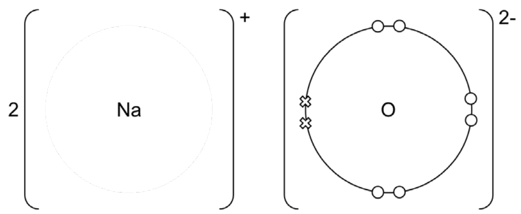
Victoria School
2024 Secondary 4 Chemistry Prelim Answer Scheme

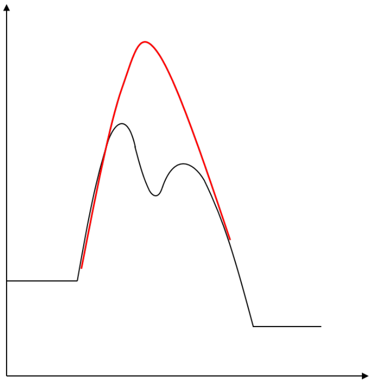
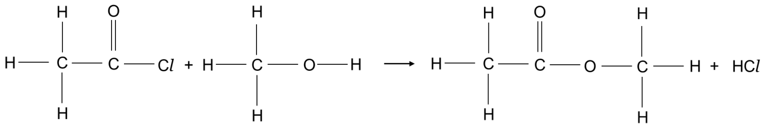
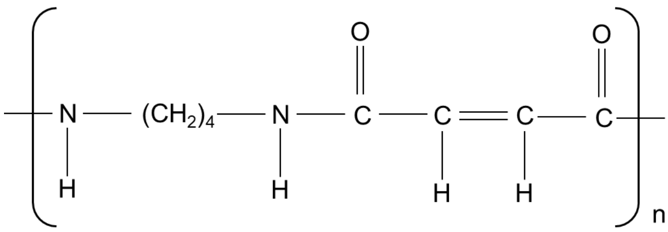
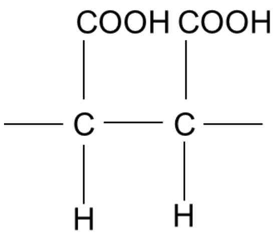
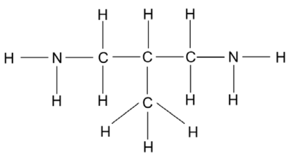
Paper 1

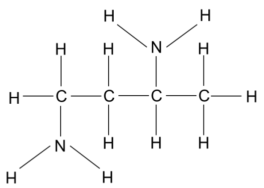
1	2	3	4	5	6	7	8	9	10
C	D	B	B	B	A	C	A	C	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	B	A	B	C	C	C	D	D	D
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	A	D	C	D	B	C	C	D	B
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
A	A	D	D	A	C	B	C	D	C

Paper 2 Section A

Qn	Suggested answers	Mark
A1	2 Across: **fluoride**	1
	3 Down: **addition**	1
	4 Down: **alloy**	1
	5 Down: **sublimation**	1
	6 Down: **fixed**	1
A2a	Sodium: The indicator would turn from **green** to **purple** REJECT: Blue Carbon: The indicator would turn from **green** to **orange** REJECT: Red	1
A2b	 [1m] – cation [1m] – anion	2
A2c	$4Na + O_2 \rightarrow 2Na_2O$ No of moles of sodium= 2.30 / 23 = 0.100 mol 4mol Na ≡ 2mol Na_2O 0.100mol Na ≡ 0.05 mol Na_2O Theoretical yield of Na_2O = 0.0500 mol x 62 = **3.10 g** $4Na + O_2 \rightarrow 2Na_2O$	1

Qn	Suggested answers	Mark
	Mass gained = 94.82 – 94.50 = 0.32g No of moles of oxygen = 0.32 / 16+16 = **0.01 mol** 1mol O_2 ≡ 2mol Na_2O 0.0100mol O_2 ≡ 0.0200 mol Na_2O Actual Yield = 0.0200 x 62 = 1.24 g Percentage Yield = 1.24 / 3.10 x 100% = **40.0 %**	 1 1
A3ai	**Bond breaking absorbs energy**, hence is **endothermic**. **Bond forming releases energy**, hence is **exothermic**. Since **more energy is released than absorbed**, the reaction is exothermic. OR The **energy absorbed when breaking the bonds in 1 mole of carbon monoxide and 1 mole of chlorine** is **less** than the **energy released when forming the bonds in 1 mole of phosgene,** hence making it an exothermic reaction.	 1 1 1 1
A3aii	The oxidation state of chlorine **decreased from 0 in Cl_2 to -1 in $COCl_2$**. This is **reduction**. The oxidation state of carbon **increased from +2 in CO to +4 in $COCl_2$**. This is **oxidation**. Since oxidation and reduction occurs at the same time, this is a redox reaction. (Must state but no marks)	1 1
A3b	At –128 °C, molecules are packed tightly and **very close together** in a **regular/orderly** manner and they can only **vibrate about their fixed positions**. (As temperature decreases, the molecules move faster and faster) and begin to settle in fixed positions. At –108 °C, the phosgene molecules are packed **closely together** in a **disorderly manner** and they are able to **slide over each other**.	1 1
A4a	• Catalysts can be **regenerated/are not consumed at the end of a reaction**. • Thus they can be (reused), so they **only need to be purchased once** • **small amount** need to be used. •	1 1
A4b	In pellet form, there is a **higher surface area** (per unit volume). **Higher frequency of effective collisions between reacting particles** (and the catalyst), leading to **a faster reaction rate.**	1 1

Qn	Suggested answers	Mark
A4ci		1
A4di	Methyl ethanoate	1
A4dii	 [1m] – balanced equation with irreversible arrow [1m] – full structural formula	2
A5a		1
A5bi		1
A5bii	Reaction in (a)(ii) **<u>requires a carboxylic acid and an amine</u>**. and (b)(i) requires **<u>C=C</u>** OR Reaction in (a)(ii) results in a **<u>loss of small molecules</u>**, reaction in (b)(i) has **<u>no loss of small molecules</u>** OR Water is a byproduct of the reaction in (a)(ii) while there are no byproducts in (b)(i) OR Breaking of C-C double bond in (a)(ii) while no breaking of double bonds in (b)(i)	1
A5c	Any 4 carbon branched chain with 2 $-NH_2$ groups  OR	1

<table>
<tr><th>Qn</th><th>Suggested answers</th><th>Mark</th></tr>
<tr><td></td><td>Any 4 carbon straight chain with 2 $-NH_2$ groups that is not on the terminal carbons.
</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>A6a</td><td>
<table>
<tr><th></th><th>C</th><th>H</th><th>N</th></tr>
<tr><td>Mass in 100 g/g</td><td>74.1</td><td>8.60</td><td>17.3</td></tr>
<tr><td>No of moles/mol</td><td>74.1 / 12
= 6.175</td><td>8.60 / 1
= 8.60</td><td>17.3 / 14
= 1.236</td></tr>
<tr><td>Mole Ratio</td><td>6.175 / 1.236
$\approx$ 5.00</td><td>8.60 / 1.236
$\approx$ 7</td><td>1.236 / 1.236
= 1</td></tr>
<tr><td>Empirical Formula</td><td colspan="3">C_5H_7N</td></tr>
</table>
Molecular Formula = nC_5H_7N
n = Relative molecular mass / relative formula mass
= 162 / 81 = 2

Molecular Formula = $C_{10}H_{14}N_2$</td><td>1

1

1</td></tr>
<tr><td>A6b</td><td>Concentration = 0.123 mol/dm³
Volume = 2 cm^3 = 2/1000 dm³ = 0.002 dm³

Number of moles
= Concentration x Volume
= 0.123 mol/dm³ x 0.002 dm³ = 0.000246 mol

Molar mass of nicotine = 162 g/mol

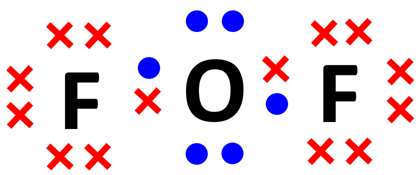
Mass = number of moles x molar mass
= 0.000246 mol x 162 g/mol
= 0.03985 g
= 39.9 mg (to 3sf) (convert g to mg)</td><td>1

1</td></tr>
<tr><td>A6c</td><td>When a cigarette is smoked, <u>carbon monoxide is inhaled by the smoker and the people around them</u>. Carbon monoxide <u>bonds readily and irreversibly</u> with <u>haemoglobin to form carboxyhaemoglobin/stable compound</u>.

This <u>reduces the amount of haemoglobin available to transport oxygen/results in less O2 transported around the body</u>, <u>leading to fatigue/dizziness, and eventually death</u>.</td><td>1

1</td></tr>
<tr><td>A6(d)(i)</td><td>
<table>
<tr><th>step number</th><th>description</th></tr>
<tr><td>2</td><td>Soak the ground tobacco in the ethanol solvent.</td></tr>
<tr><td>4</td><td>Separate the nicotine-rich solution from the solid plant material using process A.</td></tr>
</table></td><td>1</td></tr>
</table>

Qn	Suggested answers	Mark
	5 — Obtain nicotine from the mixture of ethanol and nicotine using process **B**. **3** — Stir the mixture to enhance the extraction of nicotine into the solvent. **1** — Grind the dried tobacco leaves into a fine powder.	
A6(d)(ii)	Process A: **filtration** Process B: **Fractional Distillation**	1
A7a	T, F, T, T	Any one wrong minus 1
A7bi	**Immiscible in water** and **less dense than water**, **preventing entry of air/oxygen for the respiration** by larvae.	1 1
A7bii	Kerosene has a higher M_r, hence there are **Thus more energy is needed to overcome the stronger intermolecular forces of attraction.** It is **less volatil**e, so it does not **evaporate away easily compared to petrol**	1 1
A8ai	To prevent the hot reactive sodium metal and hot chlorine gas from **reacting and reforming back sodium chloride**.	1
A8aii	**No**. **Hydrogen gas will be produced instead of sodium metal.** The electrolyte produced will be **sodium hydroxide instead of sodium chloride.**	1 1
A8b	$Cu \rightarrow Cu^{2+} + 2e^-$ **Copper loses electrons more readily than chloride ions**, hence it will be preferentially discharged, forming copper(II) ions instead of chlorine gas	1 1
A8c	**No**. The litmus paper **must be bleached in order to** confirm the presence of chlorine.	1
A8di	**colourless solution turns brown**	1
A8dii	**chlorine is more reactive than iodine** and it can **displace iodine from potassium iodide**	1
A9a	Metals **X and Y are more reactive than metal W**. Metal **W is more reactive than metal Z**.	1 1
A9b	1. Weigh a piece of metal X. 2. Half fill a test tube with water and stopper with a delivery tube. 3. Place metal X in another test tube. Connect this test-tube to the one with water.	1

Qn	Suggested answers	Mark
	4. **<u>Heat the test tube of water until steam</u>** is formed and allow the steam to pass over the heated metal X. 5. Stop heating when there is colour change observed/after 5 minutes. 6. **<u>Weigh the resulting solid after heating [method]</u>** when it has cooled down. 7. Repeat Steps 1 to 6 with metal Y. 8. **<u>Compare</u> the change in mass for both metals**. 9. **<u>The more reactive metal will have a higher change in mass</u> after 5 mins**. <u>method</u>: measure volume of gas after 10 minutes/ observe colour change of the solid before and after heating	1 1 1
A10a	Across period 2, the melting points of the fluoride compounds **<u>decreases</u>**.	1
A10bi	GeF_4	1
A10bii	No. **<u>The number of F atoms that bond to the halogens should be 1</u>**, however, for C*l*, Br and I, they can form more than one compound, which have **<u>varying number of F atoms that are bonded to them</u>**. Or give any counter example: i.e. The number of F atoms that bond to the halogens should be 1, but C*l*F$_3$ has 3 F atoms bonded to C*l*.	1 1
A10biii	The **<u>number of compounds formed between a halogen and fluorine</u>** is equal to the **<u>period number of the halogen minus 1</u>**. Or The **<u>number of compounds formed between a halogen and fluorine</u>** is always an odd number. or The **<u>number of compounds formed between a halogen and fluorine</u>** <u>increases by 1</u> as you go down the group.	1
A10biv	ClF_3, BrF_3, BrF_5, IF_3, IF_5, IF_7. /Compounds that have more than 1 bond with fluorine. These compounds have <u>more than 8 valence electrons in their outershell</u> Or They do not have a fully filled/noble gas configuration.	1 1
A10c	Neon and argon has **<u>fully-filled/completely filled valence/outermost electron shells</u>** so they are unable to react with fluorine to form compounds.	1
A10d	SAt_2or At_2S Astatine is in the **<u>same group as fluorine / also has 7 valence electrons</u>** or Astatine atom has 7 valence electrons and will share 1 electron each with 2 sulfur atoms which only has 6 valence electrons.	1 1
A10e	 [1m] – bonding electrons	2

Paper 2 Section B

Qn	Suggested answers	Mark
EITHER B11a	Number of moles of nitrogen gas required = 11.7 / 24 = 0.4875 mol Mole ratio of NaN_3 : N_2 = 2 : 3 Number of moles of sodium azide required = (0.4875 / 3) x 2 = 0.325 mol Mass of sodium azide required = 0.325 x (23 + 3(14)) = 21.125 g = **21.1 g (to 3 s.f.)**	1 1 1
B11bi	To produce **more nitrogen** so that bag will **inflate more quickly**	1
B11bii	$K_2O + Na_2O + 2SiO_2 \rightarrow K_2SiO_3 + Na_2SiO_3$.	1
B11ci	Precipitation	1
B11cii	$Pb^{2+}(aq) + 2N_3^-(aq) \rightarrow Pb(N_3)_2\ (s)$ [1m] – ionic equation, [1m] – state symbols	2
B11ciii	**Add excess lead(II) carbonate to dilute nitric acid.** **Filter** the mixture to obtain **lead(II) nitrate as the filtrate** **Heat to saturated**, then **cool and crystalise**. **Filter** the mixture and **wash** the residue with a **small amount of cold** distilled water to remove impurities and **dry between sheets of filter paper.**	 1 1
OR B11a	Water **contributes/loses a hydrogen ion** AND **methylamine gains/accepts the hydrogen ion**.	1
B11b	Accept any pH value from 8 – 12 **Sodium hydroxide is a strong base/alkali but methylamine is a weak base/alkali**. Hence, the **concentration of hydroxide ions is higher in sodium hydroxide than methylamine**. (OR concentration of hydroxide ions is lower in methylamine than sodium hydroxide)	1 1
B11ci	$2CH_3NH_2 + H_2SO_4 \rightarrow (CH_3NH_3)_2SO_4$	1
B11cii	Methylamine, water, potassium chloride	1
B11di	Green precipitate formed.	1
B11dii	$Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$ [1m] – ionic equation; [1m] – state symbols	2
B11diii	**Green solution** turns **reddish brown/brown/orange/ yellow**.	1
B11div	Oxidising agent	1