RIVER VALLEY HIGH SCHOOL

2023 SEC 3 END-OF-YEAR EXAMINATION

CHEMISTRY

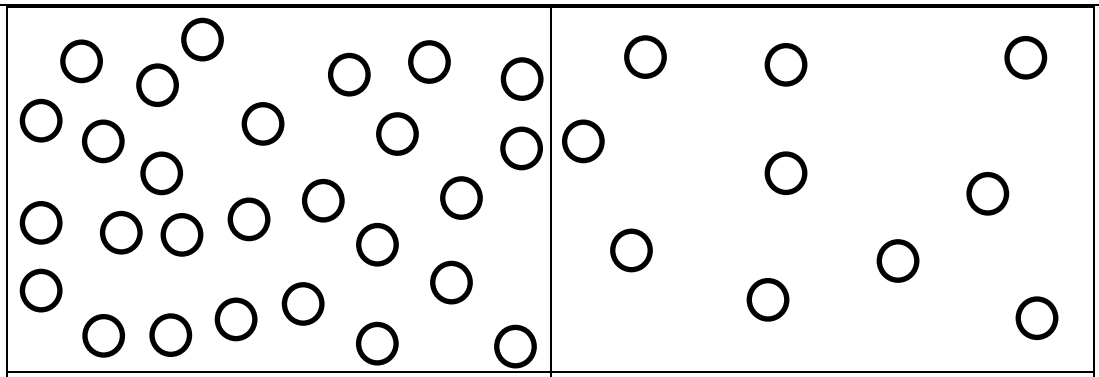
Paper 1

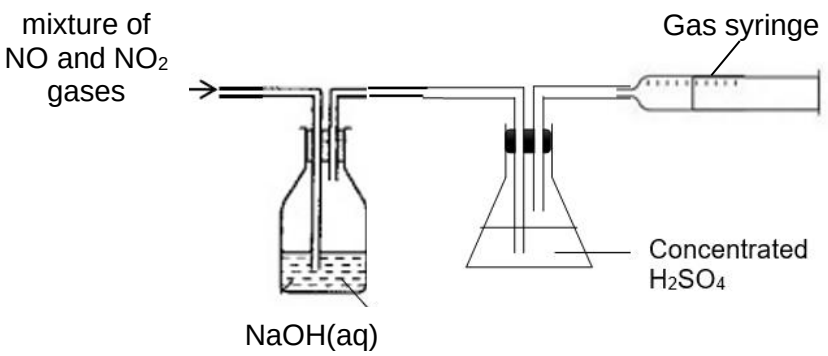
1	2	3	4	5	6	7	8	9	10
C	B	D	A	C	B	D	D	D	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	D	D	C	B	B	B	A	C	D
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
D	B	D	A	A	B	B	B	A	A

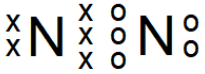
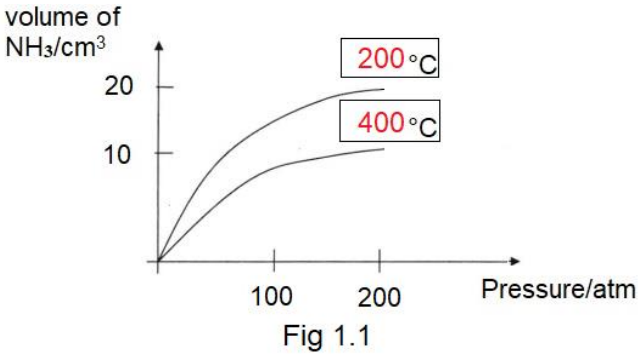
Paper 2

Section A

A1	**(a)**	A and E
	(b)	D and E
	(c)	B and F
	(d)	D

A2	**(a)**	 Box **A** Box **B**
	(b)	At a **lower temperature**, particles lose KE, move slower and **closer together / more particles per unit volume**. This **increases air density and increases lift**, making it easier for the smaller plane to take off.

	(c)	(i) 
		(ii) Test the gas collected with a moist blue litmus paper. If the gas **<u>does not cause the moist blue litmus paper to turn red</u>**, it shows that there is no acidic gas present / absence of NO_2 gas.

A3a	**(i)**	
	(ii)	 Fig 1.1
	(iii)	$N_2 \equiv 3H_2$ H_2 is the limiting reagent Theoretical yield = 300/3 x 2 = 200 cm^3 Actual yield = 20.0cm^3 % yield = 20/200 x 100 = 10.0%
	(iv)	Increase the pressure / Lower the temperature
	(b)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$
	c(i)	n_{NH3}= [4800/1000] / 24 = 0.2000 mol n_{H2O}= 7.20 / [2(1.0) +16.0] = 0.4000 mol x = 0.2000 / 0.100 = 2 y = 0.4000 / 0.100 = 4 Hence, N_2O_4
	c(ii)	NO_2

<table>
<tr><td>A4a</td><td>(i)</td><td><u>Aqueous iodine</u> is brown</td></tr>
<tr><td></td><td>(ii)</td><td>Na_2SO_4 or sodium sulfate [</td></tr>
<tr><td></td><td>(iii)</td><td>
<table>
<tr><td>element</td><td>oxidation state in reactant</td><td>oxidation state in product</td></tr>
<tr><td>copper</td><td>+2</td><td>+1</td></tr>
<tr><td>iodine</td><td>-1</td><td>0</td></tr>
</table>
</td></tr>
<tr><td></td><td>(iv)</td><td><u>Copper</u>.
Cu^{2+}/Cu/ Copper/$CuSO_4$ <u>gained electrons</u></td></tr>
<tr><td>b</td><td>(i)</td><td>Manganese / Mn / MnO_4^- is <u>reduced</u> as the <u>oxidation state of Mn decreased from +7 in MnO_4^- to +6 in MnO_4^{2-}</u></td></tr>
<tr><td></td><td>(ii)</td><td>MnO_4^{2-} + …2…H_2O + …2…e^- → MnO_2 + $4OH^-$</td></tr>
<tr><td></td><td>(iii)</td><td>MnO_2 is an <u>insoluble</u> solid</td></tr>
<tr><td></td><td>(iv)</td><td>Substance X is a <u>reducing</u> agent</td></tr>
</table>

<table>
<tr><td>A5</td><td>(a)</td><td>2nd series coin – <u>aluminium & bronze</u>. <u>Al has a relatively low / lowest density</u> of 2700 kg/m^3 compared to other metals</td></tr>
<tr><td></td><td>(b)</td><td>Both 1st and 2nd series of coins are made of alloys. In an alloy, the <u>different size of atoms disrupts the orderly arrangement</u> of atoms in pure metals. Hence, the <u>layer of atoms cannot slide easily</u> in an alloy (brass vs copper) . Hence coins made from mixture of metals are <u>stronger / harder</u>.</td></tr>
<tr><td></td><td>(c)</td><td><u>Copper</u> has a <u>higher melting point (1083ºC)</u> than <u>brass (950ºC)</u>
OR
<u>iron (1536ºC)</u> has a <u>higher melting point</u> than <u>steel (1510ºC)</u>.</td></tr>
<tr><td></td><td>d(i)</td><td>A lot of energy is required to overcome the <u>strong electrostatic attraction between metal cations and (sea of) delocalised / mobile valence electrons</u>. Hence it does not have the ability to expand upon heating.</td></tr>
<tr><td></td><td>(ii)</td><td>Diamond has a <u>giant covalent structure</u> while poly(tetrafluoroethene) has a <u>macromolecular structure</u>.
<u>More energy</u> is required to overcome the stronger <u>covalent bonds between the carbon atoms</u> than the weaker <u>intermolecular forces of attraction between the poly(tetrafluoroethene) molecules</u>.
Hence, diamond has a lower CTE than poly(tetrafluoroethene).</td></tr>
<tr><td></td><td>(iii)</td><td>• Hard
• Non-conductor of electricity
• Insoluble in all solvents / water
• High melting & boiling points</td></tr>
</table>

Section B

B6	**(a)**		A weak acid is a substance that **partially ionises / dissociates in water** to **produce / form H^+** ions.
	(b)		H_2CO_3 (aq) ⇌ H^+ (aq) + HCO_3^- (aq)
	(c)		Ocean acidification would also **dissolve / react** with the shells of calcifying organisms. Carbonic **acid** can **react with calcium carbonate to form calcium bicarbonate** (soluble in water), water and carbon dioxide.
	(d)	**(i)**	Sodium chloride / NaC*l* and sodium carbonate / Na_2CO_3 These **salts are soluble** in water. The **reagents** that are used to make these salts are also **soluble** in water.
		(ii)	**Repeat** the titration **without using the indicator**. **Evaporate** the resulting mixture / aliquot to dryness.

B7	**(a)**		Solution P
	(b)		RNH_2 (g) + H_2O (aq) ⇌ RNH_3^+ (aq) + OH^- (aq)
	(c)	**(i)**	Solution P is **neutral** as the universal indicator is green in colour. Solution P has the **same number / concentration of H^+ ions and OH^- ions**.
	(d)	**(i)**	**The solubility of Group 2 sulfates decreases down the group**.
		(ii)	9.44×10^{-6} Accept: any value in the range of 10^{-6}.
		(ii)	Add an **excess** of magnesium oxide/ magnesium hydroxide/ magnesium/ magnesium carbonate to dilute sulfuric acid until no more solid dissolves / no more effervescence observed. **Filter** to collect the **filtrate**. **Evaporate** the filtrate to dryness.