Name: Register Number: Class:

For Marker's Use

Parent's Signature:

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南僑中學

NAN CHIAU HIGH SCHOOL

PRELIMINARY EXAMINATION 2022
SECONDARY FOUR EXPRESS

PHYSICS **6091/02**

Paper 2 **23 Aug 2022 Tuesday**

1 hour 45 mins

Candidates answer on the Question Paper.
No additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided on the question paper.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid or tape.
The use of an approved calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A: 50 marks
Answer **all** questions.

Section B: 30 marks
Answer **all** questions. Question 12 has a choice of parts to answer.

The total mark for this paper is **80**.
Take gravitational field strength of Earth = 10 N kg^{-1} and acceleration due to gravity = 10 m s^{-2}.

This question paper consists of **20** printed pages, including this cover page.

Section A

Answer **all** the questions in this section

1 Fig. 1.1 (not drawn to scale) shows the side view of a steel ball 2.0 kg suspended by 2 strings attached to the ceiling. String 1 and string 2 are 35° and 55° from the vertical respectively. The tensions in strings 1 and 2 are T_1 and T_2 respectively.

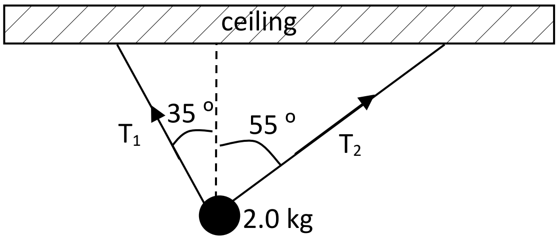

Fig. 1.1 (Side view)

(a) State and explain if the ball is at equilibrium. [2]

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(b) Calculate the weight of the ball. [1]

(c) Draw the weight and label it as **W** in Fig. 1.1. [1]

(d) By drawing a scaled vector diagram below, determine the magnitudes of tension $\mathbf{T_1}$ and tension $\mathbf{T_2}$. [3]

Tension T_1 = ______________

Tension T_2 = ______________

2 A rock is travelling in a straight line downwards at high speed in air when it enters a deep pond. Fig. 2.1 shows the speed-time graph of the rock from time t = 0 s to time t = 50 s.

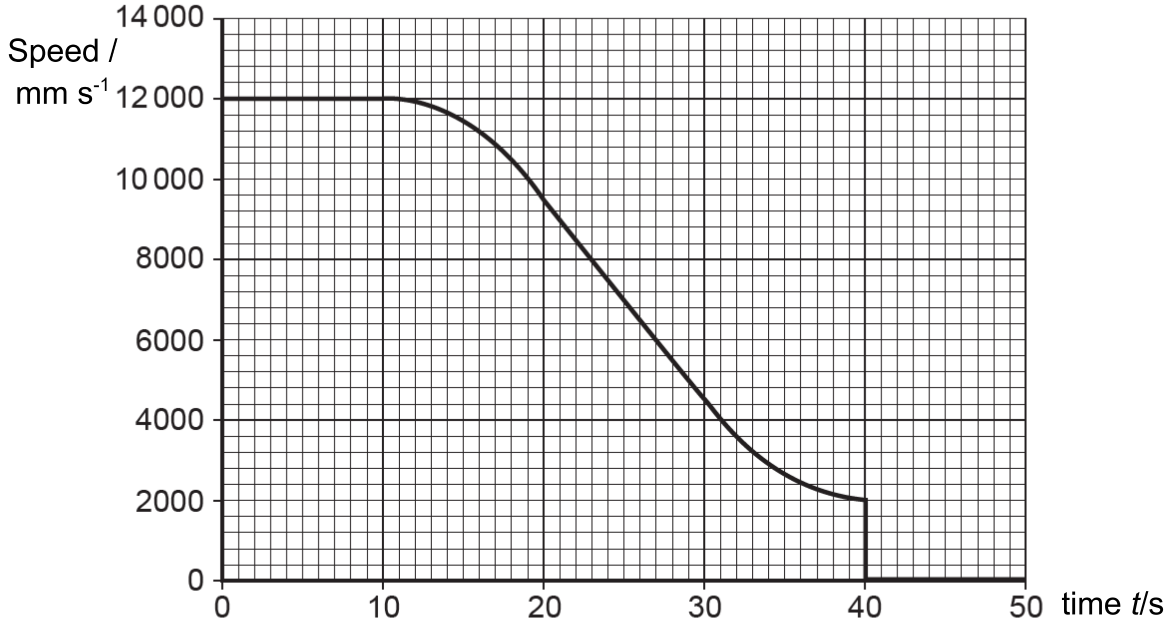

Fig. 2.1

(a) On Fig 2.1, mark on the graph with a point and label it **D**, when the rock has *increasing* deceleration. [1]

(b) Calculate the deceleration of the rock at t = 25 s. [2]

(c) Describe and explain what happens to the motion of the rock at t = 40 s. [2]

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3 Fig. 3.1 shows a 600 N man standing on the second rung of a 25 N ladder.

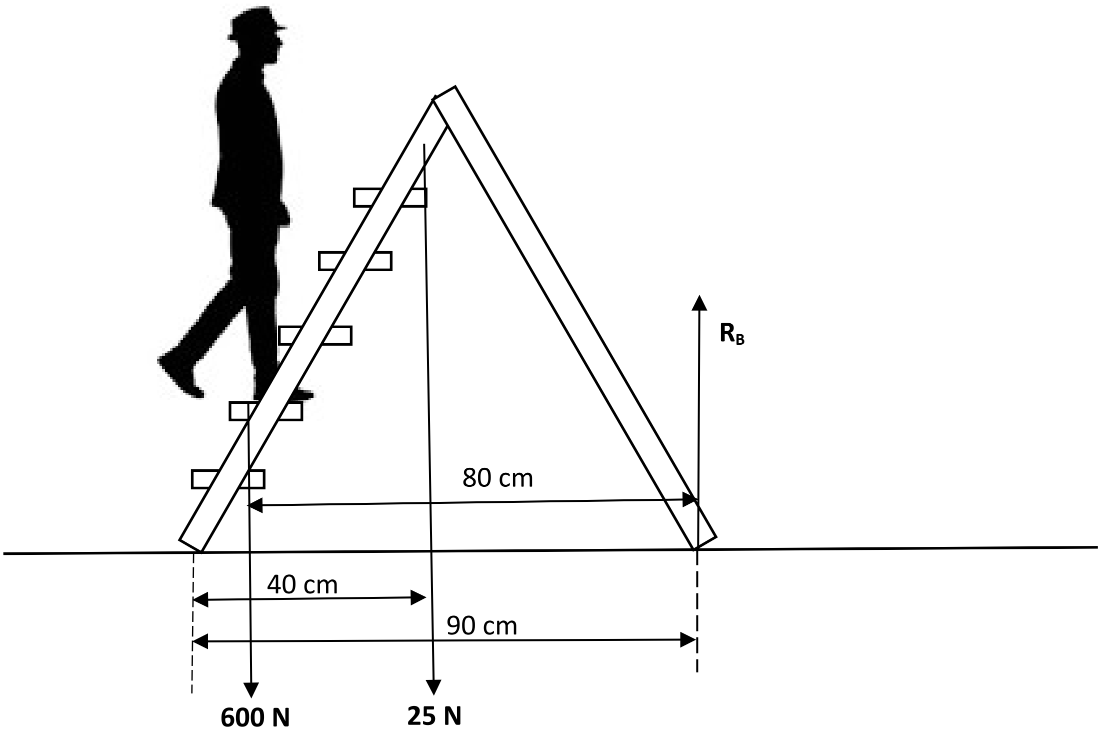

Fig. 3.1

(a) State the *Principle of Moments*. [2]

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(b) Calculate the normal reaction force $\mathbf{R_B}$. [2]

(c) The man climbs up the ladder. State what happens to the position of the centre of gravity and the stability of the man-ladder system. [2]

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4 Fig. 4.1 shows an experiment to analyse the motion of a 5.0 kg stone dropping from rest from two very different heights from the ground. In this experiment, air resistance is assumed to be negligible.

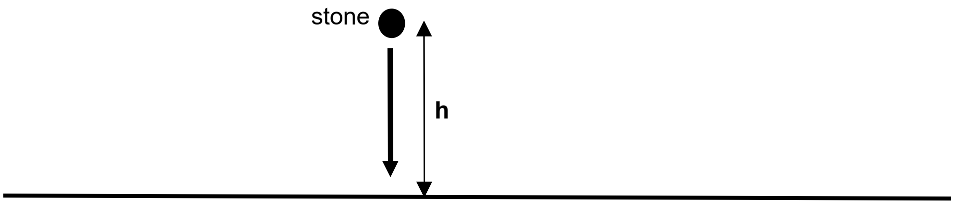

Fig. 4.1

(a) Define *gravitational field strength*. [1]

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(b) The stone is dropped from a height of 40 m from the ground.
On the axes given in Fig. 4.2, sketch the graph of the

(i) gravitational potential energy, label it as **P**, of the stone against the height, **h** from ground, and

(ii) kinetic energy, label it as **K**, of the stone against the height, **h** from the ground. [3]

The graphs drawn should clearly show the relationship between **P** and **K**. No numerical value is required for the graphs.

Fig. 4.2

(c) The gravitational field strengths of the Earth at heights of 40 m and at 40 km are 10 N kg^{-1} and 9.7 N kg^{-1} respectively.

Calculate the change in potential energy of the stone when it falls from 40 km to 40 m. [2]

5 Fig. 5.1 shows the landscape of a mountain. The reading of a mercury barometer at the foot of the mountain is 76.0 cmHg. On point **P**, the summit of the mountain, its reading drops to 70.0 cmHg. The density of mercury is 13 600 kg m^{-3} and the density of air is 1.23 kg m^{-3}.

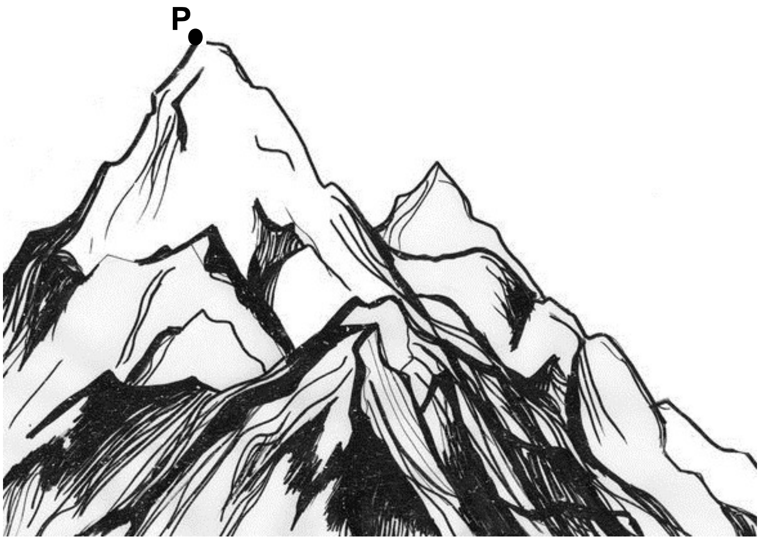

Fig. 5.1

(a) Calculate the height of the mountain. [3]

(b) Explain in terms of molecules, why the boiling point of pure water is not 100 °C at point **P**. [2]

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6 Fig. 6.1 shows an uncalibrated mercury thermometer first placed in a plastic box with 300 ml of crushed ice. After 10 seconds, the height of the mercury column was marked with a thick blue marker. The uncalibrated thermometer was then placed in 500ml of hot water heated over a stove at a constant 80 °C. When the height of the mercury column had stabilised after 2 minutes, the new height of the mercury column was marked with a thick red marker. The length between both markings were then divided into divisions of 10 °C and marked accordingly.

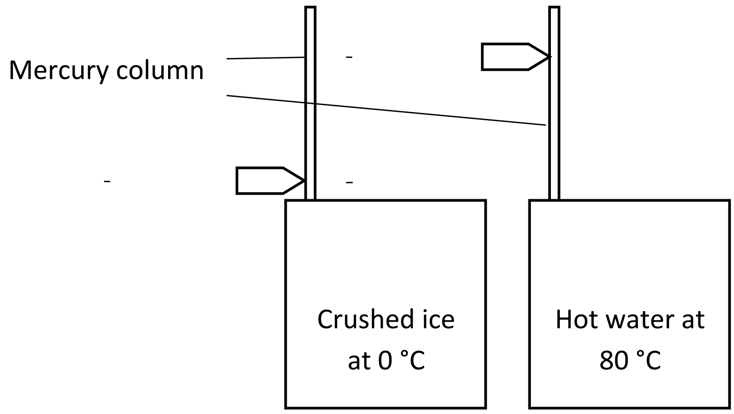

Fig. 6.1

Suggest three ways you can improve this calibration process. [3]

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7 Fig. 7.1 shows a negative charged metal plate X, an uncharged metal plate Y and a connection to earth. Plate X and Plate Y are on insulating stands.

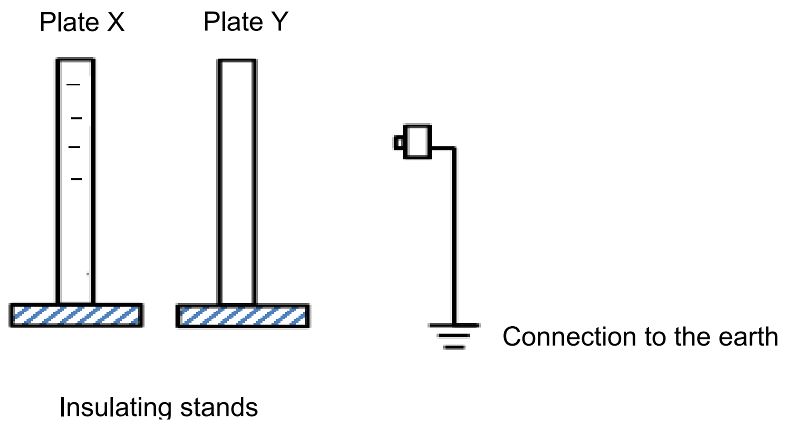

Fig. 7.1

(a) Explain what is meant by *electrostatic induction*. [1]

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(b) Explain why insulators **cannot** be charged by electrostatic induction. [1]

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(c) With the aid of the apparatus shown in Fig 7.1, describe clearly the steps to obtain a positively-charged plate Y. [2]

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8 The graphs in Fig. 8.1 show the relation between the current, I and the potential difference, V for a resistor and a lamp.

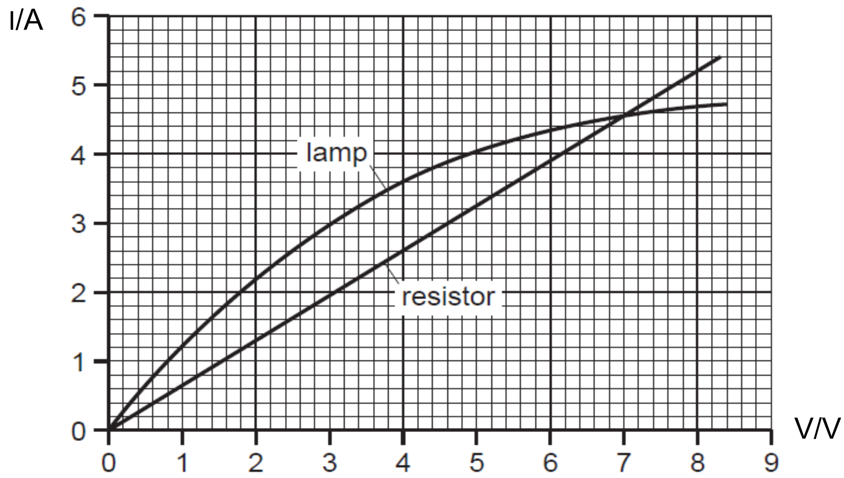

Fig. 8.1

(a) State and explain, for the resistor and the lamp, if they are *ohmic*. [3]

Resistor : ……………………………………………………………………………………………..……

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Lamp : …………………………………………………………………………………………………

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(b) Using Fig. 8.1, determine the potential difference across the lamp when it has the same resistance as the resistor. [1]

(c) The lamp is connected in series with the resistor and powered by a 7.6 V d.c. supply as shown in Fig. 8.2.

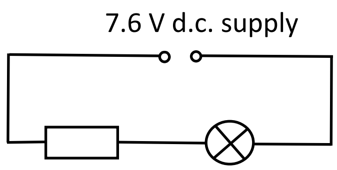

Fig. 8.2

Using Fig. 8.1, determine the resistance of the lamp in Fig. 8.2. [2]

9 A student finds an old iron bar and a magnet in a drawer.

(a) Iron is a magnetic material. State two properties of a *magnetic material*. [2]

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(b) He brings the iron bar near to a permanent magnet as shown in Fig. 9.1. The iron bar is attracted by the permanent magnet.

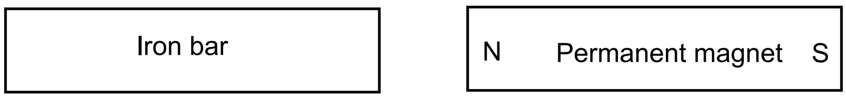

Fig. 9.1

(i) State the material the permanent magnet is made of. [1]

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(ii) Explain how the iron bar can be attracted by the permanent magnet. [2]

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(c) Describe, with an aid of a diagram, how you would de-magnetise a magnet using the electrical method. [3]

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Section B

Answer **all** the questions in this section.

10 **(a)** Fig. 10.1 shows an experimental set-up in which electrical energy from a heater is used to produce a measured rise in temperature of a liquid.

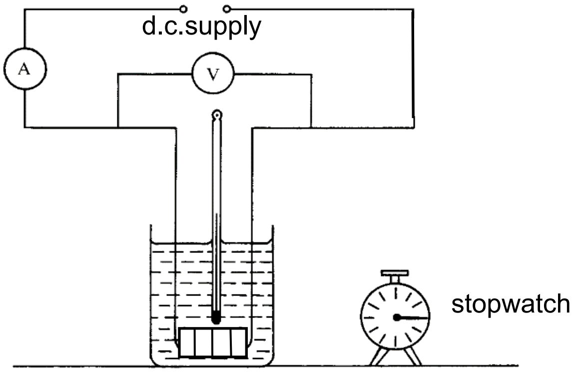

Fig. 10.1

The room temperature is 30 °C.

(i) Explain why the heater is placed at the bottom of the liquid. [2]

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(ii) The temperature of the liquid reaches 38 °C from room temperature in 12 minutes after the d.c. supply is switched on. The voltmeter and ammeter readings are 20 V and 5.0 A respectively. Calculate the combined heat capacity of the liquid and the container. [2]

(iii) A student suggests that in order to improve the accuracy of the heat capacity calculated in part (ii) above, the liquid and the container should be first cooled to 26 °C and the d.c. supply switched on until the temperature is 34 °C. Do you agree with the student's suggestion and why? [2]

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(b) Fig. 10.2 shows a graph of image distance against object distance of a converging lens.

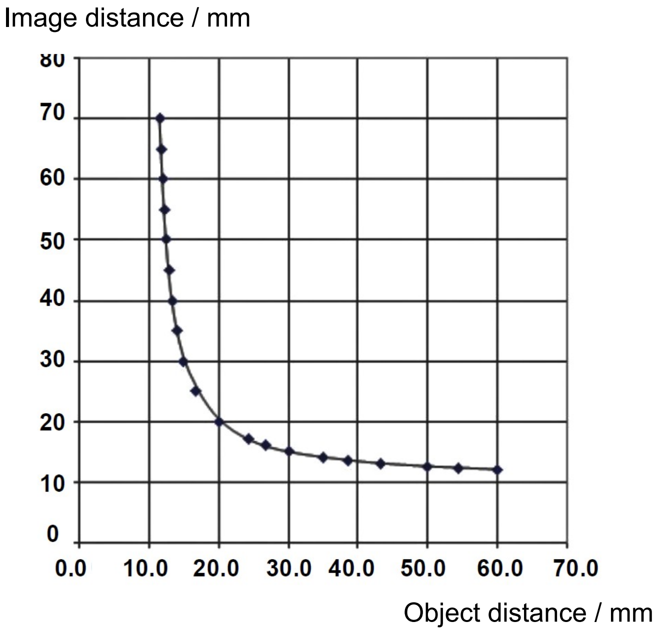

Fig. 10.2

(i) A student places an object 30.0 mm from the lens. State 3 properties of the image formed. [2]

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(ii) Using Fig. 10.2, determine the focal length of the lens. Explain your answer using either drawings, words or calculations. [2]

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11 **(a)** LASER is the acronym for Light Amplification by Simulated Emission of Radiation. Fig. 11.1 shows different brands of laser guns for industrial use and their specific wavelengths. All laser guns emit electromagnetic waves.

An enthusiastic laser user sorts out the different brands of laser guns into Types I, II and III.

He also discovers that the Red Beam laser gun emits a bright, red light.

Type	**brand of laser gun**	**wavelength / x 10^{-7} m**
I	Trace	3.2
II	Eagle Eye	4.9
	Fire Fly	5.5
	Red Beam	6.3
III	Sparrow Beak	9.8

Fig. 11.1

(i) State the type of electromagnetic waves emitted by Type I, Type II and Type III laser guns in the electromagnetic spectrum respectively. [2]

Type I : …………………………………………………………………………………………

Type II :…………………………………………………………………………………………

Type III : ………………………………………………………………………………………

(ii) State and explain which brand(s) of the laser guns listed in Fig. 11.1 can be used in a vacuum environment? [2]

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(b) A battery of e.m.f. 12 V, is connected to a light-dependent resistor (LDR), a lamp, two fixed resistors and ammeter as shown in Fig. 11.2. The resistances of the LDR is 180 Ω and 1800 Ω in bright and dark conditions respectively.

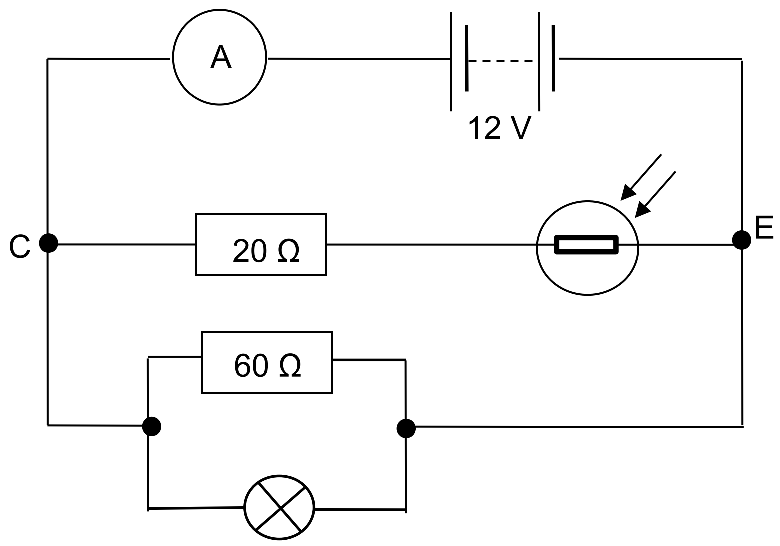

Fig. 11.2

(i) In bright condition, the ammeter reads 0.66 A. Calculate the resistance of the lamp in bright condition. [3]

(ii) The room is getting darker.

1. State and explain, if any, the changes in the brightness of the lamp. [2]

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2. State the changes if any, in the reading of the ammeter. [1]

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12 Either

(a) Fig. 12.1 shows the top view of two wires X and Y.
These wires carry equal currents vertically downwards through a piece of cardboard.

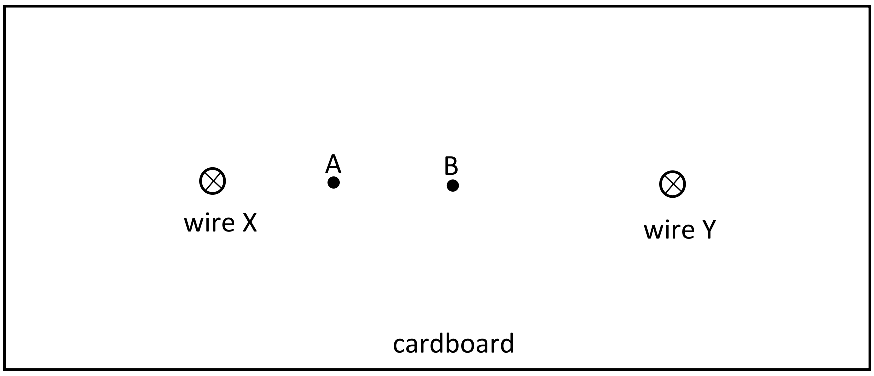

Fig. 12.1

In this question, ignore the effects of the Earth's magnetic field.

(i) On Fig 12.1, draw a complete magnetic field line that passes through point A due to the current in wire X. Mark the direction of this field line. [2]

(ii) Point B is midway between the two wires.
State and explain the direction of the magnetic field line, if any, at point B. [2]

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The current in wire Y is increased while the current in wire X is kept constant as before.

(iii) State the direction of magnetic field at point B now. [1]

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(b) Fig. 12.2 shows a simplified d.c. motor.

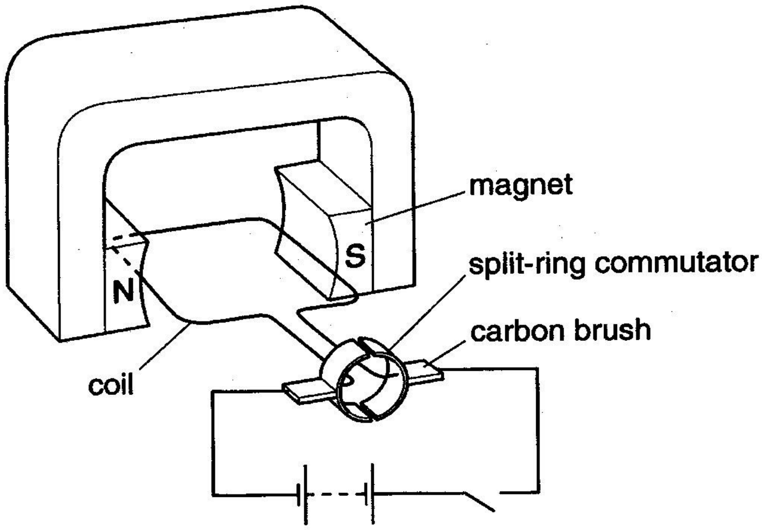

Fig. 12.2

(i) State the functions of the magnet and carbon brush. [2]

Magnet : ....

Carbon brush : ....

(ii) Explain why the coil can turn continuously in the same direction. [3]

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12 OR

(a) Fig. 12.3 shows an anemometer, a device for measuring the speed and force of the wind.

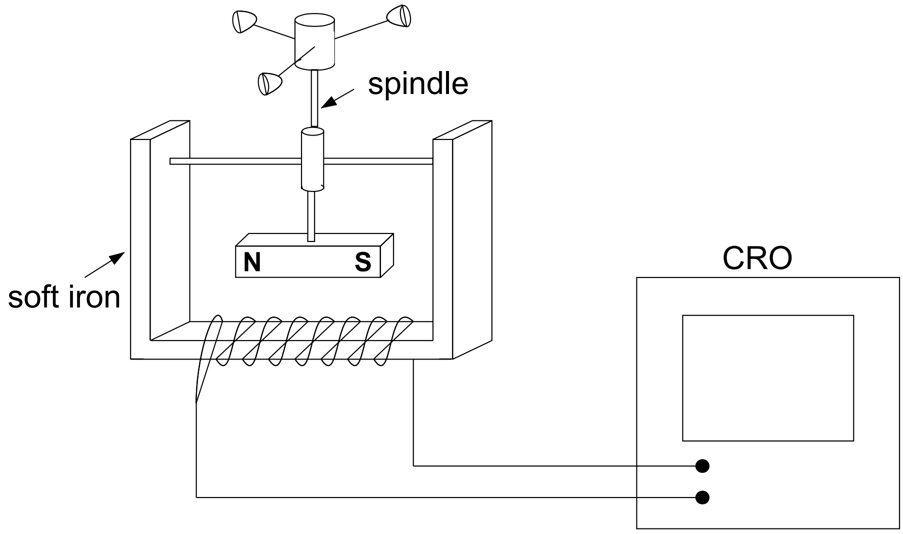

Fig. 12.3

The cups rotates about the spindle when a wind blows. The stronger the wind, the faster the spindle rotates. The spindle is also attached to a permanent magnet which is near a solenoid whose ends are connected to Cathode Ray Oscilloscope (CRO).The period of rotation is 0.50 s.

(i) Explain why an alternating electromotive force (e.m.f.) is produced in the oscilloscope when the spindle rotates. [2]

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(ii) The peak voltage of the induced e.m.f. is 0.40 V.

1. On Fig. 12.4, sketch the graph you will observe in the oscilloscope when the magnet rotates. The oscilloscope has a Y-gain of 0.10 V/div and a timebase of 0.10 s/div. [2]

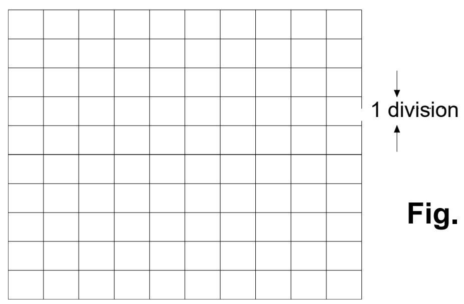

Fig. 12.4

2. On Fig 12.4, mark the instant when the magnet is in the position shown in Fig. 12.3. Label it as **A**. [1]

(iii) A semi-conducting diode is connected in series to the CRO as shown in Fig. 12.5.

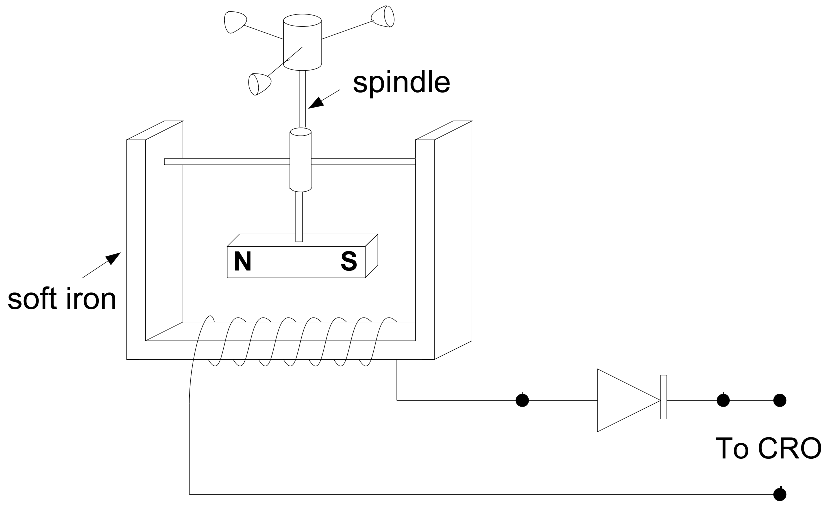

Fig. 12.5

On Fig. 12.6 below, sketch the graph shown on the CRO. [2]

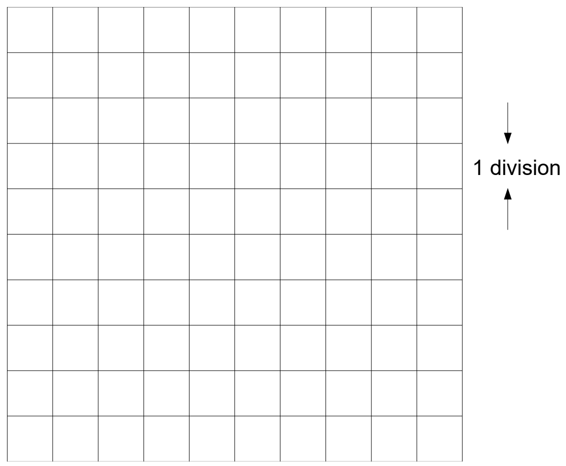

Fig. 12.6

(b) Fig. 12.7 shows a schematic diagram of a transformer.

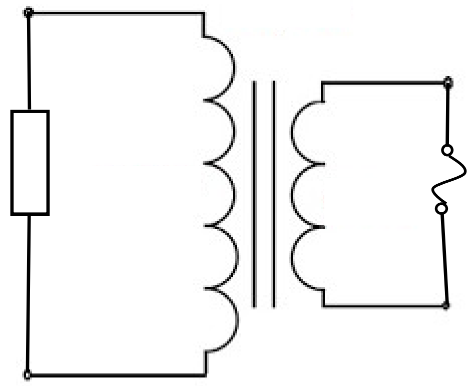

Fig. 12.7

(i) State whether it is a step-up or step-down transformer. [1]

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(ii) State one factor that will reduce this efficiency of a transformer and describe how you would improve the efficiency. [2]

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