OCR

RECOGNISING ACHIEVEMENT

# Subject: How Far, How Fast? Code: 2813/1

## Session: June Year: 2004

## Mark Scheme

| MAXIMUM MARK | 60 |
|---|---|

## ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
   You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

   x = incorrect response (errors may also be underlined)
   ^ = omission mark
   bod = benefit of the doubt (where professional judgement has been used)
   ecf = error carried forward (in consequential marking)
   con = contradiction (in cases where candidates contradict themselves in the same response)
   sf = error in the number of significant figures

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

| Abbreviations, annotations and conventions used in the Mark Scheme | / = alternative and acceptable answers for the same marking point<br>; = separates marking points<br>NOT = answers which are not worthy of credit<br>( ) = words which are not essential to gain credit<br>_____ = (underlining) key words which must be used to gain credit<br>ecf = error carried forward<br>AW = alternative wording<br>ora = or reverse argument |
|---|---|

| 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 (kJ $mol^{-1}$) | | |
| | | values for bonds broken | ✓ | |
| | | values for bonds made | ✓ | |
| | | correct answer | ✓ | |
| | | +830 (2) -2150 (2) -25 (2) -1650 (2) +100 (2) +170 (2) | | [3] |
| | | (ii) The *standard* enthalpy change of combustion requires $H_2O$ to be liquid, not gaseous *or* reaction not carried out under standard conditions/ bond energies are average values/ bond energies vary in different environments | ✓ | [1] |
| | (c) | (i) $C_3H_8(g) + 5\ O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$ *(formulae and balancing ✓state symbols ✓)* | | [2] |
| | | State symbols mark can stnd alone unless equation ridiculous | | |
| | | (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 $\Delta$Hc values is $\Delta$H for $-CH_2- + 1½O_2 \rightarrow CO_2 + H_2O$ | ✓ | |
| | | this is because C=O bonds are very strong/ reason for increasing energy release based on specific bond strengths. | ✓ | [2] |

(iii)

$$C_3H_8 \xrightarrow{x} C_2H_4 + CH_4$$

- 2220 -1410 -890

$CO_2 + H_2O$

$x - 1410 - 890 = -2220$
$x = (+) 80$

cycle including $3CO_2$ and $4H_2O$ ✓

correct data ✓

answer ✓

OR

$\Delta H^{\ominus}$ = $\Delta$H reactants – $\Delta$H products ✓

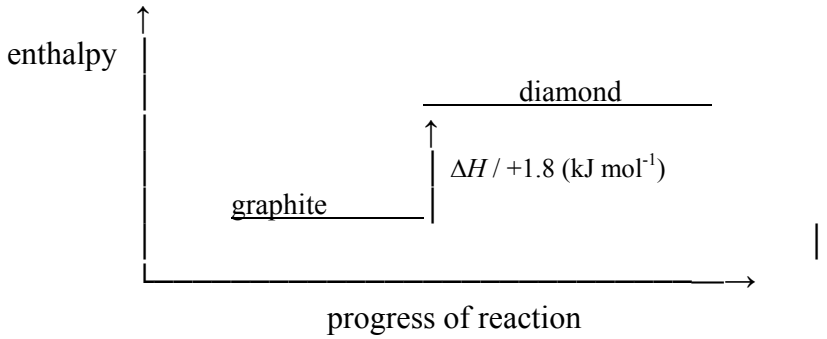
$\Delta H^{\ominus}$ = – 2220 + 890 + 1410 ✓

= (+) 80 ✓ [3]

+230 (2) -1330 (1) -1700 (2) –2740 (2)

**Total: 13**

2 (a)




labelled line for diamond above graphite (need not have arrowheads or can be double arrowheaded but if single arrowhead it must point the correct direction ✓

ΔH/ 1.8 labelled ✓

ignore any reference to Ea [2]

(b) graphite, **because** the change graphite ⟶ diamond is endothermic/ changes tend to go in the direction of lower energy level ✓ [1]

(c) diamond, **because** its density is greater than that of graphite/ reason based on known structures but must convey greater gaps in graphite ✓ [1]

(d) *(When a system in dynamic equilibrium is subjected to a change in conditions....)*
the (position of) **equilibrium** will shift/move ✓

in the direction that minimises the effect of the change (opposes/ tends to stop are OK but NOT stops/ counteracts) ✓ [2]

(e) high pressure/ 50 atms or more ✓

because the volume of 1 mol of diamond is less than that of 1 mol of graphite ✓

high temperature/ 400$^{o}$C or more ✓

because the change graphite to diamond is endothermic ✓ [4]

**Total: 10**

3 (a) (i) $Cl + O_3 \longrightarrow ClO + \mathbf{O_2}$ equation 3.1 ✓

$\mathbf{ClO} + O \longrightarrow Cl + O_2$ equation 3.2 ✓

$\mathbf{O} + \mathbf{O_3} \longrightarrow \mathbf{2O_2}$ overall equation ✓

last mark can be stand alone [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 ✓

**then**
catalyst works by:

adsorption of gases/
forming(weak) bonds to catalyst to reactants (NOT absorb) ✓

this weakens bonds in reactants/ reaction occurs on surface ✓

activation energy is lowered/ reaction proceeds by different route or mechanism ✓

desorption of products from surface/ description of desorption. ✓ [4max]

**Total: 9**

4 (a) (i) acids are $H^+$ donors/ proton donors/ release $H^+$/ electron pair acceptor ✓ [1]

(ii) strong = completely ionised/dissociated/ gives up all its $H^+$
NOT lots of $H^+$/ high concentration of $H^+$ ✓ [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/ bubbles
NOT gas formed ✓ [1]

(iii) $2H^+ + CO_3^{2-} \longrightarrow CO_2 + H_2O$
ignore state symbols
no spectator ions allowed ✓ [1]

**Total: 5**

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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 ie it must only cross the first curve once ✓ [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
NOT more collisions ✓ [2]

(b) (i) reaction rate increases with pressure ✓

because the molecules are closer together
[NOT molecules have more energy/ increased concentration] ✓ [2]

(ii) after the reaction has started the temperature goes up/energy increases/speed of the reactant molecules increases ✓

allowing **many** molecules to have $E>E_a$, and thus speeding up the reaction ✓ [2]

**Total: 8**