

Mark schemes

- | | | |
|----------|---|-----|
| 1 | B | [1] |
| 2 | D | [1] |
| 3 | D | [1] |
| 4 | B | [1] |
| 5 | B | [1] |
| 6 | D | [1] |

- 7** (a) 0.943 g water (M1)
If Mr of NiSO₄ wrong, can allow M1 and M3 from method 1 i.e. max 2

NiSO ₄	H ₂ O
$\frac{1.344}{154.8}$ (M2)	$\frac{0.943}{18}$ (M3)

(8.68 × 10 ⁻³	0.052)
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1 6 or $x = \underline{6}$ (M4)

Allow Mr = 155

Allow other methods e.g.

$$M_r(\text{NiSO}_4) = 58.7 + 32.1 + 64.0 = 154.8$$

$$n(\text{NiSO}_4) = \frac{1.344}{154.8} = 0.008682 \text{ mol (M1)}$$

$$M_r(\text{NiSO}_4 \cdot x\text{H}_2\text{O}) = \frac{2.287}{0.008682} = (263.4) \text{ (M2)}$$

$$\text{so } 18x = 263.4 - 154.8 = (108.6) \text{ (M3)}$$

$$\text{so } x = \frac{108.6}{18} = \underline{6} \text{ (M4)}$$

If using alternative method and Mr of NiSO₄ wrong, allow ecf to score M2 and M3 only i.e. max 2

4

- (b) re-heat

Heat to constant mass = 2 marks

1

check that mass is unchanged

M2 dependent on M1

Allow as alternative:

M1: record an IR spectrum

M2: peak between 3230 and 3550 (cm⁻¹)

1

[6]

8

(a) M1 $550 \times \frac{100}{95} = 579$ g would be 100% mass

Allow alternative methods.

There are 4 process marks:

1

M2 So $\frac{579}{65} = 8.91$ moles NaN₃

or

M1 $\frac{550}{65} = 8.46$ moles NaN₃ (this is 95%)

M2 So 100% would be $8.46 \times \frac{100}{95} = 8.91$ moles NaN₃

1: mass ÷ 65

2: mass or moles × 100 / 95 or × 1.05

3: moles NaN₃ × 2

4: moles NaNH₂ × 39

1

Then M3 Moles NaNH₂ = 8.91 × 2 = (17.8(2) moles)

1

M4 mass NaNH₂ = 17.8(2) × 39

1

M5 693 or 694 or 695 (g)

If 693, 694 or 695 seen to 3 sig figs award 5 marks

1

(b) M1 308 K and 150 000 Pa

1

M2 $n = \frac{PV}{RT}$ or $\frac{150\,000 \times 7.5 \times 10^{-2}}{8.31 \times 308}$

1

M3 = 4.4(0) or 4.395 moles N₂

Allow only this answer but allow to more than 3 sig figs

1

M4 Moles $\text{NaN}_3 = 4.395 \times \frac{2}{3}$ (= 2.93)

M4 is for M3 $\times \frac{2}{3}$

1

M5 Mass $\text{NaN}_3 = (2.93) \times 65$

M5 is for moles M4 $\times 65$

1

M6 = 191 g

Allow 190 to 191 g allow answers to 2 sig figs or more

1

(c) (i) $150 / 65 = 2.31$ moles NaN_3 or 2.31 moles nitrous acid

1

Conc = $2.31 \times \frac{1000}{500}$

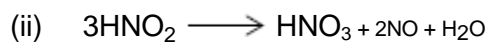
M2 is for M1 $\times 1000 / 500$

1

4.6(1) or 4.6(2) (mol dm^{-3})

Only this answer

1



Can allow multiples

1

(d) Ionic

If not ionic then CE = 0 / 3

1

Oppositely charged ions / Na^+ and N_3^- ions

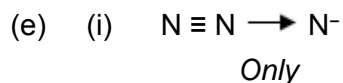
Penalise incorrect ions here but can allow M3

1

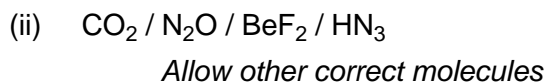
Strong attraction between (oppositely charged) ions / lots of energy needed to overcome (strong) attractions (between ions)

M3 dependent on M2

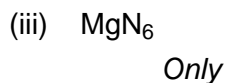
1



1



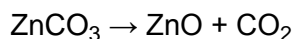
1



1

[21]

9



Ignore state symbols.

If equation incorrect, allow one mark only for correct atom economy method.

1

Percentage atom economy =

Mark consequentially for incorrect formula mass(es)

1

$$\frac{81.4}{125.4} \times 100 = 64.9$$

Accept answer to at least 2 significant figures

1

[3]

10

(a) (i) Uses sensible scales.

Lose this mark if the **plotted points** do not cover half of the paper.

Lose this mark if the graph plot goes off the squared paper

Lose this mark if volume is plotted on the x-axis

1

All points plotted correctly

Allow \pm one small square.

1

Smooth curve from 0 seconds to at least 135 seconds – the line must pass through or close to all points (\pm one small square).

Make some allowance for the difficulties of drawing a curve but do not allow very thick or doubled lines.

1

(ii) Any value in the range 91 to 105 s

Allow a range of times within this but not if 90 quoted.

1

- (b) (i) Using $pV = nRT$
This mark can be gained in a correctly substituted equation. 1
- $100\,000 \times 570 \times 10^{-6} = n \times 8.31 \times 293$
Correct answer with no working scores one mark only. 1
- $n = 0.0234 \text{ mol}$
Do not penalise precision of answer but must have a minimum of 2 significant figures. 1
- (ii) Mol of $\text{ZnCO}_3 = 0.0234$
Mark consequentially on Q6
- M1** 1
- Mass of $\text{ZnCO}_3 = M1 \times 125.4 = 2.9(3) \text{ or } 2.9(4) \text{ g}$
If 0.0225 used then mass = 2.8(2) g
- M2** 1
- (iii) Difference = $(15.00 / 5) - \text{Ans to b}$
If 2.87 g used then percentage is 4.3
- M1** 1
- Percentage = $(M1 / 3.00) \times 100$
Ignore precision beyond 2 significant figures in the final answer
If 2.82 g used from (ii) then percentage = 6.0
- M2** 1
- (c) A reaction vessel which is clearly airtight round the bung 1
- Gas collection over water or in a syringe
Collection vessel must be graduated by label or markings
Ignore any numbered volume markings. 1

[13]