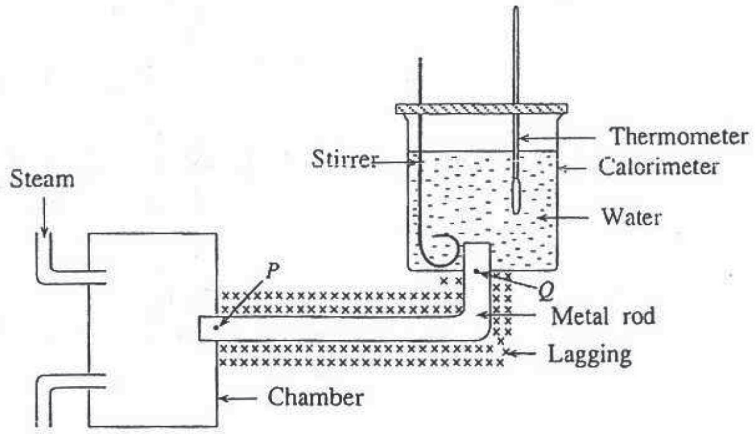
2009 A/L Structured Essay Question No (02)



The apparatus shown in the diagram can be used to determine the thermal conductivity of a metal in the form of a rod of uniform cross-section. In this experiment steam at 100 °C is passed through the chamber and the **temperature**, θ, of the water in the calorimeter is measured with **time** t.

(*a*) Give reasons as to why steam is always used in this type of experiments.

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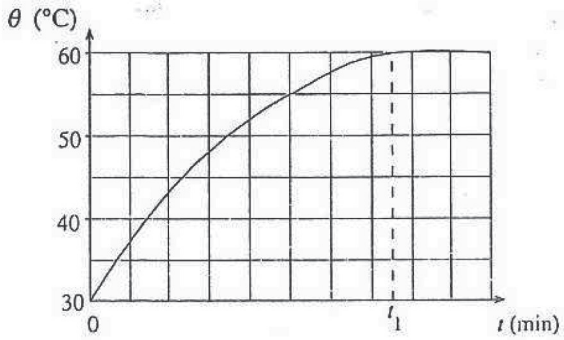
(*b*) The variation of the above mentioned θ, with t is given below.



(i) According to the graph, after $t = t_1$, θ attains a steady value. What is the reason for this?

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(ii) From 0 to t_1, the variation of θ with t is non linear, and there are two main reasons for this. What are they?

(1) .....

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(2) .....

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(iii) What is the temperature achieved by water at the steady state?

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(*c*) It has been found from a separate cooling experiment that the rate, R (in watts) of heat dissipation from the calorimeter and its contents at temperature, θ, is given by $R = 0.16\ (\theta - \theta_R)$, where θ_R is the room temperature.

(i) Calculate R at the steady state temperature. ($\theta_R = 30\,°C$)

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(ii) Hence, determine the thermal conductivity of the metal. The cross-sectional area of the rod = $1.2 \times 10^{-4}\,m^2$, and the length of the rod from P to Q = 0.4 m.

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(*d*) If the calorimeter is also lagged well, could you perform this experiment successfully? Explain your answer.

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