draw a labelled diagram showing the main parts of an X-ray tube.

(12)

(v) How are electrons produced in an X-ray tube?

(6)

(vi) What is the purpose of the high voltage in an X-ray tube?

(6)

(vii) What happens when the electrons hit the target in an X-ray tube?

(6)

(viii) Name a suitable material for use as the target.

(4)

(ix) Give one safety precaution required when using X-rays.

(4)

11. Read this passage and answer the questions below.

The National Grid - Ireland's Transmission System

The national grid system supplies electricity to customers. The grid consists of a network of high voltage transmission stations, power lines and cables delivering power to over 100 sub-stations all over Ireland. From these sub-stations power can be taken onwards on lower voltage lines to individual customers' premises.

The network includes approximately 6,000 km of overhead lines and underground cables. High voltages are used to avoid power losses which would otherwise occur when transferring power over long distances.



The control room of Ireland's national grid

Power is generated by power plants throughout the country, utilising a variety of fuel or energy sources, including gas, oil, coal, peat, hydro-electricity, wind turbines and other sources such as biomass and landfill gas. All of the major power plants feed into the national grid.

At the sub-stations power is transferred from the grid, transformed into medium and low voltage electricity and is delivered to Ireland's 2.1 million domestic, commercial and industrial customers.

(Adapted from **EIRGRID AT A GLANCE**, Eirgrid information publication.)

- (a) What are the key components of the national grid?
- (b) Why are high voltages used to transmit power over the national grid?
- (c) Why is the power supplied to domestic customers at lower voltages?
- (d) Name two renewable and two non-renewable energy sources used to generate electricity.
- (e) The national grid uses alternating current (a.c.) rather than direct current (d.c.). What is the difference between them?
- (f) Name the device used to convert high voltages to lower voltages.
- (g) Give the principle of operation of the device named in part (f).
- (h) Name the unit of electrical energy that is used in the delivery of electricity to homes and businesses.

(8 × 7)

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

(a) Define pressure. (6)

Describe an experiment to show that the atmosphere exerts pressure. (9)

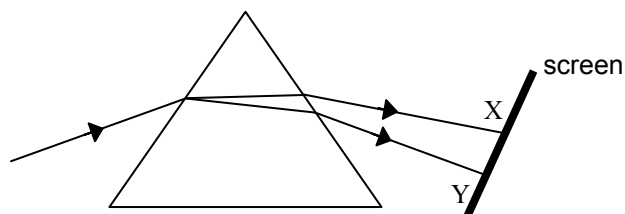
A diver swims upwards from a depth of 50 m to a depth of 20 m below the surface of the water.

Calculate the decrease in pressure on the diver as she swims upwards. (13)

(density of the water = 1000 kg m^{-3} ;
acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$)



(b) The diagram shows a beam of white light undergoing refraction and dispersion as it passes through a prism.



(i) What is meant by dispersion? (6)

(ii) What is observed on the screen between X and Y? (6)

(iii) What information does dispersion give about the nature of white light? (4)

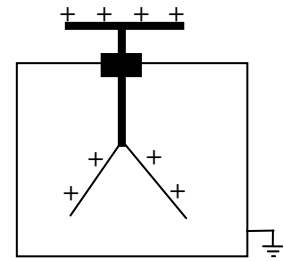
(iv) Give another method for the dispersion of light. (6)

(v) Give an everyday example of the dispersion of light. (6)

- (c) State Coulomb's law of force between electric charges. (6)

The diagram shows a positively-charged electroscope.

- (i) Give a use for an electroscope. (6)
- (ii) How can an electroscope be given a positive charge? (6)
- (iii) What is observed if you touch the cap of the electroscope with your finger? (4)
- (iv) Explain why this happens. (6)



- (d) Nuclear fission occurs in the reactor of a nuclear power station like the one shown in the photograph.



- (i) What is nuclear fission? (6)
- (ii) Name a fuel used in a nuclear reactor. (6)
- (iii) How can the reaction in a nuclear reactor be controlled? (6)
- (iv) How is the energy produced in a reactor used to generate electricity? (6)
- (v) State a hazard of nuclear reactors. (4)

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