

M1.(a) M1 $550 \times \frac{100}{95} = 579 \text{ g}$ would be 100% mass
 Allow alternative methods.
 There are 4 process marks:

1

M2 So $\frac{579}{65} = 8.91$ moles NaN_3

or

M1 $\frac{550}{65} = 8.46$ moles NaN_3 (this is 95%)

M2 So 100% would be $8.46 \times \frac{100}{95} = 8.91$ moles NaN_3

1: mass $\div 65$

2: mass or moles $\times 100 / 95$ or $\times 1.05$

3: moles $\text{NaN}_3 \times 2$

4: moles $\text{NaNH}_2 \times 39$

1

Then M3 Moles $\text{NaNH}_2 = 8.91 \times 2 = (17.8(2))$ moles

1

M4 mass $\text{NaNH}_2 = 17.8(2) \times 39$

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 N_2

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 x $\frac{2}{3}$

1

M5 Mass $\text{NaN}_3 = (2.93) \times 65$
M5 is for moles M4 x 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

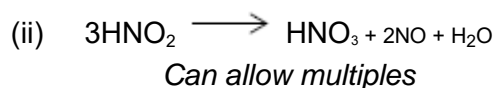
Conc = $2.31 \times \frac{1000}{500}$

M2 is for M1 x 1000 / 500

1

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

1



1

(d) Ionic
If not ionic then CE = 0 / 3

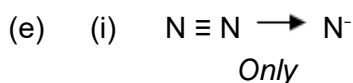
1

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

(ii) $\text{CO}_2 / \text{N}_2\text{O} / \text{BeF}_2 / \text{HN}_3$
Allow other correct molecules

1

(iii) MgN_6
Only

1

[21]

M2.(a) Stage 1

M_r for $\text{Mg}(\text{NO}_3)_2 = 148.3$

Moles of $\text{Mg}(\text{NO}_3)_2 = \frac{3.74 \times 10^{-2}}{148.3} = 2.522 \times 10^{-4} \text{ mol}$
Extended response calculation

1

Stage 2

Total moles of gas produced = $5/2 \times$ moles of $\text{Mg}(\text{NO}_3)_2$

= $5/2 \times 2.522 \times 10^{-4} = 6.305 \times 10^{-4}$

If ratio in stage 2 is incorrect, maximum marks for stage 3 is 2

1

Stage 3

$PV = nRT$ so volume of gas $V = nRT / P$

1

$V = \frac{nRT}{P} = \frac{6.305 \times 10^{-4} \times 8.31 \times 333}{1.00 \times 10^5} = 1.745 \times 10^{-6} \text{ m}^3$

1

$V = 1.745 \times 10^{-6} \times 1 \times 10^6 = 17.45 \text{ cm}^3 = 17.5 \text{ (cm}^3\text{)}$

Answer must be to 3 significant figures (answer could be 17.4 cm^3 dependent on intermediate values)

1

(b) Some of the solid is lost in weighing product / solid is blown away with the gas

1

[6]

M3.(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

$$\text{Mass of } \text{ZnCO}_3 = M1 \times 125.4 = 2.9(3) \text{ or } 2.9(4) \text{ g}$$

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

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M4.B

[1]