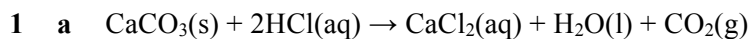
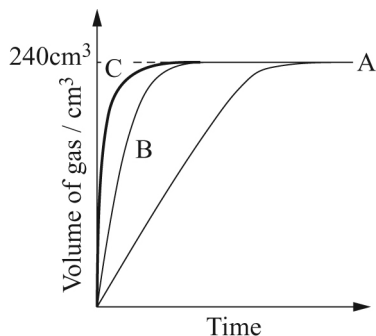


# Chapter 9: Rates of reaction

## Homework marking scheme

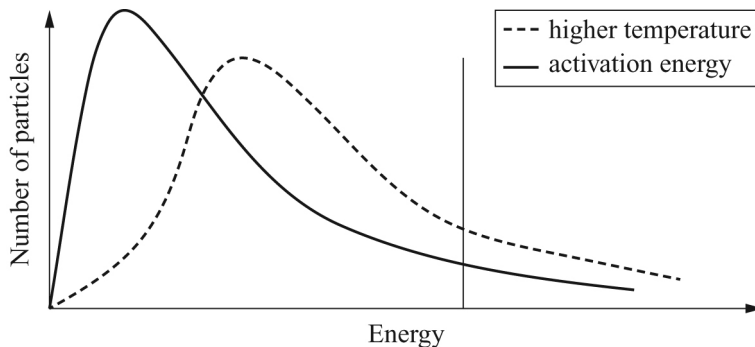


b



- i The curve A is steep at first then levels off to plateau final volume of  $\text{CO}_2$  is  $240 \text{ cm}^3$ . [1]  
[1]  
[2]
- ii Curve B is steeper at first then levels off to same value. [1]  
[1]
- iii Curve C is steeper than curve B at first then levels off to same value. [1]  
[1]

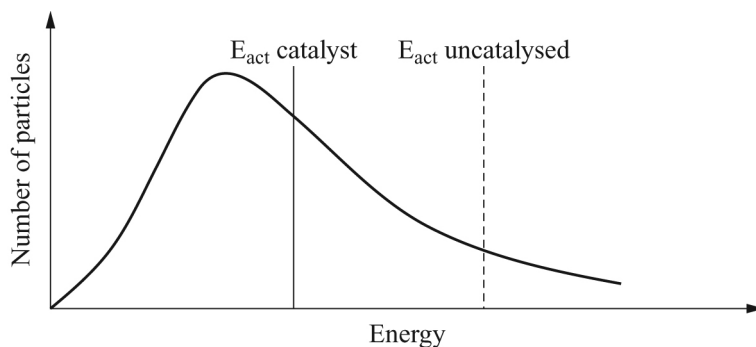
c



- Two lines with higher temperature line shifted to right and down as shown. [1]  
Both lines **must** start at origin (0,0) and not touch the horizontal axis at the right-hand side. [1]  
Correctly labelled axes. [1]  
Line for activation energy. [1]  
At a higher temperature, a greater proportion of particles have energy greater than  $E_{\text{act}}$ . [1]  
The proportion of successful collisions is greater at the higher temperature. [1]  
Also, the particles moving around more quickly means an increased frequency of collisions. [1]

- 2 a i Catalyst: a substance that speeds up a chemical reaction [1]  
 and is unchanged chemically at the end of the reaction. [1]  
 Heterogeneous: the catalyst is in a different state to the reactants and products. [1]
- ii Particles diffuse to the surface [1]  
 adsorption/chemisorption takes place [1]  
 bonds weaken/reaction occurs [1]  
 particles desorb from surface/desorption takes place. [1]

iii



- axes [1]  
 line starting at origin (0,0) [1]  
 $E_{act}$  of catalysed reaction lower than that of uncatalysed reaction. [1]  
 Area under the catalysed part of graph greater than that under the uncatalysed part. [1]  
 Therefore, a greater proportion of molecules greater than  $E_{act}$ . [1]

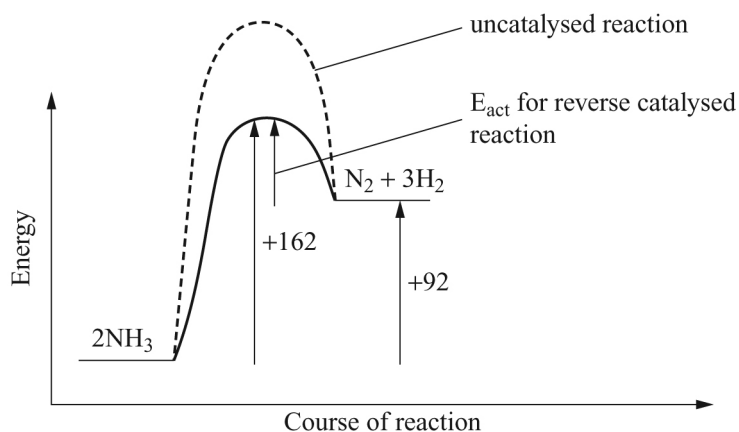
iv 
$$K_p = \frac{P^4(\text{NO}) \times P^6(\text{H}_2\text{O})}{P^4(\text{NH}_3) \times P^5(\text{O}_2)}$$
 [1]

units = Pa (10 pressure on top of expression, 9 pressure on bottom) [2]

v Exothermic because the wire glowed red hot as the reaction took place. [1]

- b i  $-46 \text{ kJ mol}^{-1}$  [1]  
 the value [1]  
 the minus sign (because the enthalpy of formation is the reverse reaction). [1]

ii



- correct and labelled axes [1]  
 two profiles, with the uncatalysed higher in energy than the catalysed [1]  
 arrows labelled correctly [1]  
 products at a higher energy than the reactants. [1]
- iii  $E_{act}(\text{reverse}) = 162 - 92 = 70 \text{ kJ mol}^{-1}$  [1]