M1.B

[1]

M2.(a) M1 550 × $\frac{100}{95}$ = 579 g would be 100% mass

Allow alternative methods.

There are 4 process marks:

1

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

or

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

M2 So 100% would be 8.46 × $\frac{100}{95}$ = 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 × 2 = (17.8(2) moles)

1

M4 mass $NaNH_2$ = 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 N_2

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

1

M4 Moles NaN_3 = 4.395 × $\frac{2}{3}$ (= 2.93)

M4 is for M3 × $\frac{2}{3}$

1

M5 Mass NaN_3 = (2.93) × 65

M5 is for moles M4 × 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 × $\frac{1000}{500}$

M2 is for M1 × 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 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) <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]

M3.(a)

<u>Method 1</u>		<u>Method 2</u>	
Mass of H_2O = 4.38−2.46		Percentage of H_2O = 44%	
(= 1.92 g)			

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

If M_r incorrect can only score M1

1

$ZnSO_4$	H_2O	ZnSO4	H2O
<u>2.46</u>	<u>1.92</u>	<u>56</u>	<u>44</u>
161.5	18	161.5	18

1

(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.

1

(b) Moles HCl = 0.12(0)

1

mol $ZnCl_2$ = 0.06(0) ***OR*** 0.12 / 2

1

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

mass $ZnCl_2$ = 0.06 × 136.4

Allow 65.4 + (2 × 35.5) for 136.4

1

= 8.18(4) (g) ***OR*** 8.2 (g)

Must be to 2 significant figures or more.
Ignore units.

1

(c) Moles $ZnCl_2 = \frac{10.7}{136.4}$ (= 0.0784)

1

OR moles Zn = 0.0784

Mass Zn reacting = 0.0784 × 65.4 = (5.13 g)

M2 is for their M1 × 65.4

1

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

M3 is M2 × 100 / 5.68 provided M2 is < 5.68

1

= 90.2% ***OR*** 90.3%

Allow alternative methods.
M1 = Moles $ZnCl_2$ = 10.7 (= 0.0784)
136.4

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

M3 = M1 × 100 / M2 = (0.0784 × 100 / 0.0869)

*M4 = 90.2% **OR** 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]

M4. (a) Hydrogen/H bonds

Not just hydrogen

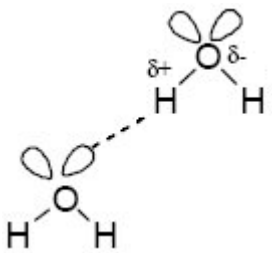
1

van der Waals/vdw/dipole-dipole/London/temporarily induced dipole/dispersion forces

Not just dipole

1

(b)



M1 for partial charges as indicated in diagram (correct minimum)

M2 for all four lone pairs

M3 for H bond from the lp to the H (δ+) on the other molecule

Lone pair on hydrogen CE = 0
OHO CE = 0
If only one molecule of water shown
CE = 0

3

(c) Hydrogen bonds/IMF (in water) stronger

OR

IMF/VDW/dipole-dipole forces (in H_2S) are weaker

OR

H bonding is the strongest IMF

Ignore energy references
Comparison must be stated or implied

1

(d) Atoms/molecules get larger/more shells/more electrons/more surface area

Not heavier/greater Mr

1

therefore increased Van der Waals/IMF forces

Ignore references to dipole-dipole forces

1

(e) Dative (covalent)/coordinate

If not dative/coordinate CE = 0/2
If covalent or blank read on

1

(Lone) pair/both electrons/two electrons on O(H_2) donated (to H^+)
OR pair/both electrons come from O(H_2)

Explanation of a coordinate bond specific to oxygen or water required
Not just H+ attracted to lone pair since that is nearer to a H bond

1

(f) ionic

1

if not ionic CE = 0

oppositely charged ions/+ and – ions or particles

atoms or molecules loses M2 and M3

1

ions attract <u>strongly</u> OR strong/many (ionic) bonds must be broken

S^- loses M2

Reference to IMF loses M2 and M3

1

[13]