Provincial Department of Education , Northern Province

General Certificate of Education (Adv. Level) Pilot Examination - December 2023

Physics II		**01**	**E**	**II**	

Three hours		**Additional Reading Time - 10 minutes**

Use additional reading time to go through the question paper , select the questions you will answer and decide which of them you will priorities

Index No .....

Important :

- This question paper consists of 21 pages
- This question paper comprises of two parts Part A and Part B. The time allocated for both parts is three hours.
- Use of calculator is not allowed

Part A – Structured Essay

(Pages 02 - 09)

Answer all the questions on this paper itself. Write your answers in the space provided for each question. Please note that the space provided is sufficient for your answers and that extensive answers are not expected

Part B - Essay

(Pages 01 - 13)

This part contains six questions of which four are to be answered . Use the papers supplied for this purpose. At the end of the time allocated for this paper , tie the two parts together so that Part A is on top of Part B before handing them over to the supervisor.

You are permitted to remove only Part B of the question paper from the Examination Hall

For the Second Paper

Part	Question Nos	Marks Awarded
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9(A)	
	9(B)	
	10(A)	
	10(B)	
Total		

Part ii (A) – Structure

Answer all the questions on this paper itself

(g = 10 m s^{-2})

1. The Following items are given for an experiment which is used to find out the density of kerosene

(1) A "U" tube of uniform area of cross section fixed in a vertical frame with suitable scale

(2) Required amounts of water and kerosene oil

(3) Funnels

(I) (a) Draw a labelled diagram of experimental setup indicating the common interface of water and kerosene oil.

(b) Mark on the drawn figure the measurements you obtain as h_1 (for kerosene) and h_2 (for water).

(II) The densities of kerosene oil and water are given by d_1 and d_2 respectively . Derive an expression for d_1 in terms of d_2 , h_1 and h_2.

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(III) (a) You are asked to determine d_1 by graphical method . Of the two liquids , water and kerosene , the height of which liquid should be selected as the independent variable ?

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(b) What is the reason for not selecting the height of the other liquid as the independent variable ?

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(IV) Which liquid should be poured into the "U" tube first ? Explain.

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(V) Suppose that the effect of surface tension is also to be considered . The surface tension of kerosene and water are T_1 and T_2 respectively. The internal radius of "U" tube is r. The angle of contact for both can be considered as zero.

(a) Write an equation which relates r, h_1, h_2 , T_1, T_2 , d_1 and d_2 .

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(b) Arrange the equation you obtained in part V (a) in order to obtain a linear graph.

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(c) When an experimental graph is drawn according to the equation arranged as mentioned in part V(b) , the gradient and the intercept are obtained as 0.8 and 1.0 cm respectively.

(1) Find the density of kerosene oil.

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(2) If r = 1 mm and $T_2 = 0.07\ Nm^{-1}$, find T_1 .

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2. (a) (i) State the conditions that should be fulfilled by a ray to undergo total internal reflection at the common interface between two media?

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(ii) Consider a light ray that enters from glass to air . Draw the incident rays for angle of incidence

(1) equal to the critical angle

(2) greater than the critical angle ,

and draw the subsequent paths of the rays . (Consider only the bright rays)

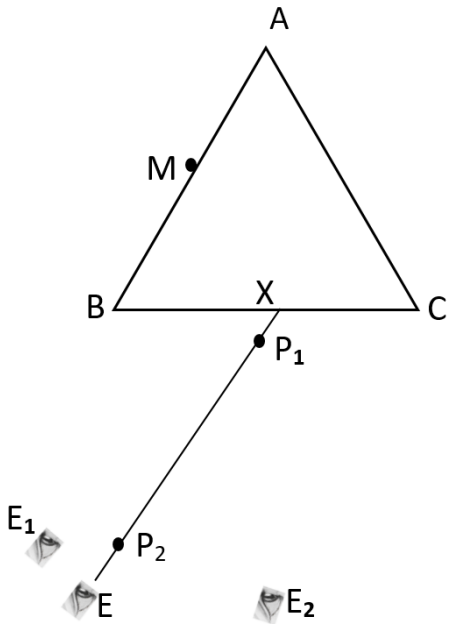
air

Glass

air

Glass

(b) An equilateral triangular prism ABC is placed on a white sheet fixed on a drawing board and the boundaries of the faces of the prism are drawn on the sheet. A pin M is stuck vertically in contact with the face AB. Eye is moved from C to B while looking the image of M through face BC towards AC . At a particular position of the eye E , two pins P_1 and P_2 are stuck in the same line with the image of M.



(i) What is the purpose of sticking M in contact with AB?

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(ii) What change of the appearance of image of the pin M can be observed when the eye passes the position E while moving it from C to B

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(iii) State the accurate experimental steps that have to be followed in sticking the pins P_1 , and P_2 ?

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(iv) In the figure , show that the geometrical construction that the student has to make in order to obtain the path of the ray that undergoes total internal reflection at the critical angle on the surface AC

(v) In the figure indicate the angle that has to be measured in order to obtain the critical angle as α

(viii) write down an expression for the refractive index of the glass (n_g) in terms of α.

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(c) (i) It is also intended to determine the refractive index of water (n_w) . A microscope slide having thin layer of water is made in contact with the face AC. What would be the new position of eye , whether E_1 or E_2 , that corresponds to the new position of P_1 and P_2 ?

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(ii) If β is the angle that corresponds with the measurement of the critical angle of for the water – glass interface , obtain expression for the refractive index of water in terms of α and β

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(iii) In an another experiment to determine the critical angle for glass- water interface, it was observed that the line joining the new positions of P_1 and P_2 coincided with the original line. Give a possible reason for this observation?

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3. You are asked to perform an experiment to determine the specific heat capacity of a liquid by using Newton's Law of cooling. The figure 1 shows an incomplete experimental arrangement for this.

(a) (i) State Newton's Law of cooling.

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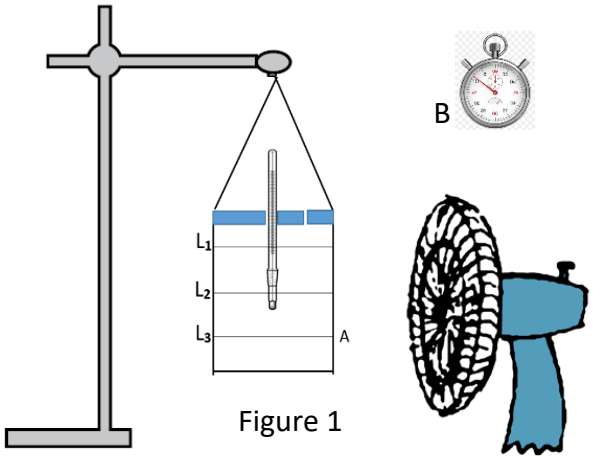

Figure 1

(ii) Give the conditions under which this law is valid.

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(b) You can select one of the items X (Glass beaker) , Y(Polished copper calorimeter) and Z (Polished copper calorimeter) from the figure 2 for the item A shown in the figure 1

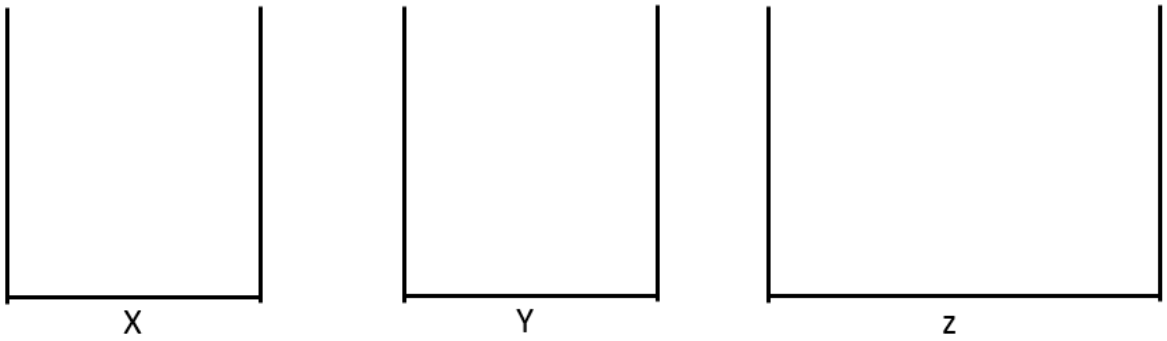

figure *2*

(i) Out of X,Y and Z select the most appropriate item that can be used for A .

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(ii) Give the reason for not selecting the other two items

Item	Reason
(a)……	……
(b)……	……

(c) Up to which level the water and the liquid should be filled in the item A ? give reason . (There are three levels L_1 , L_2 and L_3 shown in the figure 1)

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(d) The variation of the temperature of water and the liquid with time t which is measured by B, is shown below .

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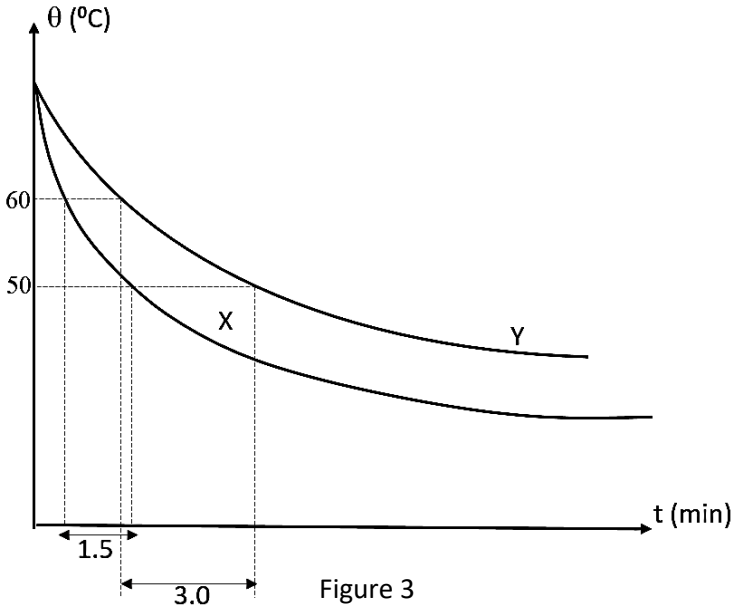

Figure 3

i. An important item is not shown in the figure 1 . Draw it in the figure 1.

ii. What is the procedure that should be followed when the temperature measurement is taken ?

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iii. If the specific heat capacity and density of the liquid are less than that of water then identify the liquid and water from the graph in figure 3.

X : …… Y : ……

iv. The following mass measurements are taken by using triple beam balance to determine specific heat capacity

X_1 = 280.0 g X_2 = 480 .0g X_3 = 452.0 g

(a) Identify the measurements corresponds to X_1, X_2 and X_3

X_1 : ……

X_2 : ……

X_3 : ……

(b) The specific heat capacity of the item A is given as 400 J kg^{-1} K^{-1}. Find the average rate of heat loss of the item A with water during the cooling from 60^0 C to 50^0 C . (specific heat capacity of the water 4200 J kg^{-1} K^{-1})

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(c) Write down the equation to calculate the specific heat capacity of the liquid S_l.

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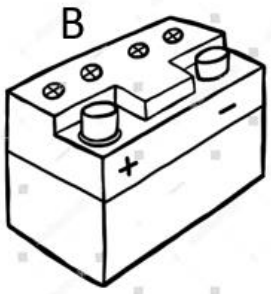
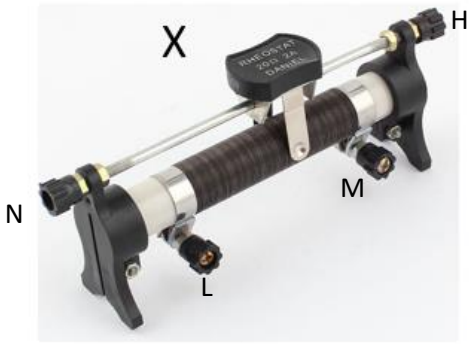
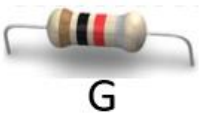
4. An incomplete circuit is shown in the figure which is arranged for verifying Ohm's Law. For this , the following electrical components are provided; a battery , switch, variable resistor , fixed resistor (small value) , voltmeter , ammeter and connecting wires . L, M, N, and H are terminals of the item X.







(a) Identify the components which are marked by the letters.

S …… B …… X ……

D …… G …… F ……

(b) Complete the circuit given in the above figure. Mark the polarity (+/-) of the terminals of ammeter and voltmeter

(c) Write down the relationship between the potential difference (V) across the resistor (R) and the current (I) through it

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(d) What would be the values of internal resistance of ammeter and voltmeter to obtain accurate final result?.

Ammeter ……

Voltmeter ……

(e) Arrange the formula you mentioned in part (c) for a linear graph and identify the independent variable and dependent variable.

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(f) Sketch the expected graph, according to the part (e) , on the axes given below.

Figure *1*

(g) A student says that It is better to send small current through the fixed resistor. Do you agree with this statement? Give reason.

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(h) Although the student followed the suitable procedure to change the quantity of the element X, the readings of the elements D and F remained unchanged. Give reason for this.

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(i) State the reason for not selecting instrument other than X for the respective purpose ?

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(j) If the resistance of the fixed resistor is not small and has the resistance which can be compared with the internal resistance of voltmeter, then draw a new circuit diagram which shows how to connect the voltmeter in this circuit to verify Ohm's law with the same electrical elements. You can use usual symbol for electrical elements to draw circuit diagram.

(k) Now suppose that you are asked to find the internal resistance of a dry cell . How do you modify the circuit using the components given above? Draw the respective circuit using symbols .