**CfE Advanced Higher**

**Unit 1 – Inorganic & Physical Chemistry**

**Part 2 – Physical Chemistry**

**HOMEWORK BOOKLET**

**Homework One**

1. The rate law for the reaction A + B → C + D is first order with respect to A and second order with respect to B. If the concentration of A is halved and the concentration of B is doubled, the rate of the reaction will

 A be unchanged

 B be increased by a factor of 2

 C be decreased by a factor of 2

 D be increased by a factor of 4 (1)

**2.** The rate law for a chemical reaction is determined by

 A theoretical calculations

 B measuring the reaction rate as a function of temperature

 C the stoichiometry of the overall chemical equation

 D measuring the reaction rate as a function of the concentration of the reacting species. (1)

**3.** The following mechanism has been proposed for the formation of ethylbenzene, C6H5CH2CH3

 CH3CH2Br + AlBr3 → AlBr4– + CH3CH2+

 CH3CH2+ + C6H6 → C6H6CH2CH3+

 C6H6CH2CH3 + + AlBr4– → AlBr3 + HBr + C6H5CH2CH3

 Which of the following is the catalyst in this reaction?

 (A) AlBr3 (B) AlBr4- (C) CH3CH2+  (D) C6H6CH2CH3 (1)

**4.** The reaction 2A + 2B C + D proceeds by the following mechanism

 2A → A2 (fast)

 A2 + B → X + C (slow)

 X + B → D (fast)

The rate equation for the reaction is

A rate = k[A][B]

 B rate = k[A]2[B]2

 C rate = k[A2][B]

 D rate = k[A]2[B] (1)

**5.** The decomposition of hydrogen peroxide in the presence of iodide ion is believed to occur via the mechanism

 H2O2(aq) + I–(aq) → H2O(l) + IO–(aq)

 H2O2(aq) + IO–(aq) → H2O(l) + O2(g) + I–(aq)

 In this mechanism, I–(aq) is

 A a catalyst

 B the activated complex

 C a reaction intermediate

 D a product of the overall reaction (1)

**6.** For the reaction A + 2B → AB2, given this data:

 rate mol l-1 s-1

 [B] mol l-1

 [A] mol l-1



 The rate law is

 A rate = k[A][B]

 B rate = k[A]2[B]

 C rate = k[A][B]2

 D rate = k[A]2[B]2 (1)

**7.** A reaction is described as being zero order with respect to a particular reactant. If the concentration of this reactant is doubled and everything else remains constant, the rate of reaction

 A doubles

 B halves

 C quadruples

 D remains unchanged. (1)

**8.** The rate equation for a reaction is:rate = k[A][B]

 The units of the rate constant are

 A mol l-1 s-1

 B s-1

 C l mol-1 s-1

 D mol-2 l2 s-1 (1)

9. For a certain reaction, it is found that the rate equation is rate = 0.015 [A][B]2. The rate of the reaction, in mol l-1 s-1, when [A] = 0.022 mol l-1 and [B] = 0.055 mol l-1is

 A 1.2x10-3

 B 4.0x10-7

 C 1.5x10-2

 D 1.0x10-6 (1)

10. If the proposed mechanism for a reaction is

 Step 1 H2O2(aq) + Br-(aq) H2O(aq) + OBr-(aq)

 Step 2 H2O2(aq) + OBr-(aq) H2O(aq) + Br-(aq) + O2(g)

the overall stoichiometric equation is

 A H2O2(aq) + Br-(aq) H2O(aq) + OBr-(aq) + O2(g)

 B 2H2O2(aq) + Br-(aq) 2H2O(aq) + OBr- (aq) + O2(g)

 C 2H2O2(aq) 2H2O(aq) + O2(g)

 D 2H2O2(aq) + Br-(aq) 2H2O(aq) + Br-(aq) + O2(g) (1)

11. Nitrogen (II) oxide reacts with oxygen according to the equation:

 2NO(g) + O2(g) 2NO2(g)

 Experiments were carried out to determine the orders of reaction with respect to NO and O2. The results of these experiments are shown below.

|  |  |  |  |
| --- | --- | --- | --- |
| Experiment  |  [NO(g)] / mol l-1  |  [O2(g)] / mol l-1  |  Rate / mol l-1 s-1  |
| 1  | 1.5 x 10-5  | 0.5 x 10-5  | 2.1 x10-7  |
| 2  | 4.5 x 10-5  | 0.5 x 10-5  | 1.9 x10-6  |
| 3  | 1.5 x 10-5  | 2.0 x 10-5  | 8.4 x10-7  |

a. Using the data, deduce the orders of reaction with respect to NO and O2. (1)

b. What is the rate equation for this reaction? (1)

c. Calculate the value of the rate constant,k, including the appropriate units. (2)

12. The table below gives data obtained to determine the kinetics for the reaction between methyl ethanoate, CH3COOCH3 , and aqueous sodium hydroxide, NaOH.

|  |  |  |  |
| --- | --- | --- | --- |
| **Experiment** | **Initial concentration of CH3COOCH3/ mol l–1** | **Initial concentration of NaOH/ mol l–1** | **Initial rate/mol l–1 s–1** |
| **1** | 1.5 × 10–2 | 2.0 × 10–2 | 6.0 × 10–5 |
| **2** | 3.0 × 10–2 | 2.0 × 10–2 | 1.2 × 10–4 |
| **3** | 6.0 × 10–2 | 1.0 × 10–2 | 1.2 × 10–4 |
| **4** | 4.5 × 10–2 | 6.0 × 10–2 |  |

a. Use the data in the table to determine the order of the reaction with respect to methyl ethanoate and sodium hydroxide. (1)

b. Write the rate law for the reaction. (1)

c. Calculate the value of the rate constant, including the appropriate units. (2)

d. Deduce the value of the initial rate for experiment 4. (1)

e. The initial rate is found by titrating samples of the reaction mixture with hydrochloric acid. Prior to the titration ice is added to the reaction mixture. Suggest a reason for adding ice to the reaction mixture. (1)

 Total Marks (20)

 **Homework Two** 1. The following reaction is first order with respect to each of the reactants.

 A + B C + D

 Which of the following is correct?

 A The rate of the reaction is independent of the concentration of either A or B.

 B The overall reaction is first order.

 C If the initial concentrations of A and B are both doubled, the rate of the reaction will be doubled.

 D As the reaction proceeds, its rate will decrease. (1)

2. For the reaction 2NO + Cl2 2NOCl, the rate equation is rate = k[NO][Cl2]. The overall order of the reaction is

 A 1

 B 2

 C 3

 D 5 (1)

3. A proposed reaction mechanism for the reaction 2A + B 2C is shown below

 B C + W slow

 W + 2A C fast

 The rate equation for this reaction is

 A Rate = k[A]2 B Rate = k[A] C Rate = k[B] D Rate = k[A][B] (1)

4. The following data refer to initial reaction rates obtained for the reaction

 X + Y + Z products

 These data fit the rate equation

 A Rate = k[X]

 B Rate = k[X][Y]

 C Rate = k[X][Y]2

 D rate =k[X][Y][Z] (1)

5. The following table of results was obtained for the reaction below

 H2O2 + 2HI 2H2O + I2



 a. Determine the order of this reaction with respect to

 (i) H2O2

 (ii) HI. (1)

 b. Write the rate equation for this reaction. (1)

 c. Calculate a value for the rate constant, k, including the appropriate units. (2)

6. Iodine reacts with propanone as follows.

 I2 + CH3COCH3 CH3COCH2I + HI

 A possible mechanism for the reaction is



a. Write the rate equation for this reaction based on the above mechanism. (1)

b. What evidence indicates the reaction is acid catalysed? (1)

c. Write the formula for any reaction intermediate in the mechanism. (1)

d. What is the overall order of this reaction? (1)

7. Consider the reaction

 NO2  + CO CO2 + NO

 The rate equation for the reaction is rate = k[NO2]2

 The first step of this two step reaction is the rate determining step. The equation for this step is

 NO2  + NO2 NO3 + NO

a. Write the equation for the second step of the reaction. (1)

b. Determine the value of X and Y in the table below.

|  |  |  |
| --- | --- | --- |
| Relative [NO2] | Relative [CO] | Relative rate |
| 1 | 1 | 1 |
| 2 | 1 | x |
| 2 | 2 | y |

 (2)

8. Two experiments were carried out to determine the orders of A and B in the reaction represented by the following equation.

 A + B C

 The graphs show the results of the experiments.



a. What is the order of reaction with respect to A? (1)

b. What is the order of reaction with respect to B? (1)

c. What are the units for the rate constant in this reaction? (1)

d. In the experiment to obtain the graph on the left, why was a large excess of reactant B used. (1)

e. Sketch the **rate versus concentration graph** for the experiment which used a large excess of A.

 Total Marks (20)

 **Homework Three**

1. The reaction of sulfur dioxide with oxygen is represented by the equation

 **W**hat will the following changes do to the position of equilibrium.

**H = -197 kJ**

2SO2(g) + O2(g) 2SO3(g)

a. Increasing the concentration sulfur dioxide.

b. Increasing the temperature.

c. Reducing the pressure.

d. Addition of an appropriate catalyst. (4)

2. Write the equilibrium expression for the following reactions.

 a. 2SO2(g) + O2(g) 2SO3(g) b. Cu(s) + 2Ag+(aq) Cu2+(aq) + 2Ag(s)

 c. N2(g) + 3H2(g) 2NH3(g) d. 3A(s) + 2B(g) C(g)

 e. [Cu(H2O)6]2+(aq) + 4NH3(aq) [Cu(NH3)4(H2O)2]2+(aq) + 4H2O(l) (5)

3. Consider the equilibrium reaction

 2AB3 A2B6

 The data shows how the equilibrium constant, K, varies with temperature.

 **K Temperature / oC**  0.12 25 3.89 77 1700 227

a. Write the equilibrium expression for this reaction. (1)

b. Will the position of equilibrium lie to the left or to the right at 25 oC. (1)

c. What will happen to the value of the equilibrium constant, K, if the concentration of AB3 is decreased? (1)

c. Use the data in the table to **explain** whether the forward reaction is exothermic or endothermic. (2)

4. Under suitable conditions the equilibrium represented below was established.

 2CH4(g) C2H2(g) + 3H2(g)

 The forward reaction is **endothermic.**

a. Write the equilibrium expression for this reaction. (1)

b. State the effect of an increase in temperature on the position of this equilibrium. (1)

c. State the effect of an increase in temperature on the value of the equilibrium constant, K, for this equilibrium. (1)

d. State the effect of an increase in the concentration of CH4(g) on the position of this equilibrium. (1)

e. State the effect of an increase in the concentration of CH4(g) on the value of the equilibrium constant, K, for this equilibrium. (1)

f. Starting with 3.0 moles of CH4(g) the equilibrium mixture was found to contain 0.7 moles of C2H2(g). Calculate the number of moles of CH4(g) and H2(g) present at equilibrium. (1)

 Total marks (20)

**Homework Four**

1. Caffeine can be extracted from coffee dissolved in water using the solvent chloromethane (CH2Cl2).

 caffeine(aq) caffeine(CH2Cl2)

 Which of the following, when increased, will change the value of the equilibrium constant for this process?

 A Temperature

 B Mass of coffee

 C Volume of water

 D Volume of dichloromethane

2. Substance **X** is distributed between equal volumes of two immiscible liquids as shown in the diagram. The number of dots represents the relative distribution of **X** in the two liquids at equilibrium.

 The value of the equilibrium constant for this system is

 A 0.46

 B 0.50

 C 2.00

 D 2.17.

3. PCl5 PCl3 + Cl2

 Adding PCl3 to the above system will

 A increase the value of the equilibrium constant

 B decrease the value of the equilibrium constant

 C increase the concentration of PCl5 and decrease the concentration of Cl2

 D decrease the concentration of PCl5 and increase the concentration of Cl2.

4. At a particular temperature, 8·0 mole of NO2 was placed in a 1 litre container and the NO2 dissociated by the following reaction:

 At equilibrium the concentration of NO(g) is 2·0 mol l–1. The equilibrium constant will have a value of

 A 0.11

 B 0.22

 C 0.33

 D 9.00.

5. AgCl(s) Ag+(aq) + Cl–(aq)

 The solubility product (*K*s) for silver chloride is given by the expression

 *K*s = [Ag+(aq)] [Cl–(aq)]

 *K*s = 1.80 x 10-10 at 25oC The solubility of silver chloride, in mol l-1, at 25oC is

 A 1.80 x 10-10

 B 3.60 x 10-10

 C 1.34 x 10-5

 D 2.68 x 10-5

6. The reaction

 Has an equilibrium constant of 3.9 at 950 oC

 The equilibrium concentrations of CO(g), H2(g) and H2O(g) are given in the table.

 What is the equilibrium concentration of CH4(g), in mol l-1, at 950 oC?

 A 0.049

 B 0.200

 C 4.90

 D 20.0

7. The partition coefficient for the system on the right can be altered by

 A adding more iodine

 B adding more cyclohexane

 C changing the temperature

 D shaking the mixture thoroughly.

8. When A(g) and (B)(g) react the following equilibrium is established.

 2A(g) + B(g) 2C(g)

 The equilibrium constant for the reaction is 3300 at 630 °C and 21 at 850 °C.

 Which line in the table is correct for this reaction?

9. 2Q(g) R(g)

 At equilibrium, the concentrations of Q and R were 0.280 mol l-1 and 1.740 mol l-1.

 Calculate the value of the equilibrium constant, *K*. (2)

10. A mixture of 3 moles of W and 1 mole of X were allowed to reach equilibrium at 27 oC. At this temperature the mixture was found to contain 0. 600 moles of Z.

 The equation for the reaction is W(l) + X(l) Y(l) + Z(l)

 Calculate the value of the equilibrium constant, *K*, at 27 oC for this reaction (3)

11. Consider the following hypothetical reaction that took place in a **closed 2 litre** flask at 25 oC. A2(g) + 2B2(g) ⇌ 2AB2(g)

The graph represents the change in the number of moles of each gas in the flask over a period of 20 minutes.

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a. Write the equilibrium expression for this hypothetical reaction. (1)

b. The reaction attained equilibrium twice during the 20 minute period. State how long it took for the reaction to reach equilibrium for the first time. (1)

c. Using the information given above, calculate the concentrations of each reactant and of the product for the time period between 5 minutes and 10 minutes. (1)

d. Using the values from part c calculate the equilibrium constant, *K*, for this reaction at 25 oC. (1)

e. What does the value calculated in part c indicate about this reaction at 25 oC. (1)

f. Why is it not possible to calculate a value for the equilibrium constant, *K*, during the first 5 minutes. (1)

g. At 10 minutes the temperature of the flask was increased. Use information from the graph to explain whether this reaction is exothermic or endothermic. (1)

 Total marks (20)

**Homework Five**

1. The Bronsted-Lowry definition of a base is a substance which acts as a

 A proton donor to form a conjugate acid

 B proton donor to form a conjugate base

 C proton acceptor to form a conjugate acid

 D proton acceptor to form a conjugate base

2. The Bronsted-Lowry definition of an acid is a substance which acts as a

 A proton donor to form a conjugate acid

 B proton donor to form a conjugate base

 C proton acceptor to form a conjugate acid

 D proton acceptor to form a conjugate base

3. Which of the following is the conjugate base in the reaction shown below?

 HX + H2O H3O+ + X-

 A HX

 B H2O

 C H3O+

 D X-

4. Which of the following is the conjugate acid in the reaction shown below?

 ZH + H3O+ ZH2+ + OH-

 A ZH

 B H3O+

 C ZH2+

D OH-

5. Identify the conjugate base in each of the following

a. H2CO3 HCO3- + H+

b. HPO42- + H2O H3O+ + PO43- (2)

6. Which species behaves as the acid in the following reactions?

a. NH3 + H2O NH4+ + OH-

b. [Fe(H2O)6]3+ + H2O [Fe(H2O)5(OH)]2+ + H3O+ (2)

7. Write equations for the dissociation of the following acids.

 a. H2NO3+ b. H3BO3 c. HClO (3)

8. Identify the base and the conjugate base in the following reactions

a. PH3 + HI PH4+ + I-

b. CO32- + H3O+ HCO3- + H2O(2)

9. The two reactions shown below demonstrate the amphoteric nature of water. Reaction 1 HSO3- + H2O OH-  + H2SO3

 Reaction 2 H2PO4- + H2O HPO4- + H3O+

 Define the term amphoteric and explain why these two reactions show this property of water. (3)

10. Phenol (hydroxybenzene) is an acidic substance. The hydroxyl group contains the only acidic hydrogen atom in the molecule.

a. Write the formula for the conjugate base of phenol. (1)

b. Why is phenol considered to be an acid? (1)

11. Consider the following reaction

 [Cr(H2O)6]3+ + 3NH3 [Cr(H2O)3(OH)3] + 3NH4+

 Explain why the ammonium ion, NH4+, is the conjugate acid in this reaction. (2)

 Total marks (20)

 **Homework Six**

1. The pH of a 0.003 mol l-1 hydrochloric acid is

 A 2.00

 B 2.52

 C 3.00

 D 0.30

2. The pH of 0·002 mol l–1 calcium hydroxide solution is

 A 2.4

 B 2.7

 C 11.3

 D 11.6

3. 500 cm3 of 0·022 mol l–1 hydrochloric acid is added to 500 cm3 of 0·020 mol l–1 sodium hydroxide solution. The pH of the resulting solution will be

 A 2

 B 3

 C 4

 D 5

4. Which of the following statements is **not** always true for aqueous solutions at 298 K?

 A *K*w = 10–14

 B pH = –log10[H+]

 C [H+] [OH–] = 10–14

 D [H+] = [OH–] = 10–7 mol l–1

5. 5·0 cm3 of a solution of hydrochloric acid was diluted to exactly 250 cm3 with water. The pH of this diluted solution was 2·00.

 A 2·0 × 10–2

 B 4·0 × 10–2

 C 4·0 × 10–1

 D 5·0 × 10–1

6. The ionic product of water has the symbol *K*w.

a. Write an expression for the ionic product of water. (1)

b. At 42 oC, the value of *K*w is 3.46 x 10–14.

 Calculate the pH of water at this temperature. (2)

c. At 75 oC, a 0.0470 mol l-1 solution of sodium hydroxide has a pH of 11.36.

 Calculate the value of *K*w at this temperature. (2)

7. The list shows some acids with their Ka values

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  | HF(aq) **1** | lrharpoons | H+(aq) + F-(aq)  | 3.4 x 10-4 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  | HIO3(aq)**2****3** | lrharpoons | H+(aq) + IO3-(aq)  | 1.7 x 10-1  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  | H3PO4(aq) **4** | lrharpoons | H+(aq) + H2PO3-(aq)  | 7.9 x 10-3  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  | H2SO3(aq) | lrharpoons | H+(aq) + HSO3-(aq)  | 1.5 x 10-2  |  |  |  |  |  |

a. Which of these acids is the strongest? (1)

b. Write an equation for the dissociation of acid **3** (1)

c. Write the expression for the dissociation constant, *K*a, for acid **2.** (1)

d. Calculate the p*K*a value for acid **4.** (1)

e. Given 0.1 mol l-1 solutions of all four acids, which one would have the highest pH value? (1)

7. 50 cm3 of 1 mol l-1 sodium hydroxide is placed in a beaker.

a. Calculate the pH of the alkali in the beaker. (1)

b. A thermometer is placed in the beaker and 100 cm3 of 2 mol l-1 hydrochloric acid is gradually added to the beaker.

 Which of the following graphs shows how the temperature in the beaker would change as the acid was added?

 Total marks (20)

 (1)

c. Calculate the pH of the resulting solution after all the hydrochloric acid has been added to the sodium hydroxide. (3)

 Total marks (20)

**Homework Seven**

1. The table shows the p*K*a values of three monoprotic acids.



a. Define the term monoprotic. (1)

b. Which of the three acids is the weakest? (1)

c. When these acids are diluted with water which of the following will decrease?

 a. pH b. p*K*a c. *K*a d. [H+(aq)] (1)

d. Calculate the Ka value of acid Y? (1)

e. Calculate the pH of a 0.30 mol l-1 solution of acid X. (2)

2. A 0.05 mol l -1 solution of chloroethanoic acid has a pH of 2.19. Use this information to calculate p*K* a for chloroethanoic acid. (2)

3. Nicotinic acid is used in the treatment of high cholesterol levels. A structural formula for nicotinic acid is

a. Write an equation to show the dissociation of nicotinic acid in water. (1)

b. The *K*a value of nicotinic acid is 1.4 x 10-4.

 Calculate the concentration of a nicotinic acid solution which has a pH of 4.26. (2)

c. Write a formula for the conjugate base of nicotinic acid. (1)

4. White wine vinegar is a solution containing ethanoic acid. The pH of a sample of white wine vinegar is 2.4.

a. Calculate the concentration of ethanoic acid in this sample of white wine vinegar. (2)

b. If a sample of hydrochloric acid with a pH of 2.4 is accurately diluted by a factor of 10, the resulting solution will have a pH of 3.4.

(i) Describe how to produce 100 cm3 of the hydrochloric acid solution with a pH 3.4 starting with the solution which has a pH of 2.4 (3)

(ii) Explain why using the same procedure on the sample of white wine vinegar would **not** raise the pH to 3.4 (2)

(c) Propanoic acid belongs to the same homologous series as ethanoic acid. Write the formula of the conjugate base of propanoic acid. (1)

 Total marks (20)



**Homework Eight**

1. A buffer solution has a pH of 4.69 and contains 0.15 mol of propanoic acid and 0.1 mol of sodium propanaote. Use this information to calculate the dissociation content, *K*a, of propanoic acid. (2)

2. Chromium(III) ions are weakly acidic in aqueous solution as shown by the following equation

a. Write the expression for the dissociation constant, Ka, for this reaction. (1)

b. *K*a has the value 1.15 x 10-4. Calculate the pH of a 0.5 mol l-1 solution of [Cr(H2O)6]3+(aq) (2)

3. The acid dissociation constant, *K*a, for the weak acid HY has the value 1.35 x 10–5.

 A buffer solution was prepared by dissolving 0.0236 mol of the salt NaY in 50.0 cm3 of a 0.428 mol l-1 solution of the weak acid HY

a. Calculate the pH of this buffer solution (3)

b. Explain why the pH of this buffer solution remains almost constant despite the addition of a small amount of sodium hydroxide. (2)

c. Explain why the pH of this buffer solution remains constant when the buffer is diluted with deionised water. (2)

4. The titration of propanoic acid with sodium hydroxide can be followed using a pH meter. The graph below was obtained when 40·0 cm3 of an aqueous solution of propanoic acid was titrated with 0·200 mol l–1 sodium hydroxide.



a. The table shows four indicators which could be used to detect the end-point of a titration.

 Why is phenolphthalein the most suitable indicator for **this** titration. (1)

b. Phenolphthalein is a weak acid. The equation shows how phenolphthalein dissociates.

With reference to the above equilibrium, explain why the colour changes from pink to colourless at the equivalence point. (1)

5. Which of the following would not be suitable to act as a buffer solution?

 A Ethanoic acid and sodium ethanoate

 B Hydrochloric acid and sodium chloride

 C Boric acid and sodium borate

 D Hydrocyanic acid and sodium cyanide

6. At 298 K, a weak acid indicator, HIn,changes colour at pH 9.2. Which of the following is **not** always true of this indicator at 298 K?

 A p*K*In = 9.2

B p*K*a= 9.2

 C [HIn] = [In**−**]

 D *K*In = 6.3 x 10-10

7. Which of the following indicators should be used in the titration of lithium hydroxide with benzoic acid?

 A Phenolphthalein, pH range 8·0 – 9·8

 B Bromothymol blue, pH range 6·0 – 7·6

 C Methyl red, pH range 4·2 – 6·2

 D Methyl orange, pH range 3·1 – 4·4

8. Indicators change colour over a pH range of two units. When a 1.0 mol l-1 solution of ethanoic acid is neutralised by a 1.0 mol l-1 solution of potassium hydroxide, the most suitable indicator range to detect the end point would be

 A 3.0 to 5.0

 B 6.0 to 8.0

 C 9.0 to 11.0

 D 12.0 to 14.0

9. It would not be appropriate to use an indicator in which of the following titrations?

 A Ethanoic acid and ammonium hydroxide

 B Sulphuric acid and sodium hydroxide

C Propanoic acid and potassium hydroxide

D Hydrochloric acid and ammonium hydroxide

10. The graph below shows the pH changes when 0·1 mol l–1 ammonia solution is added to 50 cm3of 0·1 mol l–1hydrochloric acid solution.



 Which line in the table shows an indicator which is **not** suitable for use in determining the equivalence point for the reaction?



 Total marks (20)

 **Homework Nine**

1. For a certain reaction *H*o is +89 kJ mol-1 and *S*o is +200 J K-1 mol-1

 This reaction will

 A never be thermodynamically feasible

 B be thermodynamically feasible at all temperatures

 C be thermodynamically feasible above a certain temperature

 D be thermodynamically feasible below a certain temperature.

2. In which of the following changes will there be an increase in entropy?

 A Water turning to ice

 B Ethene turning to polyethene

 C Solid carbon dioxide turning to gaseous carbon dioxide

 D A precipitate forming when two solution are mixed

3. X + Y 2Q *G*o is +10 kJ mol-1

 Which of the following can **not** be deduced from the information shown above?

 A Order of reaction

 B Position of equilibrium

 C Stoichiometry of the reaction

 D Feasibility of the reaction

4. Which of the following always increases in a spontaneous process?

 A The free energy

 B The total entropy

 C The total enthalpy

 D The surrounding temperature



5. Which line in the table is correct for the enthalpy change and entropy change when ethanol evaporates?

6.

 Assuming that liquids P and Q are in their standard states when 100 % of either is present, what is the value of *G*°, in kJ mol–1, for the reaction represented by the stoichiometric equation,

 Q(l) P(l)

 A -15 B -30 C +30 D +45

7. Which of the following reactions **must be exothermic**? One in which

 A *G*o is negative

 B *S*o is positive

 C both *G*o and *S*o are negative

 D both *G*o and *S*o are positive.

8. X + W R + S

 At 298 K the equilibrium constant for this reaction is 1.2 × 108.

 Which of the following is true?

 A The value of Δ*S* ° must be positive.

 B The value of Δ*G* ° must be positive.

 C Adding a catalyst will change the equilibrium constant.

 D Increasing the concentration of X will not change the equilibrium constant.

9. Which of the following graphs shows the 10. The standard enthalpy of formation variation in Δ*G* ° with temperature for a of magnesium bromide is the reaction which is always feasible? enthalpy change for which of the following reactions?



11. The Thermit process can be used to extract iron from iron(III) oxide.



 For the Thermit process, use the data in the table to calculate

a. the standard enthalpy change, Δ*H* ° (1)

b. the standard entropy change, Δ*S* ° (1)

c. the standard change, free energy change, Δ*G* °. (2)

d. What does the standard free energy change calculated in (c) indicate about the Thermit process? (1)

12. Burning magnesium continues to burn when placed in a jar of carbon dioxide according to the equation

a. Using the values from the table above, calculate *S* ° for the reaction. (2)

b. Using the information below and your answer to (*a*), calculate *G* ° for the burning of magnesium in carbon dioxide. (3)

 Total marks (20)