EXAM PAPERS PRACTICE

2002

XVIII

1583

**Time allowed
80 Minutes**

Score

/67

Percentage

%

CHEMISTRY

Mark Scheme

AQA
AS & A LEVEL

3.1 Physical chemistry

1 (a) Homogeneous;   All reactants in the same phase or state **(1)**

Dynamic;   Continuous or 'on-going' **(1)**

Equilibrium: Concentrations of reactants and products constant
or rates of forward and backward reactions equal **(1)**

Equation; $2NH_3 \rightleftharpoons N_2 + 3H_2$ (Must be decomposition) **(1)**

Kc; $[N_2][H_2]^3/[NH_3]^2$ **(1)**

            5

(b) Conditions: decomposition favoured by high temp **(1)**

since the reaction endothermic or logical
statement with application of Le Chatelier's
principle **(1)**

decomposition favoured by low pressure **(1)**

2 mole gas giving 4 moles gas or more gas moles
on right **(1)**

            4

(c) In practise   low pressure means low production **(1)**
low pressure means low rate **(1)**

high temperature means high rate **(1)**
high temperature expensive **(1)**

Catalyst   equilibrium yield unaffected **(1)**
rates of forward and backwards reactions
increased by an equal amount **(1)**
more hydrogen produced in a given time **(1)**

            Max 6

            [15]

2   (a)   (i)   Moles NaOH = mv/1000 = $1.50 \times 72.5/1000$ = 0.108 to 0.11 **(1)**

Moles of ethanoic acid at equilibrium = moles sodium hydroxide **(1)**
Moles ester = moles water (=moles acid reacted) **(1)**
                     = 0.200 – 0.108 = 0.090 to 0.92 **(1)**
Moles ethanol = 0.110 – 0.091 = 0.018 to 0.020 **(1)**
K_C = [Ester] [Water]/[Acid] [Alcohol] **(1)**
Allow if used correctly

= $(0.091)^2/0.109 \times 0.019$ = 3.7 to 4.9 **(1)**   7
Ignore units

NB   Allow the answer 4 one mark as correct knowledge

(ii)   Similar (types) of bond broken and made **(1)**
<u>Same</u> number of the bonds broken and made **(1)**   2
     any number if equal

     *NB   If a list given then the total number of each type of bond
             broken and made must be the same*

[9]

3 (a) 　　　　$Kc = \dfrac{[H_2][I_2]}{[HI]^2}$ **(1)**

0.05 **or** 1/20 **(1)** 　　　　　　　　　　　　　2

　(b) (i) 　forward rate increases **(1)**

reverse rate increases **(1)**

allow 1 mark for just 'increased'
allow 2 marks for 'both increased' 　　　　　　　2

　　(ii) 　no change **(1)** 　　　　　　　　　　　1

　　(iii) 　no change **(1)** 　　　　　　　　　　1

[6]

4 　　　*(must state correct effect on yield or rate to score the reason mark)*

T 　effect: 　　higher temp: 　　yield greater or shifts equilibrium to right; 　1
　　effect: 　　higher temp: 　　 rate increased; 　　　　　　　　1
　　reason: 　　endothermic

　　　　OR

　　　　more particles have E>E$_a$ 　　　　　　　　　　　1

　　　　OR

　　　　more successful/productive collisions; 　　　　　　　1

P 　effect: 　　higher pressure: yield less or shifts equilibrium to left; 　1

　　effect: 　　higher pressure: rate increased;

　　reason: increase in gas moles L to R

　　OR

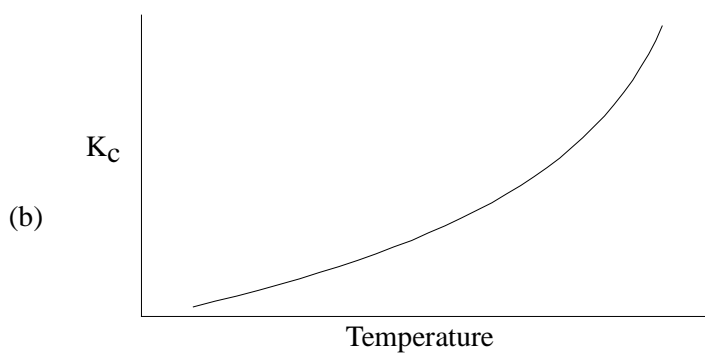　　greater collision frequency; 　　　　　　　　　　　1

　　(Q of L mark)

[6]

5 (a) *Equation* N

$_2 + O_2 \rightleftharpoons 2NO$ **(1)**

K_c $[NO]^2 / [N_2][O_2]$ **(1)**   2

(b)
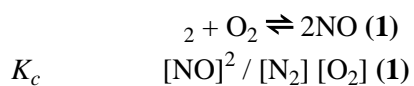
As temperature increases K_c increases (or yield increases) **(1)**
Hence reaction endothermic **(1)**   2

(c) The product yield is very small **(1)**
Yield does not justify cost of producing high temp **(1)**   2

(d) (i) $2NO + O_2 \rightleftharpoons 2NO_2$ **(1)**

    (ii) *Change in equilibrium position*   Displaced to the right **(1)**
        Change in equilibrium constant   No change **(1)**   3

[9]

6 (a) $K_c = \dfrac{[Y][H_2O]^2}{[X][CH_3OH]^2}$ **(1)**

**if K_c expression wrong lose units mark in (e) also
must be [ ]**

1

(b) *Moles of X*: 0.25 - 0.13 = 0.12 **(1)**
Moles of methanol: 0.34 - 0.26 = 0.08 **(1)**
Moles of water: 0.26 **(1)**   3

(c) Equal no. of moles on each side of equation **(1)**
OR V cancels out (provided not incorrectly qualified)

1

(d) *Calculation*: $K_c = \dfrac{\left(\dfrac{0.13}{V}\right)\left(\dfrac{0.26}{V}\right)^2}{\left(\dfrac{0.12}{V}\right)\left(\dfrac{0.08}{V}\right)^2}$ **(1)**   *1*

= 11(.4) **(1)**
**Can score all 3 conseq on (b) and (c)
If different values from (c) used allow units only
(conseq on correct K_c)**

Units of K_c: none **(1)**
but lose this mark if K_c is wrong even if none given

3

(e) decrease **(1)**   1

[9]

7 (a) (i) Increase (if wrong no further marks in part (i) 1
             higher P gives lower yield or moves to left 1
             Eqm shifts to reduce P or eqm favours side with fewer moles 1

       (ii) Endothermic if wrong no further marks in part (ii) 1
             increase T increases yield or moves to right 1
             Eqm shifts to reduce T or eqm favours endothermic direction 1

   (b) (i) Moles of iodine   = 0.023 1
             Moles of HI   = 0.172 1
             If × 2 missed, max 1 in part (iv)
                   If wrong no marks in (i)

       (ii) $K_c = \dfrac{[H_2][I_2]}{[HI]^2}$ must be square brackets (penalise once in paper) 1

             – if round, penalise but mark on in (iv)
             if K_c wrong, no marks in (iv) either but mark on from a minor
             slip in formula

       (iii) V cancels in K_c expression
             or no moles same on top and bottom of expression
             or total moles reactants = moles products,
             i.e. total no of moles does not change 1

       (iv) $K_c = \dfrac{(0.023)^2}{(0.172)^2}$ 1

             $= 0.0179$ or 1.79×10^{-2}

             Conseq on (i) 1
                   Allow 0.018 or 1.8 × 10^{-2}

       (v) $K_c = 55.9$ or 56 1
                   Conseq i.e. (answer to (iv))$^{-1}$

[13]