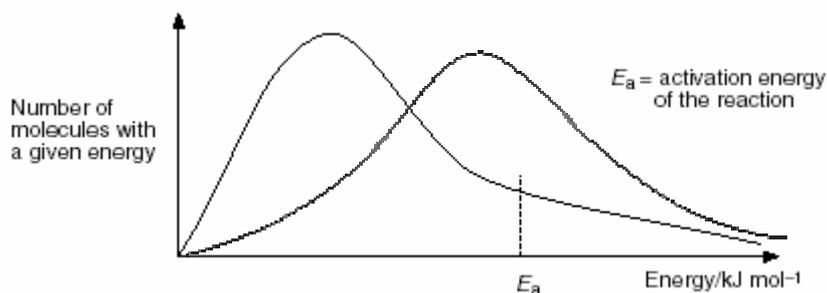


## Answers to practice exam questions for Chapter 4 Thermochemistry

### Question 1

a



- i The activation energy is the minimum energy required by the colliding particles for a reaction. **A**
- ii Maximum shifts to the right **A**
- iii There are more particles with kinetic energy greater than the energy of activation. Hence, more collisions will be successful and the reaction proceeds at a faster rate.  
M = more molecules with energy, E = plus linked to rate

### Question 2

a  $\Delta E = \sum E_{\text{bonds formed}} + \sum E_{\text{bonds broken}}$  (forming bonds is exothermic)

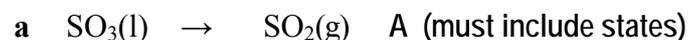
Bonds made  $2(\text{C}-\text{C}) = 2 \times -347 \text{ kJ mol}^{-1}$   
Bonds broken  $(\text{C}=\text{C}) = 620 \text{ kJ mol}^{-1}$

$$\begin{aligned}\Delta E &= -694 + 620 \text{ kJ mol}^{-1} \\ &= -74 \text{ kJ mol}^{-1}\end{aligned}$$

For 15 moles  $\Delta E = 15 \times -74 \text{ kJ mol}^{-1}$   
 $= -1110 \text{ kJ mol}^{-1}$

A = correct equation, M = correct calculation with minor error, E = correct answer with units

### Question 3



b 0.235 mol requires 10.0 kJ

$$\begin{aligned}\text{Hence, } \Delta_{\text{vap}}H^\circ(\text{SO}_3, \text{l}) &= \frac{10.0 \text{ kJ}}{0.235 \text{ mol}} \\ &= 42.6 \text{ kJ mol}^{-1} \quad \text{A (must include units)}\end{aligned}$$

c i equal to **A**

ii greater than **A**

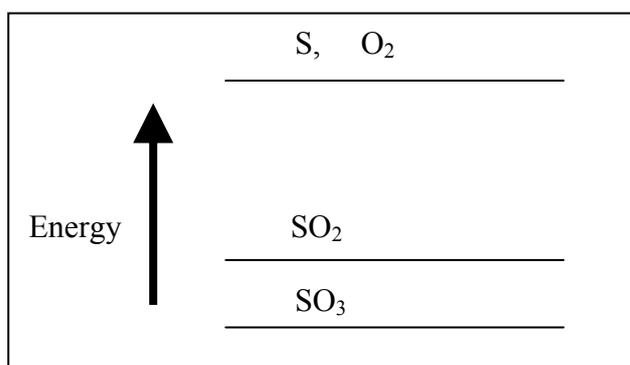
- iii Temperature is a measure of the average kinetic energy of an object, and at a given temperature all particles of gas have the same kinetic energy. Since they have the same K.E. the particle with the smaller mass (not size) has the greater speed ( $E_k = \frac{1}{2}mv^2$ ).  
M = valid argument, but incomplete, E = all points mentioned

d i exothermic A



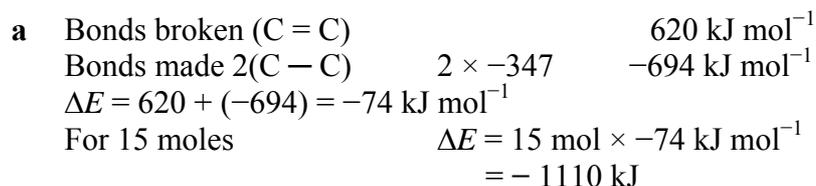
A = correct method, but error in working, M = correct answer (to 3 s.f.)

e



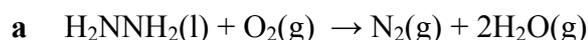
A = all correct, but reverse order, M = all correct

#### Question 4



A = correct method, but could not complete calculation correctly, M = correct, but sign wrong,  
 E = all correct

#### Question 5



b  $\Delta_r H = \sum \Delta_f H^\circ_{(\text{products})} - \sum \Delta_f H^\circ_{(\text{reactants})}$   
 $= 2 \times -394 \text{ kJ mol}^{-1} + 4 \times -242 \text{ kJ mol}^{-1} - (1 \times 50 \text{ kJ mol}^{-1})$   
 $= -1806 \text{ kJ mol}^{-1}$

A = correct equation, M = correct calculation with a minor error,  
 E = correct answer with units

c Hydrazine: 32 g releases 534 kJ  
1 g releases 16.7 kJ

Dimethylhydrazine: 60 g releases 1806 kJ  
1 g releases 30.1 kJ

Hence, dimethylhydrazine gives more heat per gram.

A = correct answer but no working, M = correct calculations and conclusion