2010. M35

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2010

PHYSICS – ORDINARY LEVEL

MONDAY, 21 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. You carried out an experiment to investigate the relationship between the acceleration of a body and the force applied to it. You did this by applying a force to a body and measuring the resulting acceleration. The table shows the data recorded during the experiment.

Force / N	0.20	0.25	0.30	0.35	0.40	0.45	0.50
acceleration / m s^{-2}	0.4	0.5	0.6	0.7	0.8	0.9	1.0

(i) Draw a labelled diagram of the apparatus you used. (9)

(ii) How did you measure the applied force? (6)

(iii) How did you minimise the effect of friction during the experiment? (6)

(iv) Plot a graph on graph paper of the body's acceleration against the force applied to it. (12)

(v) What does your graph tell you about the relationship between the acceleration of the body and the force applied to it? (7)

2. A student carried out an experiment to measure the specific heat capacity of a substance. The following is an extract from her report.

> "I set up the apparatus. I took a series of measurements before I heated the substance. I then took further measurements. I used these measurements to find the specific heat capacity of the substance."

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

(ii) Describe how the mass of the substance was determined. (6)

(iii) What other measurements did the student take during the experiment? (9)

(iv) Give the formula used to calculate the specific heat capacity of the substance. (7)

(v) Give a precaution that the student should have taken to get an accurate result. (6)

3. A student carried out an experiment to measure the focal length of a concave mirror. The student placed an object in front of the mirror so that a real image was formed. The student repeated the experiment by placing the object at different positions and each time recorded the object distance u and the image distance v.

The table shows the data recorded by the student.

u/cm	20	30	50
v/cm	65	32	23

(i) Draw a labelled diagram showing how the apparatus was arranged. (12)

(ii) Mark the distances u and v on your diagram. (6)

(iii) How was the position of the real image located? (6)

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

(v) Why did the student repeat the experiment? (4)

4. In an experiment to determine the resistivity of the material of a wire, a student measured the length, diameter and resistance of a sample of nichrome wire.

The table shows the data recorded by the student.

R/Ω	20.2		
l/cm	48.8		
d/mm	0.21	0.20	0.18

(i) Describe how the student measured the resistance of the wire. (6)

(ii) Describe how the length of the wire was measured. (4)

(iii) What instrument did the student use to measure the diameter of the wire?
Why did the student measure the diameter of the wire at different places? (12)

(iv) Using the data, calculate the cross-sectional area of the wire. (9)

(v) Find the resistivity of nichrome. (9)

$(\rho = \frac{RA}{l}\ ,\ A = \pi r^2)$

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*) State Boyle's law. (7)

(*b*) A concrete mixer delivered 50 m^3 of concrete to a building site. Calculate the mass of the concrete delivered. (7)

($\rho = \frac{m}{V}$; density of concrete = 2400 kg m^{-3})

(*c*) State Archimedes' Principle. (7)

(*d*) Which one of the following scientists is associated with the refraction of light? (7)

Rutherford Snell Joule Einstein

(*e*) If the temperature of an object is 28 °C, what is its temperature in Kelvin? (7)

(*f*) Give one difference between a light wave and a sound wave. (7)

(*g*) Sketch the magnetic field around a bar magnet. (7)

(*h*) Give a common use of a capacitor. (7)

(*i*) In semiconductors, what is meant by doping? (7)

(*j*) What type of nuclear reaction occurs in a nuclear power station? (7)

6. Define (*a*) momentum, (*b*) kinetic energy. (12)

State the principle of conservation of momentum.
Explain how this principle applies in launching a spacecraft. (12)

An ice skater of mass 50 kg is moving with a speed of 6 m s^{-1} when she collides with another skater of mass 70 kg who is standing still. The two skaters then move off together.

(i) Calculate the momentum of each skater before the collision. (6)

(ii) What is the momentum of the two skaters after the collision? (6)

(iii) Calculate the speed of the two skaters after the collision. (6)

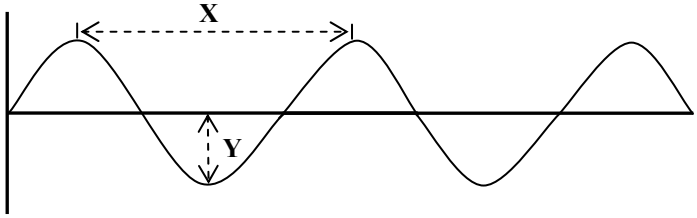
(iv) Calculate the kinetic energy of each skater before the collision. (6)

(v) Calculate the kinetic energy of the two of skaters after the collision. (4)

(vi) Comment on the total kinetic energy values before and after the collision. (4)

($p = mv$, $E_k = ½mv^2$)

7. The diagram shows a waveform.



(i) What is the name given to the distance (*a*) **X**, (*b*) **Y**? (6)

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

(iii) Explain the term natural frequency? (6)

(iv) If the natural frequency of a vibrating string is 250 Hz, calculate the wavelength of the sound produced. (9)

(v) State the wave property on which (*c*) the loudness, (*d*) the pitch, of a musical note depends. (9)

Resonance can occur between objects of the same natural frequency. An opera singer singing a high pitched note can shatter a glass. Explain why. (6)

Describe a laboratory experiment to demonstrate resonance. (14)

($c = f\lambda$, speed of sound in air = 340 m s^{-1})

8. (*a*) What is heat? (6)

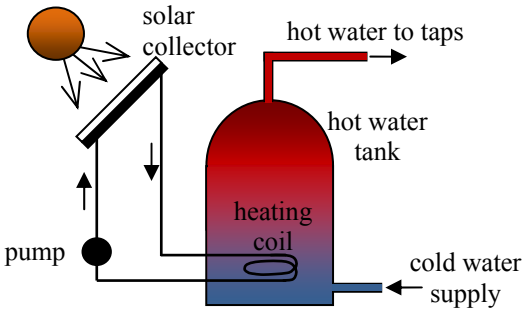
Explain how heat is transferred in a solid. (9)

Describe an experiment to compare the rates of heat transfer through different solids. (12)

Explain the term U-value. (6)

How can the U-value of the walls of a house be reduced? (4)

(*b*) The diagram shows a solar heating system.



(i) How is the sun's energy transferred to the solar collector? (3)

(ii) Why is a solar collector painted black? (3)

(iii) How is the heat transferred from the solar collector to the hot water tank? (3)

(iv) The heating coil in the hot water tank is near the bottom. Explain why. (4)

(v) Give an advantage and a disadvantage of a solar heating system. (6)

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

An electric field exists around a charged object.

(i) How would you detect the presence of an electric field? (9)

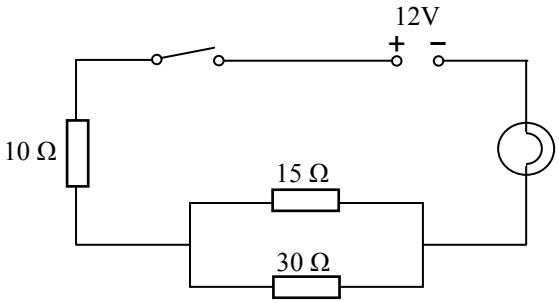
(ii) What is the unit of electric charge? (4)

Static electricity generated during a storm can cause lightning which can damage buildings. To prevent damage tall buildings have lightning conductors.

(iii) How does the lightning conductor prevent damage to the building? (6)

(iv) Suggest a suitable material for a lightning conductor. (4)

(*b*) State Ohm's law. (6)



The diagram shows a number of resistors connected to a 12 V battery and a bulb whose resistance is 4 Ω.

Calculate:

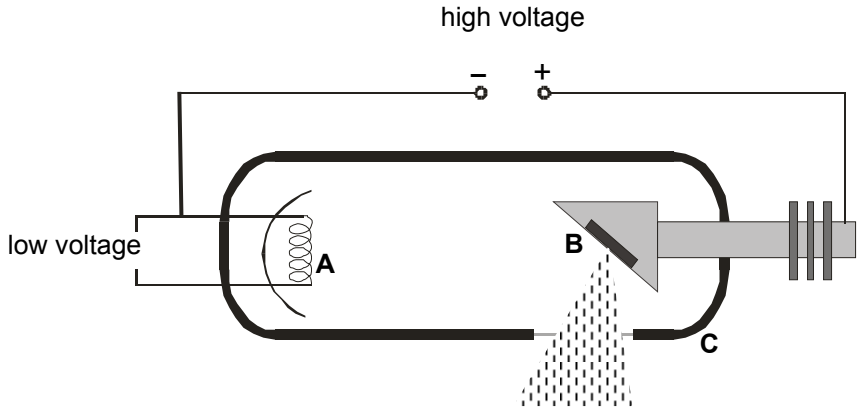
(i) the combined resistance of the 15 Ω and 30 Ω resistors (6)

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

(iii) the current flowing in the bulb. (6)

($R = R_1 + R_2$; $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$)

10. X-rays are produced when high speed electrons collide with a target in an X-ray tube as shown in the diagram.



(i) What process occurs at the filament **A**? (6)

(ii) Name a substance commonly used as the target **B**. (6)

(iii) List three properties of X-rays. (9)

(iv) Give two uses of X-rays. (6)

(v) State the function of the part marked **C**. (5)

The photoelectric effect can be regarded as the inverse of X-ray production.

(vi) What is meant by the photoelectric effect? (6)

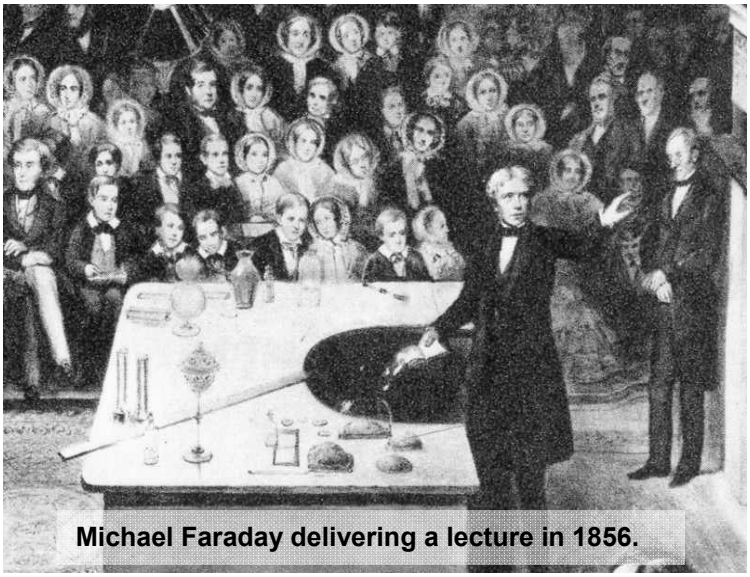
(vii) Describe an experiment to demonstrate the photoelectric effect. (12)

(viii) Give two applications of the photoelectric effect. (6)

11. Read this passage and answer the questions below.

In 1819 the Danish physicist Hans Christian Oersted discovered that an electric current flowing through a wire deflected a compass needle.

A year later the Frenchman François Arago found that a wire carrying an electric current acted as a magnet and could attract iron filings. Soon his compatriot André-Marie Ampère demonstrated that two parallel wires were attracted towards one another if each had a current flowing through it in the same direction. However, the wires repelled each other if the currents flowed in the opposite directions.



Michael Faraday delivering a lecture in 1856.

Intrigued by the fact that a flow of electricity could create magnetism, the great British experimentalist Michael Faraday decided to see if he could generate electricity using magnetism. He pushed a bar magnet in and out of a coil of wire and found an electric current being generated. The current stopped whenever the magnet was motionless within the coil.

(Adapted from '*Quantum' by Manjit Kumar, Icon Books 2008.*)

(*a*) Who discovered that an electric current can deflect a compass needle? (7)

(*b*) What did Arago discover? (7)

(*c*) What happens when currents flow in the same direction in two parallel wires? (7)

(*d*) How could two parallel wires be made to repel each other? (7)

(*e*) Draw a sketch of the apparatus Michael Faraday used to generate electricity. (7)

(*f*) What name is given to the generation of electricity discovered by Michael Faraday? (7)

(*g*) What energy conversions take place in Faraday's experiment? (7)

(*h*) How does Faraday's experiment show that a changing magnetic field is required to generate electricity? (7)

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

(*a*) The diagram shows a cyclist on a bicycle and their combined mass is 120 kg. The cyclist starts from rest and by pedalling applies a net horizontal force of 60 N to travel along a horizontal road.

Calculate:

(i) the acceleration of the cyclist (6)

(ii) the maximum velocity of the cyclist after 15 seconds (6)

(iii) the distance travelled by the cyclist during the first 15 seconds. (3)

The cyclist stops pedalling after 15 seconds and continues to freewheel for a further 80 m before coming to a stop.

(iv) Why does the bicycle stop? (6)

(v) Calculate the time taken for the cyclist to travel the final 80 m. (7)

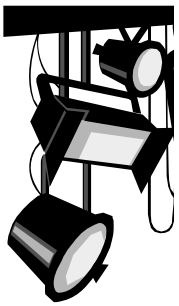
($F = ma$, $v = u + at$, $s = ut + \frac{1}{2}at^2$, $s = (\frac{u+v}{2})t$)

(*b*) What is meant by dispersion of light? (6)

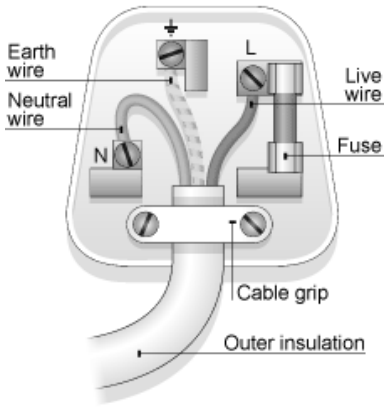
Describe an experiment to demonstrate the dispersion of light. (12)

Give an example of the dispersion of light occurring in nature. (4)

The diagram shows stage lighting similar to that found in most theatres. Only red, green and blue lights are needed to create most lighting effects. Explain why. (6)



(*c*) The diagram shows a plug which contains a fuse, an MCB and an RCD, all of which are used in domestic circuits.



(i) Explain how a fuse works. (6)

(ii) How does the fuse improve safety? (4)

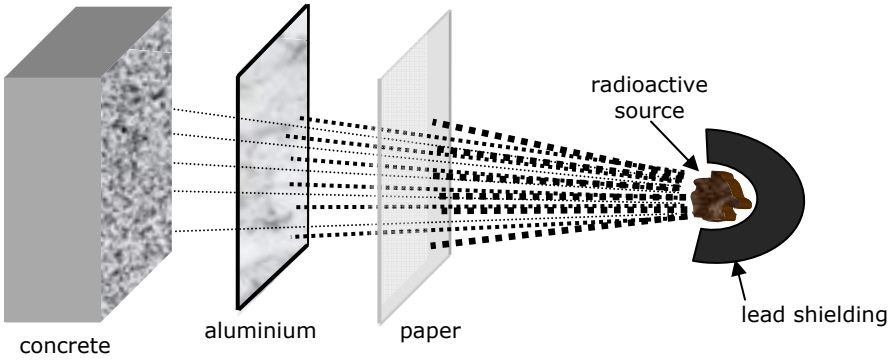
(iii) What is an MCB? (3)

(iv) What is the function of an RCD? (6)

(v) Why should an appliance be earthed? (6)

(vi) Give one other precaution that should be taken to improve safety when using electricity in the home. (3)

(*d*) What is radioactivity? (6)



The diagram shows a radioactive source emitting nuclear radiation which is passing through various materials.

(i) How do you know that the source is emitting three types of radiation? (3)

(ii) Name the radiation blocked by each material. (6)

(iii) Give one danger associated with nuclear radiation. (3)

(iv) State two precautions that should be taken when handling radioactive substances. (4)

(v) Give two uses for radioactive substances. (6)

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