



**Coimisiún na Scrúduithe Stáit  
State Examinations Commission**

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**LEAVING CERTIFICATE EXAMINATION, 2012**

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**PHYSICS – ORDINARY LEVEL**

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**MONDAY, 18 JUNE – MORNING, 9:30 to 12:30**

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

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**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.

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1. A student carried out an experiment to measure the acceleration of a moving trolley. The student measured the initial velocity of the trolley and the final velocity of the trolley, along with another measurement. The student used these measurements to find the acceleration of the trolley.
- (i) Draw a diagram to show how the student got the trolley to accelerate. (12)
  - (ii) Describe how the student measured the final velocity of the trolley. (6)
  - (iii) What other measurement did the student take? (6)
  - (iv) How did the student use the measurements to calculate the acceleration of the trolley? (10)
  - (v) Give a precaution the student took to ensure an accurate result. (6)
2. You carried out an experiment to establish the calibration curve of a thermometer.
- (i) Describe, with the aid of a diagram, the procedure you used in the experiment. (12)
  - (ii) Name the thermometric property of the thermometer you calibrated and describe how the value of this property was measured. (10)

The following table shows the data obtained in an experiment to establish the calibration curve of a thermometer.

Temperature/ $^{\circ}\text{C}$	0	20	40	60	80	100
Value of thermometric property	5	14	29	48	80	130

- (iii) Using the data in the table, draw a graph on graph paper to establish the calibration curve. Put temperature on the horizontal axis. (12)
- (iv) Use your calibration curve to determine the temperature when the value of the thermometric property is 60. (6)

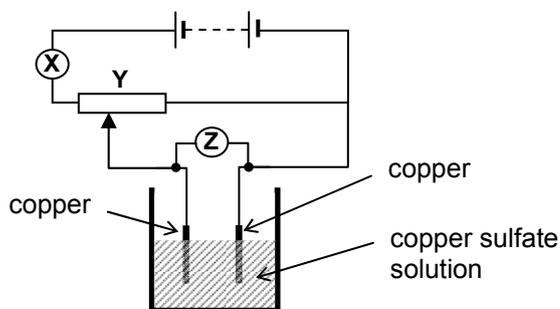
3. A student carried out an experiment to verify Snell's law of refraction. The student measured the angle of incidence  $i$  and the corresponding angle of refraction  $r$  for a ray of light passing through a glass block. The student repeated this procedure for different values of the angle  $i$ . The data recorded by the student are shown in the table.

- (i) Draw a labelled diagram of the apparatus used in the experiment. (9)
- (ii) Describe how the student found the path of the ray of light passing through the glass block. (9)
- (iii) Indicate on the diagram the angles  $i$  and  $r$ . (6)
- (iv) Copy this table into your answerbook and complete it. (9)

$i$	$r$	$\sin i$	$\sin r$	$\frac{\sin i}{\sin r}$
$25^\circ$	$16^\circ$			
$35^\circ$	$22^\circ$			
$50^\circ$	$30^\circ$			
$60^\circ$	$34^\circ$			

- (v) How does the data in the completed table verify Snell's law of refraction? (7)

4. In an experiment to investigate the variation of current  $I$  with potential difference  $V$  for a copper sulfate solution, the following apparatus was used.



- (i) Name the instrument X. (6)
- (ii) Name the apparatus Y and give its function in the experiment. (6)
- (iii) How was the potential difference measured in the experiment? (6)

The following table shows the values recorded for the current  $I$  and the corresponding potential difference  $V$  during the experiment.

$V/V$	0	1.0	2.0	3.0	4.0	5.0	6.0
$I/A$	0	0.4	0.8	1.2	1.6	2.0	2.4

Using the data in the table, draw a graph on graph paper to show the variation of current with potential difference. (12)

Calculate the slope of your graph.

Use this value to determine the resistance of the copper sulfate solution. (10)

## 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) A tow-truck pulls a car with a net horizontal force of 500 N.  
Calculate the work done in towing the car a distance of 2 km to a garage.



- (b) Give one factor on which the potential energy of a body depends.
- (c) Which one of the following instruments is used to measure atmospheric pressure?  
**hydrometer      barometer      thermometer      joulemeter**

- (d) The Tacoma Narrows Bridge collapsed, soon after construction, due to resonance. What is resonance?



- (e) A building has a low U-value. What is the advantage of this?
- (f) Why is a lightning conductor made of copper?
- (g) Why does a magnet that is free to rotate point north?
- (h) A transformer is used to change the voltage of an electrical supply.  
What is the principle of operation of a transformer?
- (i) The photo shows an LDR. Draw the electrical circuit symbol for an LDR.
- (j) What is the main source of energy in the sun?

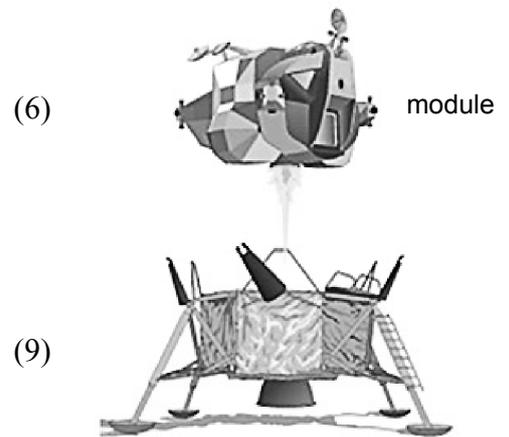


(8 × 7)

6. What is meant by the term ‘acceleration due to gravity’? (6)

A spacecraft of mass 800 kg is on the surface of the moon, where the acceleration due to gravity is  $1.6 \text{ m s}^{-2}$ .

Compare the weight of the spacecraft on the surface of the moon with its weight on earth, where the acceleration due to gravity is  $9.8 \text{ m s}^{-2}$ .



The module of the spacecraft has a mass of 600 kg, when it is launched vertically from the surface of the moon with its engine exerting an upward force of 2000 N.

- (i) Draw a diagram showing the forces acting on the module at lift-off. (6)
- (ii) What is the resultant force on the module? (6)
- (iii) Calculate the acceleration of the module during lift-off. (6)
- (iv) Calculate the velocity of the module, 20 seconds after lift-off. (6)
- (v) Would the engine of the module be able to lift it off the earth’s surface? Justify your answer in terms of the forces acting on the module. (9)
- (vi) Why is the acceleration due to gravity on the moon less than the acceleration due to gravity on earth? (5)
- (vii) Suggest a reason why the module of the spacecraft when launched from the moon does not need a streamlined shape like those that are launched from earth. (3)

7. Under certain conditions, light can undergo diffraction and interference.

- (i) Explain the underlined terms. (12)
- (ii) Describe an experiment to demonstrate the wave nature of light. (12)

The photograph shows Polaroid sunglasses which reduce glare caused by sunlight.



- (iii) Explain the term ‘polarisation’. (6)
- (iv) Describe an experiment to demonstrate the polarisation of light. (12)
- (v) What type of wave motion does light have as indicated by the experiment in part (iv)? (9)
- (vi) Why are Polaroid sunglasses more effective than non-Polaroid sunglasses at reducing glare? (5)

8. A plug is used to connect an electrical appliance in the home to the 230 volt mains supply. Modern plugs contain a small fuse which comes with a rating of 1A, 2A, 3A, 5A or 13A. The electrical energy supplied to the home is measured in kW h (*kilowatt-hour*).

- (i) What is the colour of the wire that should be connected to the fuse in a plug? (6)
- (ii) Why is there a fuse in a plug? (6)
- (iii) Explain how a fuse works. (9)
- (iv) A vacuum cleaner has a power rating of 900 W. What is the most suitable fuse to use in the plug of the vacuum cleaner? (9)
- (v) Why is a fuse of a lower rating unsuitable? (6)
- (vi) Name a device found in modern domestic circuits that has the same function as a fuse. (6)



If the vacuum cleaner is used for 90 minutes, calculate

- (vii) the number of units of electricity used; (8)
- (viii) the cost of the energy used if the price of each unit of electricity is 22 cent. (6)

9. The temperature of an object is a measure of its hotness or coldness.

- (i) What is the SI unit of temperature? (6)
- (ii) The Celsius scale is the practical temperature scale. How is the degree Celsius ( $^{\circ}\text{C}$ ) related to the SI unit of temperature? (6)

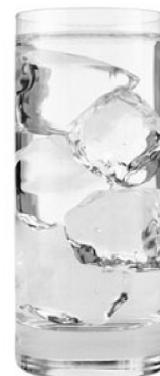
When heat is transferred to a substance, it causes a rise in temperature or a change in state of the substance, or both.

- (iii) What is heat? (6)
- (iv) Name the three methods of heat transfer. (6)
- (v) What is meant by the change in state of a substance? (3)
- (vi) Define specific latent heat. (6)

20 g of ice cubes at  $0^{\circ}\text{C}$  are added to a glass of warm water. All the ice melts quickly and cools the water to  $5^{\circ}\text{C}$ . Assuming no heat transfer to the surroundings or to the glass, calculate:

- (vii) The energy required to melt the ice. (9)
- (viii) The energy required to warm the melted ice to  $5^{\circ}\text{C}$ . (9)
- (ix) Why is it important to stir the mixture? (5)

(specific heat capacity of water =  $4180 \text{ J kg}^{-1} \text{ K}^{-1}$  ;  
specific latent heat of fusion of ice =  $3.34 \times 10^5 \text{ J kg}^{-1}$ )

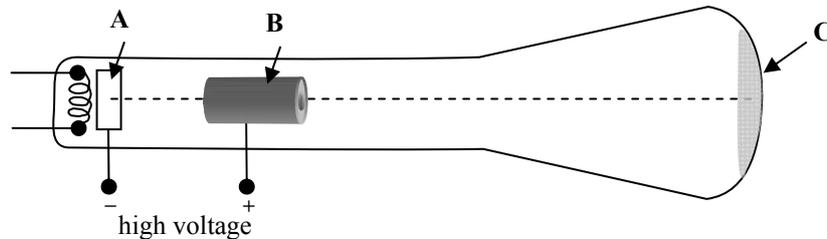


10. A cathode ray tube and an X-ray tube are practical applications of thermionic emission. In these tubes thermionic emission releases electrons, which are then accelerated into a beam.

An electron is a subatomic particle.

Name another subatomic particle and give two of its properties.

(9)



The diagram shows a simple cathode ray tube.

- (i) Name the parts labelled **A**, **B**, **C**. (9)
- (ii) Give the function of any two of these labelled parts. (9)
- (iii) How can the beam of electrons be deflected? (6)
- (iv) What happens at **C** when the electrons hit it? (6)
- (v) Why is a vacuum needed in a cathode ray tube? (3)

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

Draw a sketch of an X-ray tube.

(11)

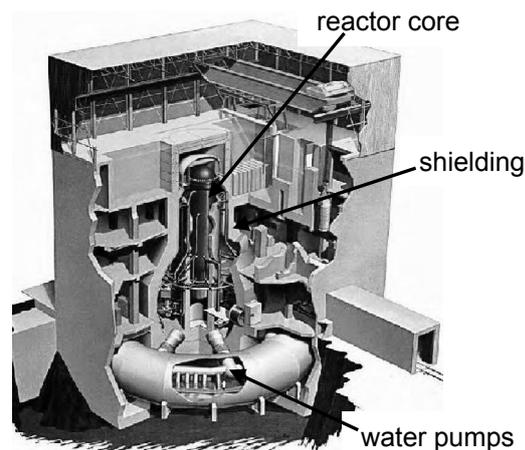
Give one safety precaution taken by a radiographer when using an X-ray machine.

(3)

11. Read this passage and answer the questions below.

### The Fukushima nuclear disaster

In March 2011, following a powerful earthquake, the Fukushima nuclear reactor in Japan was shut down automatically. A nuclear reactor generates heat by splitting atoms of uranium in a process known as nuclear fission. The uranium is contained in the reactor's fuel rods. A chain reaction is set up by the neutrons released during fission and these go on to split more atoms of uranium. The power output of the reactor is adjusted by controlling the number of neutrons that are present. Control rods made of a neutron absorber capture neutrons. Absorbing more neutrons in a control rod means that there are fewer neutrons available to cause fission. Therefore, pushing the control rods deeper into the reactor will reduce its power output, and extracting the control rods will increase it.



The Fukushima nuclear reactor continued to generate heat even after the chain reaction was stopped because of the radioactive decay of the isotopes created during nuclear fission. This decay cannot be stopped and the resulting heat must be removed by circulating cooling water through the reactor core.

When the reactor was shut down due to the earthquake, the pumps to keep the cooling water circulating should have been powered by electricity from the national grid or diesel generators. However, connections to the grid were damaged by the earthquake and the diesel generators were destroyed by the tsunami wave that followed the earthquake. As a result, no cooling was available for the reactor core and this resulted in the explosions and subsequent release of radiation, consisting of radioactive isotopes such as caesium and iodine, into the environment.

(Adapted from 'Wikipedia', June 2011)

- (a) What is meant by nuclear fission?
- (b) What is radioactivity?
- (c) What is a nuclear chain reaction?
- (d) What is the function of the control rods?
- (e) What type of material are control rods made of?
- (f) Why did the reactor still generate heat even though the chain reaction had stopped?
- (g) Why is it important to remove the heat generated?
- (h) Give one advantage of nuclear energy.

(8 × 7)

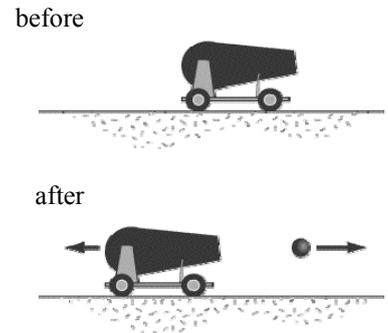
12. Answer any **two** of the following parts (a), (b), (c), (d).

(a) State the principle of conservation of momentum. (6)

A cannon of mass 1500 kg containing a cannonball of mass 80 kg was at rest on a horizontal surface as shown. The cannonball was fired from the cannon with an initial horizontal velocity of  $60 \text{ m s}^{-1}$  and the cannon recoiled.

Calculate

- (i) the recoil velocity of the cannon
- (ii) the kinetic energy of the cannon as it recoils. (12)



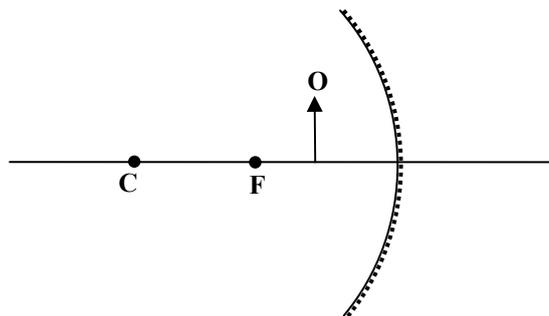
Why did the cannon recoil? (4)

Why will the cannon come to a stop in a shorter distance than the cannonball? (6)

(b) State the laws of reflection of light. (6)

How would you estimate the focal length of a concave mirror? (9)

The diagram shows an object **O** in front of a concave mirror, whose focus is at **F**.



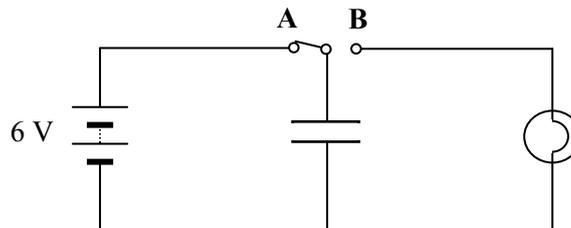
Copy and complete the diagram to show the formation of the image of the object **O**. (9)

Give one use for a concave mirror. (4)

- (c) The pitch of the sound emitted by the siren of a moving fire engine appears to change as it passes a stationary observer.



- (i) Name this phenomenon. (6)
- (ii) Explain, with the aid of a diagram, how this phenomenon occurs. (12)
- (iii) Will the crew in the fire engine notice this phenomenon?  
Give a reason for your answer. (4)
- (iv) Give an application of this phenomenon. (6)
- (d) A capacitor is connected to a switch, a battery and a bulb as shown in the diagram. When the switch is changed 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) Why does the bulb light only briefly? (6)
- (iv) The capacitor has a capacitance of  $200 \mu\text{F}$ . Calculate its charge when connected to a  $6 \text{ V}$  battery. (6)
- (v) Give a use for a capacitor. (4)

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