

A level Physics B

H557/02 Scientific literacy in physics

Question Set 5

1

This question is about the Boltzmann factor, $f = e^{-E/kT}$.

Fig. 1.1 shows how the Boltzmann factor varies with temperature for three processes: **A**, **B** and **C**.

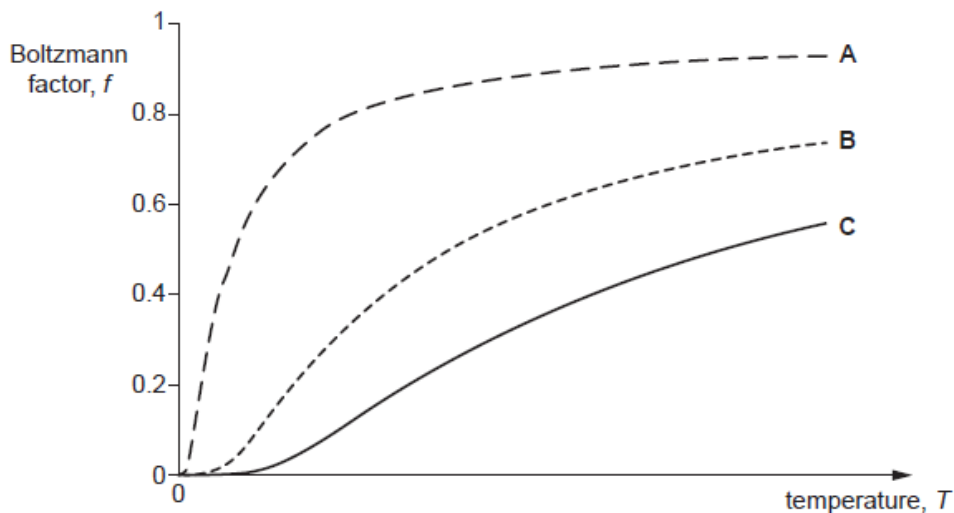


Fig. 1.1

(a) Explain how the graphs in **Fig. 1.1** show that line **C** represents the process with the greatest activation energy E . [3]

(b) This part of the question is about the evaporation of liquids; the process in which molecules of the liquid gain sufficient energy to enter into the vapour.

(i) The Boltzmann factor for water molecules escaping the liquid and entering the vapour state is 4.9×10^{-8} at 310 K.

Calculate the activation energy required for a water molecule to escape into the vapour state at this temperature.

activation energy =J [3]

(ii) Explain how particles with an average energy lower than the activation energy gain enough energy to escape into the vapour. [2]

(iii)* The activation energy for a molecule of ethyl alcohol to escape into the vapour state is 6.6×10^{-20} J.

Calculate the Boltzmann factor at 310K for this process and use ideas from the question to explain why a drop of ethyl alcohol feels colder on the skin than a drop of water.

[6]

Total Marks for Question Set 5: 14

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