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

Allow alternative methods.

There are 4 process marks:

1

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

or

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

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

1: mass ÷ 65

2: mass or moles × 100 / 95 or × 1.05

3: moles NaN_3 × 2

4: moles $NaNH_2$ × 39

1

Then M3 Moles $NaNH_2$ = 8.91 <u>× 2</u> = (17.8(2) moles)

1

M4   mass $NaNH_2$ = 17.8(2) <u>× 39</u>

1

M5   <u>693</u> or <u>694</u> or <u>695</u> (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 = $\dfrac{PV}{RT}$ or $\dfrac{150\ 000 \times 7.5 \times 10^{-2}}{8.31 \times 308}$

1

M3   = 4.4(0) or 4.395   moles N_2

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

1

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M4   Moles NaN_3 = 4.395 $\times \dfrac{2}{3}$ (= 2.93)

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

1

M5   Mass NaN_3 = (2.93) $\underline{\times 65}$

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

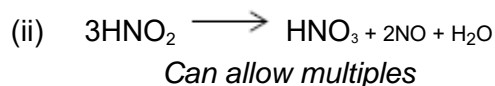(c)   (i)   150 / 65 = 2.31 moles NaN_3 or 2.31 moles nitrous acid

1

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

M2 is for M1 $\times$ 1000 / 500

1

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

Only this answer

1

(ii) $3HNO_2 \longrightarrow HNO_{3} + 2NO + H_2O$

Can allow multiples

1

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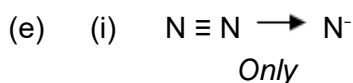
If not ionic then CE = 0 / 3

1

Oppositely charged <u>ions</u> / Na^+ and $N_3^{\,-}$ ions

Penalise incorrect ions here but can allow M3

1

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

M3 dependent on M2

1

(e)   (i) $N \equiv N \longrightarrow N^-$

Only

1

(ii) CO_2 / N_2O / BeF_2 / HN_3

Allow other correct molecules

1

(iii) MgN_6

Only

1

[21]

M2.(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 ± one small square.

1

Smooth curve from 0 seconds to at least 135 seconds − the line must pass through or close to all points (± 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 mol

Do not penalise precision of answer but must have a minimum of 2 significant figures.

1

(ii)   Mol of $ZnCO_3$ = 0.0234

Mark consequentially on Q6

M1

1

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Mass of $ZnCO_3$ = M1 × 125.4 = 2.9(3) or 2.9(4) g

If 0.0225 used then mass = 2.8(2) g

M2

1

(iii) Difference = (15.00 / 5) − Ans to b

If 2.87 g used then percentage is 4.3

M1

1

Percentage = (M1 / 3.00) × 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]

M3. $ZnCO_3 \rightarrow ZnO + CO_2$

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

$\dfrac{81.4}{125.4}$ × 100 = 64.9

Accept answer to at least 2 significant figures

1

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