

Acids, bases and salts

Question Paper 2

Level	IGCSE
Subject	Chemistry
ExamBoard	CIE
Topic	Acids, bases and salts
Sub-Topic	
Paper	(Extended) Theory
Booklet	Question Paper 2

TimeAllowed: 82 minutes

Score: / 68

Percentage: /100

1 One way of establishing a reactivity series is by displacement reactions.

(a) A series of experiments was carried out using the metals lead, magnesium, zinc and silver. Each metal was added in turn to aqueous solutions of the metal nitrates.

The order of reactivity was found to be:

magnesium	most reactive
zinc	↓
lead	
silver	least reactive

(i) Complete the table.

✓ = reacts

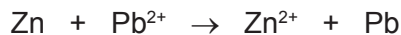
x = does not react

aqueous solution	metal			
	lead Pb	magnesium Mg	zinc Zn	silver Ag
lead(II) nitrate		✓	✓	
magnesium nitrate				
zinc nitrate				
silver nitrate				

[3]

(ii) Displacement reactions are redox reactions.

On the following equation, draw a **ring** around the reducing agent and an **arrow** to show the change which is oxidation.



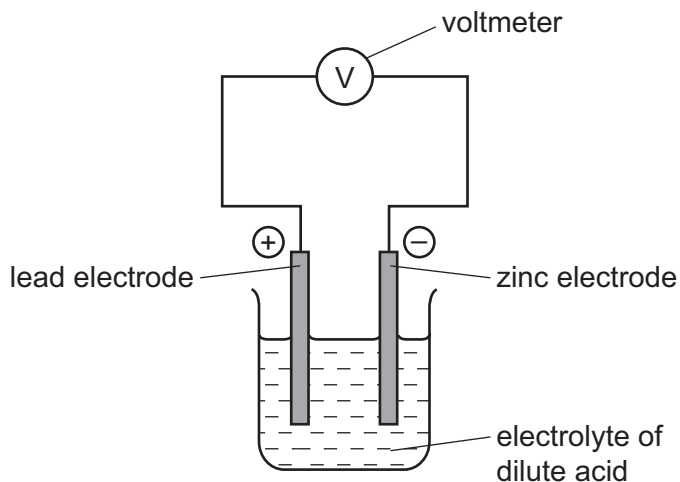
[2]

(iii) Complete the following ionic equation.



[1]

- (b) Another way of determining the order of reactivity of metals is by measuring the voltage and polarity of simple cells. The polarity of a cell is shown by which metal is the positive electrode and which metal is the negative electrode. An example of a simple cell is shown below.



- (i) Mark on the above diagram the direction of the electron flow. [1]

- (ii) Explain, in terms of electron transfer, why the more reactive metal is always the negative electrode.

.....

 [2]

- (iii) The following table gives the polarity of cells using the metals zinc, lead, copper and manganese.

cell	electrode 1	polarity	electrode 2	polarity
A	zinc	-	lead	+
B	manganese	-	lead	+
C	copper	+	lead	-

What information about the order of reactivity of these four metals can be deduced from the table?

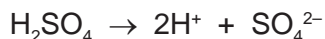
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 [2]

- (iv) What additional information is needed to establish the order of reactivity of these four metals using cells?

..... [1]

- 2 Sulfuric acid and malonic acid are both dibasic acids. One mole of a dibasic acid can form two moles of hydrogen ions.



Dibasic acids can form salts of the type Na_2X and CaX .

- (a) Malonic acid is a white crystalline solid which is soluble in water. It melts at 135°C . The structural formula of malonic acid is given below. It forms salts called malonates.



- (i) How could you determine if a sample of malonic acid is pure?

technique used

result if pure [2]

- (ii) What is the molecular formula of malonic acid?

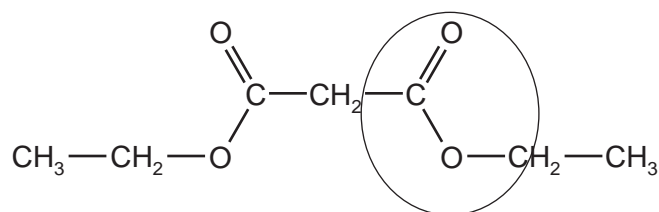
..... [1]

- (iii) When malonic acid is heated there are two products, carbon dioxide and a simpler carboxylic acid. Deduce the name and molecular formula of this acid.

.....

..... [2]

- (iv) Malonic acid reacts with ethanol to form a colourless liquid which has a 'fruity' smell. Its structural formula is given below.



What type of compound contains the group which is circled?

..... [1]

- (b) (i) Suggest why a solution of malonic acid, concentration 0.2 mol/dm^3 , has a higher pH than one of sulfuric acid of the same concentration.

..... [1]

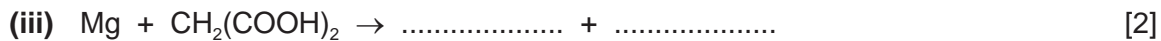
- (ii) Describe a test, other than measuring pH, which can be carried out on both acid solutions to confirm the explanation given in (b)(i) for the different pH values of the two acids.

.....
..... [2]

- (c) Complete the following equations for reactions of these two acids.

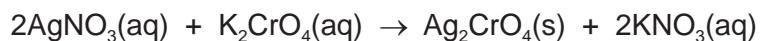


.....



[Total: 16]

- 3 Silver(I) chromate(VI) is an insoluble salt. It is prepared by precipitation. 20 cm³ of aqueous silver(I) nitrate, concentration 0.2 mol/dm³, was mixed with 20 cm³ of aqueous potassium chromate(VI), concentration 0.1 mol/dm³. After stirring, the mixture was filtered. The precipitate was washed several times with distilled water. The precipitate was then left in a warm oven for several hours.



- (a) What difficulty arises if the name of a compound of a transition element does not include its oxidation state, for example iron oxide?

.....
 [2]

- (b) These questions refer to the preparation of the salt.

- (i) Why is it necessary to filter the mixture after mixing and stirring?

..... [1]

- (ii) What is the purpose of washing the precipitate?

..... [1]

- (iii) Why leave the precipitate in a warm oven?

..... [1]

- (c) Explain why the concentrations of silver(I) nitrate and potassium chromate(VI) are different.

..... [1]

- (ii) What mass of silver(I) nitrate is needed to prepare 100 cm³ of silver(I) nitrate solution, concentration 0.2 mol/dm³?

The mass of one mole of AgNO₃ is 170 g.

.....
 [2]

- (iii) What is the maximum mass of silver(I) chromate(VI) which could be obtained from 20 cm³ of aqueous silver(I) nitrate, concentration 0.2 mol/dm³?

number of moles of AgNO₃ used = [1]

number of moles of Ag₂CrO₄ formed = [1]

mass of one mole of Ag₂CrO₄ = 332 g

mass of Ag₂CrO₄ formed = g [1]

4 Three ways of making salts are

- titration using a soluble base or carbonate
- neutralisation using an insoluble base or carbonate
- precipitation.

(a) Complete the following table of salt preparations.

method	reagent 1	reagent 2	salt
titration	sodium nitrate
neutralisation	nitric acid	copper(II) nitrate
precipitation	silver(I) chloride
neutralisation	sulfuric acid	zinc(II) carbonate

[6]

(b) Write an ionic equation with state symbols for the preparation of silver(I) chloride.

..... [2]

(ii) Complete the following equation.



[2]

[Total: 10]

- 5 A length of magnesium ribbon was added to 50 cm³ of sulfuric acid, concentration 1.0 mol/dm³. The time taken for the magnesium to react was measured. The experiment was repeated with the same volume of different acids. In all these experiments, the acid was in excess and the same length of magnesium ribbon was used.

(a)

experiment	acid	concentration in mol/dm ³	time / s
A	sulfuric acid	1.0	20
B	propanoic acid	0.5	230
C	hydrochloric acid	1.0	40
D	hydrochloric acid	0.5	80

- (i) Write these experiments in order of reaction speed. Give the experiment with the fastest speed first.

..... [1]

- (ii) Give reasons for the order you have given in (i).

.....

 [5]

- (b) Suggest **two** changes to experiment C which would increase the speed of the reaction and explain why the speed would increase. The volume of the acid, the concentration of the acid and the mass of magnesium used were kept the same.

change 1

explanation

.....

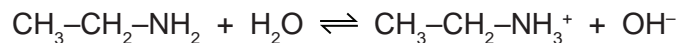
change 2

explanation

..... [5]

6 Ethylamine, $\text{CH}_3\text{-CH}_2\text{-NH}_2$, is a base which has similar properties to ammonia.

(a) In aqueous ethylamine, there is the following equilibrium.



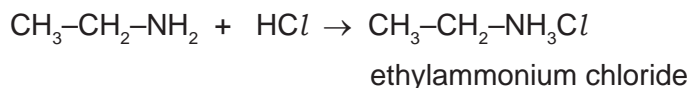
Explain why water is behaving as an acid in this reaction.

..... [1]

(b) Given aqueous solutions of ethylamine and sodium hydroxide, describe how you could show that ethylamine is a weak base like ammonia and not a strong base like sodium hydroxide.

.....
.....
..... [3]

(c) Ethylamine, like ammonia, reacts with acids to form salts.



Suggest how you could displace ethylamine from the salt, ethylammonium chloride.

.....
..... [2]

(d) Explain the chemistry of the following reaction:

When aqueous ethylamine is added to aqueous iron(III) chloride, a brown precipitate is formed.

.....

..... [2]

[Total: 8]