M1. *(penalty for sig fig error =1 mark per question)*

(a) neutron: relative mass = 1 relative charge = 0
(not 'neutral')

1

electron: relative mass = 1/1800 → 0/negligible *or*

5.56 × 10–4 → 0 relative charge = –1

1

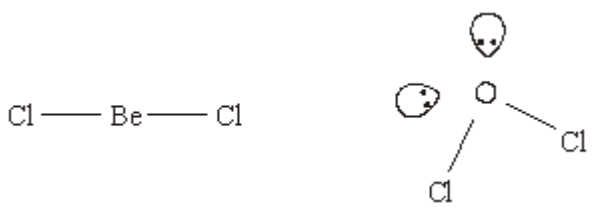
(b) $^{17}O/O^{17}$ mass number (*Do not accept 17.0*)

1

oxygen symbol 'O'
(if 'oxygen' + — 'mass number = 17'(1))
(if 'oxygen'+ — 'mass number = 17'(0))
(if at N° given but ≠ 8, treat as 'con' for M2)
(if lp on Be, diagram = 0)
(ignore bond angles)
(not dot and cross diagrams)

1

(c)



2

QoL Linear **(1)** bent / V-shaped / angular **(1)**
(mark name and shape independently)
(accept (distorted) tetrahedral)
(if balls instead of symbols, lose M1 – can award M2)
(penalise missing 'Cl' once only)
(not 'non-linear')

2

(d) M_r ($Mg(NO_3)_2$ = 58(.3) *(if At N° used, lose M1 and M2)*

1

moles $Mg(OH)_2$ = 0.0172 (conseq on wrong M2) (answer to <u>3+ s.f.</u>)

1

moles HCl = 2 × 0.0172 = 0.0344 *or* 0.0343 (mol) *(process mark)*

1

vol HCl = $\frac{0.0343 \times 1000}{1}$ = 34.3 – 34.5 (cm^3) *(unless wrong unit)*

*(if candidate **used** 0.017 or 0.0171 lose M2)*

(just answer with no working, if in range = (4).
if, say, 34 then =(2))

(if not 2:1 ratio, lose M3 and M4)

(if work on HCl, CE = 0/4)

1

[12]

M2. (a) $Mg + 2HCl \rightarrow MgCl_2 + H_2$

1

$MgO + 2HCl \rightarrow MgCl_2 + H_2O$

Allow ionic equations

1

(b) Hydrogen collection
Using a gas syringe or measuring cylinder/ graduated vessel over water

Allow if shown in a diagram

1

Measurements (i) P 1
(ii) T 1
(iii) V 1

Use ideal gas equation to calculate mol hydrogen or mass/*M*r
Mol H_2 = mol Mg (Mark consequentially to equation)

2

(c) $MgCl_2 + 2NaOH \rightarrow Mg(OH)_2 + 2NaCl$ Species

1

Balanced

1

Allow an ionic equation

$Mg(OH)_2 \rightarrow MgO + H_2O$

1

(d) ***Allow 2 significant figures in these calculations and ignore additional figures***

EITHER

Mol MgO obtained stage 2 = mass MgO/*M*rMgO

1

= 6.41/ 40.(3) = 0.159 *Allow 0.16*

Allow method mark if formula of magnesium oxide or M_r incorrect

1

Moles of Mg = moles of H_2 hence

Mol original MgO = mol MgO from stage 2 - mol H_2

1

= 0.159 – 0.0528 = 0.106 *Allow 0.11*

Mark consequentially to moles of magnesium oxide determined above

OR

Mass MgO formed from Mg = 0.0528 × M_r MgO {or 40.(3)} **(1)**

= 2.13 g

Allow 2.1 ***(1)***

Allow method mark if formula of magnesium oxide or Mr incorrect

Mass original MgO = total mass MgO - mass formed from Mg **(1)**

= 6.41 – 2.13 = 4.28 g *Allow 4.3* **(1)**

Mark consequentially mass of magnesium oxide determined above

NB

As there is an error in part (d), the mass of sample should have been 6.25 NOT 2.65, award full marks to any candidate who has crossed out their correct first answer.

1

[15]

M3. (a) (i) 4.86×10^{-3}

1

(ii) 2.43×10^{-3}

(mark conseq on (a)(i))

1

(iii) 2.43×10^{-2}

(mark conseq on (a)(ii))

1

(iv) $3.01/2.43 \times 10^{-2}$

(mark conseq on (a)(iii))

1

124

(Do not allow 124 without evidence of appropriate calculation in (a)(iii))

1

(b) $M_r(Na_2CO_3) = 106$
M_r (xH_2O) = 250 –106 = 144 *(mark conseq on M1)*
x = 8 *(mark conseq on M2)*

(Penalise sf errors once only)

3

(c) (i) PV = nRT

1

(ii) Moles A_r = 325/39.9 = 8.15

(accept M_r = 40)

1

P = nRT/V = $(8.15 \times 8.31 \times 298)/5.00 \times 10^{-3}$
= 4.03×10^6 Pa or = 4.03×10^3 kPa

Range = 4.02×10^6 Pa to 4.04×10^6 Pa

(If equation incorrectly rearranged, M3 & M4 = 0 If n =325, lose M2)

(Allow M1 if gas law in (ii) if not given in (i))

2

[12]

M4. (a) (i) $100 \times 10^{-3} \times 0.500 = 5.00 \times 10^{-2}$ (mol)

accept $5 \times 10^{-2} / 0.05$

1

(ii) $27.3 \times 10^{-3} \times 0.600 = 1.64 \times 10^{-2} / 1.638 \times 10^{-2}$ (mol) only

1

(iii) 1.64×10^{-2} (mol)

Mark conseq on (ii)

1

(iv) $5.00 \times 10^{-2} - 1.64 \times 10^{-2} = 3.36 \times 10^{-2}$ (mol)

Mark conseq on (i) & (iii)

1

(v) $3.36 \times 10^{-2} \times ½ = 1.68 \times 10^{-2}$ (mol)

If 2.78×10^{-2} used 1.39×10^{-2}

Mark conseq on (iv)

1

$1.68 \times 10^{-2} \times 132(.1)$ **or** $1.39 \times 10^{-2} \times 132(.1)$

Mark for M_r

1

= 2.22 g **or** 1.83 g

1

(b) $pV = nRT$

1

$n = \frac{0.143}{17} = 8.4(1) \times 10^{-3}$ (mol)

1

$T = \frac{pV}{nR} = \frac{100000 \times 2.86 \times 10^{-4}}{8.31 \times 8.4 \times 10^{-3}}$ (1)

1

= 408.5 – 410.5 (K)

Mark conseq on moles

***Note** Sig. fig. penalty - apply once if single sf given, unless calc works exactly*

1

[11]

M5.B

[1]

M6.C

[1]

M7.D

[1]