OCR

RECOGNISING ACHIEVEMENT

As How Far / How Fast?

Mark Scheme 2813/1
January 2004

Question	Expected Answers	Marks

1 (a) (i)   the enthalpy change when <u>1 mole</u> of compound/species/substance is formed ✓
[mention of 1 mole of *elements* negates this mark]

from its <u>elements</u> [NOT atoms/ions] (under standard conditions)   ✓ [2]

(ii)   25°C/298K **and** 1 atmos/1 x 10^5 Pa   ✓ [1]

(b)   Pb(s) + ½O_2(g) ⟶ PbO(s) *(balancing for 1 mol of PbO)*   ✓
(state symbols)   ✓u/c [2]

(c) (i) $\Delta H^{\ominus}$ = -718 - 3(-217)

= **-67** (kJ mol^{-1}) *(use of correct data & multiplier*   ✓)
(correct signs   ✓)
(correct calculation of value   ✓) [3]

some possible ecf values: +67   [2]
                                -501   [2]
                                +501   [1]
                                -1369   [2]
                                +1369   [1]

(ii) $\Delta H^{\ominus}_f$ = -718 + 10 + 2(217)

= **-274** (kJ mol^{-1}) *(use of correct data & multiplier*   ✓)
(correct signs   ✓)
(correct calculation of value   ✓) [3]

some possible ecf values: -57   [2]
                          -284   [2]   -294   [2]
                          +424   [1]   +444   [2]   -491   [2]
                          -511   [1]   -708   [1]   -1142 [2]
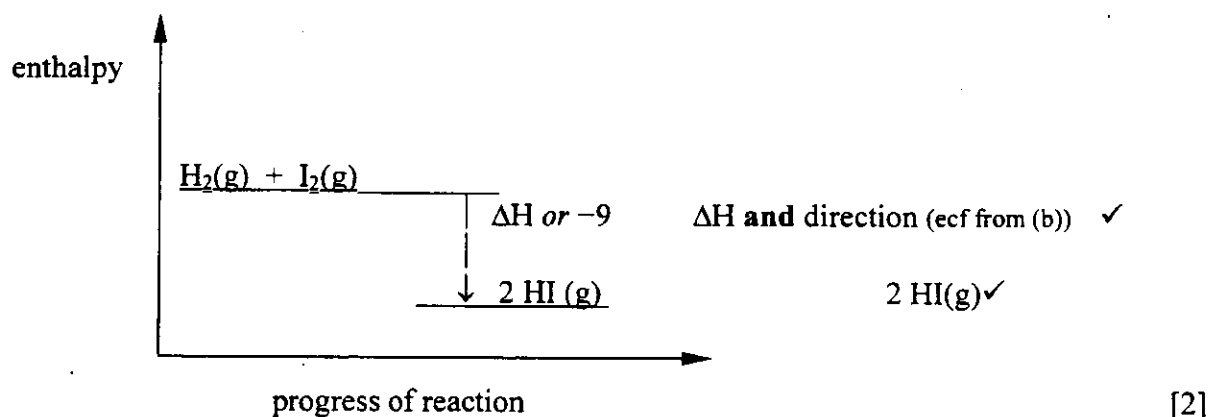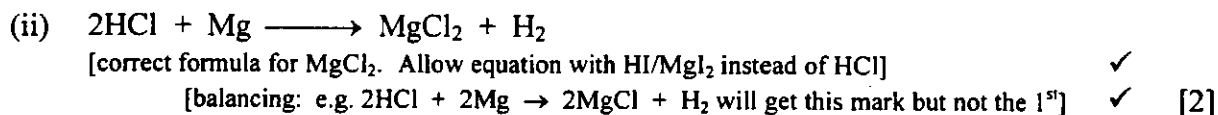
for others, work through the calc: -[1] for each error.

Total: 11

2   (a)   I-I(g) ———→ 2I(g) *(state symbols ✓)*
                (1 mole I$_2$ ✓)   [2]
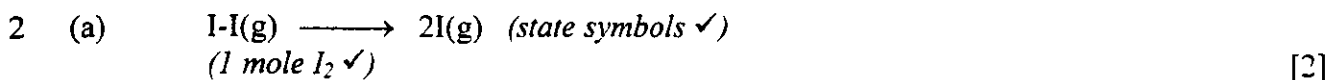
(b) $\Delta H_r^{\ominus}$ = 151 + 436 − 2(298)
           = **−9** kJ mol^{-1} *(all the right numbers & x2)*   ✓
                                 (use of the − sign)   ✓
                                 (L − R: using - sign the right way round)   ✓   [3]

     some ecf values: +9   [2]
                             +289   [2]
                             +1183   [1]

(c)

ΔH **and** direction (ecf from (b))   ✓

2 HI(g) ✓

[2]

(d) (i)   fizzing/gas/hydrogen evolved *or* Mg dissolves/disappears   ✓   [1]
             [an incorrect observation negates this mark]

     (ii)   2HCl + Mg ———→ MgCl$_2$ + H$_2$
             [correct formula for MgCl$_2$. Allow equation with HI/MgI$_2$ instead of HCl]   ✓
                     [balancing: e.g. 2HCl + 2Mg → 2MgCl + H$_2$ will get this mark but not the 1st]   ✓   [2]

     (iii)   2H$^+$ + Mg ———→ Mg^{2+} + H$_2$ ✓ (ecf if Mg$^+$)   [1]
             [NO spectator ions allowed]

(e) strong acids are completely ionised/dissociated (in solution)   ✓

     weak acids are incompletely ionised/dissociated (in solution)   ✓   [2]

     [the comparative statement that *strong acids are more ionised than weak acids* is worth [1] mark]

                                                                              Total: 13

3   (a)   *(When a system in dynamic equilibrium is subjected to a change in conditions....)*
                 the (position of) <u>equilibrium</u> will shift   ✓
                 in the direction that <u>minimises the effect of /opposes</u> the change   ✓   [2]
                 [NOT negates, nullifies or cancels]

      (b) Any two of the following bullet points   ✓✓   [2]
           • forward rate = reverse rate [NOT just "forward reaction = reverse reaction"]
           • can be approached from either direction
             ["*forward rate of reaction = reverse rate of reaction*" is worth both the above bullet
             points]
           • no change in overall macroscopic properties *or* a specific one (e.g. colour)
           • takes place in a closed system
             [N.B. every wrong point negates a correct one]

      (c)   (from yellow) to orange   ✓
                  increasing $[H^+]$ *or* more acid/HCl
                  moves equilibrium/reaction to the left *or* produces more $Cr_2O_7^{2-}$ ✓   [2]

      (d) (i)   turns lighter brown/colourless   ✓
                (equilibrium/reaction moves to the right):
                fewer molecules/particles/moles on right *or* 2 moles → 1 mole   ✓   [2]

          (ii) turns darker (brown)   ✓
                (equilibrium/reaction moves to the left): L→R/forward rxn is exothermic.   ✓   [2]

      [in (i) and (ii) mark the observation first, and then the reason. Each mark is unconditional on the other.]
      [in (ii), if neither mark is scored and you are convinced that the only error is mixing up
       endo/exo-thermic, you may award [1] mark]

                                                                                          Total: 10

4   (a) (adding a catalyst):
- speeds up a reaction
- provides an alternative route *or* forms an intermediate of some sort
- of lower E_{act} (can be read into a label on a Boltzmann distribution)
- so more molecules have $E > E_{act}$ *or* more collisions are successful
- weakens bonds in the reactants

[any 4 points. Look for these in part (b) if not all stated in (a)]   ✓✓✓✓   [4]

(b) General scheme for each example:
- identity of all reactants and all products (by names or the **correct** formulae in an (unbalanced) equation [if words given, ignore incorrect formulae]   ✓
- identity of catalyst   ✓
- whether the catalyst is hetero or homo-geneous.   ✓

example A: converting nitrogen and hydrogen into ammonia (in the Haber process)
iron/Fe [NOT Fe^{2+} etc]
heterogeneous   ✓✓✓

example B: converting unsaturated oils into fats for margarine with hydrogen
nickel/Ni
heterogeneous

                                                                              ✓✓✓   [6]

communicating the correct sense of the terms heterogeneous *or* homogeneous   QwC✓   [1]

[N.B. allow other examples, as long as they are of economic or environmental importance.]

other possibilities: catalytic converter: platinum
                       $CO + NO \longrightarrow CO_2 + N_2$
                       heterogeneous

                       fermentation: (yeast) <u>enzymes</u> , or <u>zymase</u>
                       starch/sugar $\longrightarrow$ ethanol + CO_2
                       homogeneous

                       esterification: H_2SO_4 *or* HCl (***conc.*** not needed, but ***dil*** or ***aq*** is incorrect)
                       acid + alcohol $\longrightarrow$ ester + water
                       homogeneous

                                                                              Total: 11