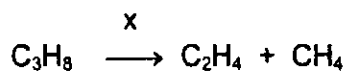




AS HOW FAR / HOW FAST ?
Mark Scheme 2813/01
June 2004

Question	Expected Answers	Marks
1	(a) the energy required to break 1 mole of gaseous bonds	✓ ✓ [2]
	(b) (i) Enthalpy of bonds broken = $4(410) + 2(500) = 2640$ Enthalpy of bonds made = $2(805) + 4(465) = 3470$ $\Delta H = -830 \text{ (kJ mol}^{-1}\text{)}$ values for bonds broken values for bonds made correct answer	✓ ✓ ✓ [3]
	(ii) The <i>standard</i> enthalpy change of combustion requires H ₂ O to be liquid, not gaseous <i>or</i> reaction not carried out under standard conditions <i>or</i> bond energies are average values/ bond energies vary in different environments	✓ [1]
	(c) (i) $\text{C}_3\text{H}_8(\text{g}) + 5 \text{O}_2(\text{g}) \longrightarrow 3\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{l})$ (balancing ✓ state symbols ✓)	[2]
	(ii) The energy for making the bonds in the product exceeds the energy required to break the bonds in the reactants/the difference between successive ΔH_c values is ΔH for $-\text{CH}_2- + 1\frac{1}{2}\text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$	✓
	this is because C=O bonds are very strong/ reason for increasing energy based on specific bond strengths	✓ [2]

(iii)



$$-2220 \quad -1410 \quad -890$$



$$x - 1410 - 890 = -2220$$

$$x = (+) 80$$

cycle including 3CO₂ and 4H₂O

✓

correct data

✓

answer

✓

OR

$$\Delta H^\circ = \Delta H \text{ reactants} - \Delta H \text{ products}$$

✓

$$\Delta H^\circ = -2220 + 890 + 1410$$

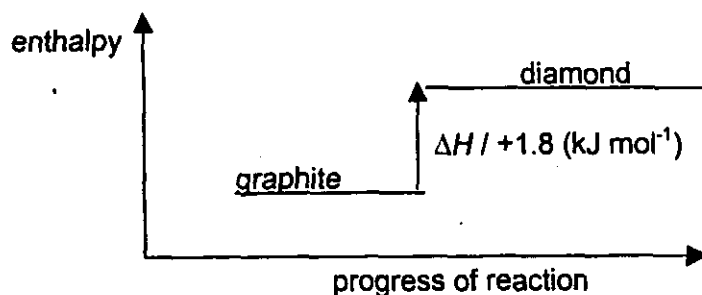
✓

$$= (+) 80$$

✓

Total: 13

2 (a)



labelled line for diamond above graphite ✓

 $\Delta H / 1.8$ labelled ✓ [2]

- (b) graphite, because the change graphite \rightarrow diamond is endothermic/
changes tend to go in direction of lower energy ✓ [1]
- (c) diamond, because its density is greater than that of graphite/
reason based on known structures ✓ [1]
- (d) (When a system in dynamic equilibrium is subjected to a change in
conditions....) the (position of) equilibrium will shift ✓
in the direction that minimises the effect of the change ✓ [2]
- (e) high pressure ✓
because the volume of 1 mol of diamond is less than that of 1 mol of graphite ✓
high temperature ✓
because the change graphite to diamond is endothermic ✓ [4]

Total: 10

Final Mark Scheme

2813/01

June 2004

- 3 (a) (i) $\text{Cl} + \text{O}_3 \longrightarrow \text{ClO} + \text{O}_2$ equation 3.1 ✓
- $\text{ClO} + \text{O} \longrightarrow \text{Cl} + \text{O}_2$ equation 3.2 ✓
- $\text{O} + \text{O}_3 \longrightarrow 2\text{O}_2$ overall equation ✓ [3]
- (ii) Cl is the catalyst ✓
- it is used up in one step and reformed in a subsequent step ✓ [2]
- (b) **Essential point**
heterogeneous means catalyst is in a different state
/phase from reagents/products ✓
- then**
catalyst works by:
- adsorption of gases onto surface/
forming(weak) bonds to catalyst to reactants ✓
- this weakens bonds in reactants/ reaction occurs on surface ✓
- activation energy is lowered/ reaction proceeds by different route ✓
- desorption of products from surface. ✓ [4max]

Total: 9

- 4 (a) (i) acids are H^+ donors/ proton donors/ electron pair acceptors ✓ [1]
- (ii) strong = completely ionised/dissociated ✓ [1]
- (b) (i) $2HCl(aq) + Na_2CO_3(aq) \longrightarrow 2NaCl(aq) + CO_2(g) + H_2O(l/aq)$ ✓ [1]
- (ii) fizzing/effervescence/gas given off ✓ [1]
- (iii) $2H^+ + CO_3^{2-} \longrightarrow CO_2 + H_2O$ ✓ [1]

Total: 5

- 5 (a) (i) curve :
starts at (0,0) and has its maximum at a lower ordinate value than given curve ✓
- and to the right of the maximum on the given curve ✓ [2]
- (ii) more molecules have $E > E_a$ (at higher T)/ shading on graph ✓
so more collisions are effective in causing reaction/
more successful collisions ✓ [2]
- (b) (i) reaction rate increases with pressure ✓
because the molecules are closer together ✓ [2]
- (ii) after the reaction has started the temperature/energy/speed of the reactant molecules increases ✓
allowing many molecules to have $E > E_a$, and thus speeding up the reaction ✓ [2]

Total: 8