

# Foundations in chemistry

## (Acids)

Total mark - 20

### Question: 1

1. A student carries out experiments using acids, bases and salts.

Calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$ , is an example of a salt.

The student prepares a solution of calcium nitrate by reacting dilute nitric acid,  $\text{HNO}_3$ , with the base calcium hydroxide,  $\text{Ca}(\text{OH})_2$ .

- (i) Why is calcium nitrate an example of a salt?

.....  
.....

[1]

- (ii) Write the equation for the reaction between dilute nitric acid and calcium hydroxide. Include state symbols.

.....

[2]

- (iii) Explain how the hydroxide ion in aqueous calcium hydroxide acts as a base when it neutralises dilute nitric acid.

.....  
.....  
.....

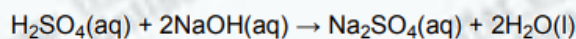
[1]

[Total 4 marks]

## Question: 2

2. (a) A student carries out a titration to find the concentration of some sulfuric acid.

The student finds that 25.00 cm<sup>3</sup> of 0.0880 mol dm<sup>-3</sup> aqueous sodium hydroxide, NaOH, is neutralised by 17.60 cm<sup>3</sup> of dilute sulfuric acid, H<sub>2</sub>SO<sub>4</sub>.



- (i) Calculate the amount, in moles, of NaOH used.

answer = ..... mol

[1]

- (ii) Determine the amount, in moles, of H<sub>2</sub>SO<sub>4</sub> used.

answer = ..... mol

[1]

- (iii) Calculate the concentration, in mol dm<sup>-3</sup>, of the sulfuric acid.

answer = ..... mol dm<sup>-3</sup>

[1]

- (b) After carrying out the titration in (a), the student left the resulting solution to crystallise. White crystals were formed, with a formula of Na<sub>2</sub>SO<sub>4</sub>·x H<sub>2</sub>O and a molar mass of 322.1 g mol<sup>-1</sup>.

- (i) What term is given to the '·x H<sub>2</sub>O' part of the formula?

.....

[1]

- (ii) Using the molar mass of the crystals, calculate the value of x.

answer = .....

[2]

[Total 6 marks]

### Question: 3

3. Ammonium compounds such as ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ , can be used as fertilisers.

- (i) Write a balanced equation to show how ammonium sulfate could be formed by the reaction between aqueous ammonia and sulfuric acid.

.....

[1]

- (ii) Ammonium sulfate is an example of a salt formed when an acid is neutralised by a base.

Explain what is meant by the term *salt*.

.....

.....

[1]

- (iii) Why is ammonia acting as a base in this neutralisation?

.....

.....

[1]

- (iv) What is the relative formula mass of  $(\text{NH}_4)_2\text{SO}_4$ ?

Give your answer to **one** decimal place.

.....

[1]

[Total 4 marks]

## Question: 4

4. Epsom salts can be used as bath salts to help relieve aches and pains.

Epsom salts are crystals of hydrated magnesium sulfate,  $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ .

A sample of Epsom salts was heated to remove the water. 1.57 g of water was removed leaving behind 1.51 g of anhydrous  $\text{MgSO}_4$ .

- (i) Calculate the amount, in mol, of anhydrous  $\text{MgSO}_4$  formed.

amount = ..... mol

[2]

- (ii) Calculate the amount, in mol, of  $\text{H}_2\text{O}$  removed.

amount = ..... mol

[1]

- (iii) Calculate the value of  $x$  in  $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ .

$x$  = .....

[1]

[Total 4 marks]

## Question: 5

5. Calcium oxide reacts with water and with nitric acid.

State the formula of the calcium compound formed when:

- (i) calcium oxide reacts with water, .....

[1]

- (ii) calcium oxide reacts with nitric acid. ....

[1]

[Total 2 marks]