2009. M 35

Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION, 2009

PHYSICS – ORDINARY LEVEL

MONDAY 15 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 measure *g*, the acceleration due to gravity.

(i)	Draw a labelled diagram of the apparatus you used.	(12)
(ii)	State what measurements you took during the experiment.	(6)
(iii)	Describe how you took one of these measurements.	(9)
(iv)	How did you calculate the value of *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.

> "In my experiment, I prepared ice which was at 0 °C and I added it to warm water in a calorimeter. I waited for all the ice to melt before taking more measurements. I used my measurements to calculate the specific latent heat of fusion of ice."

(i)	Draw a labelled diagram of the apparatus used in the experiment.	(12)
(ii)	What measurements did the student take in the experiment?	(12)
(iii)	How did the student prepare the ice for the experiment?	(4)
(iv)	How did the student know the ice was at 0 °C?	(6)
(v)	Why did the student use warm water in the experiment?	(6)

3. In an experiment, a student investigated the variation of the fundamental frequency f of a stretched string with its length l. During the experiment the student kept the tension in the string constant. The table shows the data recorded by the student.

f/Hz	100	150	200	250	300	350	400
l/m	0.50	0.33	0.25	0.20	0.166	0.142	0.125
$\frac{1}{l}$/m^{-1}						7.04	

(i) Describe, with the aid of a diagram, how the student obtained the data. (12)

(ii) Why was the tension in the string kept constant during the experiment? (6)

(iii) Copy this table and fill in the last row by calculating $\frac{1}{l}$ for each measurement. (6)

(iv) Plot a graph on graph paper to show the relationship between the fundamental frequency and the length of the stretched string (put $\frac{1}{l}$ on the X-axis). (12)

(v) What does your graph tell you about the relationship between the fundamental frequency of a stretched string and its length? (4)

4. In an experiment to investigate the variation of the resistance R of a thermistor with its temperature θ, a student measured the resistance of the thermistor at different temperatures. The table shows the measurements recorded by the student.

θ/°C	20	30	40	50	60	70	80
R/Ω	2000	1300	800	400	200	90	40

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

(ii) How did the student measure the resistance of the thermistor? (6)

(iii) Plot a graph on graph paper to show the relationship between the resistance R of the thermistor and its temperature θ (put θ on the X-axis). (12)

(iv) Use your graph to estimate the temperature of the thermistor when its resistance is 1000 Ω. (4)

(v) What does your graph tell you 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.

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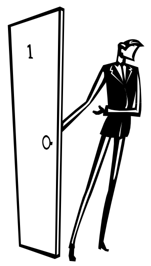
5. Answer any **eight** of the following parts *(a), (b), (c),* etc.

(a) State the principle of conservation of momentum. (7)



(b) A man opens a door by applying a force of 5 N to the door.
The distance from the point of application of the force to the fulcrum is 120 cm.
Calculate the moment of the applied force. (7)
($M = Fd$)

(c) Which of the following is the unit of energy? (7)

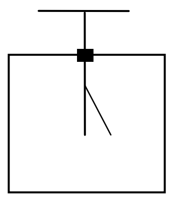
kilogram **watt** **joule** **ampere**

(d) Calculate the wavelength of a radio wave whose frequency is 252 kHz. (7)
($c = f\lambda$, $c = 3.0 \times 10^8$ m s^{-1})

(e) Draw a diagram to show the path of a ray of light travelling through an optical fibre. (7)

(f) Name the property on which the pitch of a musical note depends. (7)

(g) Name the instrument shown in the diagram. (7)



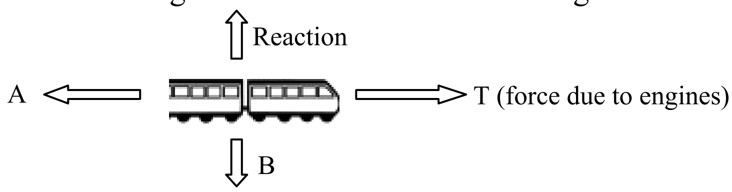
(h) What are isotopes? (7)

(i) Give one application of the photoelectric effect. (7)

(j) List **two** properties of X-rays. (7)

6. Define (i) velocity, (ii) friction. (6)

The diagram shows the forces acting on a train which was travelling horizontally.



A train of mass 30000 kg started from a station and accelerated at 0.5 m s^{-2} to reach its top speed of 50 m s^{-1} and maintained this speed for 90 minutes.

As the train approached the next station the driver applied the brakes uniformly to bring the train to a stop in a distance of 500 m.

(i) Calculate how long it took the train to reach its top speed. (4)

(ii) Calculate how far it travelled at its top speed. (6)

(iii) Calculate the acceleration experienced by the train when the brakes were applied. (6)

(iv) What was the force acting on the train when the brakes were applied? (6)

(v) Calculate the kinetic energy lost by the train in stopping. (6)

(vi) What happened to the kinetic energy lost by the train? (6)

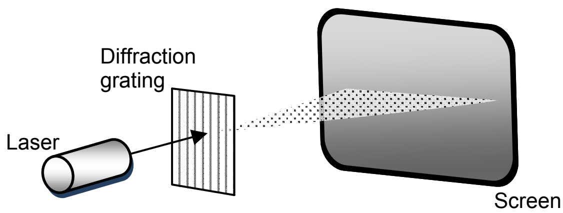
(vii) Name the force A and the force B acting on the train, as shown in the diagram. (4)

(viii) Describe the motion of the train when the force A is equal to the force T. (4)

(ix) Sketch a velocity-time graph of the train's journey. (8)

($v = u + at$, $v^2 = u^2 + 2as$, $s = ut + ½at^2$, $E_k = ½mv^2$, $F = ma$)

7. In an experiment a beam of <u>monochromatic light</u> passes through a <u>diffraction grating</u> and strikes a screen.



(i) Explain the underlined terms. (12)

(ii) Describe what is observed on the screen. (6)

(iii) Explain, with the aid of a diagram, how this phenomenon occurs. (14)

(iv) What does this experiment tell us about the nature of light? (6)

(v) Name the property of light that can be determined in this experiment. (6)

(vi) What measurements must be taken to determine the property you named? (12)

8. Plugs are used to connect electrical appliances in the home to the 230 volt ESB supply. Modern plugs contain a small fuse which comes with a rating of 1A, 2A, 3A, 5A or 13A. The electrical energy supplied by ESB to the home is measured in kWh (*kilowatt-hour*).

(i) What is the colour of the wire that should be connected to the fuse in a plug? (6)

(ii) What is the function of a fuse? (6)

(iii) Explain how a fuse works. (9)

(iv) Name another device with the same function as a fuse. (4)

(v) A coffee maker has a power rating of 800 W.
What is the most suitable fuse to use in the plug of the coffee maker? (9)

(vi) Why would it be dangerous to use a fuse with too high a rating? (6)

If the coffee maker was in use for 150 minutes, calculate:

(vii) The number of units of electricity used by the coffee maker. (10)

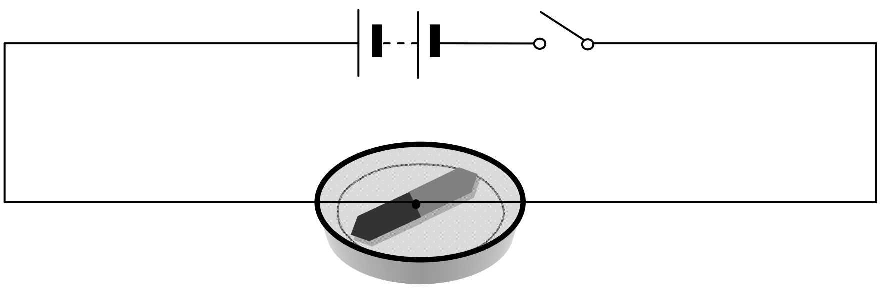
(viii) The cost of the electricity used if each unit costs 15 cent. (6)

($P = VI$)

9. A magnetic field exists in the vicinity of a magnet. What is a magnetic field? (6)

Describe an experiment to show the shape of the magnetic field around a U-shaped magnet. (12)

The diagram shows a compass placed near a wire connected to a battery and a switch.

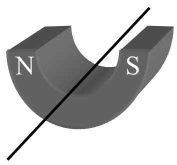


(i) Why happens to the compass when the switch is closed? (6)

(ii) What does this tell you about an electric current? (6)

(iii) What happens to the compass when the switch is opened? (6)

The wire is then placed between the poles of a U-shaped magnet, as shown in the diagram.



(iv) Describe what happens to the wire when a current flows through it. (6)

(v) What would happen if the current flowed in the opposite direction? (6)

(vi) Name two devices that are based on this effect. (8)

10. Radioactive elements are unstable and decay with the release of radiation.

How would you detect radiation? (6)

Name the three types of radiation.

(i) Which radiation is negatively charged?

(ii) Which radiation has the shortest range?

(iii) Which radiation is not affected by electric fields? (12)

Nuclear fission occurs in a nuclear reactor.

(iv) What is nuclear fission? (6)

(v) What is the role of neutrons in nuclear fission? (6)

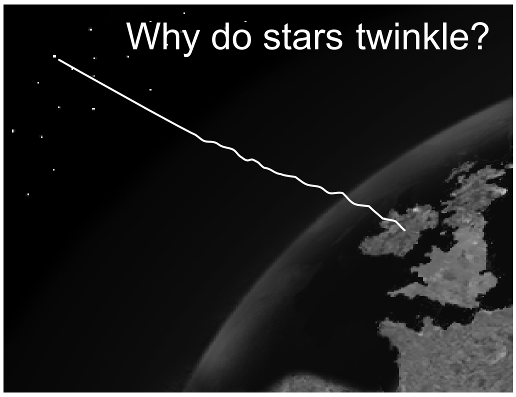
(vi) Name a fuel used in a nuclear reactor. (6)

(vii) In a nuclear reactor, how can the fission be controlled or stopped? (6)

(viii) How is the energy produced in a nuclear reactor used to generate electricity? (9)

(ix) Give one advantage and one disadvantage of a nuclear reactor as a source of energy. (5)

11. Read this passage and answer the questions below.



Why do stars and the lights of distant objects twinkle?

The twinkling of stars, also known as stellar scintillation, is due to atmospheric turbulence. The turbulence of the air is caused by heat changing the density and thus the refractive index of moving pockets of air in the earth's atmosphere. These moving pockets of air act like lenses, refracting light in random directions and causing the stars to "twinkle" – it looks as though the star moves a bit and that it changes colour, and our eyes interprets this as twinkling.

Heat rising from buildings in towns ensures the air is always turbulent around them. We don't usually notice its effect on the appearance of nearby lights, because the turbulence is small by comparison with the size of the lights. On the other hand, lights from a distant town appear so small that the effect of turbulence on them has a significant impact, which we see as twinkling.

The same phenomenon, incidentally, allows us to tell the difference between stars and planets in the night sky. Planets do not usually twinkle, because they are closer to us; they appear big enough that the twinkling is not noticeable. The point-like images of the immensely distant stars are affected by turbulent air far more than the planets.

Stars closer to the horizon appear to twinkle more than stars that are overhead - because the light from stars near the horizon has to travel through more air than the light from stars overhead and so is subject to more refraction.

(Adapted from '*Why don't Spiders Stick to their Webs? and other everyday Mysteries of Science*' by Robert Matthews, One World publications)

(*a*) What causes the twinkling of stars? (7)

(*b*) Give another name for the twinkling of stars. (7)

(*c*) What is meant by the refraction of light? (7)

(*d*) Name two properties of air that are affected by atmospheric turbulence. (7)

(*e*) Why is the air turbulent in towns? (7)

(*f*) How can you tell the difference between a planet and a star in the night sky? (7)

(*g*) Why do stars close to the horizon twinkle more? (7)

(*h*) A star emits light, what is the source of this energy? (7)

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

(*a*) Define pressure. (6)

Describe an experiment to show that the pressure in a liquid increases with depth. (12)

A diver is swimming in a lake at a depth of 5 m.
He then dives deeper until he reached a depth of 30 m.
Calculate the increase in pressure on the diver at this new depth.
(10)

($p = \rho g h$; density of water = 1000 kg m^{-3} ; g = 9.8 m s^{-2})

(*b*) What is meant by the temperature of a body? (6)

Name two scales that are used to measure temperature.
What is the boiling point of water on each of these scales? (9)

The diagram shows a laboratory thermometer, what is its thermometric property? (3)

Name one other type of thermometer and state its thermometric of property. (6)

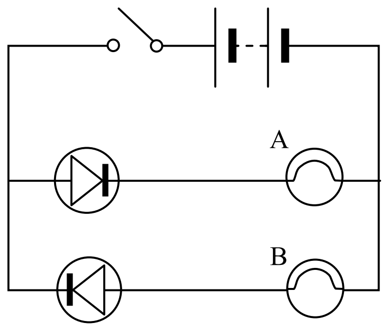
Why is there a need for a standard thermometer? (4)

(*c*) A p-n junction (diode) is formed by <u>doping</u> adjacent layers of a <u>semiconductor</u>. A depletion layer is formed at their junction.

Explain the underlined terms. (9)

How is a depletion layer formed? (6)

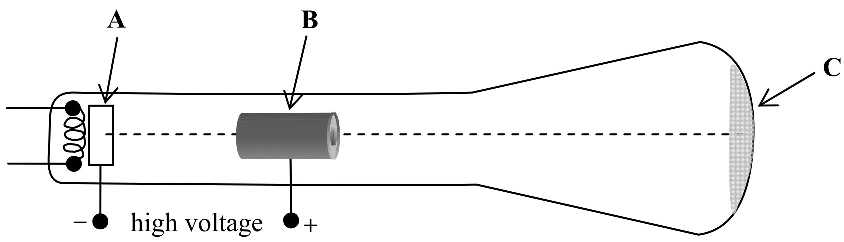
The diagram shows two diodes connected to two bulbs A and B, a 6 V supply and a switch.



What is observed when the switch is closed? (6)

Explain why this happens. (7)

(*d*) The diagram shows a simple cathode ray tube. Thermionic emission occurs at plate **A**.



(i) What is thermionic emission? (6)

(ii) What are cathode rays? (6)

(iii) Why is there a high voltage between **A** and **B**? (6)

(iv) What happens to the cathode rays when they hit the screen **C**? (6)

(v) Give a use for a cathode ray tube. (4)

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