Raffles Institution Raffles Programme
Year Four Chemistry

Name: _____ ( ) Class: _____ Date: _____

2022 FE Revision – Acids, Bases and Salts; Ionic Equations **Answers**

nitric acid	**HNO_3**	calcium hydroxide	**$Ca(OH)_2$**
sulfuric acid	**H_2SO_4**	ammonia	**NH_3**
ethanoic acid	**CH_3COOH**	copper(II) oxide	**CuO**

Reactions of Acids

1 $HCl + NaOH \rightarrow$ **$NaCl + H_2O$**

2 **2**$HNO_3 + CaCO_3 \rightarrow$ **$Ca(NO_3)_2 + H_2O + CO_2$**

3 $H_2SO_4 + Mg \rightarrow$ **$MgSO_4 + H_2$**

Reactions of Bases

1 $CaO +$ **2**$HCl \rightarrow$ **$CaCl_2 + H_2O$**

2 $NaOH + NH_4Cl \rightarrow$ **$NaCl + H_2O + NH_3$**

3 **2**$NaOH + Fe(NO_3)_2 \rightarrow$ **$2NaNO_3 + Fe(OH)_2$** **green ppt**

2$NaOH + CuSO_4 \rightarrow$ **$Na_2SO_4 + Cu(OH)_2$** **blue ppt**

Strength of Acids and Bases

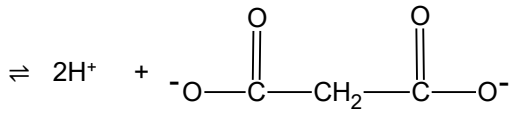
1 A strong acid is one that completely **ionises/dissociates** in water while a weak acid is one that **partially ionises/dissociates** in water

2(a) (i) **strong acid**
(ii) **strong base**
(iii) **+ H^+(aq) weak acid**
(iv) **+ OH^-(aq) weak base**

2(b) $CH_3COOH + KOH \rightarrow$ **$CH_3COOK + H_2O$**

2$CH_3COOH + Na_2CO_3 \rightarrow$ **$2NaCH_3COO + H_2O + CO_2$**

2$CH_3COOH + Mg \rightarrow$ **$(CH_3COO)_2Mg + H_2$**



3 A 10 mol dm^{-3} solution of hydrochloric acid is a concentrated solution of a strong acid while a 0.1 mol dm^{-3} solution of hydrochloric acid is a **dilute** solution of a **strong** acid.

4

(strong) acid, concentration	**$[H^+]$ / mol dm^{-3}**	**pH**
sulfuric acid, H_2SO_4, 0.0100 mol dm^{-3} H_2SO_4 is dibasic: 1 mol H_2SO_4 dissociates to produce 2 mol H^+	**0.0200**	**−lg (0.0200) = 1.70**

Acid-Base titrations

Titration	pH of equivalence point **circle your choice**
strong alkali - **strong** acid	<7 / (=7) / >7
strong alkali - weak acid	<7 / =7 / (>7) *
weak alkali - **strong** acid	(<7) / =7 / >7 *

Types of Oxides

$Na_2O + 2HCl \rightarrow$ **$2NaCl$** + H_2O

$CuO +$ **H_2SO_4** $\rightarrow CuSO_4 +$ **H_2O**

ZnO

$CO_2 + 2NaOH \rightarrow Na_2CO_3 +$ **H_2O**

$SiO_2 + CaO \rightarrow$ **$CaSiO_3$**

Solubility rules and Precipitation reactions

sulfate	most, except…	**$BaSO_4$**, calcium sulfate and **$PbSO_4$**
chloride	most, except…	silver chloride and **$PbCl_2$**
iodide	most, except…	**AgI** and Lead(II) iodide

aqueous silver nitrate and aqueous sodium iodide / potassium iodide	silver iodide
aqueous zinc nitrate and **aqueous sodium carbonate**	zinc carbonate
aqueous iron(III) nitrate and **aqueous sodium hydroxide**	iron(III) hydroxide
aqueous lead(II) nitrate and **aqueous sodium chloride**	lead(II) chloride

1 Na_2CO_3 (aq) + $CaCl_2$ (aq) → **2**NaCl (**aq**) + $CaCO_3$ (**s**)
2 **2**NaOH (**aq**) + $CuSO_4$ (**aq**) → **$Cu(OH)_2$ (s) + Na_2SO_4 (aq)**

Writing Ionic Equations **Cl_2 (g) + $2I^-$ (aq) → $2Cl^-$ (aq) + I_2 (s)**
Cu^{2+} (aq) + Zn (s) → Zn^{2+} (aq) + Cu (s)

(a) **$3OH^-$ (aq) + Fe^{3+} (aq) → $Fe(OH)_3$ (s)** red-brown precipitate: **iron(III) hydroxide**
(b) **Ag^+ (aq) + Cl^- (aq) → AgCl (s)** white precipitate: **silver chloride**

Practice Questions

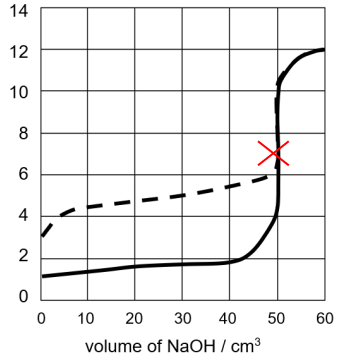
1 D 2 D 3 A 4 D 5 C

6	**method** **compound**
(a)	precipitation **magnesium carbonate** reactants: **aqueous magnesium nitrate and aqueous sodium carbonate** equation: **$Mg(NO_3)_2$ (aq) + Na_2CO_3 (aq) → $MgCO_3$ (s) + $2NaNO_3$ (aq)**
(b)	titration **sodium nitrate** reactants: **aqueous sodium hydroxide and dilute nitric acid** equation: **NaOH (aq) + HNO_3 (aq) → $NaNO_3$ (aq) + H_2O (l)**
(c)	reaction between excess metal oxide and dilute acid **copper(II) chloride** reactants: **copper(II) oxide and dilute hydrochloric acid** equation: **CuO (s) + 2HCl (aq) → $CuCl_2$ (aq) + H_2O (l)**
(d)	reaction between excess metal and dilute acid **zinc sulfate** reactants: **zinc and dilute sulfuric acid** equation: **Zn (s) + H_2SO_4 (aq) → $ZnSO_4$ (aq) + H_2 (g)**

7(a) Lead(II) chloride is an **insoluble** compound. When dilute hydrochloric acid reacts with lead(II) oxide, which is also **not soluble** in water, a solid coating of **lead(II) chloride** forms around lead(II) oxide, preventing lead(II) oxide from further reacting with **hydrochloric acid**, which means the reaction will stop.

7(b) reactants: **aqueous lead(II) nitrate and aqueous sodium chloride** (or dilute hydrochloric acid)
procedure: **step 1: mix aqueous lead(II) nitrate and aqueous sodium chloride in a beaker**
step 2: filter the mixture, collect the residue, which is lead(II) chloride
step 3: wash the residue with distilled water and air-dry the solid or dry between sheets of filter paper

8(a)



8(b) Hydrochloric acid is a strong acid while ethanoic acid is a weak acid.

The two acids have the same concentration.
Since hydrochloric acid is **fully dissociated**, it will have a **higher concentration of aqueous hydrogen ions** and hence, **a lower pH** (of 1).

Ethanoic acid **dissociates partially** and will produce a **lower concentration of aqueous hydrogen ions**.
The **pH will be higher** (at 3).