

M1. B 1

M2. B 1

M3. moles NaOH used = vol / 1000 × conc (1) = 21.7 (if uses 25 here only scores first of first 4 marks) / 1000 × 0.112 = 0.00243 (1) (consider 0.0024 as an arithmetic error loses 1 mark) (range 0.00242 to 0.00244)
moles HCl in 25 cm³ = 0.00243 (1) (or 1 mol HCl reacts with 1 mol NaOH)
moles of HCl in 250 cm³ = 0.0243 (1)
moles ZCl₄ = 0.0243 / 4 = 0.006075 (1) (or 0.006076 or 0.006 mark is for / 4)
M_r = mass / no. Moles (1) (method mark also 1.304 / 0.006075) = 214.7 (1) (or 0.006 gives 217) (allow 214 to 215)
A_r = 214.7 - 142 = 72.7 (1) (217 gives 75, 142 is 35.5 × 4)
Therefore element is Germanium (1) (allow conseq correct from A_r) (75 gives As)
If not / 4 C.E. from there on but can score 2 independent marks for (mass / moles / method and identity of element) (for candidates who use m₁v₁ = m₂v₂ and calculate [HCl] = 0.0972 allow 1st 3 marks if 25 and 21.7 wrong way round only award 1/3)

[9]

M4. D 1

M5. A 1

- M6.** (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) $M_r(\text{Na}_2\text{CO}_3) = 106$
 $M_r(x\text{H}_2\text{O}) = 250 - 106 = 144$ (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
- $P = nRT/V = (8.15 \times 8.31 \times 298)/5.00 \times 10^{-3}$
 $= 4.03 \times 10^6 \text{ Pa}$ or $= 4.03 \times 10^3 \text{ kPa}$
Range = $4.02 \times 10^6 \text{ Pa}$ to $4.04 \times 10^6 \text{ Pa}$
(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

M7. (a) Moles HCl = $\frac{\text{mass}}{M_r} = \frac{19.6}{36.5}$ (1) (= 0.537)

Concentration = $\frac{0.537}{0.25}$ (1)
 = 2.15 (mol dm⁻³) (1)

Conseq on $\frac{\text{mass}}{M_r}$ correct

min 2 d.p. 2.14 to 2.15

Ignore units

A.E. lose one mark

3

(b) (i) $\frac{21.7}{1000} \times 0.263 = 5.7(1) \times 10^{-3}$ (mol) (1)
5.7 to 5.71 × 10⁻³

(ii) $\frac{5.71 \times 10^{-3}}{2} = 2.85 \times 10^{-3}$ (mol) (1)
Conseq

(iii) $\frac{0.394}{2.85 \times 10^{-3}} = 138$ (1)
Conseq

(iv) *Relative atomic mass of M:* 138 - 60 = 78 (1)
 $\frac{78}{2} = 39$ (1)

Identify of M: Potassium or K or K⁺ (1)

Conseq

If 78 = M_r then M = selenium

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[9]

M8. B

1

M- . (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 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

$\text{range} = 89.5 - 90.5\%$

If % expression inverted, lose M4 and M5

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

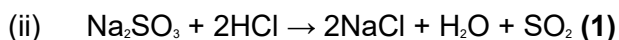
Na = $36.5/23$ S = $25.5/32(.1)$ O = $38.0/16$ (1)

$= 1.587$ $= 0.794$ $= 2.375$

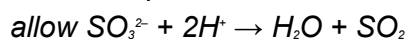
$= 2:1:3$ (1)

If no % of oxygen Max 1 (allow M2 only)

If % for Na and S transposed, or atomic numbers used, M1 only available



allow multiples



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[12]