

2009 A/L Structured Essay Question No (01)

Figure (1) shows an experimental setup of Hare's apparatus used in a school laboratory to measure the relative density of a liquid. In the figure, water and liquid are labelled as A and B respectively.

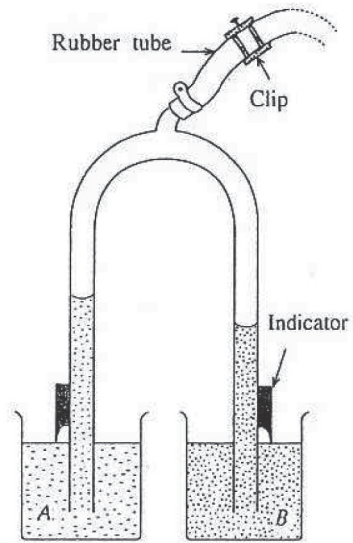


Figure (1)

- (a) (i) Give an approximate value for the diameter in cm, of the tube in both arms in a Hare's apparatus normally used in a school laboratory.

 (ii) Name the measuring instrument that is **not** shown in the figure given but needed for the experiment.

 (iii) State clearly how you would **establish** and **maintain** water and liquid columns in the arms of the Hare's apparatus.

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- (iv) What is the special advantage of this method over the U tube method?

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(b) In order to determine the surface tension as well as the density of a liquid a student has modified the Hare's apparatus by replacing its both arms with identical capillary tubes of internal radius r , as shown in figure (2).

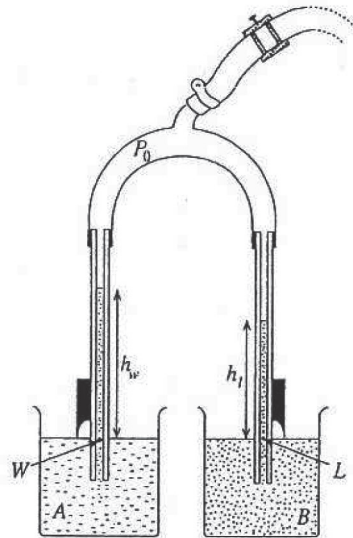


Figure (2)

- (i) Let P_0 be the pressure of air above the water and liquid meniscus, (h_w, h_l) be the heights of the columns, (d_w, d_l) be the densities and (T_w, T_l) be the surface tensions of water and liquid respectively.

If P_W, P_L are the pressures at points W and L respectively, write down expressions for P_W and P_L in terms of relevant parameters.

Assume that the contact angles of water and liquid with glass are zero.

P_W :

P_L :

(ii) Hence derive an expression for h_w in terms of h_p , d_w , d_l , T_w , T_l , r and g in the form of $y = mx + c$.

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(iii) If you draw graph of h_w versus h_p and if you know the values of d_w , T_w , r and g what quantities you should extract from the graph to determine T_l and d_l ?

To determine T_l

To determine d_l

(iv) Why is it always suitable to have the heights of the water and liquid columns as large as possible?

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