Name: MARKING SCHEME Class: ..... Adm.No. .....

Index No..... Candidate's Signature.....Date.....

232/2
PHYSICS
THEORY
Paper 2
SEPTEMBER 2022
Time: 2 hours

MANGU HIGH SCHOOL

MOCK EXAM 2022

PAPER 2

Instructions to Candidates

- *Write your name, admission number, class, Index no. and signature in the spaces provided at the top of the page.*
- *This paper consists of two sections; A and B.*
- *Answer ALL the questions in the spaces provided.*
- *Non-programmable silent electronic calculator and KNEC mathematical table may be used*
- *ALL working MUST be shown clearly*
- *Candidates should answer the questions in English.*

This paper consists of 12 printed pages. ***Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing***

Where necessary use g = 10 N/kg, or10 m/s²

FOR EXAMINER'S USE ONLY

SECTION	QUESTIONS	MAXIMUM SCORE	CANDIDATE'S SCORE
A	1 – 13	25	
B	14	9	
	15	9	
	16	9	
	17	12	
	18	9	
	19	7	
		80	

SECTION A (25 MARKS)

1. In an experiment to determine the presence of charge on a body, a material to be tested was brought close to the cap of a positively charged electroscope. There was no divergence observed from the leaf of electroscope. State the possible reason for the observation. (1 mark)

The material was an insulator / had no charge on its surface / neutral material.

2. A cog wheel with 20 teeth is rotated with a stiff card pressing lightly against the teeth. Sound is produced when the rotating teeth strikes the card. Calculate the wavelength of sound produced if the wheel makes 20 revolutions per second. (Velocity of sound in air is 330m/s). (2 marks)

f = No. of teeth x revolutions

$= 20 \times 20 = 400\,Hz$

$\lambda = V/f = \frac{330}{400} = 0.825\,m$

3. State any two ways of in increasing the size of an image formed by a ~~fixed~~ pinhole camera. (2 mks)

- Reducing the distance between the object and the pinhole
- increasing the distance between screen and pinhole

4. **Figure 1** shows a symbol representing an electrical device.

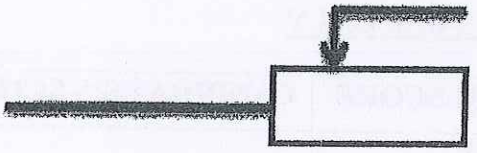


Figure 1

Name the device represented by the symbol (1 mark)

variable resistor / rheostat / potential divider / rheo potentiometer

5. A car battery is rated 40Ah and is expected to supply a constant current for 200 minutes. Determine the amount of current delivered. (2 marks)

$I = Q/t = \frac{40}{200} \times 60$

$= 12\,A$

6. The **figure 2** below show a soft iron plate in a solenoid and a permanent magnet suspended by a spring.

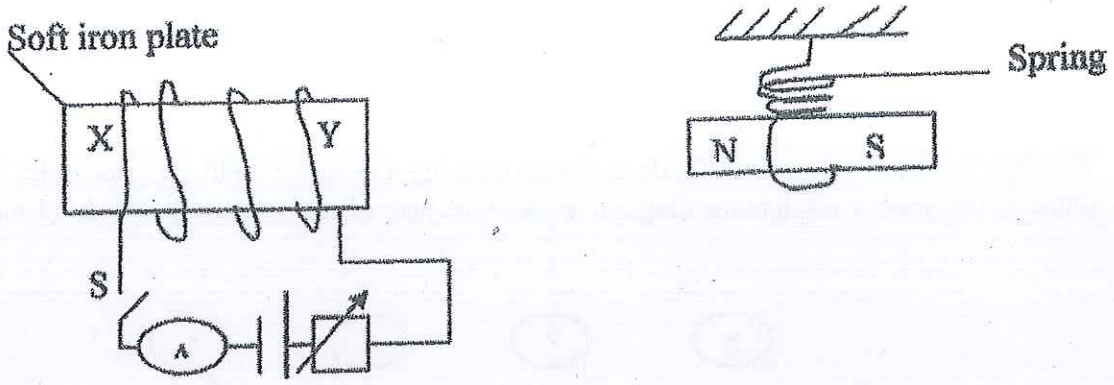


Figure 2

State with reason the behaviour of the magnet when the switch S is closed. (2 mks)

Magnet moves away from the solenoid / it is repelled
End Y acquires a N-pole which repels the N-pole of the permanent magnet.

7. **Figure 3** shows a cell of e.m.f 1.5V connected with an ammeter, a 1.5Ω resistor a 1Ω and switch. A voltmeter is connected across the cell.

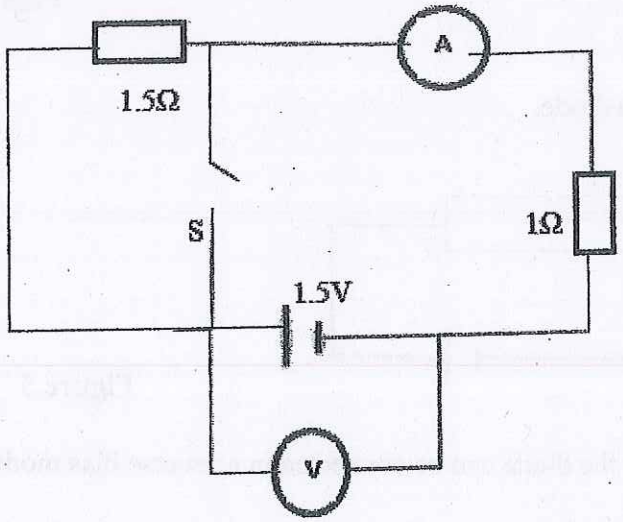


Figure 3

With the switch ~~open~~ closed, the voltmeter reads 1.25V. Given that the internal resistance of the cell is 0.5Ω, determine the ammeter reading when switch S is closed. (3 marks)

1.5Ω resistor is short circuited

$E = V + Ir$

$1.5 = 1.25 + 0.5r$

$I = 0.5A$

8. Water waves pass a point in a swimming pool at the rate of 30 crests per 60 seconds. One of the crests was observed to take 2 seconds to travel between 2 points, 6m apart. Determine the wavelength of the water waves. (3 marks)

$v = 6/2 = 3\,m/s$

$f = \frac{30}{60} = 0.5\,Hz$

$\lambda = v/f = 3/0.5 = 6m$

9. The **figure 4** below shows a cathode ray beam entering a magnetic field, perpendicular to the plane of the paper complete the diagram to show the path of the beam in the field. (1 mark)

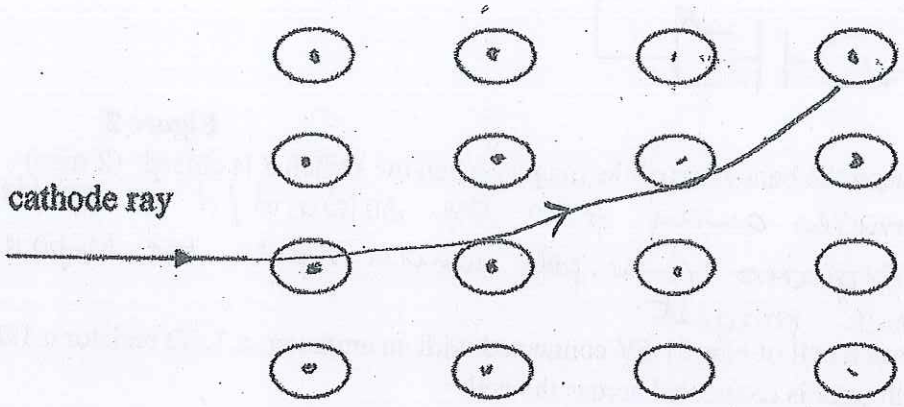


Figure 4

10. The **figure 5** below shows a junction diode.

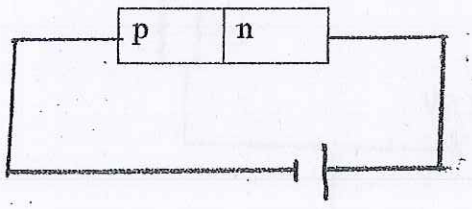


Figure 5

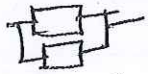
Complete the diagram to show how the diode can be connected in a reverse bias mode. (1 mark)

11. An electric heater rated 240V, 3000W is to be connected to a 240V mains supply, through a 10A fuse. Determine whether the fuse is suitable or not. (3 marks)

$I = P/V = \frac{3000}{240} = 12.5A$

The fuse is not suitable as it allows a lower current/lower rating.

12. Two heating coils A and B connected in parallel in a circuit produces power of 36W and 54W respectively. Calculate the ratio of their resistance. (2 marks)



$P_A = 36W$

$P_B = 54W$

$P = \frac{V^2}{R} \Rightarrow V^2 = PR$

But V is the same

$P_A R_A = P_B R_B$

$36 R_A = 54 R_B$

$\frac{R_A}{R_B} = \frac{54}{36} = 3/2$

$R_A : R_B = 3 : 2$

$R_B : R_A = 2 : 3$

13. The figure 6 below show a conductor carrying electric current place between two magnetic poles.

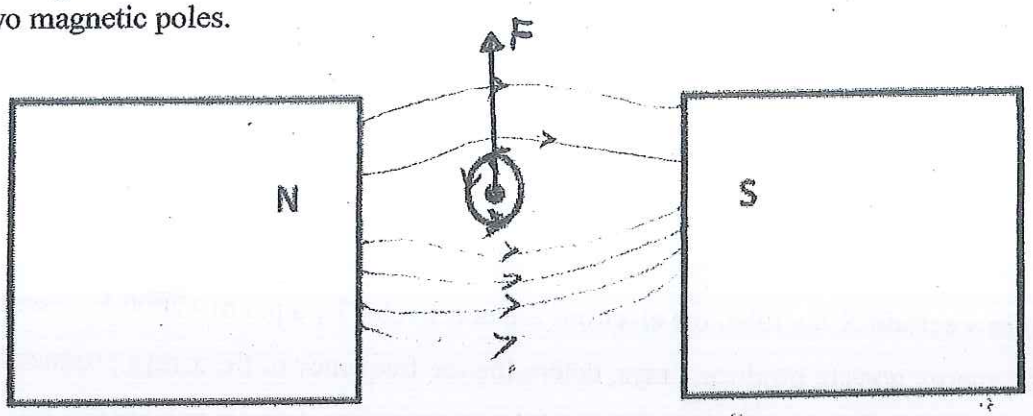


Figure 6

Complete the diagram by sketching the magnetic field and also show the direction of the force on the conductor. (2 marks)

SECTION B (55 MARKS)

14. (a) **Figure 7** shows parts of a simple x-ray tube.

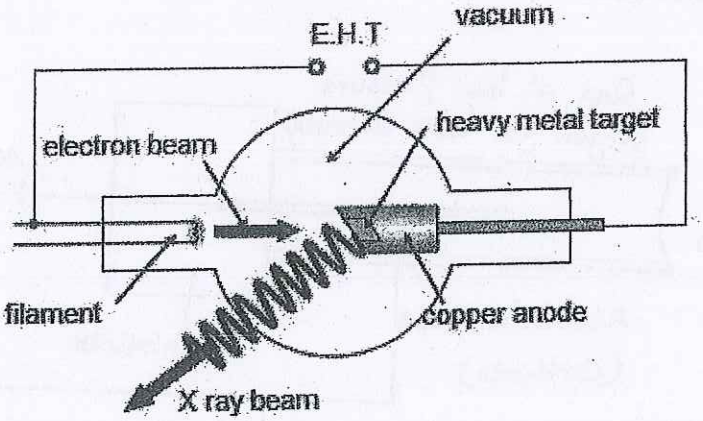


Figure 7

(i) Explain how the beam of x-ray is produced. (3 marks)

Stream of fast moving e⁻s produced from filament by thermionic emission are accelerated to anode. They are suddenly stopped by a metal target producing x-rays.

(ii) State how the current and voltage from the Extra High Tension (E.H.T) source can be used to:

(I) Increase the intensity of x-ray beam produced. (1 mark)

Increasing current through filament

(II) Decrease the strength of the x-ray beam produced (1 mark)

Decreasing accelerating potential/voltage

(iii) Tungsten is an example of element used as metal target. State the property that enables it to be used as a target. (1 marks)

It has a high melting point.

b) In a certain X ray tube, the electrons are accelerated by a p.d of 12000 V. Assuming that all the energy goes to produce x rays, determine the frequency of the x rays produced (take planks constant h= 6.62 $x10^{-34}$Js, and the charge of an electron e=1.6$x10^{-19}$ C)

(3marks)

$eV = hf$

$1.6 \times 10^{-19} \times 12000 = 6.62 \times 10^{-34} f$

$f = 2.9 \times 10^{18}$ Hz

15. (a) The **figure 8** below shows a diagram of a Geiger Muller tube connected to a power supply and a pulse counter.

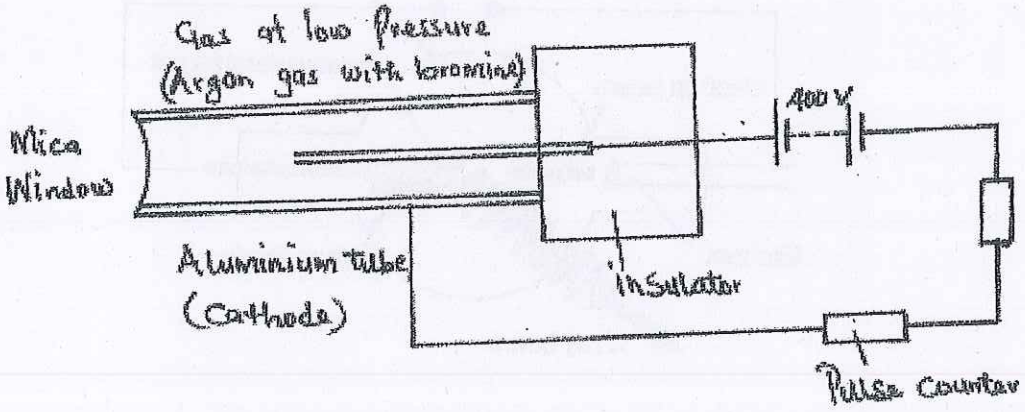


Figure 8

(i)State why should the argon gas be at low pressure. (1mark)

To initiate discharge. It allows for secondary ionisation creating an avalanche of electrons.

(ii)State the purpose of the bromine gas in the tube. (1mark)

Quenching agent - Absorbs energy of positive ions before they cause secondary electron emission

(iii)Suggest one way of increasing the sensitivity of the tube (1mark)

Amplifying the current

(iv) Find the value of a and b in the following equation. (2marks)

$$^{234}_{92}U \rightarrow ^{a}_{b}X + 2\alpha$$

a....226.....b....88.....

b) The **figure 9** below shows a PN junction diode used in a rectifier.

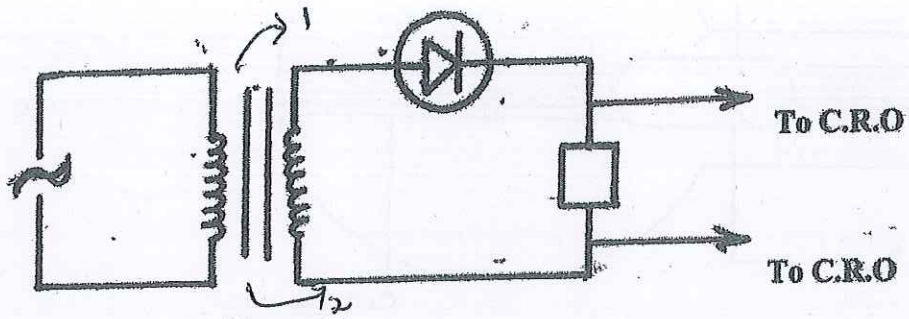
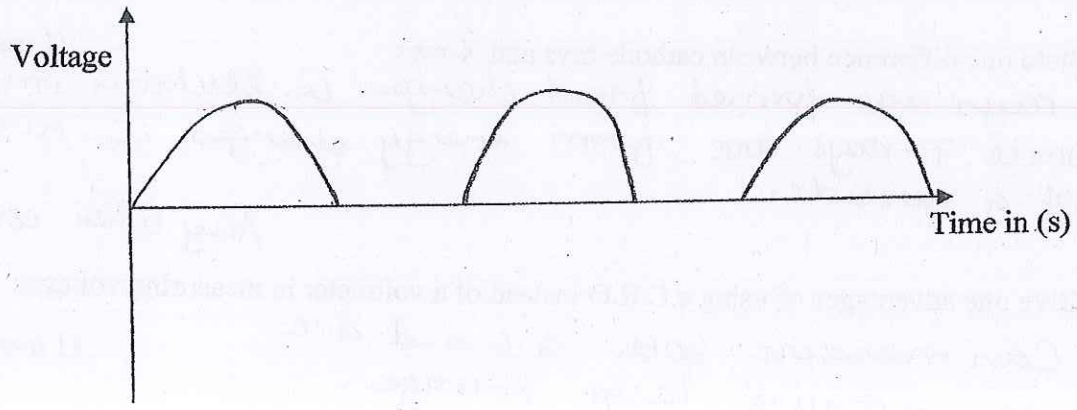


Figure 9

i)Describe how the rectification is achieved (3 marks)

During the 1st cycle the diode is forward biased so it conducts. A current flows through the resistor. During the 2nd cycle the diode is reverse biased so it does not conduct. No current passes through resistor. The process keeps repeating itself.

ii) In the space provided below, sketch the output signal displayed on the CRO during the rectification process. (1 mark)



16. The figure 10 below shows a cathode ray tube

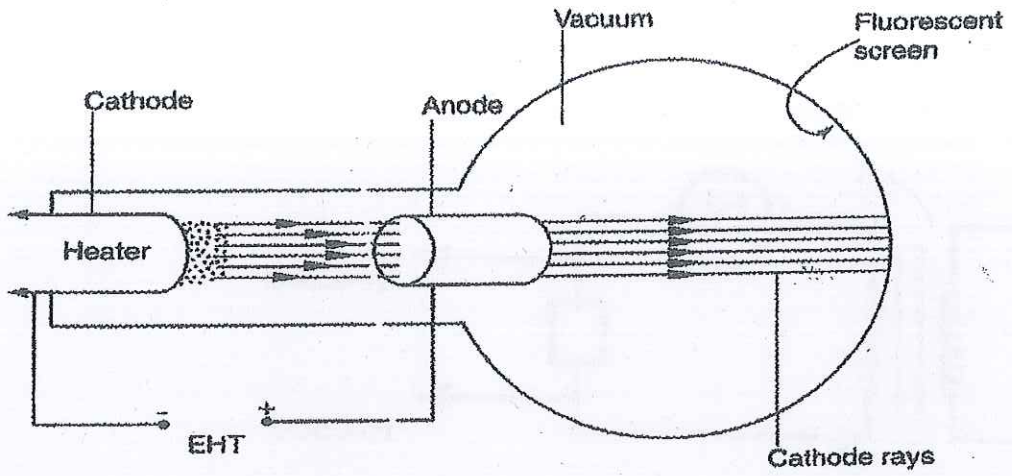


Figure 10

a) State how the intensity of the fluorescence on the screen can be increased. (1 mark)

- increasing the p.d of the cathode
- making the grid less negative

b) State the effect of having air in the tube instead of a vacuum (2 marks)

There will be collisions between air particles and the ionization electrons in motion reducing the energy of the electrons

c) State one difference between cathode rays and X-rays (1 mark)

X-rays are formed from changes in electron structure while γ-rays are from energy changes in nucleus of a nuclide.

Any other correct

d) Give one advantages of using a C.R.O instead of a voltmeter in measuring voltages (1 mark)

- Can measure both a.c and d.c
- can measure large voltage
- Gives instant value.

g) The **figure 11** below shows an a.c. voltage. If the Y-gain control reads 10V/cm and the time base reads 5 milliseconds/cm

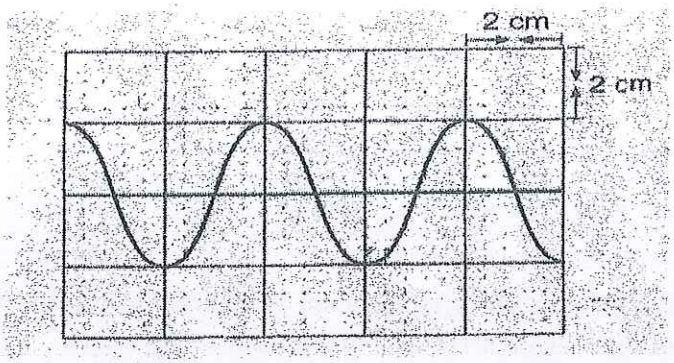


Figure 11

Calculate:

i) The frequency of the alternating voltage (2 marks)

$T = 4 \times 5 = 20\,ms$
$= 20 \times 10^{-3}$

$f = 1/T = 1/20\times10^{-3}$
$= 50Hz$

ii) Peak to peak voltage of the alternating voltage (2 marks)

$V = 4 \times 10$
$= 40\,V$

17. (a)(i) It is observed that when ultra-violet radiation is directed onto a clean zinc plate connected to the cap of a negatively charged leaf electroscope, the leaf falls. Explain this observation (2 marks)

Electrons are dislodged from the zinc metal by U-V radiations. The electrons emitted are repelled by the negative charges leaving the plate positively charged. Electrons from the leaf move to the cap and leaf fal

(ii) Explain why the leaf of the electroscope does not fall when infra- red radiation is directed onto the zinc plate (1 mark)

The energy of IR radiation is lower than the work function of the zinc plate/metal.

b) State the effect on the electrons emitted by the photoelectric effect when:

(i) The intensity of incident radiation is increased (1 mark)

Increases the no. of photoelectrons thus increasing the photocurrent.

(ii) The frequency of the incident radiation is increased (1 mark)

Speed of electrons increases

c) Light of wavelength 4.3×10^{-7}m is incident on two different metal surfaces, nickel and potassium. (Take speed of light as 3.0×10^{8} ms^{-1} and planks constant h as 6.63×10^{-34}Js).

(i) Determine the energy of the incident radiation. (2 marks)

$E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{4.3 \times 10^{-7}}$

$= 4.626 \times 10^{-19}$ J

(ii) If the work function of nickel is 8.0×10^{-19}J and that of potassium is 3.68×10^{-19}J, state with a reason from which of the two metals the given light will eject electrons.
(2 marks)

Potassium

Energy of radiation is greater than its work function.

(iii) Determine the velocity of the emitted electrons from the metal surface in b(ii).

(Take the mass of an electron as 9.1×10^{-31} kg). (3 marks)

$E = W_0 + \frac{1}{2}mv^2$

$4.626 \times 10^{-19} = 3.68 \times 10^{-19} + \left(\frac{1}{2} \times 9.1 \times 10^{-31}\right)v^2$

$v = 4.56 \times 10^{5}$ m/s $\quad 4.559 \times 10^{5}$ m/s

18. a) i) State the meaning of the term critical angle as applied in refraction of light. (1 mark)

This is the angle of incidence in the optically denser medium whose angle of refraction in the less optically dense medium is 90°

ii)The **figure 12** shows a ray of light incident on a glass-air interface.

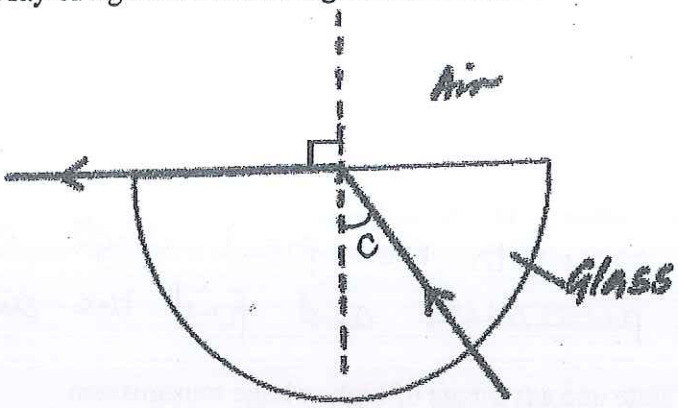


Figure 12

(I) Show on the diagram the critical angle, **c**. (1 mark)

II)Given that the refractive index of the glass is ${}_a\eta_g$, and that the critical angle **c** = 42°, determine the value of is ${}_a\eta_g$. (3 marks)

$a\eta g = 1/\sin C = 1/\sin 42^\circ = 1.4945$

(b) The **figure 13** shows an experimental set up consisting of a mounted convex lens L, cardboard screen with cross-wires at the centre, a plane mirror, a metre rule and a candle.

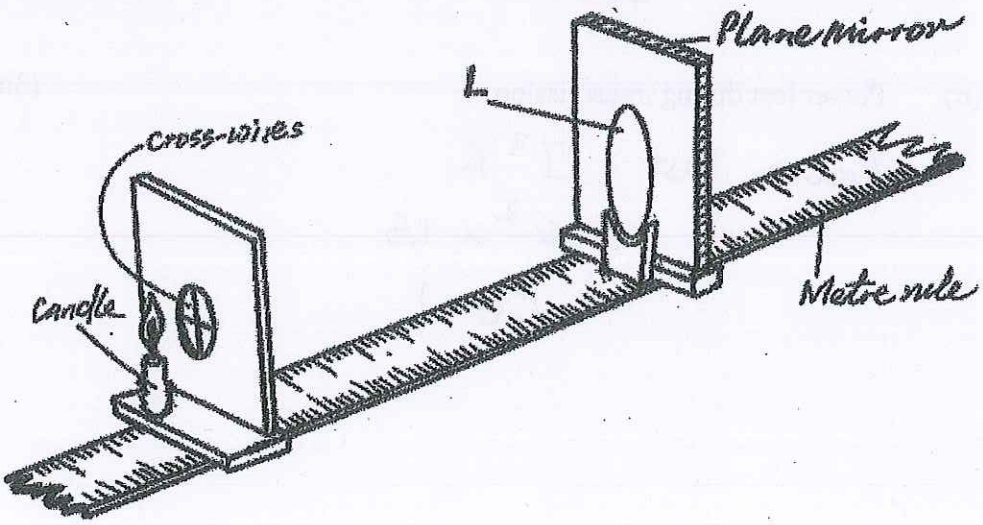


Figure 13

Describe how the set-up may be used to determine the focal length, f, of the lens. (4 marks)

- Move the cardboard with a crosswire along the metre rule until a sharp image of the crosswire is formed alongside the object crosswire ✓
- Measure the distance between the lens and the cardboard ✓ This is equal to the focal length of the lens. ✓
- Repeat procedure and find the average value of f. ✓

19. a) State one advantage of high voltage transmission. (1mark)

The current is low and therefore energy loss is reduced.

(b) A generator produces 150kw at a voltage of 5kV. The voltage is stepped up to 60kV and transmitted through cables of resistance 15Ω to a step-down transformer in a substation. If both transformers are 80% efficient, calculate the:

(i) Current through the transmission cables. (3marks)

$\frac{80}{100} \times 150000 = 120000\ W$

$I = P/V = \frac{120000}{60000} = 2\ A$

(ii) Power lost during transmission. (3marks)

Power lost $= I^2 R$

$= 2^2 \times 15$

$= 60\ W$