

1. (i) The H^+ ion in an (nitric) acid has been replaced by a metal ion
OR by a Ca^{2+} ion ✓

DO NOT ALLOW it has been produced by the reaction of an acid and a base as this is stated in the question.

IGNORE references to replacement by NH_4^+ ions or positive ions.

ALLOW H OR Hydrogen for H^+ ;

DO NOT ALLOW Hydrogen atoms

ALLOW Ca OR Calcium for Ca^{2+} .

DO NOT ALLOW Calcium atoms

ALLOW 'metal' for 'metal ion'

1

- (ii) $2HNO_3(aq) + Ca(OH)_2(aq) \rightarrow Ca(NO_3)_2(aq) + 2H_2O(l)$

Formulae ✓

Balance **AND** states ✓

ALLOW multiples

ALLOW (aq) **OR** (s) for $Ca(OH)_2$

2

- (iii) Accepts a proton **OR** accepts H^+ ✓

ALLOW $H^+ + OH^- \rightarrow H_2O$

ALLOW OH^- reacts with H^+ **OR** OH^- takes H^+

ALLOW OH^- 'attracts' H^+ if 'to form water' is seen

DO NOT ALLOW OH^- neutralises H^+ ('neutralises' is in the question)

1

[4]

2. (a) (i) Calculate correctly $\frac{0.0880 \times 25.0}{1000} = 2.20 \times 10^{-3}$ mol

OR 0.00220 mol ✓

ALLOW 0.0022 **OR** 2.2×10^{-3} mol

1

- (ii) Calculates correctly $\frac{0.00220}{2} = 1.10 \times 10^{-3}$ mol

OR 0.00110 mol ✓

ALLOW 0.0011 **OR** 1.1×10^{-3} mol

ALLOW ECF for answer (i)/2 as calculator value or correct rounding to 2 significant figures or more but ignore trailing zeroes

1

(iii) $\frac{0.00110 \times 1000}{17.60} = 0.0625 \text{ mol dm}^{-3}$

OR $6.25 \times 10^{-2} \text{ mol dm}^{-3}$ ✓

ALLOW 0.063 OR $6.3 \times 10^{-2} \text{ mol dm}^{-3}$

ALLOW ECF for answer (ii) $\times 1000/17.60$

OR

ECF from (i) for answer (i)/2 $\times 1000/17.60$ as calculator value or correct rounding to 2 significant figures or more but ignore trailing zeroes

1

(b) (i) (The number of) Water(s) of crystallisation ✓

IGNORE hydrated OR hydrous

1

(ii) 142.1 ✓

ALLOW 142

ALLOW M_r expressed as a sum

ALLOW ECF from incorrect M_r and x is calculated correctly

$$x = \frac{(322.1 - 142.1)}{18.0} = 10 \text{ ✓}$$

ALLOW ECF values of x from nearest whole number to calculator value

ALLOW 2 marks if final answer is 10 without any working

2

[6]

3. (i) $2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$ ✓

ALLOW $2\text{NH}_4\text{OH} + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4 + 2\text{H}_2\text{O}$

ALLOW $\text{NH}_3 + \text{H}^+ \rightarrow \text{NH}_4^+$

ALLOW any correct multiple

IGNORE state symbols

1

(ii) when the H^+ in an acid is replaced by a metal ion **OR** an ammonium ion **OR** a + ion ✓

ALLOW H for H^+ ;

ALLOW 'metal' for 'metal ion'

i.e.: H in an acid can be replaced by a metal

1

(iii) accepts a proton **OR** accepts H^+ ✓
ALLOW donates a lone pair
ALLOW removes H^+
ALLOW forms OH^- ions

1

(iv) 132.1 ✓
IGNORE units
NO OTHER ACCEPTABLE ANSWER

1

[4]

4. (i) $M(\text{MgSO}_4) = 120.4 \text{ OR } 120 \text{ (g mol}^{-1}\text{)} \checkmark$
 $\text{mol MgSO}_4 = \frac{1.51}{120.4} = 0.0125 \text{ mol } \checkmark$
ALLOW 0.013 up to calculator value of 0.012541528 correctly rounded (from $M = 120.4 \text{ g mol}^{-1}$)
ALLOW 0.013 up to calculator value of 0.012583333 correctly rounded (from $M = 120 \text{ g mol}^{-1}$)
ALLOW ecf from incorrect M i.e. $1.51 \div M$

2

(ii) $\frac{1.57}{18.0} = 0.0872(2) \text{ (mol)} \checkmark$
ALLOW 0.09 up to calculator value of 0.08722222

1

(iii) $\times = 7 \checkmark$
ALLOW ecf i.e. answer to (ii) \div answer to (i)
ALLOW correctly calculated answer from 1 significant figure up to calculator value, i.e. \times does not have to be a whole number. Likely response = 6.95 ✓

1

[4]

5. (i) $\text{Ca(OH)}_2 \checkmark$
IGNORE charges, even if wrong

1

- (ii) $\text{Ca}(\text{NO}_3)_2$ ✓
IGNORE charges, even if wrong 1 [2]
6. (i) Molar mass of $\text{CaCO}_3 = 100.1 \text{ g mol}^{-1}$ (1)
 $2.68/100.1 = 0.0268/0.027$ (1) 2
- (ii) $0.0268 \text{ mol} \times 24,000 = 643 \text{ cm}^3$ (1) 1
- (iii) moles $\text{HNO}_3 = 2 \times 0.0268$
 $= 0.0536 / 0.054 \text{ mol}$ (1)
(i.e. answer to (i) $\times 2$)
 volume of $\text{HNO}_3 = 0.0536 \times 1000/2.50 = 21.4 \text{ cm}^3$ (1) 2 [5]
7. (i) MgO has reacted with CO_2 ✓ 1
- (ii) Solid dissolves / disappears ✓
 Fizzing / bubbles ✓ 2
 $\text{MgO} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$ ✓
 $\text{MgCO}_3 + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$ ✓
 both reactions form magnesium chloride/ MgCl_2 ✓ 3 [6]
8. (i) $\text{CaCO}_3 (\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O} (\text{l})$
 $\text{CaO}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O} (\text{l})$
 each balanced equation 1 mark (2)
 all state symbols (1) 3
- (ii) CaCO_3 fizzes/ gas given off/ gas evolved / carbon dioxide evolved (1) 1 [4]
9. (i) a proton donor ✓ 1
- (ii) $\text{MgO} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$ ✓ 1 [2]

10. CaCO_3 reacts with (or neutralises) HCl ✓
 (or $\text{CaCO}_3 + \text{HCl}$ in an equation)
 $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ ✓
 (correct equation would score both marks)

[2]

11. (i) as a base (1) accepts a proton/ H^+ / **neutralises** an acid/
 reacts with acid to form salt/ has a **lone** pair of electrons (1) 2
 (ii) fertiliser (1) 1
 (iii) manufacture of explosives/ dyes/ nitric acid/ fibres/ ammonium
 nitrate/ urea/ refrigeration/ cleaning agents/ fertiliser
 (if not allowed in (ii) (1) 1

[4]

12. (i) fizzing/gas/hydrogen evolved *or* Mg dissolves/disappears ✓ 1
 [an incorrect observation negates this mark]
 (ii) $2\text{HCl} + \text{Mg} \rightarrow \text{MgCl}_2 + \text{H}_2$
 [correct formula for MgCl_2 . Allow equation with HI/MgI_2 instead of HCl] ✓
 [balancing: e.g. $2\text{HCl} + 2\text{Mg} \rightarrow 2\text{MgCl} + \text{H}_2$ will get this mark but
 not the 1st] ✓ 2

[3]

13. No mark scheme available

14. No mark scheme available