O

JURONGVILLE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
Secondary 4 Express

STUDENT NAME

CLASS

INDEX NUMBER

PHYSICS 6091/02

Paper 2 Theory **12 August 2024**

Candidates answer on the Question Paper. **1 hour 45 minutes**
No additional materials are required.

READ THESE INSTRUCTIONS FIRST
Do not open this booklet until you are told to do so.

Write your Name, Index number and Class in the spaces at the top of this page.
Write in dark blue or black ink.
You may use an HB soft pencil for any diagrams or graph.
Do not use staples, paper clips, glue or correction fluid.

Section A:
Answer **all** the questions in the spaces provided.

Section B:
Answer only **one** of the two questions from this section.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for the sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in the brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	/ 70
Section B	/ 10
Total	/ 80

Setter: Mr Lam Seng Tat

This document consists of 18 printed pages.

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Section A (70 marks)

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

1 A student releases a rubber ball from rest. It hits the ground with a velocity of +6.0 m/s. The acceleration due to gravity is 10.0 m/s^2.

(a) Calculate the time taken for the ball to hit the ground after the student drops it.

time taken = …….. [2]

(b) The ball bounced immediately without loss of energy. The ball reaches back to its original height before it was caught by the student.

On Fig. 1.1, draw the velocity-time graph for the ball. [2]

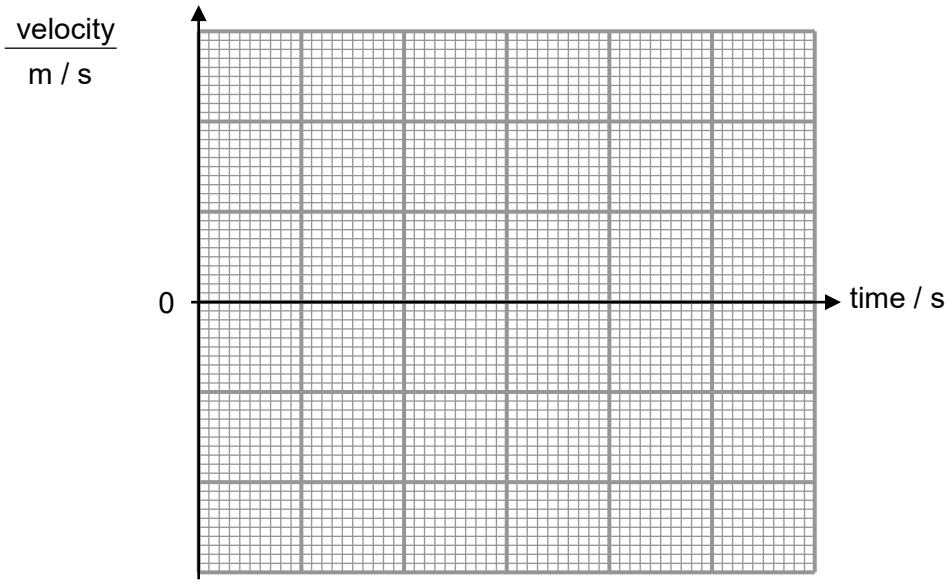


Fig. 1.1

(c) Calculate the height at which the rubber ball was released.

height = …….. [2]

[Total:6]

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2 Fig. 2.1 shows a kite flown by a student. The kite has a weight of 5 N and is held in position by a string with tension of 40 N.

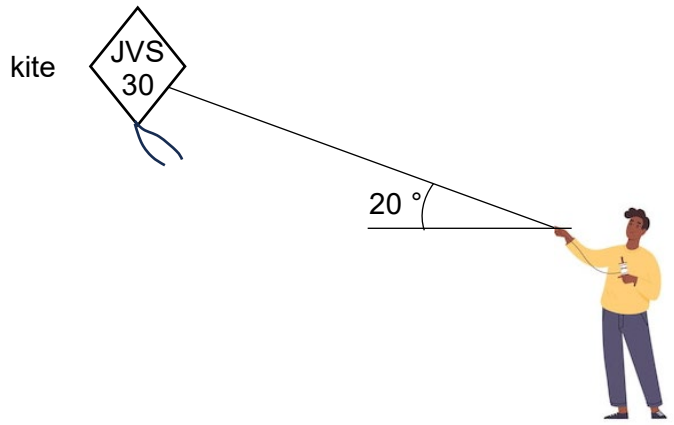


Fig. 2.1

(a) In the space below, draw a scaled and labelled diagram to determine the resultant force of the weight of the kite and the tension of the string acting on the kite. Determine the force due to the wind acting on the kite to keep the kite in position. [1]

magnitude of force due to wind = …….. [1]

direction of force due to wind = ……..…….. [1]

(b) Calculate the acceleration of the kite if the kite is allowed to fly in the direction of the wind force. Assume the same force due to wind as in **(a)** and take gravitational field strength to be 10 N/kg.

acceleration = …….. [2]

[Total:5]

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3 Fig. 3.1 shows a 2 m uniform plank kept in a horizontal position by two supports, A and B. The plank has a weight of 24 N. A 76 N load is placed vertically above support B.

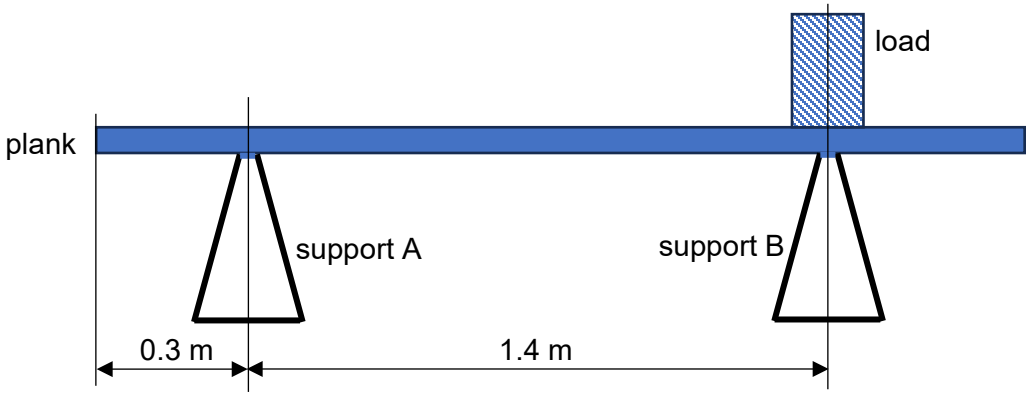


Fig. 3.1

(a) Explain why the load does not produce a moment about support B.

……

……

……[1]

(b) Calculate the force acting at support A when the load is placed vertically above support B.

force at support A = …….. [2]

(c) Calculate the maximum distance that the load can be moved to the right of support B such that the plank does not lift from support A.

distance moved = …….. [2]

[Total:5]

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4 Fig. 4.1 shows a 29 kg gas cylinder placed on a horizontal floor. The gas cylinder exerts 2.3 kPa on the floor.



Fig. 4.1

(a) Define pressure.

……

……[1]

(b) Calculate the base area of the gas cylinder.

area = …… [2]

(c) Fig. 4.2 shows a manometer used to measure the pressure inside the gas cylinder.

Calculate the pressure in the gas cylinder. The atmospheric pressure is 1.0×10^5 Pa. The density of mercury is 13 600 kg/m^3.

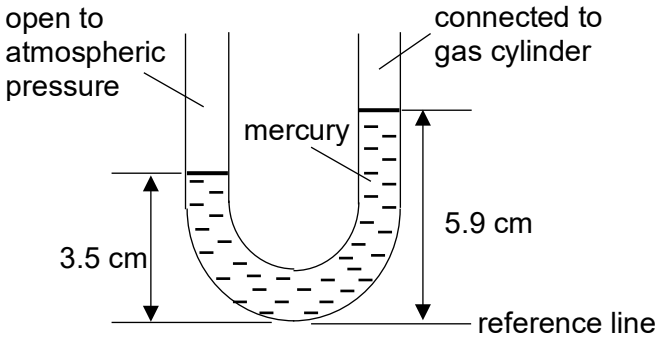


Fig. 4.2

pressure in gas cylinder = …… [2]

[Total:5]

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5 **(a)** Dust particles in an enclosed container were observed to move faster after some time.

Describe how this observation relates to the change in energy and temperature of the gas in the container.

……

……

……

……[2]

(b) Explain why an electric heater used to heat air in a room is placed on the floor.

……

……

……

……[2]

(c) Fig. 5.1 shows a steel pot used to boil water. The 1.2 kg pot contains 3.0 kg of water at 30 °C room temperature. Steel has a specific heat capacity of 445 J/kg K. Water has a specific heat capacity of 4200 J/kgK and specific latent heat of vaporisation of 2.3 x 10^6 J/kg.



Fig. 5.1

(i) Define specific latent heat of vaporisation.

……

……[1]

(ii) A 2000 W induction cooker is used to boil water. The steel pot reaches a temperature of 120 °C while water is boiling at 100 °C.

Calculate the time taken to boil 0.5 kg of water. Assume no energy loss to the surroundings.

time taken = …… [2]

[Total:7]

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6 Fig. 6.1 shows a boy playing a violin.



Fig. 6.1

(a) Explain how sound from the violin is produced and transmitted.

……

……

……

……[2]

(b) Fig. 6.2 shows a representation of a violin note.

Sketch on Fig. 6.2 another note twice the pitch and twice the loudness. [2]

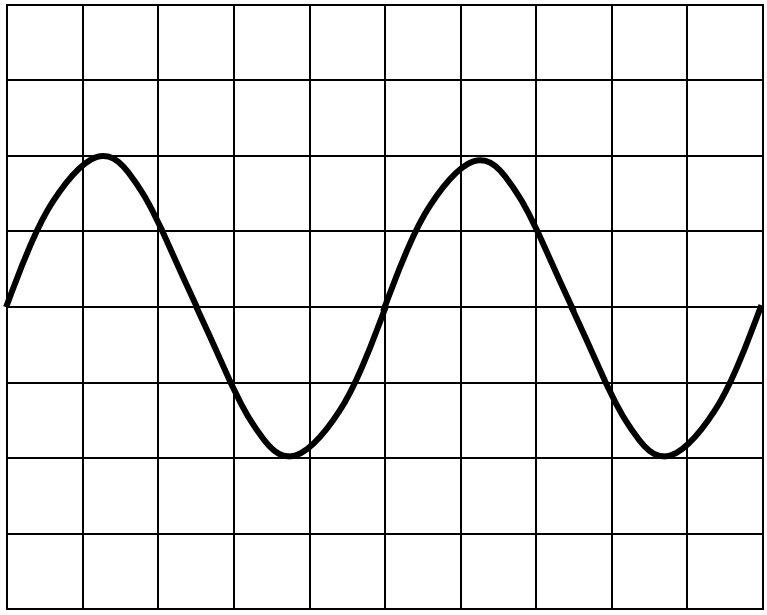


Fig. 6.2

(c) A violin note with wavelength of 1.2 m and period of 0.002 s is transmitted through a liquid.

Calculate the speed of sound in the liquid.

speed = …… [2]

[Total:6]

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7 Fig. 7.1 shows a circuit diagram with two fixed resistors, a light-dependent resistor (LDR) and a thermistor connected in parallel with a 12 V battery. Table 7.2 shows the resistance of the LDR and thermistor in different situations.

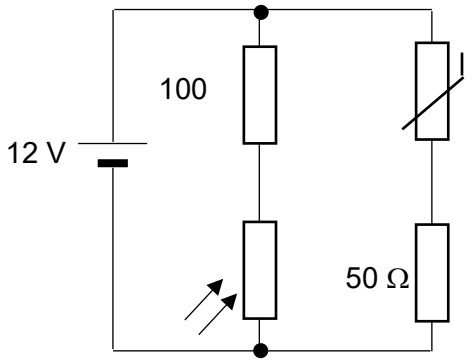


Fig. 7.1

Table 7.2

component	situation	resistance / Ω
light-dependent resistor (LDR)	bright	400
	dark	15 000
thermistor	hot	300
	cold	12 000

(a) Calculate the current flow in the battery when the circuit is in a dark and hot room.

current = …… [2]

(b) Without calculating, state the situation when the current flow in the battery is the largest. Explain your answer.

……

……

……

……

……[2]

(c) Calculate the potential difference across the LDR when the circuit is in a bright and cold room.

potential difference = …… [1]

(d) Explain why the potential difference across the LDR is the same as in **(c)** when the circuit is in a bright and hot room.

……

……[1]

[Total:6]

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8 Fig. 8.1 shows an electric oven connected to the mains supply with a three-pin plug.



Fig. 8.1

(a) Explain why a three-pin plug is necessary to connect the electric oven to the main supply.

.....

.....

.....

.....

.....[2]

(b) The plug has a fuse.
Explain the function of the fuse and how it is connected to the mains supply.

.....

.....

.....

.....

.....[2]

(c) The electric oven is rated 800 W and the mains supply is 240 V.
Determine a suitable fuse for the oven. The available fuses are 1 A, 3 A, 5 A, 7 A, 10 A and 13 A.

fuse selected = ... [1]

[Total:5]

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9 Fig. 9.1 shows the parts of a motor.

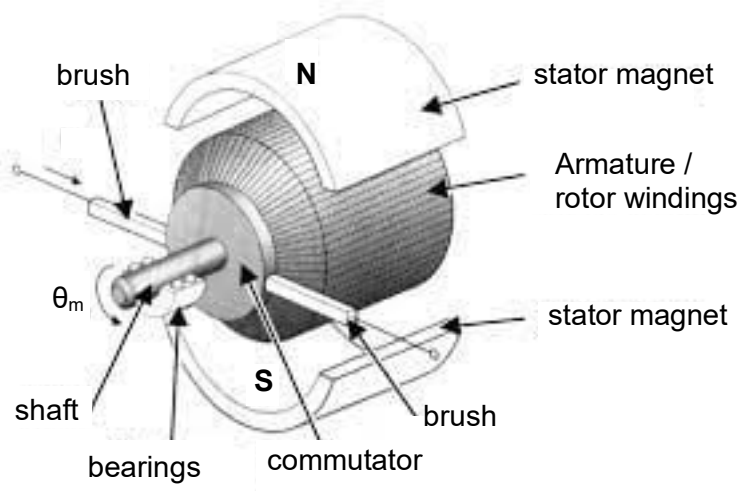


Fig. 9.1

(a) State what is meant by hard and soft magnetic materials in terms of their magnetic properties.

……

……

……

……

……[2]

(b) Rotor windings are coils of wires. The coils of wires are wound round soft iron.

Explain the function of the soft iron.

……

……

……[1]

(c) Describe the function of the commutator in the motor.

……

……

……

……

……[2]

[Total:5]

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10 Fig. 10.1 shows some information about strontium-90.

Naturally occurring strontium is nonradioactive and nontoxic at levels normally found in the environment but strontium-90, is a radiation hazard. It is produced by nuclear fission. It undergoes nuclear decay into yttrium-90. Strontium-90 has applications in medicine and industry.

Symbol	**Sr**
Protons	**38**
Neutrons	**52**
Radioactive decay	**beta**
Decay product	**yttrium (Y)**

Fig. 10.1

(a) Write down strontium-90 in nuclide notation. [1]

(b) Explain what is meant by nuclear decay.

……..……..……..

……[1]

(c) Write down the equation in nuclide notation to represent the beta decay for strontium-90. [1]

(d) Strontium-90 is produced by nuclear fission.

Explain the difference between nuclear fission and nuclear fusion.

……

……

……

……

……[2]

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(e) Table 10.2 shows the count rate of a sample of strontium-90 over a period of time.

Plot the data on Fig. 10.3 and use the graph to determine the half-life of strontium-90.

Table 10.2

time / years	count rate / count/s
0	1000
20	620
40	380
60	230
80	110
100	60

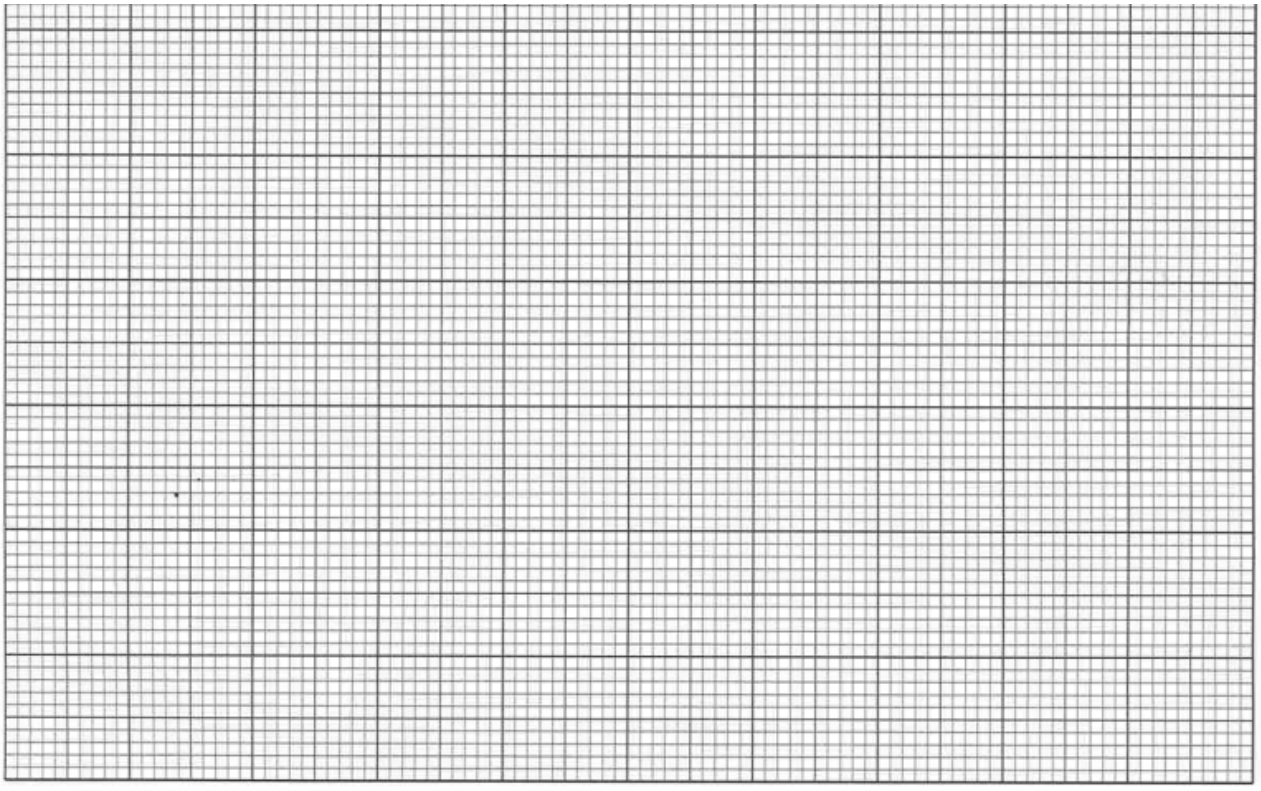


Fig. 10.3

Half-life = …… [3]

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(f) One of the uses of strontium-90 is to determine the thickness of steel sheets. Fig. 10.4 shows the set-up in a steel sheet factory.

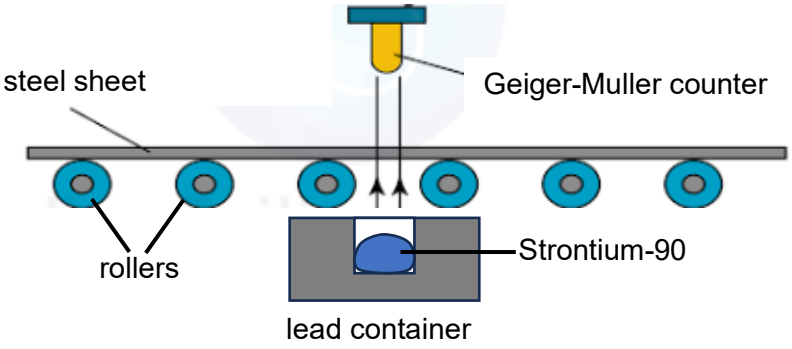


Fig. 10.4

(i) Explain how Geiger-Muller counter is used to determine the changes in the thickness of the steel sheet.

.....

.....

.....

.....

.....[2]

(ii) Describe two ways to reduce being exposed to radioactive emissions.

.....

.....

.....

.....

.....[2]

[Total:12]

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11 Fig. 11.1 shows a box pulled up a slope with a string using a smooth pulley. The box has a weight of 25 N.

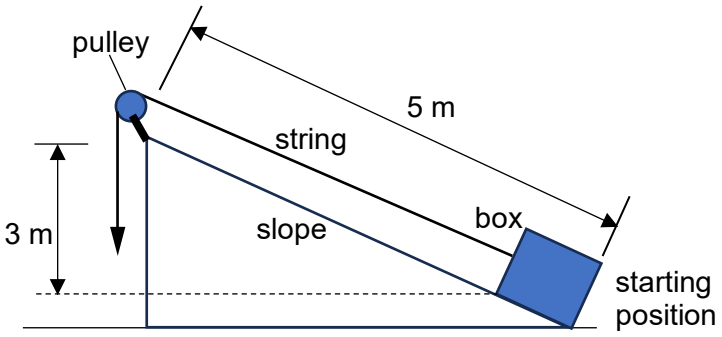


Fig. 11.1

(a) Calculate the gravitational potential energy store of the box when it reaches the highest point of the slope.

gravitational potential energy store = ... [2]

(b) Calculate the energy required to move the box up at constant speed if the frictional force between the box and slope is 12 N.

energy required = ... [2]

(c) The string was released when the box reached the highest point of the slope. The box moves down the slope with the same amount of friction of 12 N.

Calculate the speed of the box when it reaches the starting position.

speed of box = ... [2]

(d) A motor, with an efficiency of 85%, is used to pull the box up the slope.

Calculate the energy required by the motor to pull the box up to the highest point.

energy required by motor = ... [2]

[Total:8]

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Section B (10 marks)

Answer only **one** of the two questions from this section.

12 Fig. 12.1 shows a beam of light incident on the surface of container of water. The refractive index of water is 1.34.

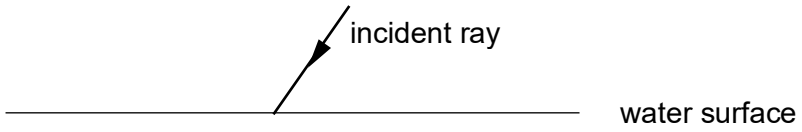


Fig. 12.1

(a) The beam of light is refracted in water.

On Fig. 12.1, draw the refracted ray in the water. Indicate clearly the angle of incidence with a ' **i** ' and angle of refraction with a ' **r** '. [2]

(b) Calculate the angle of incidence if the angle of refraction is 25.3°.

angle of incidence = …… [2]

(c) Define refractive index.

……..……..

……[1]

(d) The speed of light in vacuum is 3 x 10^8 m/s.

Calculate the speed of light in water.

speed of light in water = …… [2]

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(e) State what is meant by critical angle.

……..……..……..

……[1]

(f) Calculate the critical angle for water.

critical angle = …… [2]

[Total:10]

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13 Fig. 13.1 shows a setup showing electromagnetic induction.

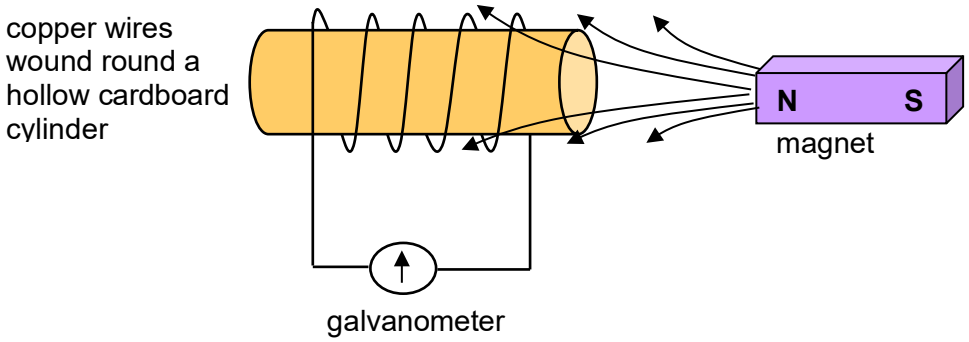


Fig.

(a) Describe **three** ways to increase the induced electromotive force in the above setup.

.....

.....

.....

.....

.....[3]

(b) Fig. 13.2 shows a simple a.c. generator.

(i) Complete the diagram by naming the parts F, G, H of the generator. [1]

(ii) Draw arrows to show the direction of the current flow in the coil and the resistor when the coil is rotating clockwise about the axle. [1]

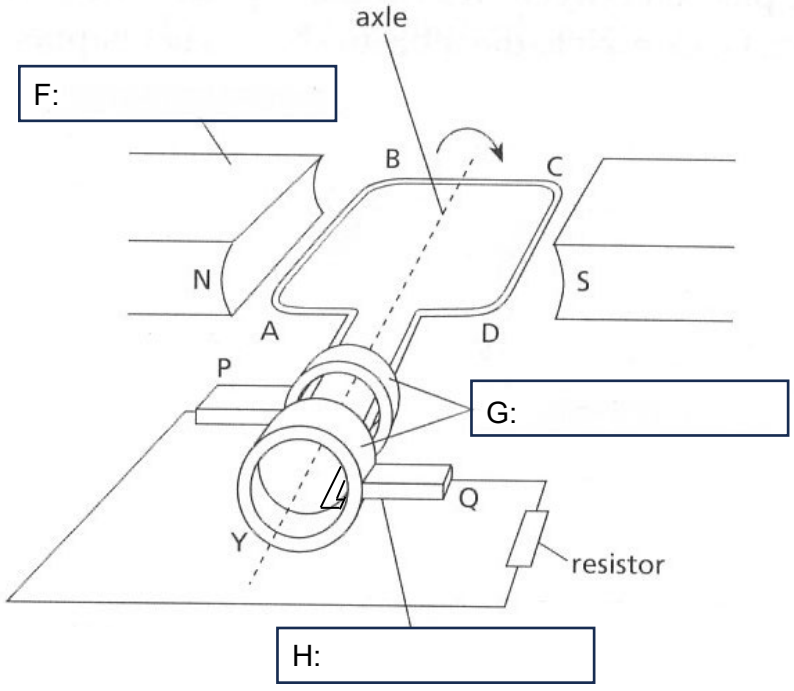


Fig.

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(c) Fig. 13.3 shows a simple electrical power distribution from a power station to homes.

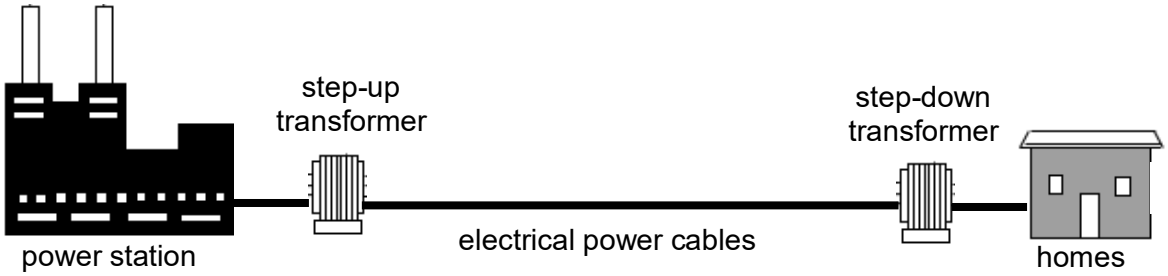


Fig.

(i) Explain the function of the two transformers in terms of the distribution of electrical supply.

……

……

……

……

……[2]

(ii) With the aid of a simple labelled diagram of a transformer, describe the structure and principle of operation of a simple iron-core transformer.

……

……

……

……

……[3]

[Total:10]

End of Paper

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