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LEAVING CERTIFICATE EXAMINATION, 2002

PHYSICS – ORDINARY LEVEL

MONDAY, 17 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 have carried out an experiment to measure *g*, the acceleration due to gravity.

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

Describe the procedure involved in measuring the time in this experiment. (9)

As well as measuring time, what other measurement did you take? (6)

Outline how you got a value for *g* from your measurements. (9)

Name one precaution you took to get an accurate result. (4)

2. In a report of an experiment to investigate the variation of fundamental frequency of a stretched string with length, a student wrote the following.

"The wire was set vibrating at a known frequency.
The length of the wire was adjusted until it vibrated at its fundamental frequency. The length was recorded.
A different frequency was applied to the wire and new measurements were taken.
This procedure was repeated a few times."

How was the wire set vibrating? (9)
How was the length adjusted? (6)

The table shows the measurements recorded by the student.

fundamental frequency/Hz	650	395	290	260	192	174	163
length/m	0.20	0.33	0.45	0.50	0.66	0.75	0.80
$\frac{1}{\text{length}}$ /m^{-1}							

Copy the table and complete the last row by calculating $\frac{1}{\text{length}}$ for each measurement. (6)

Plot a graph on graph paper of fundamental frequency against $\frac{1}{\text{length}}$. Put fundamental frequency on the vertical axis. (12)

What does the graph tell you about the relationship between fundamental frequency and length? (7)

3. A student carried out an experiment to measure the focal length of a concave mirror. The student placed an object at different positions in front of the mirror so that a real image was formed in each case.

The table shows the measurements recorded by the student for the object distance u and the image distance v.

u/cm	20	30	40	50
v/cm	64	43	41	35

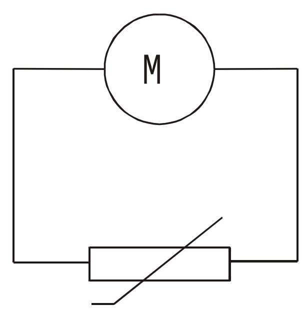
Draw a labelled diagram showing how the apparatus was arranged. (9)

Describe how the student found the position of the image. (7)

Show on your diagram the object distance u and the image distance v. (6)

Using the formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ or otherwise and the above data, find an average value for the focal length f of the mirror. (18)

4. The circuit diagram shows a thermistor connected to a meter M. A student used the circuit to measure the resistance R of the thermistor at different temperatures θ.



Name the meter M used to measure the resistance of the thermistor. (6)

Explain, with the aid of a labelled diagram, how the student varied the temperature of the thermistor. (9)

How did the student measure the temperature of the thermistor? (6)

The table shows the measurements recorded by the student.

θ/°C	20	30	40	50	60	70	80	90
R/Ω	1300	900	640	460	340	260	200	150

Draw a graph on graph paper of resistance R against temperature θ. Put temperature on the horizontal axis. (12)

Using your graph, estimate the temperature of the thermistor when the meter M read 740 Ω. (7)

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? (7)

(b) A car of mass 800 kg is travelling at 10 m s^{-1}. What is its kinetic energy? ($E_k = \frac{1}{2}mv^2$) (7)

(c) In the following table, match the scientist in the first column with the law in the second column. (7)

A. Michael Faraday	1. Law of refraction
B. Isaac Newton	2. Law of electromagnetic induction
C. Willebrord Snell	3. Law of gravitation

(d) What is the effect of increasing the U-value of a structure? (7)

(e) What physical quantity is measured in decibels? (7)

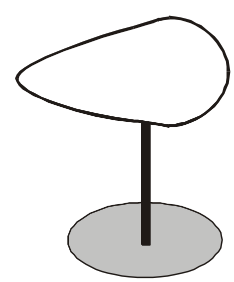
(f) A lens has a power of +50 m^{-1}. What type of lens is it and what is its focal length? ($P = \frac{1}{f}$) (7)

(g) What is meant by a thermometric property? (7)

(h) Give an example of the Doppler effect. (7)

(i) What is the purpose of a miniature circuit breaker (MCB) in an electrical circuit? (7)

(j) A pear-shaped conductor is placed on an insulated stand as shown. The conductor is given a positive charge. Copy the diagram and show how the charge is distributed over the conductor. (7)



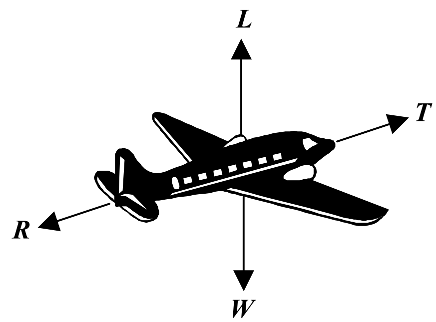
6. Define (i) velocity, (ii) acceleration. (12)

Copy and complete the following statement of Newton's first law of motion.

"An object stays at rest or moves with constant velocity (i.e. it does not accelerate) unless……………….." (6)

The diagram shows the forces acting on an aircraft travelling horizontally at a constant speed through the air.

L is the upward force acting on the aircraft.
W is the weight of the aircraft.
T is the force due to the engines.
R is the force due to air resistance.



What happens to the aircraft when the force *L* is greater than the weight of the aircraft? (6)

What happens to the aircraft when the force *T* is greater than the force *R*? (6)

The force *T* exerted by the engines is 20 000 N. Calculate the work done by the engines while the aircraft travels a distance of 500 km. (6)

The aircraft was travelling at a speed of 60 m s^{-1} when it landed on the runway. It took two minutes to stop. Calculate the acceleration of the aircraft while coming to a stop. (9)

The aircraft had a mass of 50 000 kg. What was the force required to stop the aircraft? (6)

Using Newton's first law of motion, explain what would happen to the passengers if they were not wearing seatbelts while the aircraft was landing. (5)

($W = Fs$; $v = u + at$; $F = ma$)

7. The dispersion of white light can be produced by <u>refraction</u> or <u>diffraction</u>. Explain the underlined terms. (18)

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

The following table gives examples of electromagnetic waves and their typical wavelengths.

wave	radio	microwave	infrared	light	ultraviolet
wavelength	100 m	0.1m	1μm	600 nm	10 nm

Name one property that all of these waves have in common. (6)

What is the frequency of the radio waves? The speed of light is 3×10^8 m s^{-1}. (6)

Describe how infrared radiation can be detected. (6)

Give two uses of microwaves. (8)

$(c = f\lambda)$

8. Explain (i) potential difference, (ii) electric current. (12)

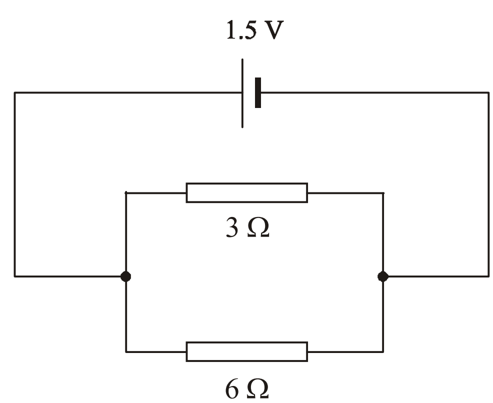
Give one difference between conduction in metals and conduction in semiconductors. (6)

A circuit consists of a 3 Ω resistor and a 6 Ω resistor connected in parallel to a 1.5 V d.c. supply as shown.

Calculate the total resistance of the two resistors. (9)

Calculate the current flowing in the circuit. (6)

What is the current in the 3 Ω resistor? (6)



Semiconductors can be made p-type or n-type. How is a semiconductor made p-type? (6)

Draw a diagram showing a p-n junction connected in forward bias to a d.c. supply. (6)

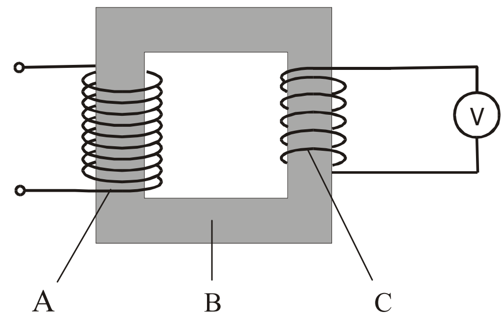
Give two uses of semiconductors. (5)

$\left(V = IR;\ \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \right)$

9. What is electromagnetic induction? (9)

Describe an experiment to demonstrate electromagnetic induction. (12)

The transformer is a device based on the principle of electromagnetic induction.
Name two devices that use transformers. (6)



Name the parts of the transformer labelled A, B and C in the diagram. (9)

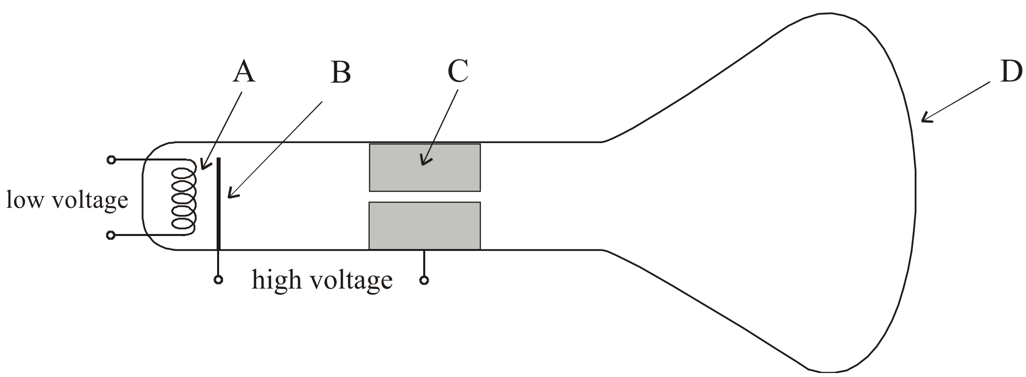
The mains electricity supply (230 V) is connected to A, which has 400 turns. C has 100 turns. What is the reading on the voltmeter? (9)

How is the part labelled B designed to make the transformer more efficient? (6)

The efficiency of a transformer is 90%. What does this mean? (5)

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

10. What is thermionic emission? (9)

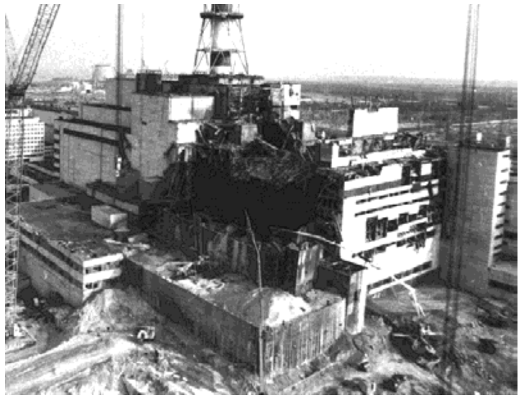


The diagram shows a simple cathode ray tube.
Name the parts labeled A, B, C and D in the diagram. (12)
Give the function of any two of these parts. (12)
How can the beam of electrons be deflected? (6)
Give a use of a cathode ray tube. (3)

In an X-ray tube, electrons are also produced by thermionic emission.
Draw a sketch of an X-ray tube. (11)

Why is a lead shield normally put around an X-ray tube? (3)

11. Read the following passage and answer the accompanying questions.



Chernobyl

The world's most devastating nuclear accident happened at Chernobyl in the Ukraine in 1986. In the early hours of the morning of 26 April of that year, there were two loud explosions that blew the roof off and completely destroyed the No. 4 reactor, releasing during the course of the following days, 6 to 7 tonnes of radioactive material, with a total activity of about 10^{18} becquerels, into the atmosphere.

The discharge included over a hundred radioisotopes, but iodine and caesium isotopes were of main relevance from a human health and environmental point of view. Contamination in the surrounding areas was widespread, with the half-life of some of the materials measured in thousands of years.

Large numbers of people involved in the initial clean up of the plant received average total body radiation doses of about 100 mSv - about five times the maximum dose permitted for workers in nuclear facilities. Average worldwide total body radiation dose from natural 'background' radiation is about 2.4 mSv annually.

During, and soon after the accident and the initial clean-up, at least 30 plant personnel and firefighters died from burns and radiation. In the eight years following the accident, a further 300 suffered radiation sickness, and there are possible links between the accident and increased numbers of thyroid cancers in neighbouring regions.

(Adapted from "Physics – a teacher's handbook", Dept. of Education and Science.)

(a) What is meant by a nuclear accident? (7)

(b) The No. 4 reactor was a fission reactor. What is nuclear fission? (7)

(c) Name two parts of a nuclear fission reactor. (7)

(d) What is measured in becquerels? (7)

(e) Give two examples of radioisotopes. (7)

(f) What is meant by the half-life of a substance? (7)

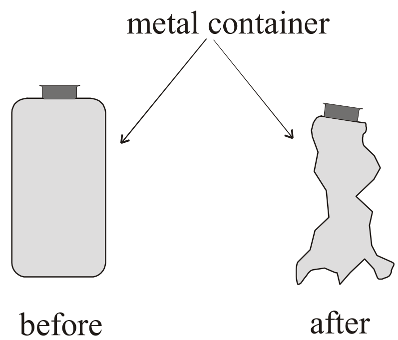
(g) What is meant by background radiation? (7)

(h) Give two effects of radiation on the human body. (7)

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

(a) What is meant by pressure? Give the unit of pressure. (9)

Name an instrument used to measure pressure. (6)



When air is removed from the metal container shown in the diagram, it collapses. Explain why. (9)

The wind exerts a horizontal force of 1000 N on a wall of area 20 m^2. Calculate the pressure at the wall. (4)

$(p = \frac{F}{A})$

(b) Define specific heat capacity. (9)

An electric kettle contains 1.5 kg of water. The specific heat capacity of water is 4180 J kg^{-1} K^{-1}. Calculate the amount of energy required to raise the temperature of the water from 15 ^{o}C to 100 ^{o}C. (9)

The kettle takes 4 minutes to heat the water from 15 ^{o}C to 100 ^{o}C. Calculate the power of the kettle. (Assume all the energy supplied is used to heat the water.) (6)

Why is the heating element of an electric kettle near the bottom? (4)

$(Q = mc\Delta\theta;\ P = \frac{W}{t})$

(c) Define capacitance. (6)

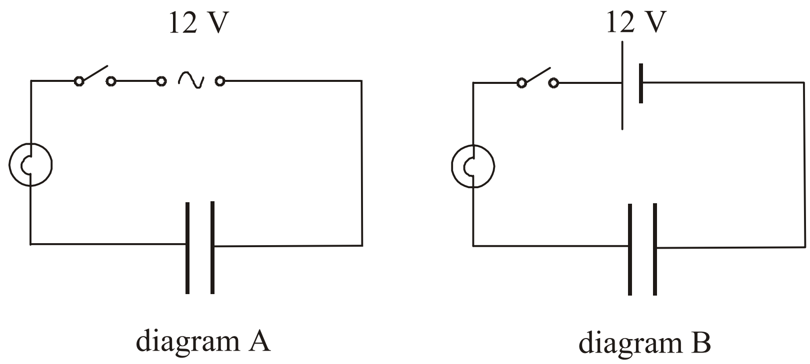


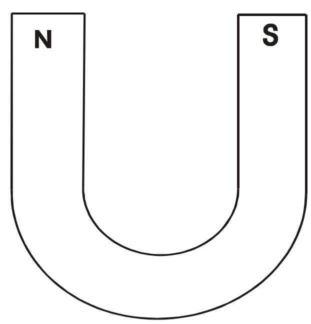
Diagram A shows a capacitor connected to a bulb and a 12 V a.c. supply.

Diagram B shows the same capacitor connected to the bulb, but connected to a 12 V d.c. supply.

What happens in each case when the switch is closed? Explain your answer. (10)

Describe an experiment to demonstrate that a capacitor can store energy. (12)

(d) The diagram shows a U-shaped magnet. Copy the diagram and show on it the magnetic field lines due to the magnet. (6)



Describe an experiment to demonstrate that a current-carrying conductor in a magnetic field experiences a force. (12)

List two factors that affect the size of the force on the conductor. (6)

Name one device that is based on the principle that a current-carrying conductor in a magnetic field experiences a force. (4)