

Part 2 (70 marks = 35% of paper)

Answer ALL questions in part 2 in the spaces provided below.

1. Write equations for any reactions that occur in the following procedures. If no reaction occurs write "no reaction".

In each case describe **in full** what could be observed including any

- colours
- odours

- precipitates (give the colour)
- gases evolved (give the colour or describe as colourless)

If no change is observable, this should be stated

- (a) Dilute hydrochloric acid is poured into a solution of ammonium carbonate.

Equation: _____

Observation: _____

(3 marks)

- (b) A solution of 6 mol L^{-1} potassium hydroxide is added to metallic chromium.

Equation: _____

Observation: _____

(3 marks)

- (c) Sodium sulfate solution is mixed with an aqueous solution of barium nitrate.

Equation: _____

Observation: _____

(3 marks)

- (d) Potassium permanganate solution is added to a mixture of sulfuric and hydrochloric acids.

Equation: _____

Observation: _____

(3 marks)

2. Write equations to show how the hydrogen sulfate ion (HSO_4^{1-}) can act as both an acid and a base. Underline the conjugate base or acid of it in each case.

As acid :

As base :

(4 marks)

3. Identify by name or formula an example of each of the following.

a transition metal complex ion	
an aqueous solution which is a non-electrolyte	
an oxidizing agent weaker than Mn^{2+} but stronger than Ca^{2+} .	
a weak, inorganic base	
a primary standard for an acid – base titration	
an ionic compound which dissolves in water to produce an acidic solution	

(6marks)

4. How is it possible for a solution of a weak acid such as CH_3COOH to have the same pH (eg 3) as a strong acid such as HCl ? Use equations where appropriate.

(4 marks)

5. An equilibrium system is described by the following equation :



Write 'increase', 'decrease' or 'no change' in the table to indicate the effect of the given changes on the rate of reaction and the equilibrium yield.

Imposed change	Effect on Rate	Effect on Yield
System is warmed		
More solid Al_2O_3 is added		
NaOH solution is added to the system		
The volume in of the system is increased		

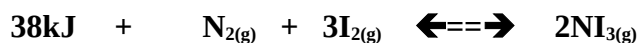
(8 marks)

6. Write the equilibrium constant expression for the following systems.



(2 marks)

7. The curves below describe the changes in concentration of the equilibrium system



- (a) When was equilibrium first reached in the system.

(2 mark)

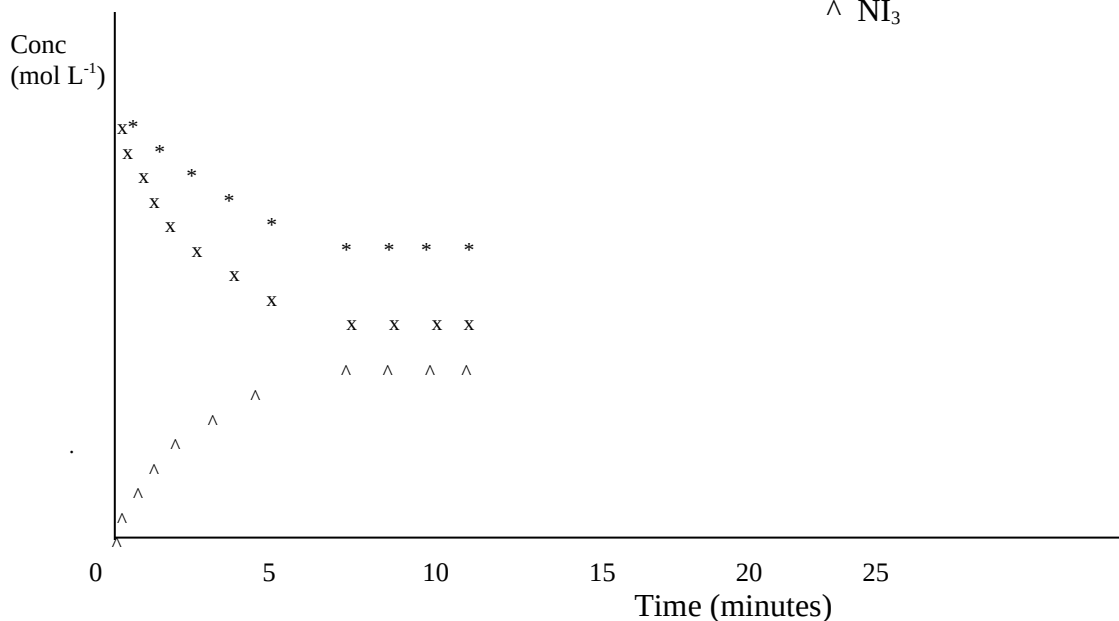
- (b) What observation could be used to determine that equilibrium has been established ?

(2 mark)

- (c) Use the following information to complete the curves until $t = 25$ min

At $t = 10$ minutes the system was cooled and equilibrium was established again at $t = 15$ minutes.
(Use your knowledge of equilibrium principles to make any reasonable estimate of the new equilibrium concentrations of each gas .

Key: * N_2
x I_2
^ NI_3



(4 marks)

8. Phenolphthalein is used as an indicator to titrate a solution of potassium hydroxide a standardised ethanoic acid solution

(a) Explain, with the use of an equation, the value of pH at the equivalence point for this titration

(2 marks)

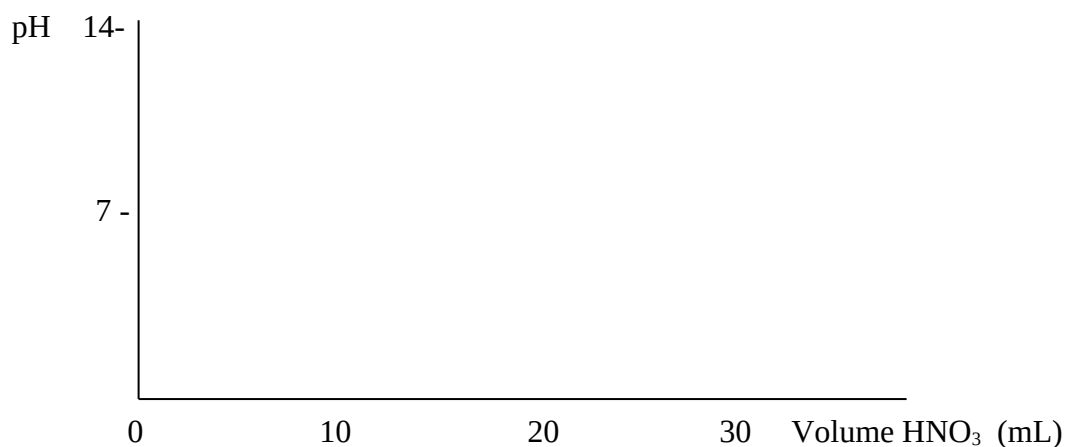
(b) Explain whether or not this indicator is appropriate for this titration

(2 marks)

(c) A 20.00mL aliquot of ethanoic acid solution is placed in the conical flask, potassium hydroxide in the burette.

Sketch a pH curve to show how the pH changes as HNO_3 is delivered from the burette.

Label the equivalence point on your curve. The titration volume is 13.70 mL



(3 marks)

9. In selecting a primary standard for a titration, what criteria should be used ?

(3 marks)

10. For each of the following pairs of substances describe a chemical test that would distinguish between them. Describe the distinguishing observations , but no equations are required

	Chemical test (Describe fully)	Observation in each case
ammonium sulfate and ammonium chloride		With ammonium sulfate
		With ammonium chloride
magnesium and zinc		With magnesium
		With zinc
hydrogen peroxide and water		With hydrogen peroxide
		With water

(6 marks)

11. Consider 0.300 mol L^{-1} solutions of the following substances

aluminium nitrate; potassium carbonate ; glucose; magnesium chloride; phosphoric acid

(a) Which solution has the highest concentration of ions? Explain.

(b) Which solution has the highest pH? Explain

(c) Which solution has the lowest electrical conductivity? Explain

(6 marks)

12. Sketch an electrochemical cell composed of the following two half cells: Fe/Fe^{3+} and Cr/Cr^{3+} .
On your diagram,

- show the movement of ions and electrons.
- label the anode & cathode

(4 marks)

Write an equation for the reaction at each electrode.

Anode:	
Cathode:	

(2 marks)

Determine the cell e.m.f.

(1 mark)

Describe what you would observe during the operation of the cell.

(2 marks)

END OF PART 2