Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION 2007

PHYSICS – ORDINARY LEVEL

MONDAY 18 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.

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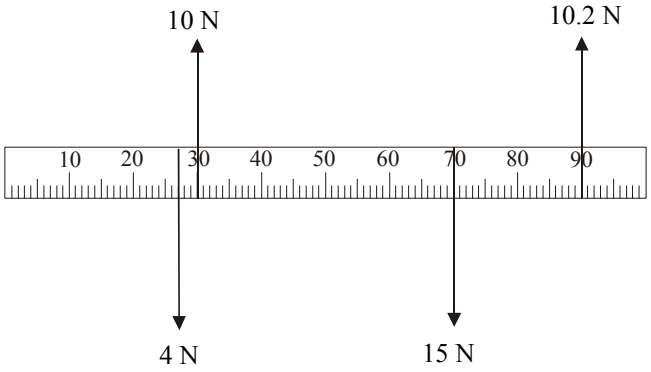
1. A student investigated the laws of equilibrium for a set of co-planar forces acting on a metre stick. The weight of the metre stick was 1.2 N and its centre of gravity was at the 50 cm mark. The student applied the forces shown to the metre stick until it was in equilibrium.



(i) How did the student know the metre stick was in equilibrium? (4)

(ii) Copy the diagram and show **all** the forces acting on the metre stick. (6)

(iii) (a) Find the total upward force acting on the metre stick.

(b) Find the total downward force acting on the metre stick.

(c) Explain how these values verify one of the laws of equilibrium. (15)

(iv) (a) Find the sum of the anticlockwise moments of the upward forces about the 0 mark.

(b) Find the sum of the clockwise moments of the downward forces about the 0 mark.

(c) Explain how these values verify the other law of equilibrium. (15)

2. You carried out an experiment to measure the wavelength of a monochromatic light source using a diffraction grating. The diffraction grating had 600 lines per mm.

(i) Draw a labelled diagram of the apparatus you used. (12)

(ii) Name a source of monochromatic light. (4)

(iii) State what measurements you took during the experiment. (6)

(iv) What is the distance between each line on the diffraction grating? (6)

(v) How did you determine the wavelength of the light? (6)

(vi) Give one precaution that you took to get an accurate result. (6)

3. A student carried out an experiment to obtain the calibration curve of a thermometer. The following is an extract from her report.

> I placed the thermometer I was calibrating in a beaker of water along with a mercury thermometer which I used as the standard. I recorded the value of the thermometric property of my thermometer and the temperature of the water as shown on the mercury thermometer. I repeated this procedure at different temperatures. The following is the table of results that I obtained.

Temperature/°C	0	20	40	60	80	100
Value of thermometric property	4	12	24	40	64	150

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

(ii) Using the data in the table, draw a graph on graph paper of the value of the thermometric property against its temperature. Put temperature on the horizontal axis (X-axis). (12)

(iii) Use your graph to estimate the temperature when the value of the thermometric property is 50. (6)

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

(v) How was the value of this thermometric property measured? (4)

4. In an experiment to verify Joule's law, a heating coil was placed in a fixed mass of water. A current I was allowed to flow through the coil for a fixed length of time and the rise in temperature $\Delta\theta$ was recorded. This was repeated for different values of I.
The table shows the data recorded.

(i) Draw a labelled diagram of the apparatus used. (12)

(ii) How was the current changed during the experiment? (4)

(iii) Copy the table and complete it in your answerbook. (6)

I/A	1.0	1.5	2.0	2.5	3.0	3.5	4.0
I^2/A^2			4				
$\Delta\theta$/°C	2.2	5.0	8.8	13.8	20.0	26.0	35.2

(iv) Using the data in the completed table, draw a graph on graph paper of $\Delta\theta$ against I^2. Put I^2 on the horizontal axis (X-axis). (12)

(v) Explain how your graph verifies Joule's law ($\Delta\theta \propto I^2$). (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.

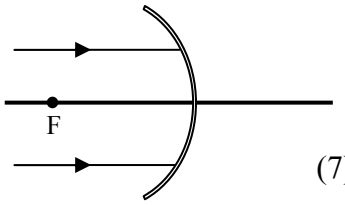
(a) State Newton's second law of motion. (7)

(b) Which of the following is **not** a renewable source of energy?
wind **nuclear** **solar** **hydroelectric** (7)

(c) The temperature of a body is 34 °C. What is its temperature in kelvin? (7)

(d) Name two methods by which heat can be transferred. (7)

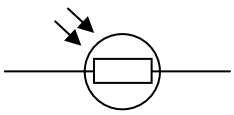
(e) The diagram shows parallel rays of light approaching a concave mirror. Copy the diagram and show the paths of the rays after they strike the mirror. (7)



(f) Give one application of the Doppler effect. (7)

(g) Name two safety devices that are used in domestic electric circuits. (7)

(h) Name the electrical component represented in the diagram. (7)

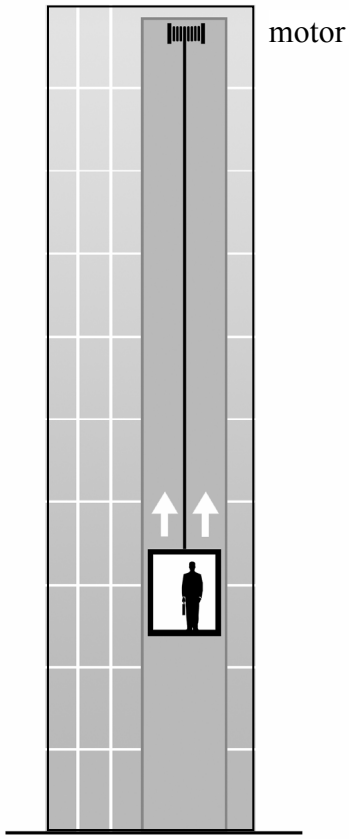


(i) Draw a sketch of the magnetic field around a bar magnet. (7)

(j) The half life of a radioactive element is 3 days. What fraction of a sample of the radioactive element will remain after 9 days? (7)

6. Define (i) work, (ii) power, and give the unit of measurement for each one. (18)

What is the difference between potential energy and kinetic energy? (6)



An empty lift has a weight of 7200 N and is powered by an electric motor. The lift takes a person up 25 m in 40 seconds. The person weighs 800 N.

Calculate:

(i) the total weight raised by the lift's motor (4)

(ii) the work done by the lift's motor (6)

(iii) the power output of the motor (6)

(iv) the energy gained by the person in taking the lift. (6)

If instead the person climbed the stairs to the same height in 2 minutes, calculate the power generated by the person in climbing the stairs. (5)

Give two disadvantages of using a lift. (5)

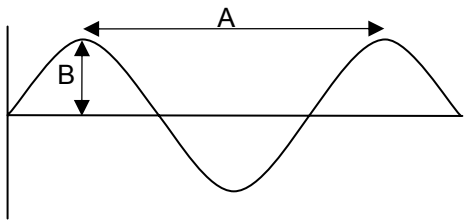
($W = Fs$, $P = \frac{W}{t}$)

7. Resonance occurs when a vibrating object causes vibrations in nearby objects which have the same natural frequency.

Explain the underlined terms. (12)

Describe an experiment to demonstrate resonance. (12)

The diagram shows the waveform of a musical note.



What is the name given to (i) the distance **A**, (ii) height **B**? (9)

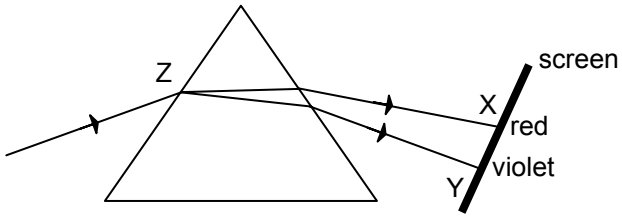
Explain what is meant by the frequency of a wave. (6)

State the wave property on which (i) the loudness, (ii) the pitch, of a note depends. (8)

A tin-whistle produces a note of 256 Hz. Calculate the wavelength of this note.
The speed of sound in air is 340 m s^{-1} (9)

($c = f\lambda$)

8. *(a)* Dispersion occurs when a beam of white light passes through a prism forming a spectrum on a screen, as shown in the diagram.



(i) What is meant by the terms *dispersion* and *spectrum*? (10)

(ii) What happens to the white light when it enters the prism at **Z**? (6)

(iii) Name the invisible radiation formed on the screen at (i) region **X**, (ii) region **Y**. (9)

(iv) Describe how to detect one of these invisible radiations. (12)

(v) Give a use for one of these invisible radiations. (6)

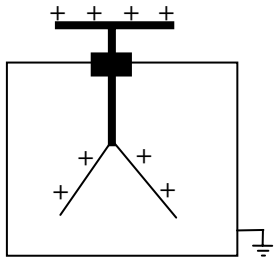
(b) The colour on a TV screen is made by mixing the primary colours.

(i) Name the primary colours. (9)

(ii) How is a secondary colour (e.g. yellow) produced on a TV screen? (4)

9. *(a)* State Coulomb's law of force between charges. (9)

The diagram shows a positively charged gold leaf electroscope.

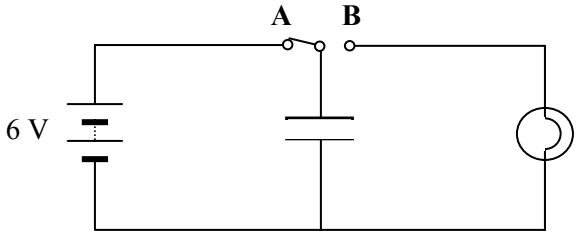


(i) Describe how an electroscope is given a positive charge. (9)

(ii) What is observed when the cap of an electroscope is earthed? Why does this happen? (9)

(iii) How is the cap of the electroscope earthed? (6)

(b) A capacitor is connected to a switch, a battery and a bulb as shown in the diagram. When the switch is moved from position **A** to position **B**, the bulb lights briefly.



(i) What happens to the capacitor when the switch is in position **A**? (6)

(ii) Why does the bulb light when the switch is in position **B**? (6)

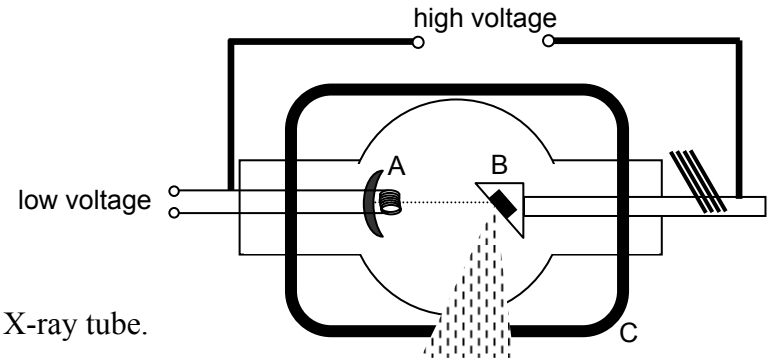
(iii) When the switch is in position **A** the capacitor has a charge of 0.6 C, calculate its capacitance. (6)

(iv) Give a use for a capacitor. (5)

$(C = \frac{Q}{V})$

10. X-rays were discovered by Wilhelm Röntgen in 1895.

What are X-rays? Give one use for X-rays. (12)



The diagram shows a simple X-ray tube.

Name the parts labelled **A**, **B** and **C**. (12)

Electrons are emitted from **A**, accelerated across the tube and strike **B**.

(i) Explain how the electrons are emitted from **A**. (12)

(ii) What is the purpose of the high voltage supply? (6)

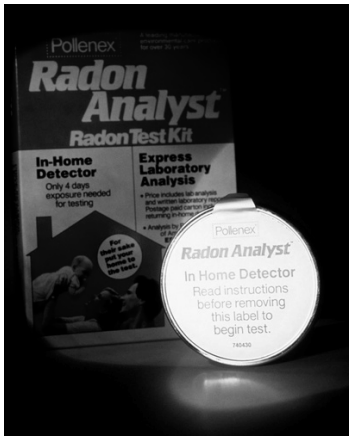
(iii) What happens when the electrons hit part **B**? (4)

(iv) Name a suitable material to use for part **B**. (6)

(v) Give one safety precaution when using X-rays. (4)

11. Read this passage and answer the questions below.

Radon is a naturally occurring radioactive gas. It originates from the decay of uranium, which is present in small quantities in rocks and soils. Radon is colourless, odourless and tasteless and can only be detected using special equipment, like a Geiger-Müller tube, that can measure the radiation it releases. Because it is a gas, radon can move freely through the soil and enter the atmosphere. When radon reaches the open air, it is quickly diluted to harmless concentrations, but when it enters an enclosed space, such as a house, it can sometimes accumulate to unacceptably high concentrations. Radon can enter a building from the ground through small cracks in floors and through gaps around pipes and cables. Radon is drawn from the ground into a building because the indoor air pressure is usually lower than outdoors. Being radioactive, radon decays releasing radiation. When radon is inhaled into the lungs the radiation released can cause damage to the lung tissue.



(Adapted from *Understanding Radon, A Householder's Guide* by the RPII.)

(a) What is radioactivity? (7)

(b) What is the source of radon? (7)

(c) Name a detector of radiation. (7)

(d) How does radon enter a building? (7)

(e) How can the build-up of radon in the home be prevented? (7)

(f) Why is radon dangerous? (7)

(g) Why is radon harmless in the open air? (7)

(h) Name a radioactive element other than radon. (7)

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

(a) State the principle of conservation of momentum.

A rocket is launched by expelling gas from its engines. Use the principle of conservation of momentum to explain why a rocket rises. (16)

The diagram shows two shopping trolleys each of mass 12 kg on a smooth level floor.
Trolley **A** moving at 3.5 m s^{-1} strikes trolley **B**, which is at rest.
After the collision both trolleys move together in the same direction.

Calculate:

(i) the initial momentum of trolley **A**

(ii) the common velocity of the trolleys after the collision. (12)

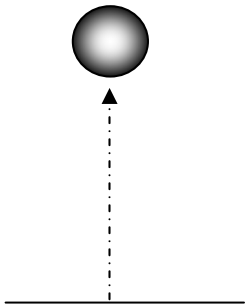
(*p = mu)*

(b) (i) Define pressure.

Describe an experiment to demonstrate that the atmosphere exerts pressure. (14)

(ii) State Boyle's law.

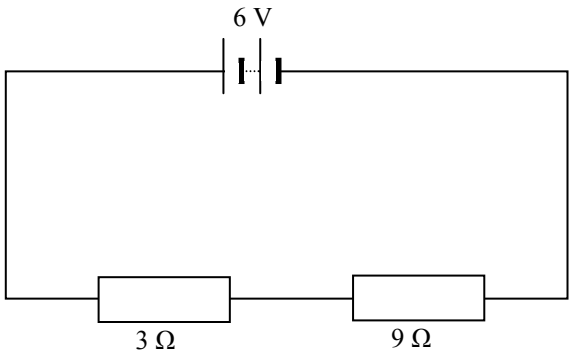
A balloon rises through the atmosphere while the temperature remains constant.
The volume of the balloon is 2 m^3 at ground level where the pressure is 1000 hPa.



Find the volume of the balloon when it has risen to a height where the atmospheric pressure is 500 hPa.

What will happen to the balloon as it continues to rise? (14)

(c) State Ohm's law. (6)



The circuit diagram shows two resistors connected in series with a 6 V battery.
Calculate:

(i) the total resistance of the circuit (6)

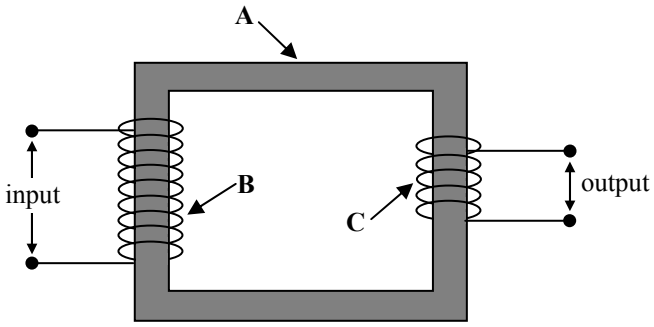
(ii) the current in the circuit (6)

(iii) the potential difference across the 9 Ω resistor. (6)

Name an instrument used to measure potential difference. (4)

($V=IR$)

(d) What is electromagnetic induction? (10)



The diagram shows a transformer.

(i) Name the parts labelled **A** and **B**.

(ii) The input voltage is 230 V. Part **B** has 4600 turns and part **C** has 120 turns. Calculate the output voltage.

(iii) Name a device that uses a transformer. (18)

($\frac{V_i}{V_o} = \frac{N_p}{N_s}$)

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