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^o given but ≠ 8, treat as 'con' for M2)*
                (if lp on Be, diagram = 0)
                (ignore bond angles)
                (not dot and cross diagrams)

1

(c)
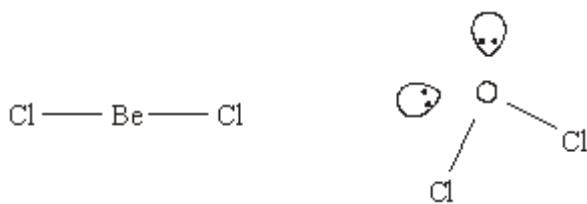
2

   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^o 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 = $\dfrac{0.0343 \times 1000}{1}$ = 34.3 – 34.5 (cm³) *(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.B

[1]

M3.   (a)   (i)   Atoms with the same number of protons / proton number **(1)**
         NOT same atomic number

        with different numbers of neutrons **(1)**
         ***NOT** different mass number / fewer neutrons*

    (ii)   Chemical properties depend on the <u>number</u> or <u>amount</u> of (outer) electrons **(1)** <u>OR</u>, isotopes have the same electron configuration / same number of e⁻

    (iii)   23/6.023 × 10²³ **(1)**
         CE = 0 if inverted or multiplied

        tied to M1 3.8(2) × 10⁻²³   [2-5 sig figs] **(1)**

5

    (b) $1s^2\ 2s^2\ 2p^6\ 3s^1$ **(1)**
         accept subscripted figures

1

    (c)   Highest energy e⁻ / outer e⁻s / last e⁻ in (3)d sub-shell **(1)**

OR <u>d</u> sub-shell being filled / is incomplete
OR highest energy sub-shell is (3)d
<u>NOT</u> transition element / e⁻ configuration ends at 3d
Q of L

1

(d) $^{15}_{7}N$ N correct symbol **(1)**

allow N^{15}_{7}
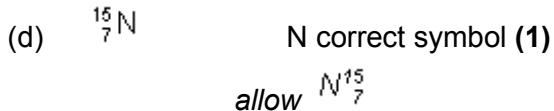
Mass number = 15 <u>AND</u> atomic number = 7 **(1)**

2

[9]

M4. D

[1]

M5.   (a)   Proton: mass 1, charge + 1 **(1)**
Neutron: mass 1, charge 0 **(1)**
Electron mass 1/1840, charge -1 **(1)**
Allow mass = 0, or negligible, or 1/1800 to 1/2000

Isotopes have the same number of protons **(1)**
OR atomic number

different number of neutrons **(1)**

Isotopes have the same electronic configuration **(1)**
OR same number of electrons

Chemical properties depend on electrons **(1)**

7

(b) $\dfrac{\text{average}\textbf{(1)}\ \text{mass of an atom/isotopes}}{\text{mass of 1 atom of }^{12}C} \times 12$ **(1)**

$$OR\ \frac{mass\ of\ 1\ mol\ of\ atoms}{mass\ of\ 1\ atom\ of\ ^{12}C}\ \times 12\ or\ in\ words$$

Spectrum gives (relative) abundance **(1)**
> *OR % or amount*

And *m/z* **(1)**
Multiply *m/z* by relative abundance for each isotope **(1)**
> *Allow instead of m/z mass no, Aᵣ or actual value from example*

Sum these values **(1)**
Divide by the sum of the relative abundances **(1)**
> *only award this mark if previous 2 given*
> *Max 2 if e.g. has only 2 isotopes*

7

[14]