4.3.3   Physics Paper 3 (232/3)

Question 1

You are provided with the following:

-     two biconvex lenses labelled A and B.
-     a light source.
-     Screen I with a hole and cross wires at its centre.
-     Screen II.
-     a metre rule.
-     a plane mirror.
-     a piece of cellotape.
-     two lens holders.
-     a stand, boss and clamp.

Proceed as follows:

(a)   Mount lens A on the lens holder. Fix the plane mirror at the back of the lens using the cellotape provided. Use the stand to hold the light source in line with the crosswires on screen I and lens A with the plane mirror as shown in **figure 1**.
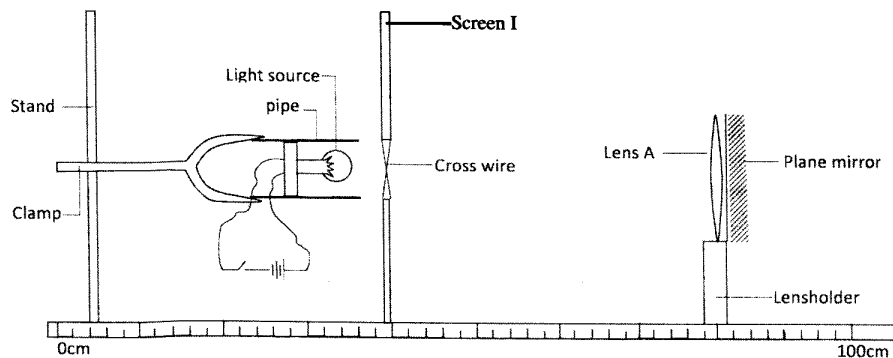

FIG 1

(b)   Switch on the lamp. Adjust the position of the lens with the mirror until a sharp image of the crosswires is formed on screen I beside the crosswires. Measure the distance l_1 between the screen and lens A.

$l_1 = $ .... cm.   (1 mark)

(c)   Replace lens A with lens B. Fix the plane mirror at the back of lens B. Repeat the procedure in (b) above. Measure the distance l_2 between the screen and lens B.

$l_2 = $ .... cm.   (1 mark)

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(d)   Remove the mirror from the lens holder.
      Arrange the light source, Screen I (with crosswires), lens A, lens B and screen II in line
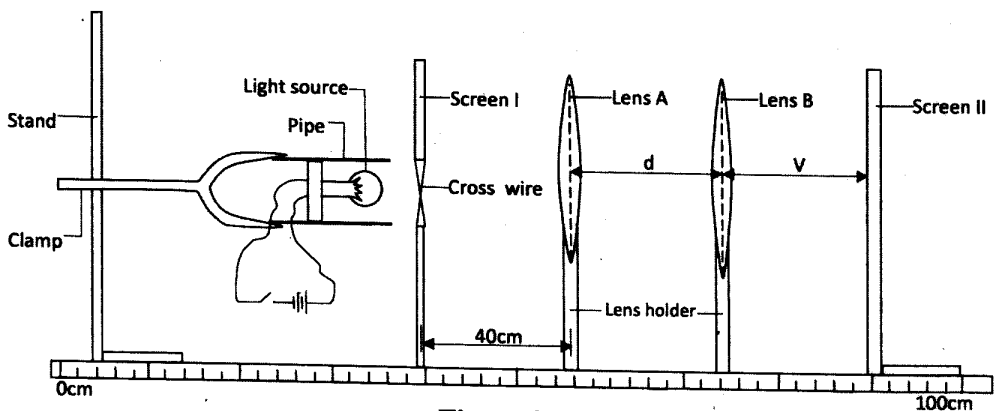   as shown in **figure 2**.

Figure 2

(e)   Set the distance between Screen I and lens A to be 40 cm. **Ensure that this
      distance is maintained throughout the rest of the experiment.**
      Set the distance d between lens A and lens B to be 65 cm. Adjust the position of
      screen II to obtain a sharp image of the cross wires on it. Measure the distance v
      between lens B and screen II.
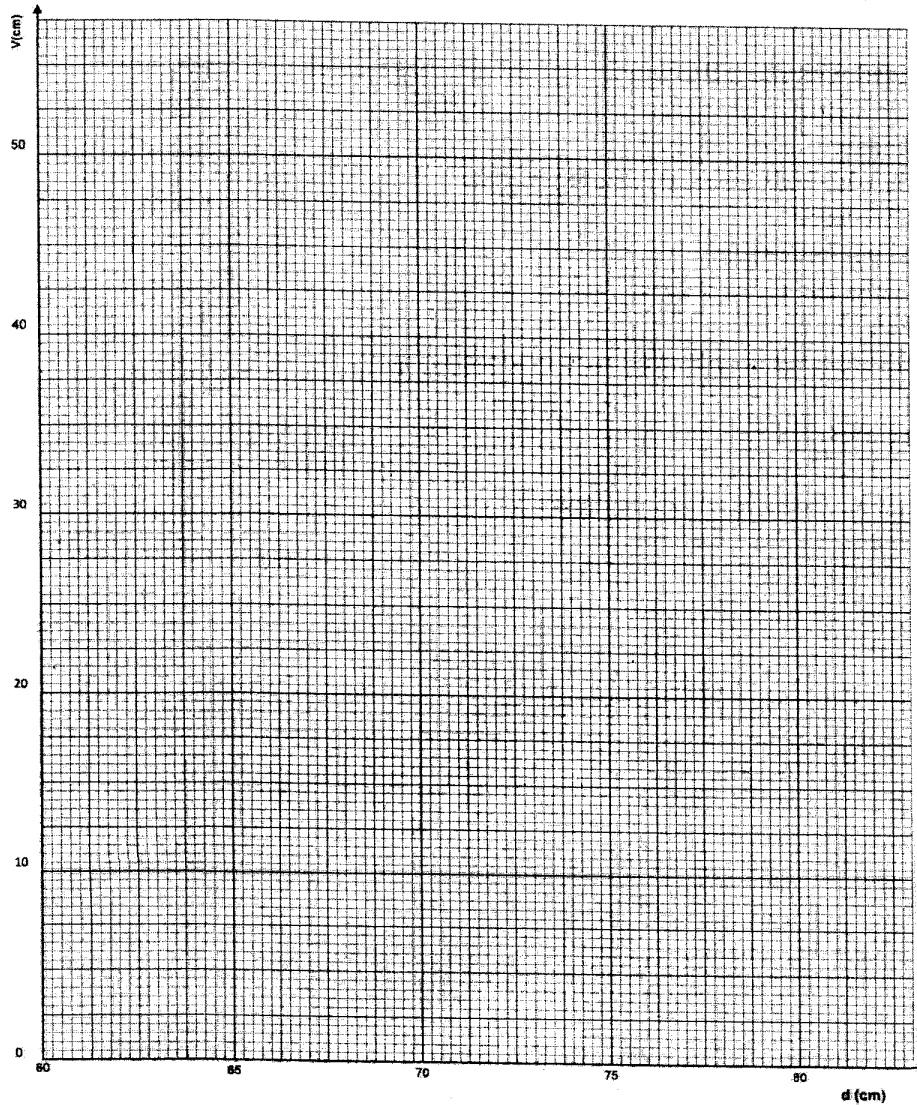   Repeat the experiment for other values of d shown in table 1 and complete the table.

Table 1

d(cm)	65	67	69	71	73	77	80
v(cm)							

(7 marks)

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(f)   On the axes provided below, plot the graph of v(y-axis) against d.   (3 marks)

(g)   (i)   From the graph, at d = 70 cm, determine:

        I.   the value of v.   (1 mark)
        II.   the slope S of the graph.   (3 marks)

    (ii)   Given that $K = \dfrac{-225}{(d-55)^2}$

        determine the value of K.   (2 marks)

    (iii)   Determine the value of m given that $m = \dfrac{S}{K}$ (2 marks)
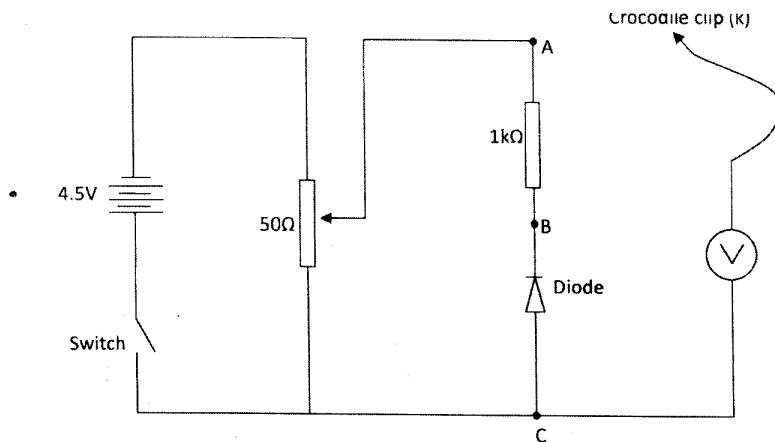
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Question 2

You are provided with the following:

- a voltmeter
- a diode with ends labelled B and C
- a 1 kΩ resistor
- a 50 Ω potentiometer
- 3 dry cells and a cell holder
- a switch
- 8 connecting wires (at least 4 with crocodile clips)

Proceed as follows:

(a) Set up the circuit as shown in **figure 3**.

(b) (i) Connect the crocodile clip K to point A. Adjust the potentiometer by turning the knob until the voltmeter reading is maximum.

Maximum voltmeter reading = ... volts.   (1 mark)

(ii) Without adjusting the potentiometer, disconnect the crocodile clip K from point A and connect it to point B. Record the voltmeter reading.

Voltmeter reading = ... volts.   (1 mark)

(iii) Explain why the voltmeter reading in b(i) is different from that in b(ii).   (2 marks)

(c) Disconnect the crocodile clip K from point B and connect it to point A. Adjust the potentiometer so that the voltmeter reading V_A is 1.0 V. Disconnect the crocodile clip K from A and connect it to point B. Record the voltmeter reading V_B.
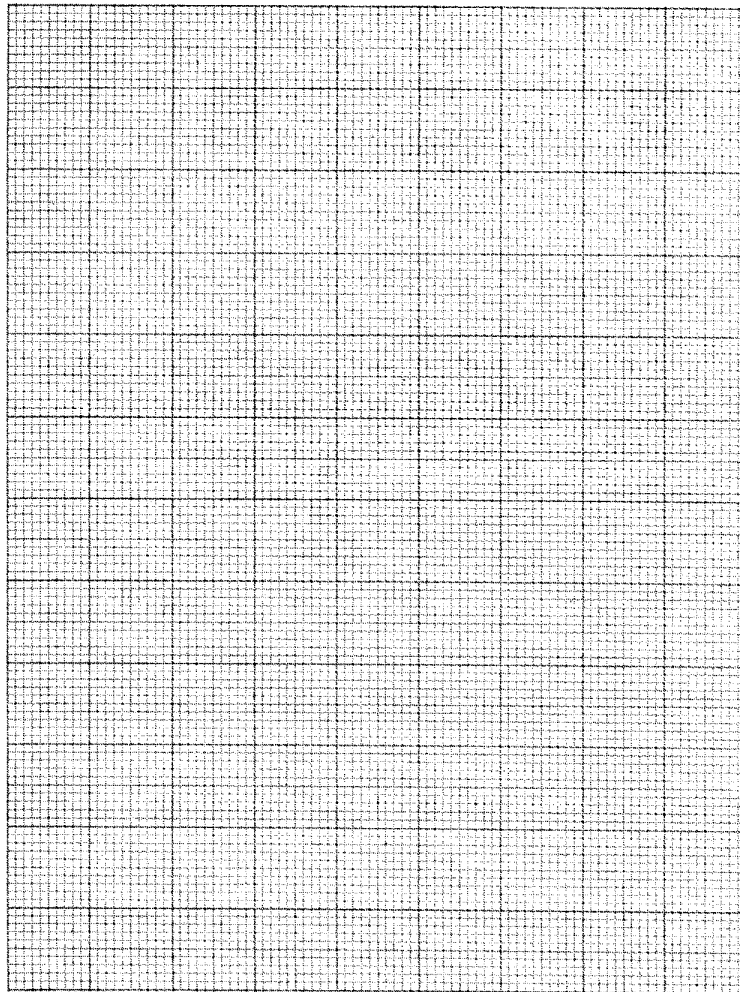
V_B = ... volts.   (1 mark)

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(d)   By adjusting the potentiometer to obtain other values of V_A(when K is at A) shown in **table 2**,
       repeat the procedure in (c) to obtain the corresponding values of V_B(when K is at B) and
       complete the table.   (7 marks)

Table 2

V_A (V)	V_B (V)	$I = \left(\dfrac{V_A - V_B}{1000}\right)$ (A)
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		

(e)   On the grid provided, plot a graph of I (y-axis) against V_B.   (5 marks)

(f)   Use the graph to determine the resistance of the diode when the current is 0.45 mA.
                                                                                               (3 marks)

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