

YEAR 11 ATAR CHEMISTRY
*** ACIDS BASES and STOICHIOMETRY**

Sit (time: 50mins)

MULTIPLE CHOICE SECTION: Circle one answer

1. Which of the following is **NOT** a characteristic of acid solutions?

- a. React with zinc to produce hydrogen gas.
- ☒ b. Contain less H_3O^+ ions than OH^- ions.
- c. Turn blue litmus red
- d. Taste sour

2. Consider the following three chemical reactions:

Sodium carbonate with hydrochloric acid

Copper hydroxide with sulphuric acid

Sodium hydroxide with nitric acid

Which of the following substances is produced in ALL of the above reactions?

- a. Carbon dioxide
- ☒ b. Water
- c. Hydrogen gas
- d. A sodium salt

3. When ethanoic acid is dissolved in water, only a small proportion of the acid molecules become ionised. This acid can therefore be described as a

- a. Dilute acid
- b. Concentrated acid
- ☒ c. Weak acid
- d. Strong acid

4. Which of the following pairs of reagents could be used in a neutralisation experiment?

- a. Sodium chloride and silver nitrate
- ☒ b. Sodium hydroxide and hydrochloric acid
- c. Sodium chloride and water
- d. Sulphuric acid and hydrochloric acid

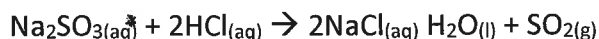
5. A solution containing only potassium nitrate and water can be made by adding together solutions of

- a. Potassium sulphate and nitrous acid
- ☒ b. Potassium hydroxide and nitric acid
- c. Potassium chloride and nitric acid
- d. Potassium carbonate and sodium sulphate

6. Which of the following solutions has the highest pH?

- a. 0.001 M Hydrochloric acid
- ☒ b. 0.200 M Sodium hydroxide
- c. 0.004 M Ethanoic acid
- d. 0.010 M Nitric acid

7. The reaction of sodium sulphite with hydrochloric acid can be represented by the following equation:



On the basis of the information in the equation, which of the following is true?

- When one mole of sodium sulphite is treated with any acid, one mole of sulphur dioxide gas will be always be produced
 - A reaction will only take place if sodium sulphite and hydrochloric acid are present in the mole ratio 1:2
 - The ratio by mass of sodium sulphite to hydrochloric acid in a reaction mixture of stoichiometric proportions is 1:2
 - ☒ 0.4 mol of water will be produced when 0.8 mol of hydrochloric acid reacts completely with excess sodium sulphite
8. An excess of dilute nitric acid is added to 0.3 mol of calcium carbonate. The mass of carbon dioxide produced by this reaction is closest to:
- ☒ $0.3 \times 44 \text{ g}$
 - $0.3 \times 60 \text{ g}$
 - $0.3 \times 100 \text{ g}$
 - $0.3 \times 100 \times 44 \text{ g}$
9. Some dilute acid was put into a beaker and a few drops of *Congo Red* indicator was added to it. The solution went blue. When a solution of sodium hydroxide was added to the same beaker, the solution turned red. Which one of the following could be added to restore the blue colour in the beaker?
- water
 - cloudy ammonia
 - petrol
 - ☒ vinegar

The next three questions refer to the following information:

The table below lists the pH of four solutions J, K, L and M

Solution	pH
J	1
K	4
L	7
M	10

10. Which one of the following statements about the acid-base character of the solutions is true?
- ☒ Solution K is more acidic than solution L
 - Solution M is more acidic than solution K
 - Solution L is more basic than solution M
 - Solution J is more basic than solution L.
11. Which solution has the highest concentration of hydrogen ions?
- ☒ J
 - L
 - M
 - There is insufficient information to decide.
12. Which one of these solutions could be water?
- J
 - K
 - ☒ L
 - M

SHORT ANSWER SECTION:

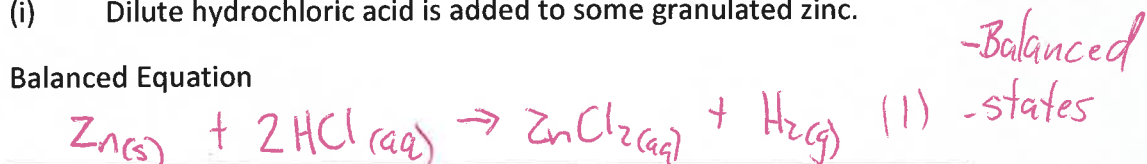
[18 marks]

13. Write **balanced equation** & the **Nett ionic** equations for any reactions that occur in the following procedures. If no reaction occurs write 'no reaction'.

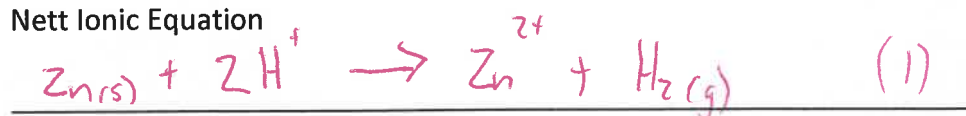
In each case **describe in full** what you would observe, including any colours, odours, precipitates (give colours), gases evolved etc.

(i) Dilute hydrochloric acid is added to some granulated zinc.

Balanced Equation



Nett Ionic Equation

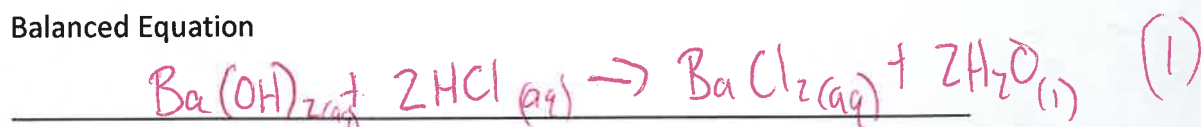


Observations

- Metal dissolved (1) - Need both
- Bubbling (effervescence)

(ii) Solutions of barium hydroxide and hydrochloric acid are mixed.

Balanced Equation



Nett Ionic Equation



Observations

No observations (1) - Either
- Clear liquid. (6 marks)

14. Other than their effects on indicators, state any two properties of bases.

- Bitter Taste - Caustic & Slippery (any two)
- Conductivity - react with metal (2 marks)

15. Give an example of:

a. A dilute solution of a strong base

0.1M NaOH

b. A concentrated solution of a weak acid

10M CH₃COOH (2 marks)

- Dilute < conc.
- Need [] & species

16. One drop of 1 mol L^{-1} sodium hydroxide is added to a solution of 1 mol L^{-1} nitric acid. Ignoring changes that would result from the slight increase in volume of the solution, what will be the effect (increase, decrease or no change) on the following concentrations?

- a. $[\text{OH}^{-}(\text{aq})]$ Increase
 b. $[\text{H}^{+}(\text{aq})]$ Decrease
 c. $[\text{NO}_3^{-}(\text{aq})]$ No change
 d. pH of the solution Increase

e. Which of your answers in (a) – (d) above would be different if the slight increase in volume of the solution had not been ignored? Why?

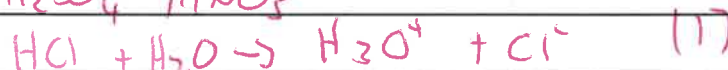
(1) C. A change in $v(\text{PO}_3^{-}) \rightarrow$ a change in $[\text{PO}_3^{-}]$ as $C = \frac{n}{v}$ (1)

(6 marks)

17. Give the Arrhenius definition of an acid. You should use an example and include an equation in your answer.

Arrhenius: Acid is molecule that has H^{+} . (1)

Eg: HCl , H_2SO_4 , HNO_3



(2 marks)



-need Example & equation

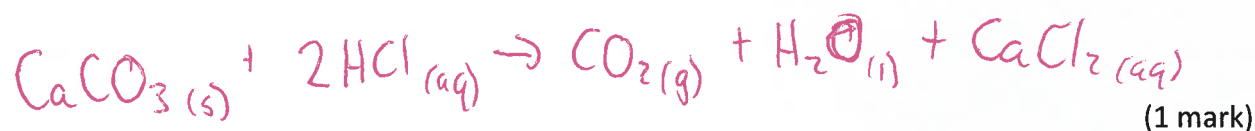
SECTION THREE EXTENDED RESPONSE

[20 MARKS]

All answers should be expressed to the appropriate number of significant figures with the correct units. Show your working or reasoning clearly.

18. A student adds solid calcium carbonate to 50.0 mL of a 0.350 mol L⁻¹ hydrochloric acid solution. [8 marks]

a. Write a balanced molecular equation for this reaction.



b. Calculate the mass of calcium carbonate needed to neutralise the acid.

$$\begin{aligned} n(\text{HCl}) &= c \times v = 0.350 \times 0.05 = 1.75 \times 10^{-2} \text{ mol} \quad (1) \\ n(\text{CaCO}_3) &= \frac{1}{2} \times n(\text{HCl}) = \frac{1}{2} \times 1.75 \times 10^{-2} = 8.75 \times 10^{-3} \text{ mol} \quad (1) \\ m(\text{CaCO}_3) &= n \times M = 8.75 \times 10^{-3} \times 100.06 \\ &= 0.875 \text{ g} \quad (1) \\ &\quad (1) \text{ 3 sig fig} \end{aligned}$$

(5 marks)

c. What volume of carbon dioxide gas would be produced at STP?

$$\begin{aligned} n(\text{CO}_2) &= n(\text{CaCO}_3) = 8.75 \times 10^{-3} \text{ mol} \quad (1) \\ V(\text{CO}_2) &= n \times 22.71 = 8.75 \times 10^{-3} \times 22.71 \\ &= 0.199 \text{ L} \quad (1) \end{aligned}$$

→ need 3 SF

(2 marks)

19. In a neutralisation reaction, 22.15 mL of hydrochloric acid was needed to fully react with 28.0 mL of potassium hydroxide solution. If the concentration of hydrochloric acid was 0.215 mol L⁻¹, what was the concentration of the potassium hydroxide solution?

[4 marks]



$$n(\text{HCl}) = C \times V = 0.215 \times 0.02215 = 4.76 \times 10^{-3} \text{ mol} \quad (1)$$

$$n(\text{KOH}) = n(\text{HCl}) = 4.76 \times 10^{-3} \text{ mol} \quad (1)$$

$$[\text{KOH}] = \frac{n}{V} = \frac{4.76 \times 10^{-3}}{0.028} = 0.170 \text{ mol/L} \quad (1)$$

(M)

-need 3SF

20. Calculate the mass of sodium hydroxide needed to dissolve in water to produce 350 mL of a 0.100 mol L⁻¹ solution of sodium hydroxide.

[2 marks]

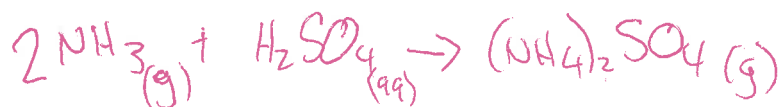
$$n(\text{NaOH}) = C \times V = 0.1 \times 0.35 = 0.035 \text{ mol} \quad (1)$$

$$m(\text{NaOH}) = n \times M = 0.035 \times 39.988 = 1.399 = 1.40 \text{ g} \quad (1)$$

-Need 3SF

21. In order to produce the fertilizer ammonium sulphate, ammonia gas can be passed through sulphuric acid solution. [6 marks]

a. Write a balanced molecular equation for the reaction.



(1 mark)

b. Calculate the volume of ammonia gas (at STP) needed to produce 14.7kg of fertilizer.

$$- n((\text{NH}_4)_2\text{SO}_4) = \frac{m}{M} = \frac{14700 \text{ (1)}}{132.14} = 111.276 \text{ mol (1)}$$

$$- n(\text{NH}_3) = \frac{2}{1} \times n((\text{NH}_4)_2\text{SO}_4) = 2 \times 111.276 = 222.55 \text{ mol (1)}$$

$$\begin{aligned} - V(\text{NH}_3) &= n \times 22.71 \text{ (1)} \\ &= 222.55 \times 22.71 \\ &= 5054 \text{ L} \\ &= 5.05 \times 10^3 \text{ L (1)} \end{aligned}$$

- Need 3SF

(5 marks)

End of Test