

- M1.** (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 number or amount of  
 (outer) electrons **(1)** OR, isotopes have the same electron  
 configuration / same number of e<sup>-</sup>
- (iii)  $23/6.023 \times 10^{23}$  **(1)**  
*CE = 0 if inverted or multiplied*  
 tied to M1  $3.8(2) \times 10^{-23}$  [2-5 sig figs] **(1)**
- 5

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

- (c) Highest energy e<sup>-</sup> / outer e<sup>-</sup>s / last e<sup>-</sup> in (3)d sub-shell **(1)**  
OR d sub-shell being filled / is incomplete  
OR highest energy sub-shell is (3)d  
NOT transition element / e<sup>-</sup> configuration ends at 3d  
 Q of L
- 1

- (d)  ${}^{15}_7\text{N}$  N correct symbol **(1)**  
*allow*  $\text{N}^{15}_7$
- Mass number = 15 AND atomic number = 7 **(1)**
- 2

**[9]**

- M2.** (a) (i)  $75.0 \times 10^{-3} \times 0.500 = 0.0375$  (mol) **(1)**  
*accept 0.037 or 0.038*

(ii)  $21.6 \times 10^{-3} \times 0.500 = 0.0108$  (mol) **(1)**  
accept 0.011  
If both (i) and (ii) answers wrong, allow ONE process mark for both correct processes

(iii)  $\frac{0.0375 - 0.0108}{2} = 0.01335$  (mol) **(1)**  
Not conseq – must use figures shown

(iv) Moles of  $\text{MgCO}_3 = 0.0267/2 = 0.01335$  (mol) **(1)**  
allow 0.0134 - 0.0133

Mass of  $\text{MgCO}_3 = 0.01335 \times 84.3$  **(1)**  
allow 84  
mark conseq on moles  $\text{MgCO}_3$

$= 1.125\text{g}$  **(1)**  
accept 1.13g  
mark conseq

Percentage  $\text{MgCO}_3 = 1.125/1.25 \times 100$  **(1)**  
mark conseq (check for inversion)

$= 90\%$  **(1)**  
mark conseq

range = 89.5 - 90.5%  
If % expression inverted, lose M4 and M5

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(b) (i) % oxygen = 38.0 **(1)**

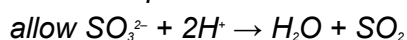
Na =  $36.5/23$       S =  $25.5/32(.1)$       O =  $38.0/16$  **(1)**  
 $= 1.587$        $= 0.794$        $= 2.375$

$= 2:1:3$  **(1)**

If no % of oxygen Max 1 (allow M2 only)  
If % for Na and S transposed, or atomic numbers used, M1 only available

(ii)  $\text{Na}_2\text{SO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{SO}_2$  **(1)**

allow multiples



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[12]

M3.A

[1]

M4.D

[1]

M5. (a) (i)  $pV = nRT$  (1)

(ii) Moles ethanol =  $n = 1.36/46$  (=0.0296 mol) (1)

$$V = nRT/p = \frac{0.0296 \times 8.31 \times 366}{100000} \quad (1)$$

if  $V = p/nRT$  lose M3 and M4

$$= 8.996 \times 10^{-4} \text{ (m}^3\text{)} \quad (1)$$

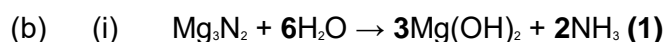
$$= 899 \text{ (900) cm}^3 \quad (1) \quad \text{range} = 895 - 905$$

If final answer = 0.899 award (2 + M1); if = 0.899 dm<sup>3</sup> or if = 912 award (3 + M1)

**Note:** If 1.36 or 46 or 46/1.36 used as number of moles ( $n$ ) then M2 and M4 not available

**Note:** If pressure = 100 then, unless answer = 0.899 dm<sup>3</sup>, deduct M3 and mark consequentially

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$$(ii) \text{ Moles NH}_3 = \frac{0.263}{17} \text{ (=0.0155 mol)} \quad (1)$$

$$\text{Number of molecules of NH}_3 = 0.0155 \times 6.02 \times 10^{23} \quad (1)$$

[mark conseq] =  $9.31 \times 10^{21}$  **(1)**

[range  $9.2 \times 10^{21}$  to  $9.4 \times 10^{21}$ ]

Conseq (*min 2 sig fig*)

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(c) Moles NaCl =  $800/58.5$  (= 13.68) **(1)**

Moles of NaHCO<sub>3</sub> = 13.68 **(1)**

Moles of Na<sub>2</sub>CO<sub>3</sub> =  $13.68/2$  = 6.84 **(1)**

Mass of Na<sub>2</sub>CO<sub>3</sub> =  $6.84 \times 106 = 725$  g **(1)** [range = 724 – 727]

[1450 g (range 1448 – 1454) is worth 3 marks]

*Accept valid calculation method, e.g. reacting masses or calculations via the mass of sodium present. Also, candidates may deduce a direct 2:1 ratio for NaCl:Na<sub>2</sub>CO<sub>3</sub>*

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**[13]**