



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION, 2011

PHYSICS – ORDINARY LEVEL

MONDAY, 20 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. The following is an extract from a student's report of an experiment to verify the principle of conservation of momentum.

"I arranged the apparatus. I then measured the mass of each trolley. During the experiment I took further measurements to determine the velocities of the trolleys. I used my measurements to verify the principle of conservation of momentum."

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

2. During an experiment to measure the specific latent heat of vaporisation of water, cold water was placed in an insulated copper calorimeter. Dry steam was passed into the water causing a rise in temperature of the water and the calorimeter. The following data were recorded.

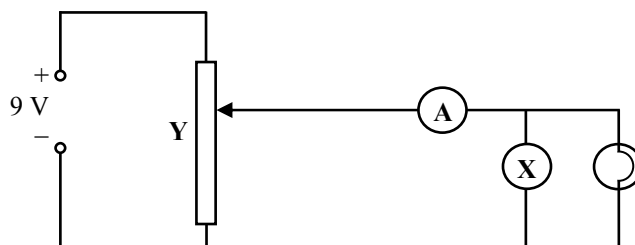
Mass of calorimeter	= 73.40 g
Mass of cold water	= 67.50 g
Initial temperature of water + calorimeter	= 10 °C
Temperature of steam	= 100 °C
Mass of steam added	= 1.03 g
Final temperature of water + calorimeter	= 19 °C

- (i) Draw a labelled diagram of the apparatus used in the experiment. (9)
- (ii) What was the rise in temperature of the water in the experiment? (6)
- (iii) Describe how the mass of the cold water was found. (7)
- (iv) How was the steam dried? (6)
- (v) Calculate:
 - (a) the heat gained by the water and the calorimeter
 - (b) the heat lost by the condensed steam
 - (c) the latent heat of vaporisation of water. (12)

(specific heat capacity of copper = $390 \text{ J Kg}^{-1} \text{ K}^{-1}$; specific heat capacity of water = $4180 \text{ J Kg}^{-1} \text{ K}^{-1}$)

3. You carried out an experiment to measure the speed of sound in air by measuring the frequency and wavelength of a sound wave.
- (i) Draw a labelled diagram of the apparatus that you used. (9)
 - (ii) How did you find the frequency of the sound wave? (6)
 - (iii) How was the wavelength of the sound wave measured? (9)
 - (iv) How did you use the measurements to calculate the speed of the sound wave? (12)
 - (v) Why should you repeat the experiment? (4)

4. The diagram shows a circuit used to investigate the variation of current with potential difference for a filament lamp.



- (i) Name the instrument **X**. What does it measure? (4)
- (ii) Name the component **Y**. What does it do? (6)

The table shows the values recorded for the current and the potential difference during the investigation.

Potential difference / V	1	2	3	4	5	6	7
Current / A	0.9	1.6	2.1	2.5	2.8	3.0	3.1

- (iii) Draw a graph, on graph paper, of the current against the potential difference. (12)
- (iv) What does your graph tell you about the variation of current with potential difference for a filament lamp? (9)
- (v) Using your graph, calculate the resistance of the lamp when the potential difference across the lamp is 5.5 V. (9)

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) What is friction?

(b) What is the relationship between G , the gravitational constant and g , the acceleration due to gravity?

(c) A crowbar is an example of a lever. Give another example of a lever.



(d) Which one of the following terms is associated with a wave motion?

half-life

interference

induction

doping

(e) Name the three ways by which heat can travel from one place to another.

(f) Give two uses of a concave mirror.

(g) What is the colour of the earth cable in a standard 3-pin plug?

(h) How does a miniature circuit breaker (MCB) improve safety in a domestic circuit?



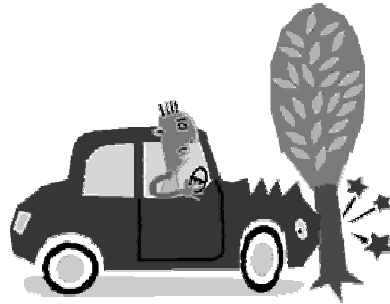
(i) Give a use for an electroscope.

(j) Give a disadvantage of a named renewable source of energy.

(8 × 7)

6. State Newton's first law of motion. (6)

A car of mass 1400 kg was travelling with a constant speed of 15 m s^{-1} when it struck a tree and came to a complete stop in 0.4 s.



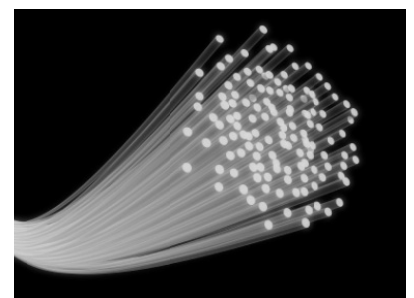
- (i) Draw a diagram of the forces acting on the car before it hit the tree. (9)
- (ii) Calculate the acceleration of the car during the collision. (9)
- (iii) Calculate the net force acting on the car during the collision. (6)
- (iv) Calculate the kinetic energy of the moving car before it struck the tree. (6)
- (v) What happened to the kinetic energy of the moving car? (9)
- (vi) A back seat passenger could injure other occupants during a collision. Explain, with reference to Newton's laws of motion, how this could occur. How is this risk of injury minimised? (11)

7. Light rays can undergo reflection and refraction. Both of these can occur when light is travelling from a denser medium, such as glass, to a less dense medium, such as air.

- (i) Explain the underlined terms. (12)
- (ii) Give a practical application of the reflection of light. (3)
- (iii) State the laws of reflection of light. (9)
- (iv) Explain, with the aid of a diagram, how total internal reflection can occur. (9)
- (v) What is meant by the 'critical angle' in total internal reflection? (6)

The photo shows an optical fibre which is used for the transmission of data using light waves.

- (vi) Draw a diagram to show how light waves travel along an optical fibre. (9)
- (vii) Give two advantages of using optical fibres instead of copper wires when transmitting data. (5)
- (viii) Optical fibres are also used in medicine. Give an example of their use in medicine. (3)



8. (a) (i) What is meant by a thermometric property? (6)
- (ii) Name two different thermometric properties. (6)
- (iii) Name two different thermometers. (4)
- (iv) Describe how to calibrate a thermometer. (12)
- (v) Why is there a need for a standard thermometer? (6)

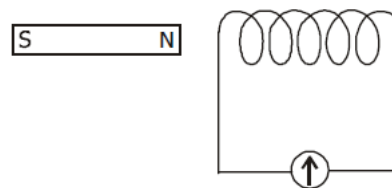
- (b) An electric kettle is filled with 500 g of water and is initially at a temperature of 15 °C. The kettle has a power rating of 2 kW.



- (i) Calculate the energy required to raise the temperature of the water to 100 °C. (9)
- (ii) How much energy is supplied by the kettle every second? (3)
- (iii) How long will it take the kettle to heat the water to 100 °C? (6)
- (iv) Name a suitable material for the handle of the kettle. Justify your answer. (4)
- (specific heat capacity of water = 4180 J Kg⁻¹ K⁻¹)

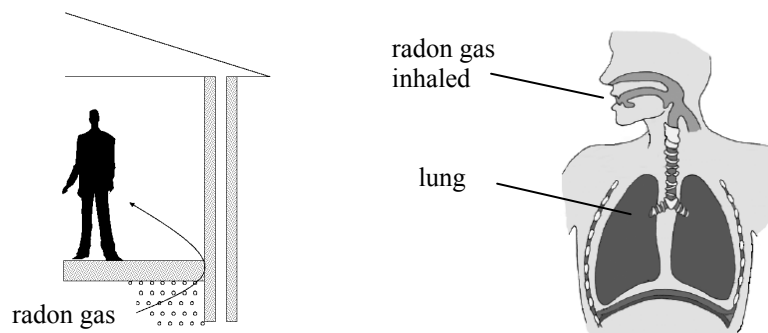
9. (a) State Faraday's law of electromagnetic induction. (9)

A coil of wire is connected to a sensitive meter, as shown in the diagram.



- (i) What is observed on the meter when the magnet is moved towards the coil? (6)
- (ii) What is observed on the meter when the magnet is stationary in the coil? (3)
- (iii) Explain these observations. (9)
- (iv) How would changing the speed of the magnet affect the observations? (5)
- (b) Transformers are used to step up or step down a.c. voltages.
- (i) What is meant by a.c.? (6)
- (ii) Draw a labelled diagram showing the structure of a transformer. (9)
- (iii) The input coil of a transformer has 200 turns of wire and is connected to a 230 V a.c. supply. What is the voltage across the output coil, when it has 600 turns? (9)

10. Radon is a radioactive gas which emits alpha particles. Radon gas comes into houses through gaps in the floors. Exposure to radon gas can cause lung cancer.



- (i) What is radioactivity? (6)
- (ii) Name the other two types of radiation emitted by radioactive sources. (6)
- (iii) Describe an experiment to distinguish between the three types of radiation. (12)
- (iv) List three properties of one of these radiations. (9)

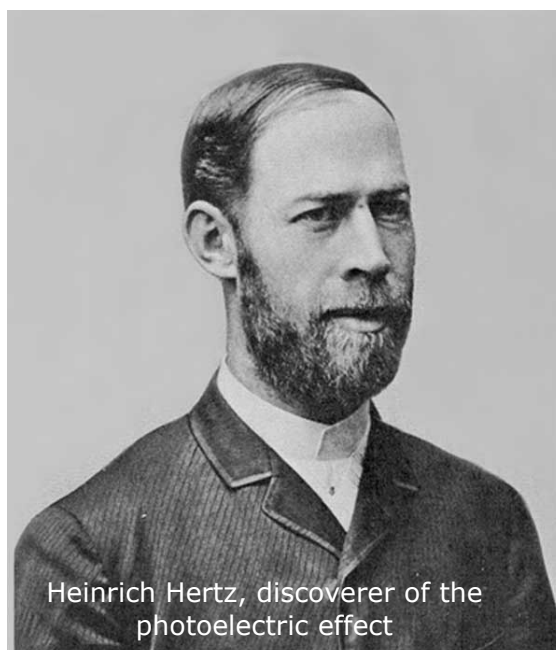
The most stable isotope of radon has a half-life of 4 days.

- (v) What are isotopes? (6)
- (vi) Why is it important to prevent radon gas entering your home? (5)
- (vii) If no more radon gas entered your home, how long would it be until one eighth of the radon gas was left? (6)
- (viii) Give two uses of radioisotopes. (6)

11. Read this passage and answer the questions below.

Einstein explained the photoelectric effect by using Planck's quantum theory ($E=hf$). The German physicist Heinrich Hertz in 1887 was the first to discover that when light shines on certain metals, they emit electrons. Metals have the property that some of their electrons are only loosely bound within atoms, which is why they are such good conductors of electricity. When light strikes a metallic surface it transfers its energy to the metal, in the same way as when light shines on your skin, causing you to feel warmer. This transfer of energy from the light can agitate electrons in the metal, and some of the loosely bound electrons can be knocked off the surface of the metal.

But the strange features of the photoelectric effect become apparent when one studies the more detailed properties of the released electrons. As the intensity of the light – its brightness – is increased the number of released electrons will also increase, but their speed stays the same. On the other hand, the speed of the released electrons will increase if the frequency of the light shining on the metal is increased.



Heinrich Hertz, discoverer of the photoelectric effect

(Adapted from '*Elegant Universe*' by Brian Greene, Vintage 2000)

- (a) Who discovered the photoelectric effect?
- (b) Who explained the photoelectric effect?
- (c) What happens when light shines on certain metals?
- (d) Why is a metal a good conductor of electricity?
- (e) Why does your skin feel warm when light shines on it?
- (f) In the photoelectric effect, what happens when the intensity of the light is increased?
- (g) How can the speed of electrons emitted in the photoelectric effect be controlled?
- (h) Give one application of the photoelectric effect.

(8 × 7)

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

(a) State Boyle's law. (6)

Describe an experiment to demonstrate that the atmosphere exerts a pressure. (12)



Atmospheric pressure at the top of Mount Everest is very low at 3.0×10^4 Pa, which is why climbers need oxygen tanks.

A climber uses a 5.0 litre tank with an internal gas pressure of 4.2×10^6 Pa to supply oxygen.

What volume of gas will be available at the top of Mount Everest, when the gas is released from the tank? (10)

(b) Loudness, pitch and quality are characteristics of a musical note. Name the physical property of a sound wave on which each characteristic depends. (12)

A bat detector allows us to hear the sounds emitted by bats. The detector is needed as humans cannot hear the sounds emitted by bats as they are outside our *frequency limits of audibility*.

(i) What is meant by the frequency limits of audibility? (6)

(ii) What name is given to a sound whose frequency is greater than our upper frequency limit of audibility? (4)

(iii) A bat emitted a sound wave and detected its reflection from a wall 0.02 s later.
Calculate the distance of the bat from the wall. (6)

(speed of sound in air = 340 m s^{-1})



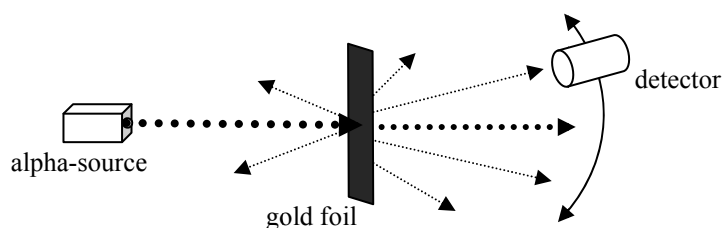
- (c) What is an electric current, and give its unit of measurement? (9)
- State the three effects of an electric current. (4)
- How would you demonstrate one of the effects? (9)



An electric screwdriver has a power rating of 120 W when connected to its 24 V battery.

Calculate the current supplied by the battery when the screwdriver is turned on. (6)

- (d) The diagram shows an arrangement used to investigate the structure of the atom. During the investigation, alpha-particles were fired at a thin sheet of gold foil in a vacuum.



- (i) What are alpha-particles? (6)
- (ii) What happened to the alpha-particles in the experiment? (6)
- (iii) What did the experiment reveal about the structure of the atom? (6)
- (iv) Name the scientist who designed the experiment. (6)
- (v) Name a suitable detector of alpha-particles. (4)

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