

M1.B

[1]

M2.D

[1]

M3.C

[1]

M4. (a) (i) Avogadro's number/constant of molecules/particles/species / 6×10^{23}
[Not 'atoms']

1

Or same number of particles as (there are atoms)
[Not molecules]

in 12.(00)g of ^{12}C

1

(ii) Moles $\text{O}_2 = \frac{0.350}{32}$ ($= 1.09 \times 10^{-2}$ mol)

1

$= 29 (\times 1.09 \times 10^{-2})$

[Accept answers via 4 separate mole calculations]

1

$= 0.316 - 0.317$ mol [answer to 3 + sf]

[Mark conseq on errors in M1/M2] (1)

1

(iii) Moles of nitroglycerine $= 4 \times 1.09 \times 10^{-2}$ ($= 0.0438$ mol)
[Mark conseq on their moles of O_2]

1

M_r of nitroglycerine = 227 or number string

1

Moles of nitroglycerine = $227 \times 0.0438 = 9.90 - 9.93$ (g)

[answer to 3+ sf]

[If string OK but final answer wrong then allow M6 but AE for M7]

[Mark conseq on error in M_r] [Penalise wrong units]

[Penalise sig. fig. errors once only in whole question]

(b) $pV = nRT$ or $pV = \frac{mRT}{V}$ or $p = \frac{mRT}{V}$

1

$$p = \frac{mRT}{V} = \frac{0.873 \times 8.31 \times 1100}{1.00 \times 10^{-3}}$$

1

$$= 7980093 \text{ or } 7980 \text{ or } 7.98$$

[ignore s.f.]

1

units = Pa or kPa or MPa (as appropriate)

[If error in conversion from Pa, treat as a contradiction of the units mark]

[If transfer error, mark conseq but penalise M2]

[If data from outside of above used, penalise M2 and M3]

[If pV expression incorrectly rearranged, penalise M2 and M3]

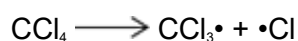
[if $T = 1373 \text{ K}$ used, penalise M2]

1

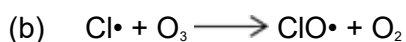
[11]

M5.(a) UV light

1



1



1



1

(c) M_r of $\text{CF}_3\text{Cl} = 104.5$

Moles freon = $1.78 \times 10^{-4} \times 10^3 / 104.5 = 1.70 \times 10^{-3}$

1

Number of molecules = $1.70 \times 10^{-3} \times 6.02 \times 10^{23} = 1.02 \times 10^{21}$

1

Molecules in $500 \text{ cm}^3 = (1.02 \times 10^{21} \times 500 \times 10^{-6}) / 100 = 5.10 \times 10^{15}$

Allow answer in the range $5.10\text{--}5.13 \times 10^{15}$

Answer must be given to this precision

1

[7]

M6. (a) (i) 0.0212

Need 3 sig figs

Allow correct answer to 3 sig figs eg 2.12×10^{-2}

1

(ii) 0.0106

Mark is for (a)(i) divided by 2 leading to correct answer 2 sig figs

1

(iii) $M_r = \underline{100.1}$

1.06 g

Allow 100.1 as 'string'

Need 3 sig figs or more

Consequential on (a)(ii) $\times 100(.1)$

2

(iv) Neutralisation or acid / base reaction

Allow acid / alkali reaction

Apply list principle

1

(b) (i) $T = 304(K)$ and $P = 100\,000 (Pa)$

Only T and P correctly converted

1

$$\frac{100\,000 \times 3.50 \times 10^{-3}}{8.31 \times 304} \text{ OR } n = \frac{PV}{RT}$$

1

0.139 (mol)

Allow 0.138 – 0.139

1

(ii) 0.0276 – 0.0278(mol)

Allow answer to (b)(i) divided by 5 leading to a correct answer

Allow 0.028

1

(c) 4.20 g $\text{Ca}(\text{NO}_3)_2$

1

$\text{Ca}(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$

$$\frac{4.20}{164(.1)} \quad \frac{1.84}{18}$$

Mark is for dividing by the correct Mr values

M2 and M3 dependent on correct M1

0.0256

0.102

M2 can be awarded here instead

1

:

3.98

$x = 4$

If $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ seen with working then award 3 marks

Credit alternative method which gives $x = 4$

1

[12]

M7.B

[1]

M8.(a)

Method 1

Mass of H₂O = 4.38 - 2.46

(= 1.92 g)

Method 2

Percentage of H₂O = 44%

*If there is an AE in M1 then can score M2 and M3
If M1 incorrect can only score M1*

ZnSO₄

H₂O

ZnSO₄

H₂O

2.46

1.92

56

44

161.5

18

161.5

18

(0.0152

0.107)

(0.347

2.444)

(1 : 7)

(1 : 7)

x = 7

x = 7

*If x = 7 with working then award 3 marks.
Allow alternative methods.
If M1 incorrect due to AE, M3 must be an integer.*

(b) Moles HCl = 0.12(0)

$$\text{mol ZnCl}_2 = \underline{0.06(0)} \text{ OR } \underline{0.12 / 2}$$

1

If M2 incorrect then CE and cannot score M2, M3 and M4.

$$\text{mass ZnCl}_2 = 0.06 \times 136.4$$

Allow 65.4 + (2 × 35.5) for 136.4

1

$$= \underline{8.18(4)} \text{ (g) OR } \underline{8.2} \text{ (g)}$$

Must be to 2 significant figures or more.

Ignore units.

1

$$(c) \text{ Moles ZnCl}_2 = \frac{10.7}{136.4} (= 0.0784)$$

1

$$\text{OR moles Zn} = 0.0784$$

$$\text{Mass Zn reacting} = 0.0784 \times 65.4 = (5.13 \text{ g})$$

M2 is for their M1 × 65.4

1

$$\% \text{ purity of Zn} = \frac{5.13}{5.68} \times 100$$

$$\text{M3 is } M2 \times 100 / 5.68 \text{ provided } M2 \text{ is } < 5.68$$

1

$$= \underline{90.2\%} \text{ OR } \underline{90.3\%}$$

Allow alternative methods.

$$M1 = \text{Moles ZnCl}_2 = \frac{10.7}{136.4} (= 0.0784)$$

$$M2 = \text{Theoretical moles Zn} = \frac{5.68}{65.4} (= 0.0869)$$

$$M3 = M1 \times 100 / M2 = (0.0784 \times 100 / 0.0869)$$

$$M4 = \underline{90.2\%} \text{ OR } \underline{90.3\%}$$

1

(d) Ionic

If not ionic CE = 0/3

1

Strong (electrostatic) attraction (between ions)

1

between oppositely charged ions / + and - ions / F^- and Zn^{2+} ions

If IMF, molecules, metallic bonding implied CE = 0/3

1

[14]