MOLES, EQUATIONS AND ACIDS TEST MS

1. (i) 0.0268 **OR** 0.027 **OR** 0.02675 mol ✓
NO OTHER ACCEPTABLE ANSWER

1

(ii) 1.61×10^{22} ✓
ALLOW *1.6×10^{22} up to calculator value*
ALLOW
ECF *answer to* ***(i)*** $\times 6.02 \times 10^{23}$
ALLOW *any value for N_A in the range:*
$6.0 \times 10^{23} - 6.1 \times 10^{23}$

1

[2]

2. (i) $0.438/87.6 = 5.00 \times 10^{-3}$ / 0.00500 mol ✓ 1

(ii) $0.00500 \times 24.0 = 0.120$ dm^3 ✓ (accept 120 cm^3) 1

(iii) $0.00500 \times 1000/200 = 0.0250$ mol dm^{-3} ✓ 1

[3]

3. (i) Molar mass CaO = 56.1 (g mol^{-1}) ✓ (anywhere) 2

moles CaO = $\frac{1.50}{56.1}$ = = 0.0267/0.027 ✓ calc: 0.0267379

Allow 56 which gives 0.0268

(ii) moles $HNO_3 = 2 \times 0.0267$

= 0.0534 or 0.0535 /0.053 mol ✓

(i.e. answer to (i) x 2)

volume of HNO_3 = $\frac{0.0534\ (\text{or } 5) \times 1000}{2.50}$ = 21.4 cm^3 ✓ 2

calc from value above = 21.3903743

If 0.053 mol, answer is 21 cm^3 but accept 21.2 cm^3
If 0.054 mol, answer is 22 cm^3 but accept 21.6 cm^3

[4]

4. Calculates correctly:

Mol of $Sr(NO_3)_2 = \frac{5.29}{211.6} = 0.0250$ ✓

ALLOW *0.025*

Calculates correctly:

Mol of gas = 5/2 × 0.0250 = 0.0625 ✓

ALLOW *ECF for first answer × 2.5 as calculator value or correct rounding to 2 significant figures or more but ignore trailing zeroes*

Calculates correctly:

Volume of gas = 24.0 × 0.0625 = 1.50 dm^3 ✓

ALLOW *ECF for second answer × 24(.0) as calculator value or correct rounding to 2 significant figures or more but ignore trailing zeroes*

DO NOT ALLOW *ECF of first answer × 24(.0) (which gives 0.6(0) dm^3) as this has not measured the volume of any gas, simply 0.0250 mol of solid $Sr(NO_3)_2$ converted into a gas*

i.e. This answer would give ***one*** *mark*

ALLOW *1.5 dm^3*

ALLOW *ECF producing correct volume of NO_2 only*

i.e. 1.2(0) dm^3 would give ***two*** *marks*

OR

ALLOW *ECF producing correct volume of O_2 only*

i.e. 0.3(0) dm^3 would give ***two*** *marks*

3

[3]

5. (i) 12 × 50/1000 = 0.600 mol ✓ 1

(ii) 4 mol $HCl \rightarrow$ 1 mol Cl_2 / moles Cl_2 = 0.15 mol ✓

vol of Cl_2 = 0.15 × 24 = 3.60 dm^3 ✓ 2

2nd mark is consequential on molar ratio given

[3]

6. (i) Mass Sb_2S_3 in stibnite = 5% of 500 kg = 25.0 kg ✓

Moles Sb_2S_3 = $\frac{25.0\times10^3}{340}$ / 73.5/ 73.529 /73.53/ 74 mol ✓

(calculator value: 73.52941176)

If 5% is not used, 1471 mol; ecf for 2nd mark

(calculator value: 1470.588235)

If 5% is used 2nd, 73.6 mol: OK for both marks 2

(ii) moles Sb = 2 × 73.5 mol ✓

mass Sb = 2 × 73.5 × 122 g = 17.9 kg ✓

If the 2 isn't used, answer = 73.5 × 122 = 8.95 ✓

ecf ans from (i) x 2

ecf ans above x 2

OR

% Sb = 244/340 = 71.7% ✓

mass Sb = 25.0 × 71.7/100 = 17.9 kg ✓ (ecf as above) 2

[4]

7. (a) (i) Calculate correctly $\frac{0.0880\times25.0}{1000} = 2.20\times10^{-3}$ mol

OR 0.00220 mol ✓

ALLOW *0.0022* ***OR*** *2.2 × 10^{-3} mol*

1

(ii) Calculates correctly $\frac{0.00220}{2}$ = 1.10 × 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) $\frac{0.00110\times1000}{17.60} = 0.0625$ mol dm^{-3}

OR 6.25 × 10^{-2} mol dm^{-3} ✓

ALLOW *0.063* ***OR*** *6.3 × 10^{-2} mol dm^{-3}*

ALLOW *ECF for answer* ***(ii)*** *× 1000/17.60*

OR

ECF from ***(i)*** *for answer* ***(i)****/2 × 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***

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

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]

8. (i) $M(MgSO_4) = 120.4$ OR 120 ($g\ mol^{-1}$) ✓

mol $MgSO_4 = \frac{1.51}{120.4} = 0.0125\ mol$ ✓

ALLOW *0.013 up to calculator value of 0.012541528 correctly rounded (from M = 120.4 g mol^{-1})*

ALLOW *0.013 up to calculator value of 0.012583333 correctly rounded (from M = 120 g mol^{-1})*

ALLOW *ecf from incorrect M i.e. 1.51 ÷ M*

2

(ii) $\frac{1.57}{18.0} = 0.0872(2)$ (mol) ✓

ALLOW *0.09 up to calculator value of 0.08722222*

1

(iii) × = 7 ✓

ALLOW *ecf i.e. answer to (ii) ÷ answer to (i)*

ALLOW *correctly calculated answer from 1 significant figure up to calculator value, ie, × does not have to be a whole number. Likely response = 6.95* ✓

1

[4]

9. (i) **Simplest (whole number) ratio** of atoms/moles/elements ✓ 1

(ii) ratio Rb : Ag : I = 7.42/85.5 : 37.48/108 : 55.10/127

or 0.0868 : 0.347 : 0.434

or 1 : 4 : 5 ✓

= $RbAg_4I_5$ ✓ 2

[3]

10. (i) moles Ti = 1.44/47.9 = 0.0301 mol/0.03 mol 1
(accept use of answer from (b))

(ii) mass of C*l* = 5.70-1.44 = 4.26 g ✓
moles C*l* = 4.26/35.5 = 0.120 mol ✓ 2
5.70/35.5 = 0.161 mol gets 1 mark

(iii) Ti:C*l* = 0.0301 : 0.12 = 1:4.
Empirical formula = $TiCl_4$ ✓
0.0301 : 0.161 mol gives $TiCl_5$ for 1 mark 1

(iv) $Ti + 2Cl_2 \rightarrow TiCl_4$ ✓ 1
(ecf possible from (iii)
covalent ✓

[5]

11. (i) a proton donor ✓ 1

(ii) $MgO + 2HCl \rightarrow MgCl_2 + H_2O$ ✓ 1

[2]

12. (i) $CaCO_3$ (s) + 2HC*l*(aq) → $CaCl_2$(aq) + CO_2(g) +H_2O (l)

$CaO(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O$ (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]

13. (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]

14. (i) $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ ✓

ALLOW $2NH_4OH + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2H_2O$

ALLOW $NH_3 + H^+ \rightarrow NH_4^+$

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]