7.0 PHYSICS (232)

In the year 2008, the KCSE Physics examination was tested in three papers. These were:

- **Paper 1 (232/1)**: This was a theory paper consisting of two sections; ***Section A*** which has short answer questions and ***Section B*** which has structured questions. Candidates were required to answer questions from both sections. The questions in this paper were drawn from the ***Heat*** and ***Mechanics*** parts of the syllabus.

- **Paper 2 (232/2)**: This was also a theory paper consisting of two sections: ***Section A*** which had short answer questions while ***Section B*** had structured questions. All questions were compulsory and were drawn from ***Optics, Waves, Electricity, Magnetism*** and ***Modern Physics***.

- **Paper 3 (232/3)**: This was a practical paper testing a variety of skills in all areas of the syllabus.

7.1 GENERAL CANDIDATES' PERFORMANCE

The candidates' performance statistics in the KCSE Physics examination since the year 2006 when the syllabus was revised are as shown in the table below:

Table 12: Candidates' Overall Performance in Physics in the years 2006, 2007 and 2008

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
2006	1		80	24.00	15.62
	2		80	35.75	17.05
	3		40	20.88	7.22
	Overall	**72,299**	**200**	**80.63**	**37.00**
2007	1		80	23.46	13.43
	2		80	33.33	17.93
	3		40	25.85	7.14
	Overall	**83,162**	**200**	**82.63**	**35.00**
2008	1		80	25.32	14.66
	2		80	24.17	16.34
	3		40	23.92	7.31
	Overall	**93,692**	**200**	**73.42**	**35.43**

From the table above, it can be observed that:

7.1.1 The candidature increased from ***83,162*** in the year 2007 to ***93,692*** in the year 2008, an increase of ***10,530*** candidates ***(12.66%)***.

7.1.2 There was improvement in the performance of ***paper 1 (232/1)***, which improved from a mean of ***23.46*** in the year 2007 to ***25.32*** in the year 2008.

7.1.3 ***Paper 2 (232/2)*** and ***paper 3 (232/3)*** recorded a decline in performance in the year 2008.

7.1.4 The overall performance declined when compared to the previous year. In the year 2008 the overall mean was ***73.42*** as compared to the year 2007 when the overall mean was ***82.63.***

The following is a discussion of the questions in which candidates performed poorly.

7.2 PAPER 1 (232/1)

Question 1

A drug manufacturer gives the mass of the active ingredient in a tablet as 5 mg.
Express this quantity in kilogramme and in standard form.

Candidates were required to convert mg to Kg and express the result in standard form.

Weaknesses

Candidates did not know the relationship between mg and Kg and as such were unable to differentiate the negative and positive index.

Expected Response

5.0×10^{-6} Kg

Question 5

Fig. 2 shows a flask filled with water. The flask is fitted with a cork through which a tube is inserted. When the flask is cooled, the water level rises slightly, then falls steadily.

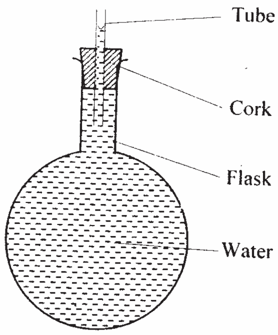


Figure 2

Explain this observation.

Candidates were required to explain the behaviour of water in the tube, when the flask is cooled.

Weaknesses

Candidates were unable to relate the rates of contraction of glass and water. Most candidates attributed the behaviour to anomalous expansion, while others only explained the expansion and not contraction.

Expected Responses

When the flask is cooled it contracts/volume reduces but due to poor conductivity of glass, subsequently as both cool the contraction of water is greater than that of glass.

Question 8

Fig. 4 shows a conical flask 15cm high, filled with a liquid of density $1200kgm^{-3}$. The atmospheric pressure of the surrounding is 8.4×10^4Pa.

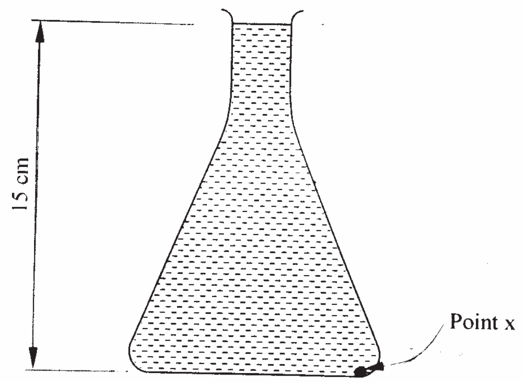


Figure 4

Determine the pressure at the point marked **X**, at the bottom of the flask.

Candidates were required to determine pressure at the point marked x in the liquid.

Weaknesses

Candidates did not combine liquid pressure and atmospheric pressure. They only calculated pressure due to the liquid but not total pressure.

Expected Responses

Pressure in liquids	=	ρgh
	=	$1200 \times 10 \times 15 \times 10^{-2}$
	=	1800 Pa
Total pressure	=	$(8.4 + 0.18) \times 10^4$ Pa = 8.58×10^4 Pa.

Questions 10 and 11

Fig. 5 shows a toy resting on top of a closed bottle. Use the information on the figure to answer questions 10 and 11.

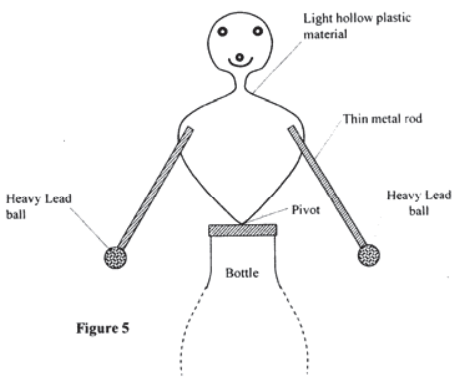


Figure 5

10 Mark on the diagram, point Q, the approximate centre of gravity of the toy.

11 Giving a reason, name the state of equilibrium of the toy.

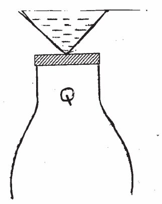
Candidates were required to draw and mark the position of centre of gravity of the toy and name the state of equilibrium giving reasons.

Weaknesses

Candidates could not relate the position of the centre of gravity with the heavy masses used and the lines of symmetry of the toy. They thought of the toy being unstable because of its shape.

Expected Responses

10.



11. ***Stable equilibrium:*** When it is slightly tilted, centre of gravity is raised. When released it recovers/returns to its original position.

Question 16

(a) Define the term heat capacity.

(b) You are provided with the apparatus shown in Fig. 9 and a stop watch.

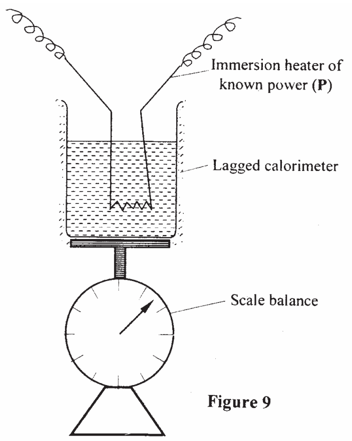


Figure 9

Describe an experiment to determine the specific latent heat of steam, l, using the set up. In your answer clearly explain the measurements to be made and how these measurements could be used to determine l.

(c) A block of metal of mass 150g at 100°C is dropped into a lagged calorimeter of heat capacity $40JK^{-1}$ containing 100g of water at 25°C. The temperature of the resulting mixture is 34°C. (specific heat capacity of water = $4200JKgK^{-1}$).

Determine:

(i) heat gained by calorimeter;

(ii) heat gained by water;

(iii) heat lost by the metal block;

(iv) specific heat capacity of the metal block.

Candidates were required to define heat capacity, describe an experiment that can be used to determine latent heat of vaporization and use heat equations to calculate heat lost and specific heat capacity of metal.

Weaknesses

Candidates confused heat capacity with specific heat capacity. They used wrong equations to calculate heat capacity. New apparatus were introduced in the given set up.

Expected Responses

a) Heat capacity of a body is the energy required to raise the temperature of the body by one degree centigrade or one Kelvin.

b) Measurements

Initial mass of water + calorimeter = M_1
Final mass of water + calorimeter = M_f
Time taken to evaporate ($M_f - M_1$) mass of steam = t
Heat given out by heater = Heat of vaporization

$$Pt = (M_1 - M_f) L$$

$$L = \frac{Pt}{M_1 - M_f}$$

c) (i) ***Heat gained by the calorimeter***

Heat capacity x $\Delta T = 40(34-25) = 40x9 = 360J$

(ii) ***Heat gained by water***

M_w x C_w x ΔT

= $100 \times 10^{-3} \times 4.2 \times 10^{3} (34-25) = 3780J$

(iii) ***Heat lost by metal block***

$M_m C_m (100-34)$

(iv) $150 \times 10^{-3} \times C_m (100-34)$

= 360 + 3780

= 4140

$$Cm = \frac{4140}{150x10^{-3}x66}$$

= 418 J $Kg^{-1}K^{-1}$

7.3 PAPER 2 (232/2)

Question 2

A leaf electroscope **A** is charged and placed on the bench. Another uncharged leaf electroscope **B** is placed on the same bench and moved close to **A** until the caps touch. State and explain what is observed on the leaves of **A** and **B**.

Candidates were required to explain charging of an electroscope by contact.

Weaknesses

Candidates were unable to describe the ***'rise'*** and ***'fall'*** of the leaf. Some candidates wrote "***collapsing***", ***"falling"*** without saying how far. Sharing of charge was not understood.

Expected Responses

The leaf in A falls some distance while the leaf in B rises some distance; the two leaf electroscopes share the charge.

Question 8

Figure 5 shows wavefronts approaching the boundary between two media.

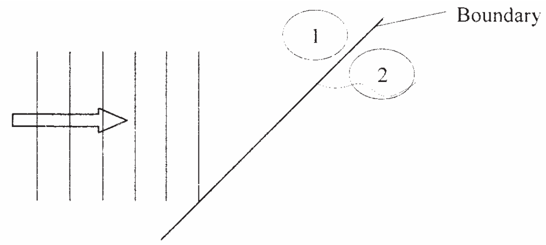


Figure 5

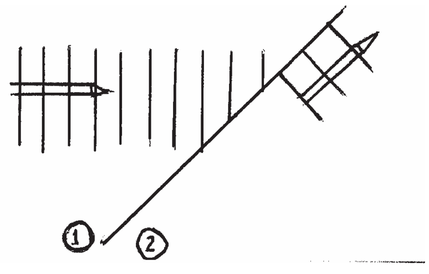
The speed of the waves in medium (2) is higher than that in medium (1). On the same diagram complete the figure to show the wavefronts after crossing the boundary.

Candidates were required to show the wavefronts of waves after crossing the boundary.

Weaknesses

Candidates were unable to relate speed and wavelength after refraction. Most did not indicate the direction.

Expected Response



Question 9

Figure 6 shows a circuit in which a battery of negligible internal resistance, two resistors, a capacitor, a voltmeter and a switch are connected.

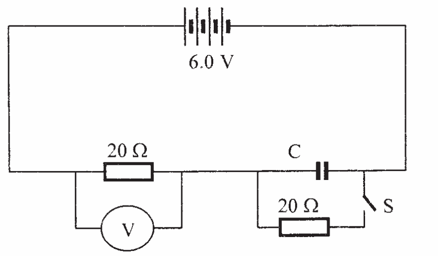


Figure 6

Giving a reason for your answer in each case, state the reading of the voltimeter, V, when the switch is

(i) Open
V =

Reason.

(ii) Closed
V =

Reason.

Candidates were tested on the charging of a capacitor.

Weaknesses

Reading of the voltmeter was poorly explained.

Expected Responses

i) $V = 0V$ (since there is no current)
ii) Current flows in the resistor V = 3V

Question 10

A heating coil is rated 100W, 240V. At what rate would it dissipate energy if it is connected to a 220V supply?

Candidates were required to apply the formular for power P = $\frac{V^2}{R}$

Weaknesses

Most candidates could not relate $\frac{V^2}{R}$ to VI. They did not realize that R is constant.

Expected Responses

P = $\frac{V^2}{R}$, R = $\frac{240^2}{100}$

P = $\frac{220^2}{240^2/100}$ = $84JS^{-1}$

Question 12

A narrow beam of electrons in a cathode ray oscilloscope (CRO) strike the screen producing a spot. State what is observed on the screen if a low frequency a.c source is connected across the y-input of the CRO.

Candidates were required to explain frequency of the a-c source on the C.R.O.

Weaknesses

Candidates could not relate frequency and movement of the spot up and down.

Expected Response

The spot moves up and down.

Question 18

(a) Figure 12 shows two circuits close to each other.

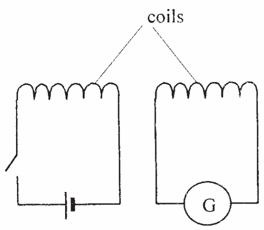


Figure 12

When the switch is closed, the galvenometer shows a reading and then returns to zero. When the switch is then opened, the galvonometer shows a reading in the opposite direction and then returns to zero. Explain these observations.

(b) Explain how energy losses in a transformer are reduced by having:

(i) a soft-iron core;

(ii) a laminated core.

(c) An ideal transformer has 2000 turns in the primary circuit and 200 turns in the secondary circuit. When the primary circuit is connected to a 400V a.c. source, the power delivered to a resistor in the secondary circuit is found to be 800W. Determine the current in:

(i) the secondary circuit;

(ii) the primary circuit.

Candidates were required to explain principles of induction and how energy losses in a transformer are reduced.

Weaknesses

Candidates seemed not to have understood induction of E.m.f in relation to build up and collapse of magnetic flux. ***"Ideal"*** transformer was also not understood.

Expected Responses

a) When the switch is closed, flux in the coil on L.H.S. grows and links the other coil inducing e.m.f. When the current is steady no flux change and hence no induced E.m.f; when the switch is opened, the flux collapses even in the coil on R.H.S. inducing current in opposite direction.

b) (i) Soft iron reduces losses due to hysteresis (or magnetic losses). This is because the domain in soft iron responds quickly to change in magnetic field (or have low frequency).

(ii) Laminated core reduces losses due to eddy currents, reducing them considerably.

c) (i) $$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$\frac{V_p}{N_p} = 400$$

$N_p = 2000$ $N_s = 200$

$V_s = 40V$

Power = $V_s I_s = 800$w

$$I_s = \frac{800w}{40v} = 20A$$

(ii) $$P_p = P_s = 800w = 400xI_p$$

$$I_p = 2A$$

7.4 PAPER 3 (232/3)

This was the practical paper and it consisted of two questions in which candidates were examined on a variety of skills.

Question 1

PART A

You are provided with the following:

- copper wire
- a retort stand, boss and clamp
- an optical pin mounted on a cork
- a stop watch
- wire cutters (to be shared)
- a metre rule or half metre rule.

Proceed as follows:

(a) Clamp the cork so that the optical pin is horizontal. Hang the copper wire from the pin by the loop as shown in figure 1. Ensure the wire is straight and the length X between the lower tip and the optical pin is 32 cm. If the length exceeds 32 cm reduce by cutting at the lower tip using the wire cutters provided.

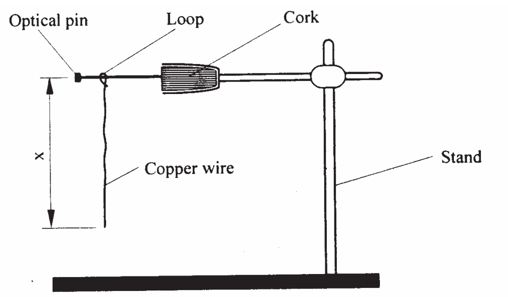


Figure 1

(b) Displace the lower tip of the wire slightly in a plane perpendicular to the optical pin and then release it. Measure the time t for 20 oscillations of the wire and record the value in **table 1**.

(c) Repeat the procedure in (b) above for other values of X shown in the table. *(Note that each length X is obtained by cutting off an appropriate length from the lower tip of the wire. For example to get X = 28 cm cut off 4 cm from the lower end).* Complete the table.

Table 1

Length X (cm)	32	28	24	20	16	12
time t for 20 oscillations (s)						
Period $T = {}^{t}/_{20}$ (s)						
T^2 (s^2)						

(d) Plot a graph of T^2(y-axis) against x.

(e) (i) Determine the slope, S, of the graph .

(ii) Obtain the value of k in the equation $S = \frac{8\pi}{3k}$

PART B

You are provided with the following:

- a cylindrical container
- some water
- a stop watch
- a metre rule or half-metre rule
- a boiling tube
- some sand
- a rubber band

Proceed as follows:

(f) Tie the rubber band round the boiling tube so that it is at a distance L = 12 cm from the bottom of the tube (see fig 2a). Pour water into the cylindrical container until the level is about 2.0 cm from the top of the beaker. Float the boiling tube in the water in the container. Add sand gradually into the boiling tube until the tube sinks to the 12 cm mark.

See figure 2(b).

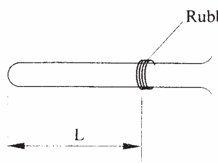


Figure 2(a)

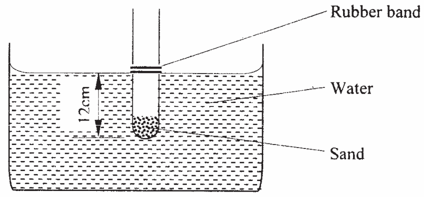


Figure 2(b)

(g) Depress the boiling tube slightly and release so that it oscillates vertically without touching the sides of the container. Measure and record in table 2 the time t_1, for five oscillations of the boiling tube. Repeat the procedure two more times to obtain t_2, and t_3 and record the values in table 2. Complete the table.

Table 2

t_1((s)	t_2(s)	t_3(s)	Average t(s) $t = \left(\frac{t_1 + t_2 + t_3}{3}\right)$	$T = \frac{t}{5}$(s)

(h) Evaluate $P = \frac{40L}{T^2}$ given that L is the length of the tube upto the rubber band in (f) and T is the value obtained in (g) above. (2 marks)

P =

The following skills were tested:

- Use of stopwatch and metre rule.
- Ability to divide and obtain squares of numbers.
- Drawing of graphs.

Weaknesses

- Reading of stopwatch was difficult for some candidates. They recorded the readings as seen on the screen, that is, 0:18:16.
- Some candidates had difficulties in approximations when carrying out the division and squaring.
- Accurate measurement of length using a metre rule was a problem to some candidates.
- Plotting of graphs was also difficult for some candidates.

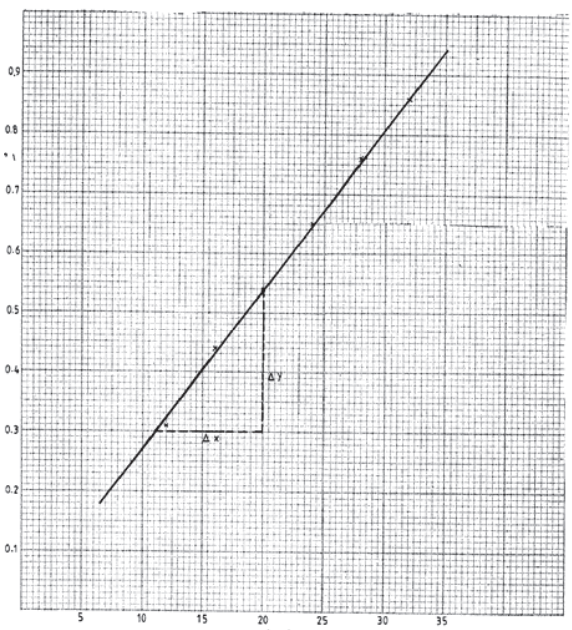
Expected Responses

PART A

(c)

Length X (cm)	32	28	24	20	16	12
Time t for 20 oscillations	18.50	17.40	16.15	14.75	13.30	11.20
Period $T = \frac{t}{20}(s)$	0.925	0.870	0.808	0.738	0.665	0.560
$T^2(s^2)$	0.856	0.757	0.652	0.544	0.442	0.314

(d)



(e) (i) slope $S = \dfrac{0.54 - 0.30}{20 - 11}$

$$= \frac{0.24}{9} = 0.0267\frac{s^2}{cm}$$

(ii) S $= \dfrac{8\pi}{3k}$

$$0.0267 = \frac{8\pi}{3k}$$

$$\therefore \ k = \frac{8\pi}{3x\,0.0267}$$

$= 313.767$ cm/s^2.

PART B

(g)

t(s)	$t_{1\,(s)}$	t_2 (s)	t_3 (s)	Average t(s)	$T = \frac{t}{5}(s)$
	3.46	3.25	3.44	3.34	0.67

(h) P - $\dfrac{40L}{T^2}$ $= \dfrac{40x12}{0.67^2}$

$=$ 1069 cm/s^2

$=$ 10.7 m/s^2 (accept values between 9 and 11 m/s^2).

Question 2

PART A

You are provided with the following:

- a triangular glass prism
- a piece of soft board
- four (4) optical pins
- a sheet of plain paper.

Proceed as follows:

(a) Place the plain sheet of paper on the soft board. Trace the triangular outline of the prism on the sheet of paper. Remove the prism and use a ruler to extend the three sides of the outline. See figure 3(a).

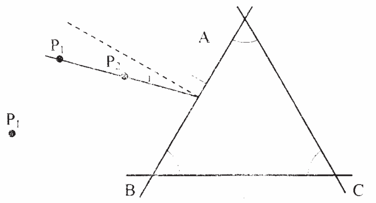


Figure 3(a)

Use a protractor to measure the refracting angle R of the prism.

R =..................

(b) On the side AB of the triangular outline, draw a normal at a point half-way between A and B. *This normal will be used for the rest of this experiment.*

(c) Draw a line at an angle i=30° to the normal. Stick two pins P_1 and P_2 vertically on this line. See figure 3(a).

(d) Place the prism accurately on the outline. By viewing through the prism from side AC stick two other pins P_3 and P_4 vertically such that they are in line with the images of pins P_1 and P_2. Remove the prism and the pins. Draw a line joining marks made by P_3 and P_4. Extend this line to meet AC. (See figure 3(b)).
Measure and record in table 3 the value of angle θ.

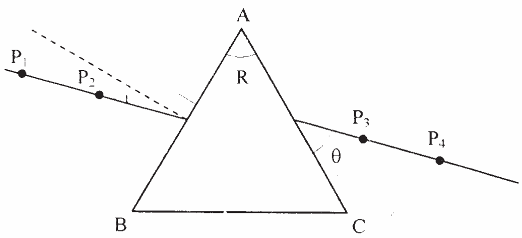


Figure 3(b)

(e) Repeat the procedures in (c) and (d) above for other values of i shown in table 3. Complete the table.

N.B. ***The sheet of paper with the drawing must be handed in with this question paper. Ensure you write your name and index number on the sheet of paper.***

Table 3

Angle of incidence i(deg)	30	35	40	45	50	55	60
Angle θ (deg)							
Angle of emergence, E=90-θ (deg)							

(f) (i) On the grid provided plot the graph of the angle of emergence E (y-axis) against the angle of incidence i.

(ii) Use the graph to find i_0 the angle of incidence at which i = E

(iii) Evaluate

(I) $y = 2i_0 - R$

(II) $b = 2 \sin i_0$

PART B

You are provided with the following:

- a lens and a lens holder
- a screen with cross-wires
- a candle
- a metre rule

Proceed as follows:

(g) Arrange the lighted candle, the lens and the screen as shown in figure 4. Adjust the position of the screen until a sharp inverted image of the candle is formed on the screen.

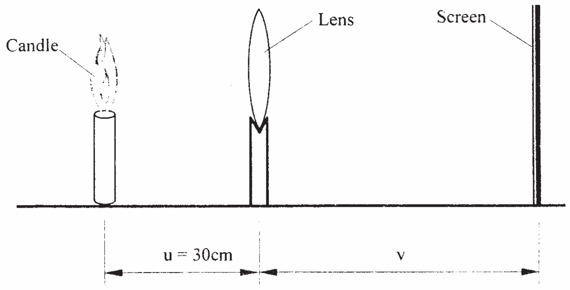


Figure 4

(i) Measure the image distance v,

v = ... cm

(ii) Determine the focal length of the lens using the formula.

$$f = \frac{uv}{u + v}$$

(h) Now arrange the lighted candle, the screen with cross wires and the lens as shown in figure 5. *Ensure that the centre of the lens, the cross-wires, and the candle flame lie on the same horizontal line.* The candle flame should be placed close to the cross-wires for better illumination.

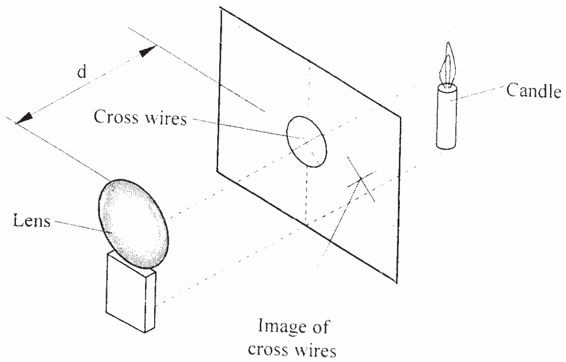


Figure 5

(i) Adjust the position of the lens until a sharp image of the cross-wires is formed on the screen next to the crosswires. *(Hint: You may have to rotate the lens slightly about a vertical axis so that the image of the cross-wires falls on the screen next to the cross-wires and not on the cross-wires).*

Measure the distance d, between the lens and the screen.

d = ... cm

(ii) Evaluate:

I. $L = \dfrac{df}{f - d}$

II. $X = \dfrac{L}{2f} + 1$

The following skills were tested:

- Measurement of angles using a protractor.
- Obtaining the refracted ray by pin method.
- Use of metre rule to obtain image distance in location of image.
- Plotting of graphs and analysis of data from the graph.

Weaknesses

- Candidates were unable to locate the image using the pins using P_3 and P_4.
- They portrayed weaknesses in location of image of the candle in part (B), thus image distance between the lens and screen could not be obtained.
- Candidates had problems in plotting of graphs, that is, choosing appropriate scales.

Expected Responses

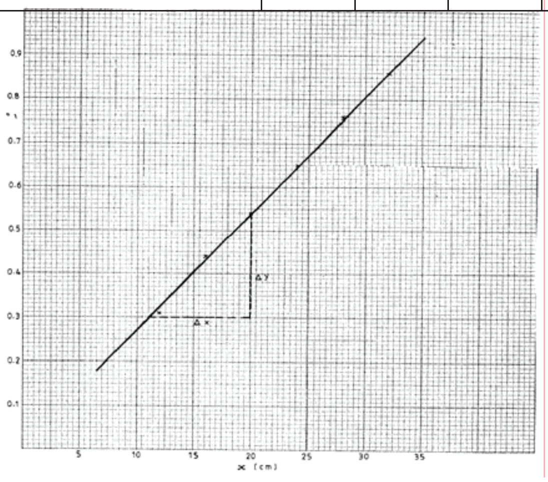
PART A

(a) A = 60°

(e)

Angle of incidence i (deg)	30	35	40	45	50	55	60
Angle Q (deg)	16.5	24.0	31.5	36.0	38.9	45.0	50.0
Angle of emergence E=90-θ	73.5	66.0	58.5	54.0	51.1	45.0	40.0

(f) (i)



(ii) $i_o = 49°$

(iii) (I) $y = 2i_0 - R$
$= 2(49) - 60 = 38°$

(II) k $= 2 \sin 49° = 1.51$

PART B

(g) (i) V = 60 cm

(ii) $f = \frac{uv}{u+v} = \frac{(30)(60)}{90} = 20cm$

(h) (i) d = 10 cm

(ii) I = $\frac{df}{f-d} = \frac{10x20}{10} = 20$

II x = $\frac{L}{2f} + 1 = \frac{20}{40} + 1 = \frac{20}{40} + 1$

= 1.5

7.5 ADVICE TO TEACHERS

Teachers are advised to do more practicals in optics for deeper understanding of the area.