OCR
Oxford Cambridge and RSA

AS Level Chemistry A

H032/01 Breadth in chemistry

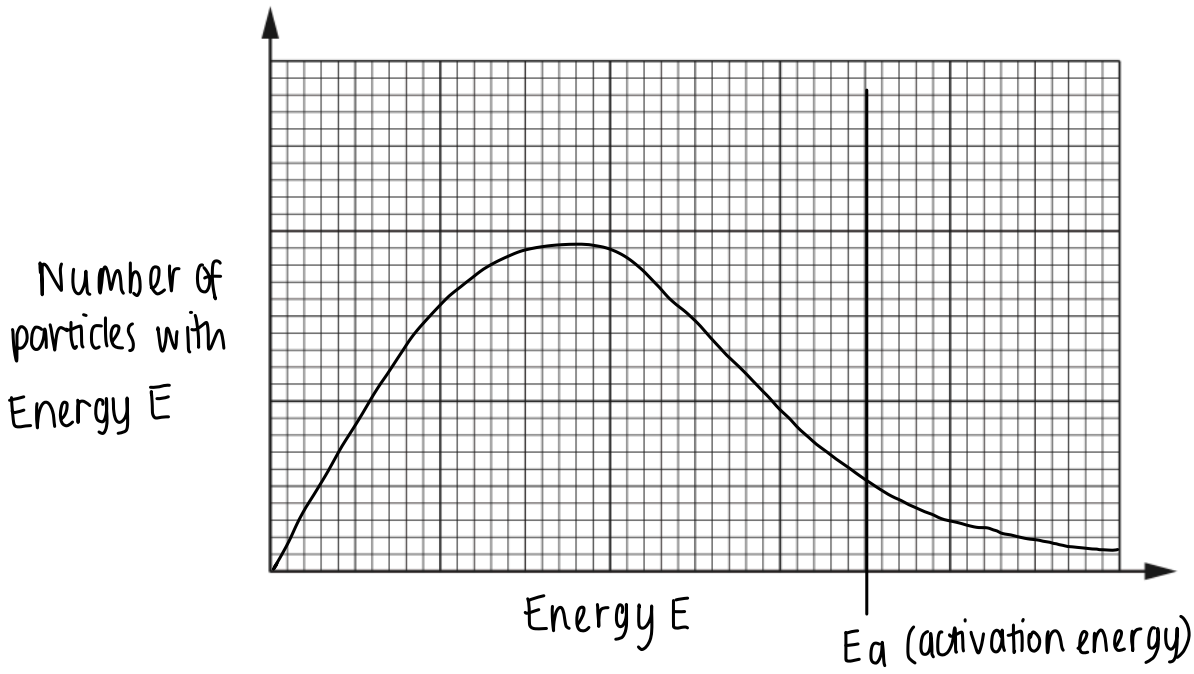
Question Set 10

1. Methanol can be prepared industrially by reacting carbon monoxide with hydrogen in the presenceof a copper catalyst. This is a reversible reaction.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

(a) Using the Boltzmann distribution model, explain why the rate of a reaction increases in thepresence of a catalyst.

You are provided with the axes below, which should be labelled.



[4]

Only the particles under the curve to the right of the activation energy have enough energy to react; a catalyst moves the activation energy to the left, therefore more particles have E ⩾ Ea and so there are more frequent successful collisions so a faster rate of reaction because the activation energy has been lowered by the catalyst.

(b) Explain why use of the catalyst reduces energy demand and benefits the environment.

A catalyst increases the rate of reaction by providing an alternative pathway for the reaction, one with a lower activation energy A lower temperature is therefore required to be generated meaning less fossil fuels are burned and less CO_2 is released into the atmosphere. **[2]**

(c) A chemist investigates the equilibrium that produces methanol:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

The chemist mixes CO(g) with $H_2(g)$ and leaves the mixture to react until equilibrium is reached.

The equilibrium mixture is analysed and found to contain the following concentrations.

Substance	Concentration /mol dm^{-3}
CO(g)	0.310
$H_2(g)$	0.240
$CH_3OH(g)$	0.260

$$K_c = \frac{[CH_3OH]}{[CO][H_2]^2} \rightarrow \frac{mol\,dm^{-3}}{(mol\,dm^{-3})^3} \rightarrow \frac{1}{(mol\,dm^{-3})^2} \rightarrow mol^{-2}\,dm^6$$

$$= \frac{0.260}{(0.310)(0.24)^2}$$

$$K_c = 14.6\ mol^{-2}\,dm^6$$

Calculate the numerical value of K_c for this equilibrium.

Give your answer to an **appropriate** number of significant figures.

[2]

Total Marks for Question Set 10: 8