# FUCHUN SECONDARY SCHOOL
# PRELIMINARY EXAMINATION 2021
# SECONDARY 4 EXPRESS

| Candidate name | |
|---|---|

| Centre number | S | | | | | Index number | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| Class: | |
|---|---|

**PHYSICS** **6091/02**

Paper 2 Theory

**31 August 2021**
**1 hour 45 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

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**READ THESE INSTRUCTIONS FIRST**

Write your name, centre number, class and index number on this Question Paper.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

**Section A**
Answer **all** questions.

**Section B**
Answer **all** questions. **Question 11** has a choice of parts to answer.

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 sound use in Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

| | **For Examiner's Use** |
|---|---|
| **Section A** | |
| **Section B** | |
| **Total** | **/80** |

Name of setter: Mdm Rohizan Talib

This document consists of **18** pages and **0** blank page.

## Section A [50 marks]

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

**1** Fig. 1.1 shows a large metal washer.

The washer is 0.15 cm think and the internal and external diameter are shown on Fig. 1.1.

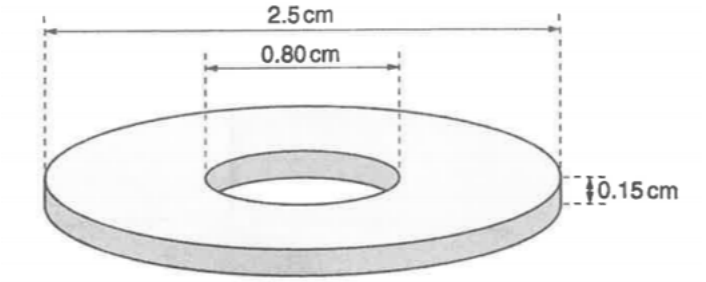



**Fig. 1.1** (not to scale)

**(a)** A student uses a ruler to measure the internal diameter of the washer.

**(i)** Describe one practical problem in taking this measurement.

……

……[1]

**(ii)** State the name of a measuring instrument that is used to take this measurement more accurately.

……[1]

**(b)** The mass of the metal washer is 5.4 g.

**(i)** Calculate the volume of metal in the washer.

volume = …… [2]

**(ii)** Calculate the density of the metal.

density = ……. [2]

**2** Fig. 2.1 shows a velocity-time graph for a car initially travelling forward in a horizontal straight line.

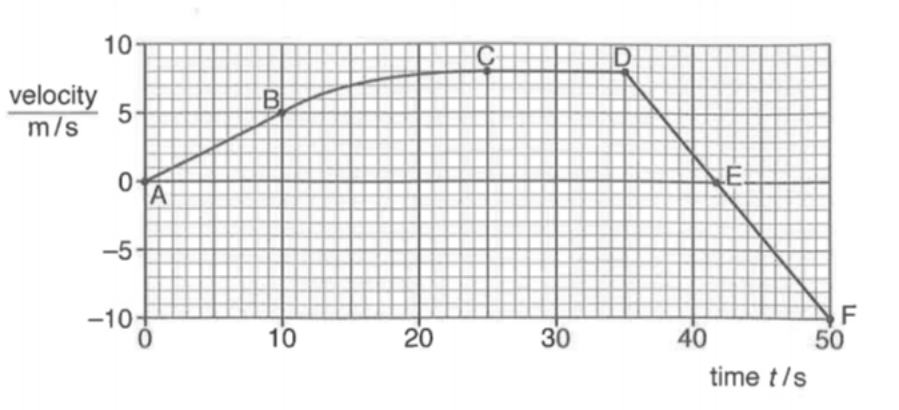



**Fig. 2.1**

**(a)** Describe the motion of the car

**(i)** between A and B,

……

……[1]

**(ii)** between B and C,

……

……...[1]

**(iii)** between E and F.

……

……[1]

**(b)** The car travels 133 m when it reaches point C. Calculate how far is the car from the starting point at the end of 50 s.

distance from starting point = ..... [2]

**3** Fig. 3.1 shows a helicopter stationary in the air.

Vertical lift forces are produced by the front rotor and by the back rotor.

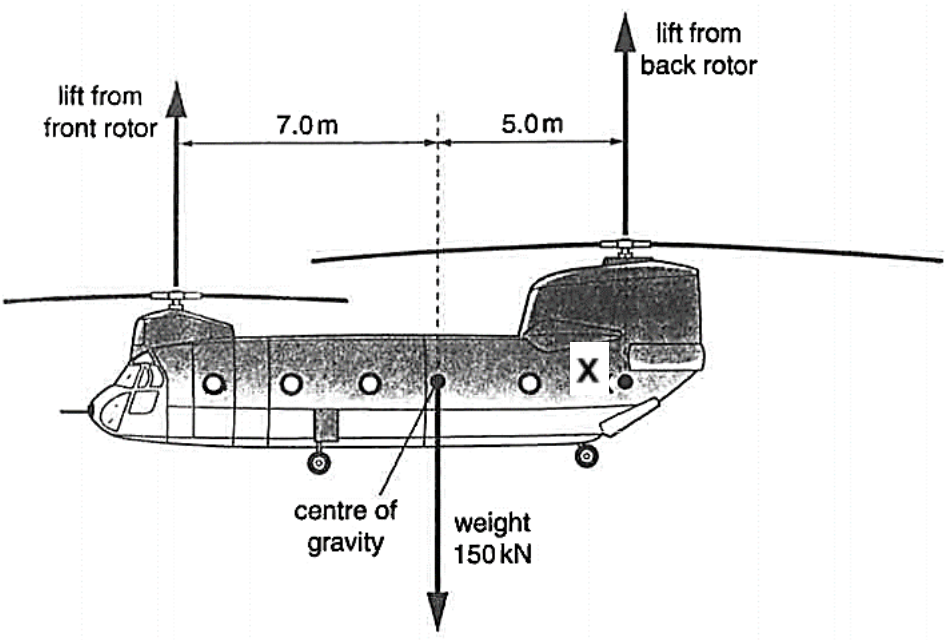



**Fig. 3.1** (not to scale)

The weight of the helicopter is 150 kN. Horizontal distances are marked on Fig. 3.1.

**(a)** **(i)** State what is meant by *centre of gravity*.

.....

.....[1]

**(ii)** Describe the difference between mass and weight.

.....

.....[1]

**(iii)** Determine the mass of the helicopter.

The gravitational field strength $g$ is 10 N/kg.

mass = ..... [1]

**(b)** **(i)** By taking moments about point X, calculate the lift force from the front rotor.

lift force = …… [2]

**(ii)** Calculate the lift force from the back rotor.

lift force = …… [1]

**(c)** The helicopter pilot adjusts the lift forces at the front and back of the helicopter.

The front of the helicopter tilts down, whilst the centre of gravity of the helicopter stays at the same height

State how the lift forces from the rotors are adjusted to achieve this effect.

……

……

……

……[2]

**4** Fig. 4.1 shows the path of a metal ball fired into the air at an angle to the horizontal.

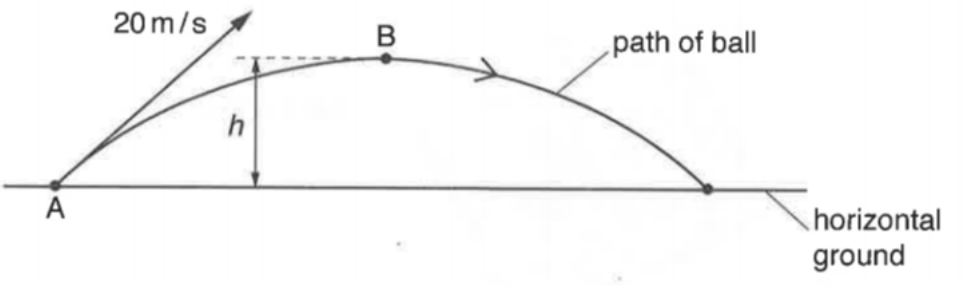



**Fig. 4.1** (not to scale)

**(a)** Describe and explain the energy possessed by the ball at point A and point B, assuming air resistance has a negligible effect on the motion of the ball.

……

……

……

……[2]

**(b)** The metal ball has a mass of 1.6 kg. The speed of the ball at A is 20 m/s.

**(i)** Calculate the kinetic energy of the ball at A.

kinetic energy = …… [2]

**(ii)** The kinetic energy of the ball at B is 180 J.

Calculate

1. the gain in gravitational potential energy of th eball as it moves from A to B,

gain in gravitational potential energy = …… [1]

2. the change in vertical height *h* of the ball as it rises from A to B.
The gravitational field strength *g* = 10 N/kg.

*h* = …… [2]

**5** Fig. 5.1 shows a refrigerator with a freezing compartment at the top.


**Fig. 5.1**

**(a)** When water is placed in ice-cube tray in the freezing compartment, it turns into ice at the freezing point.

**(i)** Describe the arrangement of water molecules.

……

……[1]

**(ii)** Describe and explain, using ideas about molecules, what happens to the energy of water as it turns into ice at the melting point.

……

……[1]

**(b)** An ice-cube tray is filled with 400 g of water at 20 $^0$C. It is placed in the freezing compartment of the refrigerator and all the water becomes ice at 0 $^0$C.

The specific heat capacity of water is 4.2 J/(g$^0$C) and the specific latent heat of fusion of water is 330 J/g.

Calculate the total energy that is removed from the water.

energy = …….. [3]

**(c)** Explain why placing the freezing compartment at the top cools all of the air in the refrigerator.

…….....

…….....

…….....

…….....[2]

**6** Sound waves is a longitudinal waves.

**(a)** State what is meant by *longitudinal waves*.

……

……[1]

**(b)** A student measures the speed of sound in air using an echo from a cliff.

She stands facing the cliff and clap two wooden blocks, as shown in Fig. 6.1.

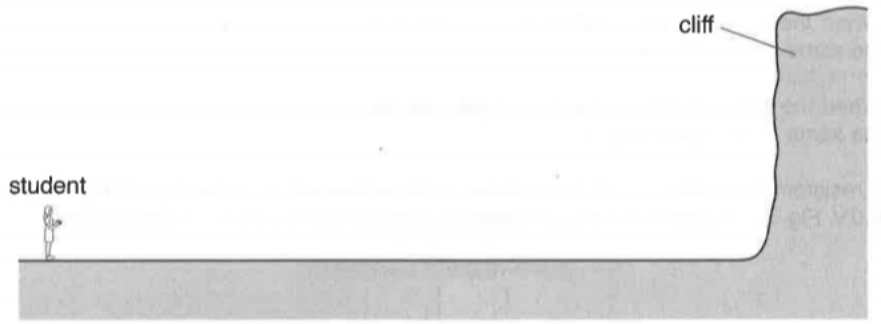



**Fig. 6.1**

The echo arrives 3.8 s after she claps the blocks.

She walks 150 m towards the cliff and then claps the blocks again. The echo now arrives 2.9 s after she claps.

Calculate the speed of sound in air using these data. Give your answer to an appropriate number of significant figures.

speed = …… [3]

**(c)** The student produces a percussion sound using other blocks of wood.

State how the sound heard changes when

**(i)** the amplitude of the sound increases,

……[1]

**(ii)** the wavelength of the sound decreases.

……[1]

**7** When a negatively-charged metal sphere with an insulated handle is brought near to an uncharged metal plate as shown in Fig. 7.1, the sensitive centre-zero galvanometer shows a momentary deflection to the right.

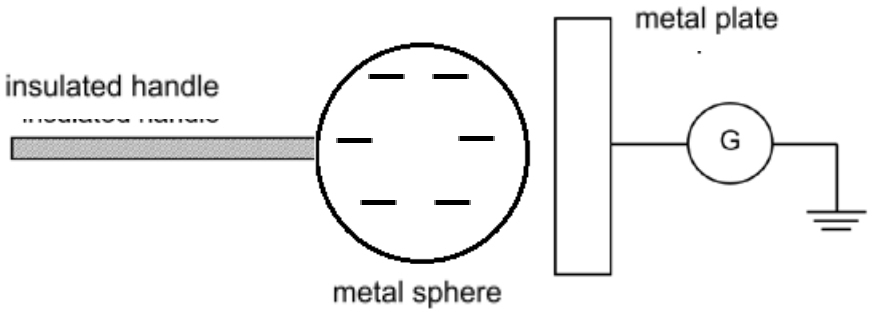



**Fig. 7.1**

**(a)** Explain what causes the momentary deflection of the galvanometer.

……

……

……

…….....[2]

**(b)** On Fig. 7.1, draw the distribution of the charges induced on the metal plate after the momentary deflection in the galvanometer. [1]

**(c)** The charge on one electron is $1.6 \times 10^{-19}$ C.

Calculate the number of electrons passing through galvanometer if the galvanometer records a momentary deflection of 0.25 A in 0.2 seconds.

number of electrons = …….. [2]

**8** The plug shown in Fig. 8.1 connects a toaster to the mains supply.

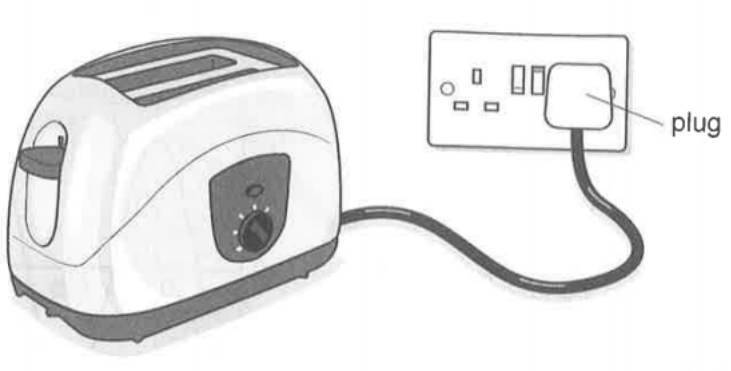



**Fig. 8.1**

The plug contains a fuse connected in the live wire.

**(a)** Explain why the fuse is connected in the live wire.

……

……

……[2]

**(b)** The toaster has a power rating of 800 W, and is connected to the 220 V mains supply. Fuses of 3A, 5A and 13A are available.

**(i)** Calculate the current in the toaster.

current = …… [2]

**(ii)** Suggest which of the three fuses is the best to use in the plug and explain why the other fuses are less suitable.

……

……

……

……[2]

## Section B [30 marks]

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Q11**.

**9** A photocell, a type of light dependent resistor (LDR), can be used in many different types of circuits and the applications are listed below.

The applications of photocells include an automatic headlight dimmer, a night light control and a position sensor.

Before a photocell can be used, it is often calibrated in the lab to determine its resistance under different lighting conditions.

Fig. 9.1 shows a photocell that is being tested. A torch shines on the cell and a multimeter displays the resistance of the photocell.

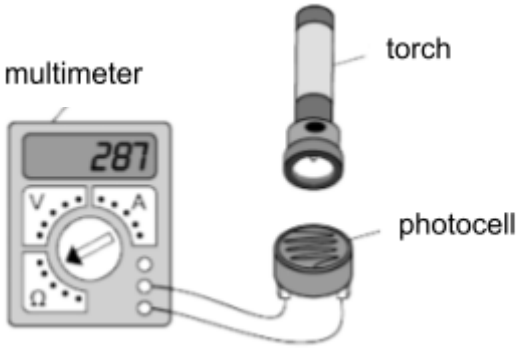



**Fig. 9.1**

Fig. 9.2 shows how the resistance *R* of this photocell varies with light intensity, measured in the number of lux.

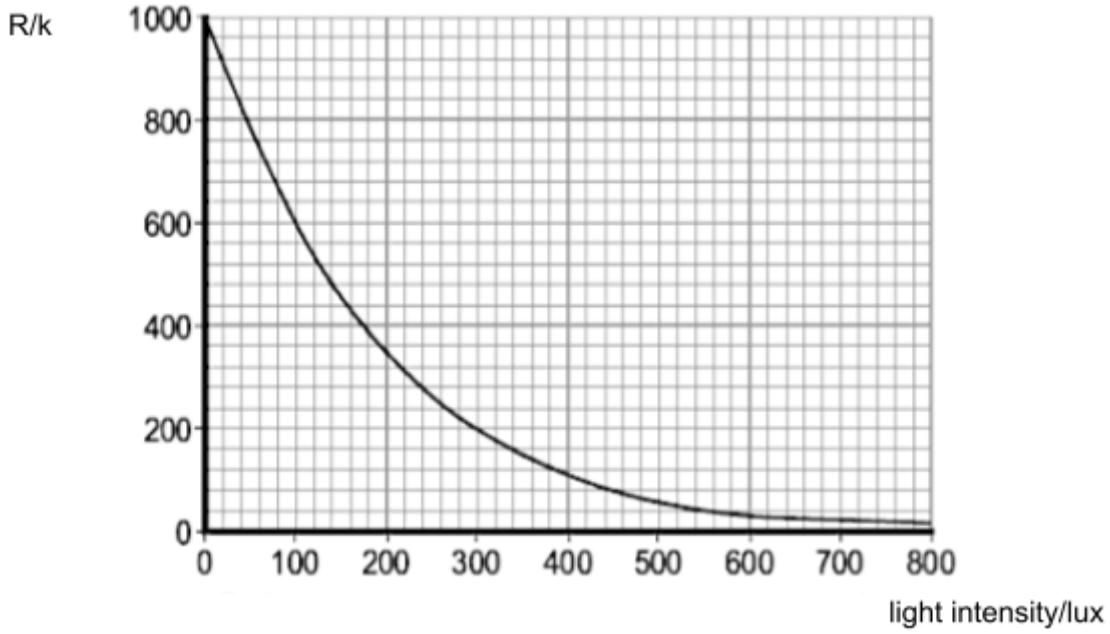



**Fig. 9.2**

The table below shows the light intensity under certain sample lighting conditions.

| light source illumination | light intensity/lux |
|---|---|
| moonlight | 0.20 |
| filament lamp at 1.0 m | 80 |
| filament lamp at 0.10 m | 100 |
| fluorescent lighting | 500 |
| bright sunlight | 30,000 |

**(a)** A light dependent resistor is an example of an input transducer.

State what is meant by an *input transducer*.

……

……[1]

**(b)** Fig. 9.3 shows a test circuit where the photocell is to be connected across points PQ.

The test circuit is used to simulate an automatic headlight dimmer. The headlight is connected in parallel to the photocell and is lit when the switch is closed. When the environment becomes brighter, the headlight will dim.

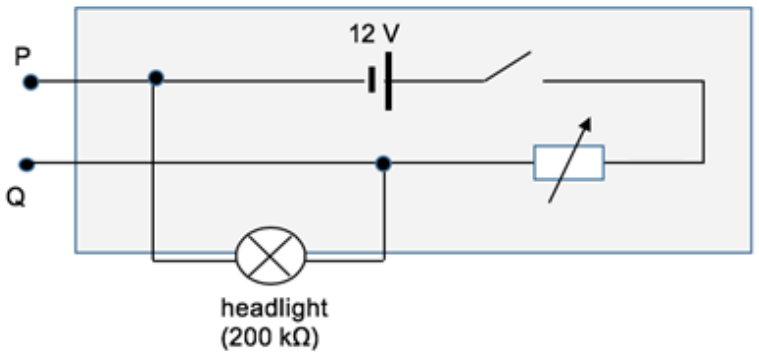



**Fig. 9.3**

**(i)** On Fig. 9.3, sketch the symbol of the photocell across PQ. [1]

**(ii)** A filament lamp is placed 0.10 m away from the photocell.

Determine the resistance of the photocell and hence calculate the total resistance across PQ due to the lamp and the photocell.

resistance of photocell = ……..

total resistance across PQ = …….. [3]

**(iii)** Hence calculate the resistance of the rheostat that will enable a p.d. of 8.0 V across PQ.

resistance = …….. [2]

**(c)** Explain how brightening the environment will cause the headlight to dim.

…….....

…….....

…….....

…….....

…….....

…….....

…….....[3]

**10** Fig. 10.1 below shows a right-angled triangle PQR, which is a cross-section of a glass prism. Angle PQR is 60°. A ray of light UV is incident and refracted at surface PR of the glass prism such that angle UVP is 35°

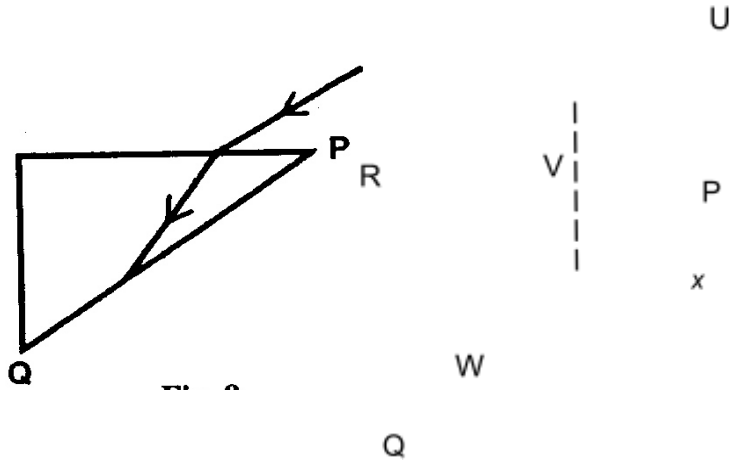



**Fig. 10.1**

**(a)** Given that the refractive index of glass is 1.75.

**(i)** Define the *refractive index* of glass.

……

……..[1]

**(ii)** Calculate angle *x*.

*x* = …….. [2]

**(b)** When the ray of light strikes surface PQ at W, it experiences total internal reflection.

**(i)** Explain, using appropriate calculation, how total internal reflection occur at W.

……

……

……

……..[2]

**(ii)** On Fig. 10.1, draw the path of the light UV after total internal reflection at W until it emerges back to air. [2]

**(c)** Light has a wavelength of 750 nm.

**(i)** Calculate the frequency of light in air, assuming that speed of light in air is the same as that of speed of light in vacuum.

frequency = …….. [2]

**(ii)** Describe how the frequency of light changes as it enters from air to glass.

……

……..[1]

**11 EITHER**

Fig. 11.1 shows the structure of an a.c. generator. The coil turns at a constant speed in the clockwise direction as shown.

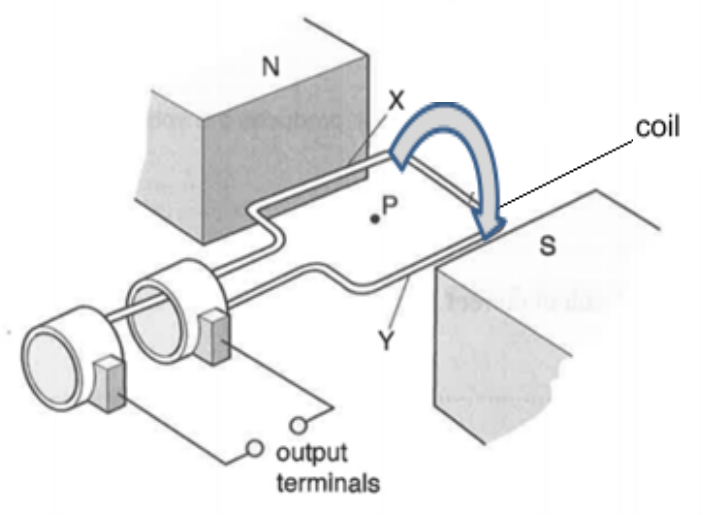



**Fig. 11.1**

**(a)** On Fig. 11.1, draw an arrow to show the direction of the magnetic field at point P caused by the poles of the magnet. [1]

**(b)** Fig. 11.2 shows how the output voltage of the generator varies with time.

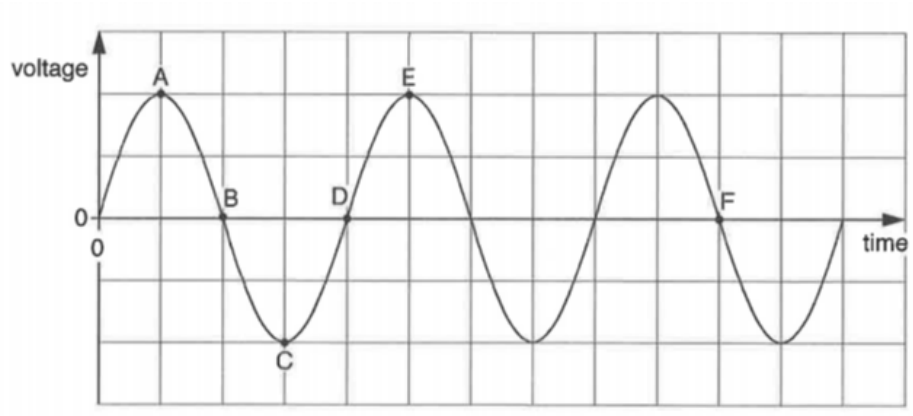



**Fig. 11.2**

Fig. 11.1 shows the coil horizontal with side X near the N-pole of the magnet. At this position, the voltage produced is shown as point A on Fig. 11.2.

**(i)** Explain why an output voltage is produced.

……

……

……[2]

**(ii)** State which point on Fig. 11.2 shows the voltage when the coil is horizontal, with side X near the S-pole of the magnet.

……[1]

**(iii)** Draw the coil in the space between the poles of the magnet in Fig. 11.3 below that produces the voltage show as point F on Fig. 11.2. Label the side X of the coil. [1]

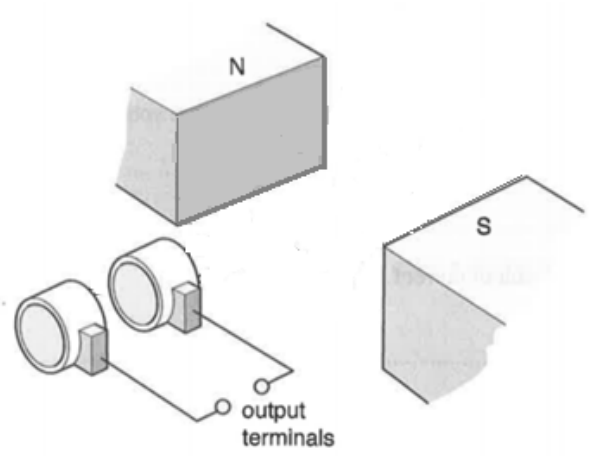



**Fig. 11.3**

**(c)** The a.c. generator produces maximum output voltage of 6V and the output terminals of the a.c. generator are connected to the primary coil of a transformer shown in Fig. 11.4.

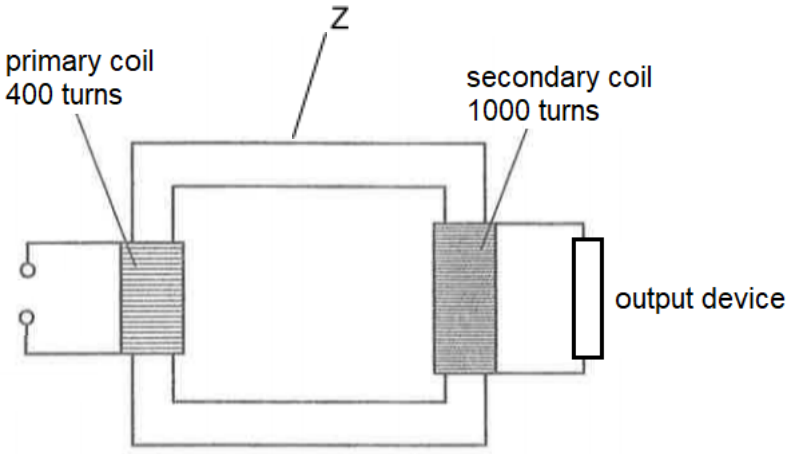



**Fig. 11.4**

**(i)** Label part Z: ……[1]

**(ii)** Describe how the transformer is able to change the voltage in the primary coil.

……

……

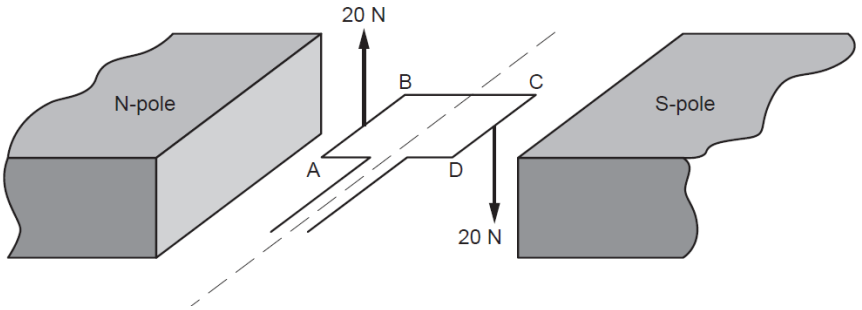
……[2]

**(iii)** The output device has a resistance of 25 Ω. Calculate the power dissipated in the output device.

power = …….. [2]

**11 OR**

Fig. 11.5 shows a current-carrying coil ABCD in a magnetic field.




**(a) (i)** State and explain the direction of current flow in the coil at this instant.

……

……

……[2]

**(ii)** Explain why forces are produced on the coil.

……

……[1]

**(iii)** The forces can be increased when the coil is in a stronger magnetic field. State two other ways to increase the force on the coil.

……

……

……[2]

**(b)** Fig 11.6 shows part of the rectangular coil ABCD and the ends X and Y.

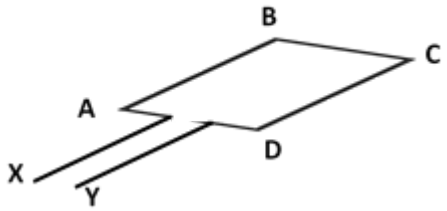



**Fig. 11.6**

**(i)** On Fig. 11.6, draw the external circuit which the rectangular coil is connected to at X and Y, including a split-ring commutator, brushes and a battery.

Label your circuit. [3]

**(ii)** The coil rotates continuously in the direction of the force when the split-ring commutator is used. Explain how the split-ring commutator causes this.

……

……

……[2]

**End of paper**