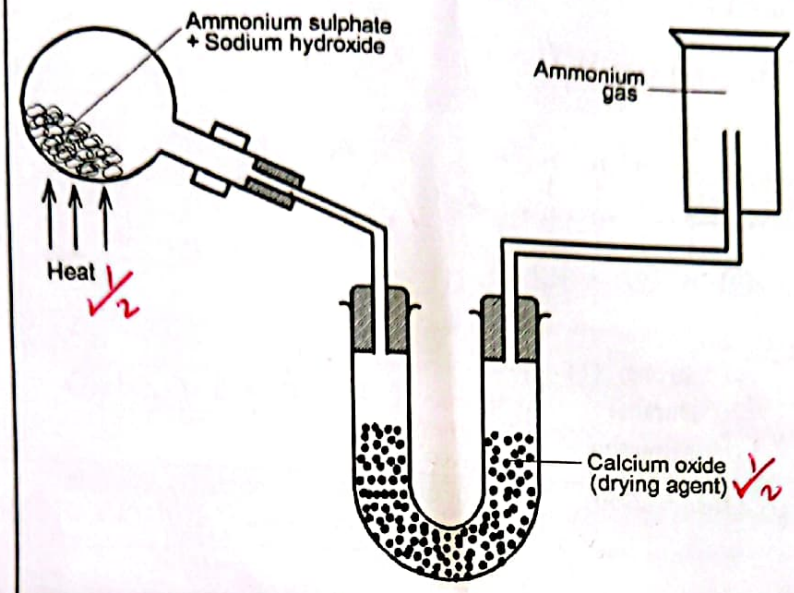
No.		Responses	Marks
1.	(a)	Burette (1) / Pipette / Syringe / Graduated teat pipette (dropper), volumetric flask.	
	(b)	Deflagrating spoon (1) / A pair of tongs / Metallic test tube holders / Forceps / Tweezers	
	(c)	Desiccator (1)	3 marks
2.	(a)	The alpha particles have a high charge $\frac{1}{2}$ so high ability to pull electrons. // The alpha particles have high mass $\frac{1}{2}$ leading to slow speed and more contact $\sqrt{\frac{1}{2}}$ time with substances.	
	(b)	Alpha particles have low penetrating $\frac{1}{2}$ power and are stopped by paper // while Beta $\sqrt{\frac{1}{2}}$ particles have higher penetrating power and pass through paper but are stopped by aluminium $\frac{1}{2}$ foil.	3 marks
3.		React a sample of the nitrate with sodium sulphate, if a white precipitate forms, the salt is lead(II) nitrate (1)	
		React a sample of the nitrate with aqueous ammonia, if it forms a precipitate that dissolves in excess, the salt is zinc nitrate (1)	
		React a sample of the nitrate with aqueous ammonia, if a precipitate is formed and persists even after adding excess ammonia then it is aluminium nitrate (1)	3 marks
4.	(a)	The reaction involves bond formation which is exothermic (1)	
	(b)	**Observation:** Yellow colour intensifies (1) / More yellow / Brown colour changes to yellow / Brown colour diminishes / decreases	
		Explanation: The equilibrium shifts to the right the direction with few molecules of gas (1) / Forward rxn is favoured / Fewer molecules formed.	3 marks

Alt. Qn 3.

- Add aq. NH_3 dropwise until in excess, $Zn(NO_3)_2$ forms a white ppt that is soluble
- To the remaining ($Al(NO_3)_2$ & $Pb(NO_3)_2$) add aq. Na_2SO_4; $Pb(NO_3)_2$ forms a white ppt, $Al(NO_3)_2$ does not.

No.		Responses	Marks
5.	(a)	$(NH_4)_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2NH_{3(g)} + 2H_2O_{(l)}$ (1) ✓1 (s) (s) (s) (aq)  Accept the used syringe collection method ½ Workability ½ (2)	3 marks
6.	(a)	C, B, A, D ✓1 (1) Accept: D, A, B, C ✓1 → increasing reactivity decreasing reactivity D, A, B, C without an arrow ½	3 marks
	(b)	(i) ✓1 Colour changes from black to brown (1) // Brown solid formed. (ii) ✓1 No colour change // solid remains white (1)	
7.	(a)	Mass of dry salt after heating = (67.00 − 57.20) = 9.8 g ($\frac{1}{2}$) ½ Accept without working.	3 marks
	(b)	Mass of water = (78.60 − 67.00) = 11.6 g ($\frac{1}{2}$) ½	
	(c)	R.F.M of Na_2CO_3 = 106 g R.F.M of H_2O = 18 g Moles of $Na_2CO_3 = \frac{9.8}{106} = 0.09$ ($\frac{1}{2}$) ½ Moles of water $= \frac{11.6}{18} = 0.64$ ($\frac{1}{2}$) ½ $X = \frac{0.64}{0.09}$ ($\frac{1}{2}$) ½ $X \approx 7.11$ $X \approx 7$ ½	

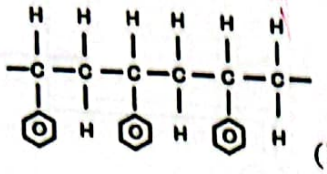
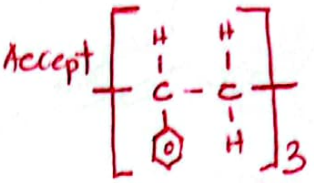
	Na_2CO_3	H_2O
RFM	106	18
Mass of Na_2CO_3	9.8	11.6
No. of moles	$\frac{9.8}{106}$	$\frac{11.6}{18}$
Moles	0.09	0.64
Mole ratio	$\frac{0.09}{0.09}$	$\frac{0.64}{0.09}$
	1	7.11
	1	7

Alternatively:

½	½
0.0925	0.6444
0.0925	0.6444
0.0925	0.0925
1	6.97
1	7 ½

R.A.M (s) not given accept any value if RFM used correctly. (3)

Accept any value for RFM RMM of Na_2CO_3 & H_2O used correctly. Penalize X = 7 ½mk for X = 7 (Max = 1½)

No.		Responses	Marks
		= 7.11 ≃ 7 ($\frac{1}{2}$)	3 marks
8.	(a)	Phenylethene (1) // Styrene ✓1	
	(b)	 (1) ✓1 Accept  Penalize if 3 is written on the left.	
	(c)	- Strong (1) ✓1 - Durable - Attractive – Easily be moulded into various shapes. – Resistant to chemical attack. (Acid, Base, Air, Rain) – cheap. Any 1 for 1mk.	3 marks
9.	(a)	(i) **Observation:** Colour of anhydrous cobalt(II) chloride changes from blue to pink ($\frac{1}{2}$). ✓½ // Changes to pink. **Explanation:** Anhydrous cobalt(II) chloride which is blue absorbs water to form hydrated cobalt(II) chloride which is pink ($\frac{1}{2}$). ✓½ (ii) pH decreases ($\frac{1}{2}$) because carbon(IV) oxide dissolves to form carbonic acid ($\frac{1}{2}$). // acidic soln. ✓½	Rej: pH 1, 2, 3
	(b)	To pull / suck the gases through the apparatus (1) ✓1 // Suction pump.	3 marks
10.	(a)	(i) Heat change, $\Delta H = m \times c \times \Delta T$ $\Delta T = 6.1°C$ $\Delta H = 6.1 \times 4.2 \times 200$ ($\frac{1}{2}$) ✓½ $= 5124$ J ✓½ $= 5.1$ kJ ($\frac{1}{2}$)	Accept + sign included
	(b)	(ii) Moles of hydrochloric acid $= \frac{1.0 \times 100}{1000}$ ($\frac{1}{2}$) $= 0.1$ moles ✓½ $\Delta H_{neut} = \frac{5.1}{0.1} \times 1$ $= -51.0$ kJmol^{-1} ($\frac{1}{2}$) ✓½ (b) ✓½ Ammonia is a weak base // Ammonia does not ionize completely and some energy is used to ionize it ✓½ before neutralization can take place. (1)	– Negative sign must be included otherwise, penalize ½ mk. – Ignore units 3 marks

No.		Responses	Marks
11.	(a)	(i) Limestone: Produces calcium oxide which helps remove impurities from the ore (1). // CaO forms slag // Production of CO_2 ½ that is reduced by C to form CO for reduction of the ore. ½ ½ ½ ½	
		(ii) Coke: – burns in air to produce carbon(II) oxide which reduces the iron ore to iron metal (1)// – Coke produces heat which is a requirement in the blast furnace. ½ ½ ½	
	(b)	The iron produced is brittle ($\frac{1}{2}$) hence breaks easily ($\frac{1}{2}$). // since it contains impurities ½ collapse.	3 marks
12.			

	Type of forces	Structure
X	Van der waals forces ($\frac{1}{2}$) // Intermolecular //	Simple molecular ($\frac{1}{2}$) // Molecular.
Y	Electrostatic forces ($\frac{1}{2}$) // Metallic bond	Giant metallic ($\frac{1}{2}$) // Metallic
Z	Electrostatic forces ($\frac{1}{2}$) // Ionic bond Electrovalent	Giant ionic ($\frac{1}{2}$) // Ionic // Electrovalent

Award even without mention of simple / Giant.

3 marks

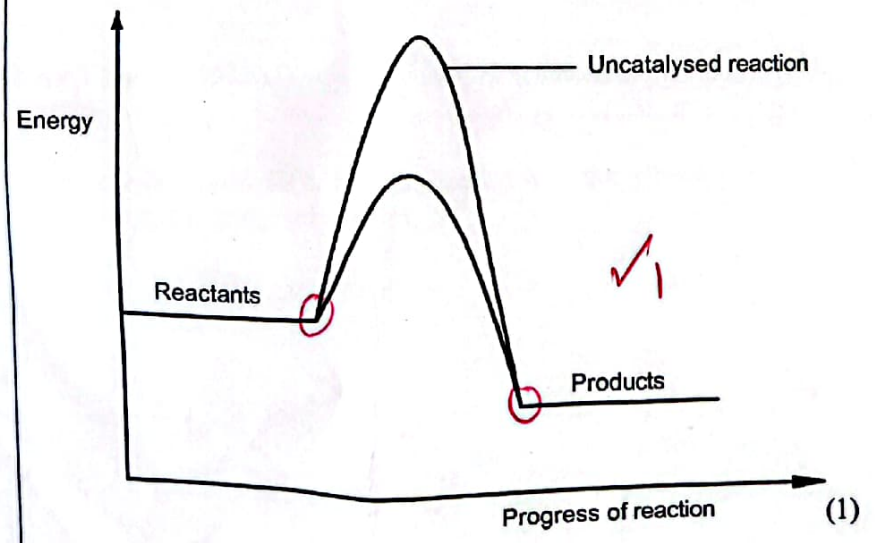
13.	(a)	Add barium nitrate solution ✓1 to a sample of aqueous sodium sulphite (1). The two salts react and a white precipitate ½ of barium sulphite is formed. The precipitate dissolves when dilute acid nitric(V) acid is added (1). ½ ½ // bubble of a gas.	
	(b)	Add acidified potassium dichromate(VI) ½ ½ to a sample of aqueous sodium sulphite ($\frac{1}{2}$). The colour of potassium dichromate changes from orange to green ½ ($\frac{1}{2}$).	Penalize ½ mk for wrong commitment of initial colour of $H^+/K_2Cr_2O_7$
			3 marks
14.		$\begin{matrix} H & H \\ \vert & \vert \\ C=C \\ \vert & \vert \\ H & H \end{matrix} + 3(O=O) \rightarrow 2(O=C=O) + 2(H-O-H)$	
		Enthalpy of reactants = + 612 + (496 x 4) + 3 (412) ($\frac{1}{2}$) ½	
		= 612 + 1984 + 1236	
		= + 3832 kJ ($\frac{1}{2}$) ½ Ignore any +/- sign.	
		Enthalpy of products = (- 743 x 4) + (- 463 x 4) ($\frac{1}{2}$) ½	
		= - 2972 + - 1852	
		= - 4824 kJ ($\frac{1}{2}$) ½ Ignore any +/- sign	
		ΔH = Enthalpy of reactants + Enthalpy of products	
		= +3832 +- 4824 ($\frac{1}{2}$) ½	
		= - 992 $kJmol^{-1}$ ($\frac{1}{2}$) ½ Ignore units	3 marks

No.		Responses	Marks
15.	(a)	To increase the concentration of hydrogen ions hence increases the conductivity (1). // To ionize water // To add H^+ ions // To electrolyze it	
	(b)	$2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$ = 12 × 2 × 3600 = 86,400 C (1) 1 Faraday = 96,500 2F = 2 × 96,500 = 193, 000 C Moles of ~~oxygen~~ hydrogen = $\frac{86400}{193000}$ = 0.4477 moles ($\frac{1}{2}$) 1 mole = 24 dm^3 $0.4477 = \frac{0.4477 \times 24}{1}$ = 10.7448 dm^3 ($\frac{1}{2}$) Accept Formula Volume = $\frac{I \times t \times M.G.V}{N^2 g\ ions \times 96,500}$ $= \frac{12 \times 2 \times 60 \times 60 \times 24}{2 \times 96,500}$ = 10.744 dm^3 // 10,744.04 cm^3 $\frac{0.4477 \times 24,000}{1}$ 10,744.8 cm^3	3 marks
16.	(a)	High temperature will denature / destroy / Kill the yeast which is used as a catalyst (1).	
	(b)	By distillation / fractional distillation / redistillation to remove water (1).	
	(c)	**Uses of ethanol in hospital** • Sedative • As a sanitizer (1) • Antiseptic • Disinfectant • Solvent for some drugs • Sterilizer Any 1	3 marks
17.	(a)	Pencil does not dissolve in the solvent, hence does not contaminate the sample (1). // To avoid impurities in the solvent	
	(b)	The baseline should not come into contact with the solvent to prevent the dye from dissolving in the solvent (1).	
	(c)	To prevent the solvent from evaporating (1).	3 marks
18.	(a)	Manganese(IV) oxide (MnO_2) (1)	

Iron (III) chloride, $FeCl_3$
Potassium iodide, KI
Lead (IV) oxide, PbO_2
Copper (II) oxide, CuO
Chromium (III) oxide, Cr_2O_3

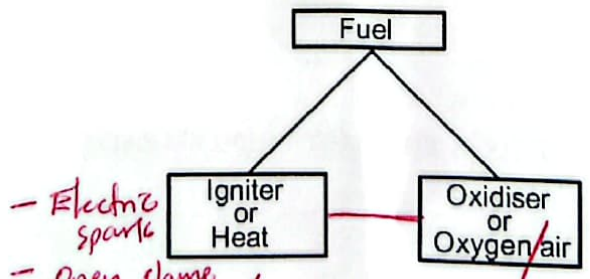
18 (a) Manganese (IV) oxide ; MnO_2 ✓1 Any 1

No.		Responses	Marks
3	(b)	(i) Moles of $H_2O_2 = \frac{6.12\ g}{34\ g}$ $(\frac{1}{2})$ ✓½ $= 0.18$ moles ✓½ (ii) Moles of oxygen $= \frac{0.18}{2}$ $(\frac{1}{2})$ $= 0.09$ ✓½ → Consequential marking. Volume of oxygen $= 0.09 \times 24000$ $(\frac{1}{2})$ $= 2{,}160\ cm^3$ $(\frac{1}{2})$ ✓½	3 marks
3	19.	– NH_3 is oxidized to nitrogen(II) oxide in the presence of ~~iron (Fe)~~ (Platinum/Pt-Rhodium) ✓1 catalyst at high temperatures (1). copper wire – Nitrogen(II) oxide is further oxidized in air form ✓½ to nitrogen(IV) oxide ~~to form nitric(V) acid (1).~~ Dissolve NO_2 in water to form HNO_3 ✓½ – The remaining ammonia reacted with nitric(V) acid to form ammonium nitrate (1). ✓1	3 marks
3	20. (a)	✗(i) X – Concentrated sulphuric(VI) acid $(\frac{1}{2})$ / sulphuric (VI) acid ✓½ To dehydrate (remove water) $(\frac{1}{2})$ / Dehydration. ✗(ii) Y – Calcium hydroxide / any aqueous hydroxide $(\frac{1}{2})$ / NaOH/KOH ✓½ To remove/absorb carbon(IV) oxide $(\frac{1}{2})$	Rej. Dil. H_2SO_4 Accept correct formula
	(b)	Carbon(II) oxide is soluble in cold water. (1) / Insoluble in warm water / slightly soluble in warm water. Reject: Insoluble in water	3 marks

No.		Responses	Marks
21.	(a)	$2H_2 + O_2 \rightarrow 2H_2O$ ($\frac{1}{2}$) // Mole ratio $2H_2 : 1O_2$ ✓½ 2g 2g Moles = $\frac{2g}{2}$ $\frac{2g}{32}$ 1 0.0625 ($\frac{1}{2}$) ✓½ Moles of water = $0.0625 \times 2 = 0.125$ ($\frac{1}{2}$) ✓½ Mass = moles × molar mass = $0.125 \times 18\ gmol^{-1}$ = 2.25 g ($\frac{1}{2}$) ✓½ (3) (b) Moles of H_2 that reacted = moles of water produced = 0.125 (0.0625×2) ~~(b)~~ Mass of H_2 that reacted = 0.125×2 = 0.25 g ($\frac{1}{2}$) ✓½ Unreacted hydrogen = 2 − 0.25 = 1.75 g ($\frac{1}{2}$) ✓½ Consequential. Alternatively (Using Masses) $2H_2 + O_2 \rightarrow 2H_2O$ $32g\ of\ O_2 \rightarrow 36g\ of\ H_2O$ $2g\ of\ O_2 \rightarrow \frac{2 \times 36}{32}$ $= 2.25g$. Alternatively. Moles of $H_2 = 2 \times 0.0625 = 0.125$. Unused moles $= 1 - 0.125 = 0.875$. Mass of $H_2 = 0.875 \times 2$ $= 1.75g$.	3 marks
22.	(a)	This is because different reactants have different bond energies and require different energies for the bonds to be broken (1). ✓1	
	(b)	 (1) ✓1 (3)	
	(c)	The uncatalyzed E_a is high // Catalyst lowers activation energy ✓1	

No.		Responses	Marks
		The catalyst activation energy is high (1).	3 marks
23.	(a)	<table><tr><th>Ions</th><th>No. of electrons</th><th>No. of protons</th><th>No. of neutrons</th></tr><tr><td>$^{31}_{15}P^{3-}$</td><td>18 ✓</td><td>15 ✓</td><td>16 ✓</td></tr><tr><td>$^{56}_{26}Fe^{2+}$</td><td>24 ½</td><td>26 ½</td><td>30</td></tr><tr><td>$^{x}_{y}O^{n}$</td><td>10</td><td>8</td><td>9</td></tr></table> (2) All 3 – 1mk. 2 – ½ mk. 1 – 0 mk 0 – 0mk. $^{x}_{y}O^{n} \longrightarrow {}^{17}_{8}O^{2-}$ (1)
	(b)	$x = 17$ ✓ $y = 8$ ✓ $n = 2^-$ ✓ All 3 – 1mk. 2 – ½mk 1 – 0 mk 0 – 0mk	3 marks

24.	(a)	Bromine (½) // Br_2 (aq) ½
		 Oxidation number reduced from 0 to −1 so it is reduced as it oxidizes Iodine (½). ½
		 Iodide (½) // $I^-_{(aq)}$ ½
		 Oxidation number increased from −1 to 0 so it is oxidized as it reduces Bromine (½). ½	

	(b)	$CaCO_{3(s)} + 2H^+_{(aq)} \longrightarrow Ca^{2+}_{(aq)} + CO_{2(g)} + H_2O_{(l)}$ (1) ✓1	3 marks
25.	(a)	Iron(III) chloride (1) // Ferric chloride // $FeCl_3$ ✓1	
	(b)	$Fe(OH)_2$ (1) ✓1	
	(c)	$Fe^{2+}_{(aq)} + Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + Fe_{(s)}$ (1) ✓1	3 marks
26.		 (2) ✓1 – Electric spark – Open flame – Hot surface ✓1 – Friction – Static (charge)	2 marks

No.		Responses	Marks
27.	(a)	Moles of Helium $= \frac{100\text{ g}}{4\text{ g/mol}}$ $= 25$ moles	
		1 mole $= 24\text{ dm}^3$	
		Volume of helium $= \frac{25}{1} \times 24{,}000$ ($\frac{1}{2}$) $= 600\text{ dm}^3$ ($\frac{1}{2}$)	
	(b)	$P_1 = 1$ atmosphere	
		$V_1 = 600\text{ dm}^3$	
		$T_1 = 298$ K	
		$P_2 = 0.85$ atmosphere	
		$T_2 = 283$ K	
		$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	
		$\frac{1 \times 600}{298} = \frac{0.85 \times V_2}{283}$ (1)	
		$169{,}800 = 253.3\ V_2$	
		$V_2 = \frac{169800}{253.3}$ ($\frac{1}{2}$)	
		$V_2 = 670.3\text{ dm}^3$ ($\frac{1}{2}$)	
			3 marks

$4\text{ g of He} \rightarrow 24\text{ dm}^3$

$100\text{ g of He} \rightarrow \frac{100 \times 24}{4} = 600\text{ dm}^3$

All.

$\frac{25}{1} \times 24{,}000$

$600{,}000\text{ cm}^3$

Temp in K

- Allow consequential marking upto end and deny ½ mk.
- Correct sub. without formular; Award 1½ mks.

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