Class	Adm. No.

Candidate Name: ____________________

H

millennia institute

2025 Preliminary Examination
Pre-University 2

H1 CHEMISTRY **8873/02**

Paper 2 Structured Questions **27 August 2025**

2 hours

Candidates answer on the Question paper.

Additional materials: Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not turn over this question paper until you are told to do so.

Write your name, class and admission number in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** the questions.

Section B
Answer **one** question.

The use of an approved scientific calculator is expected, where appropriate.

The number of marks is given in brackets [ ] at the end of each question or part question.

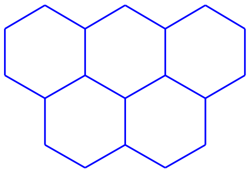
Question	Section A				Section B	**Total**
	1	2	3	4	5 / 6	
Marks	19	11	22	8	20	**80**

Section A

Answer **all** the questions in this section in the spaces provided.

1 **(a)** Graphene is a nanomaterial.

(i) Draw a diagram to represent part of a graphene layer which contains at least five complete rings of carbon atoms.



[1]

(ii) Graphene has high tensile strength. Explain what this means.

....

....[1]

resistant to breaking

(iii) Explain why graphene has high tensile strength.

....

....[1]

strong covalent bonds between atoms

(iv) Graphene is able to conduct electricity. Explain why.

....

....

....[1]

each carbon atom contributes one electron
delocalise over layer
act as mobile charge carrier

(b) Nickel catalyses a reaction between methane and steam.

(i) State the electronic configuration of Ni.

$1s^2$ ....[1]

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8\ 4s^2$

(note: write the electronic configuration in terms of ascending order of the principal quantum shells)

(ii) Outline the mode of action as nickel catalyses the reaction between methane and steam.

Include bond forming and bond breaking in your answer.

....

....

....

....[3]

adsorption of molecules onto nickel surface
forming weak interactions
with alternative reaction pathway of lower activation energy
reactant bonds weaken and break
product bonds form
desorption of molecules from the surface of the catalyst

(iii) The nickel catalyst is made of nanoparticles. Explain what it means by a *nanoparticle*.

....

....[1]

all 3 dimensions on the nanoscale of 1 to 100 nm

(iv) Explain how nickel being made of nanoparticles would facilitate the catalysis of the reaction.

....

....[1]

large surface area to volume ratio
allows more molecule to bind

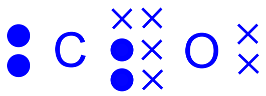
(c) Methane and steam react to form a mixture of carbon monoxide and hydrogen known as syngas.

All four gases exist as an equilibrium mixture.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H$$

(i) In the carbon monoxide molecule, one of the covalent bonds is a dative bond.

Draw the 'dot-and-cross' diagram to show the bonding in a molecule of carbon monoxide.



(note: dative bond)

[1]

(ii) Use bond energy values from the *Data Booklet* to calculate the enthalpy change of the forward reaction, ΔH.

ΔH = sum of energies of bonds broken – sum of energies of bonds formed
= 4(410) + 2(460) – 1077 – 3(436)
= +175 kJ mol^{-1}
(note: enthalpy change requires + sign to be indicated)

[2]

(iii) In the manufacture of syngas, 1.00 mol of $CH_4(g)$ and 1.00 mol of $H_2O(g)$ were injected into a 2.00 dm^3 reaction chamber at 700 °C.

At equilibrium, 0.26 mol of CO(g) was formed.

Calculate the equilibrium constant, K_c, for the reaction at 700 °C.

Conc. / mol dm^{-3}	$CH_4(g)$	+	$H_2O(g)$	$\rightleftharpoons$	CO(g)	+	$3H_2(g)$
I	0.50		0.50				
C	–0.13		–0.13		+0.13		+0.39
E	0.37		0.37		0.13		0.39

$$K_c = \frac{[CO][H_2]^3}{[CH_4][H_2O]} = \frac{(0.13)(0.39)^3}{(0.37)(0.37)} = 0.0563 \text{ mol}^2 \text{ dm}^{-6}$$

[2]

(iv) With reference to your answer in **(c)(ii)**, explain how increasing the temperature to 1000 °C would affect the equilibrium position and K_c value.

....

....

....

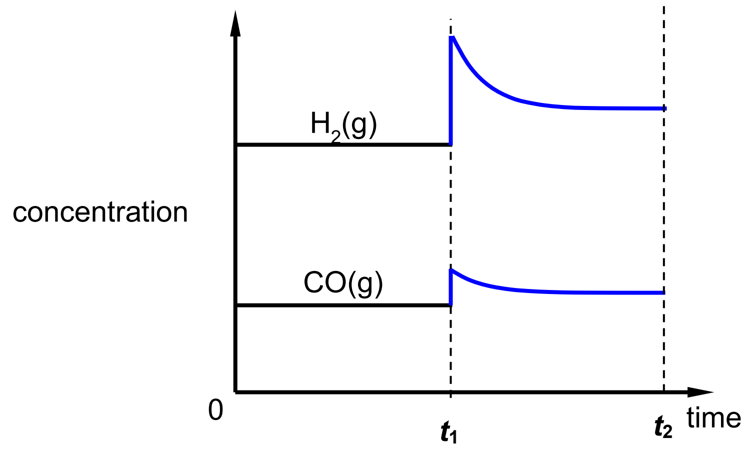
....[2]

equilibrium position shifts right
and the value of K_c increases

to offset temperature increase
by absorbing excess heat energy, favours endothermic reaction.
(forward reaction is endothermic)

(v) At time t_1, the reaction chamber was suddenly compressed such that its volume decreased.
Complete the graph below until time t_2 to show how the concentrations of CO(g) and H_2(g) would change as a result of the sudden compression.

[2]



both graphs sharply increase, with H_2(g) increasing more (due to a higher number of moles). [Sharp increase in concentration as the volume of the chamber was compressed suddenly]
both graphs decrease (equilibrium shift left to counter the increase in concentration) with a curve until plateauing before reaching t_2, with H_2(g) decreasing more (due to larger number of moles, more reacted)

[Total: 19]

2 **(a)** Hydrogen halides are molecules consisting of a hydrogen atom covalently bonded to a halogen atom.

	HF	HC*l*	HBr	HI
boiling point / °C	20	–85	–66	–35

(i) Explain the relative boiling points of the 4 hydrogen halides shown above.

....

....

....

....

....

....[3]

HC*l*, HBr, HI:
more electrons from HC*l* to HBr to HI:
more polarisable
stronger instantaneous dipole-induced dipole forces of attraction between molecules
HC*l* has the lowest boiling point.

HF:
hydrogen bonding between molecules
strongest intermolecular forces of attraction, requires more energy to overcome.
HF has the highest boiling point.

(ii) State and explain the trend in thermal stability of the 4 hydrogen halides shown above.

....

....

....

....

....[2]

H–F > H–C*l* > H–Br > H–I

larger halogen atom
weaker overlap of orbitals
longer bond length, resulting in lower bond energies
thus, requires less energy to break (less thermally stable).

(b) Healthy teeth are protected by a hard layer of enamel. The main component of enamel is hydroxyapatite, $Ca_5(PO_4)_3OH$.

Hydroxyapatite exists in equilibrium with its aqueous ions (equilibrium 1) in the saliva, which is the surrounding fluid.

The saliva itself consists of various ions, making it a buffer solution (equilibrium 2).

tooth | saliva

(equilibrium 1)

$$Ca_5(PO_4)_3OH(s) \rightleftharpoons 5Ca^{2+}(aq) + 3PO_4^{3-}(aq) + OH^-(aq)$$

(equilibrium 2)

$$PO_4^{3-}(aq) + H^+(aq) \rightleftharpoons HPO_4^{2-}(aq)$$

(i) Explain, in terms of structure and bonding, why hydroxyapatite is hard.

....

....

....[2]

giant ionic structure

there are strong electrostatic forces of attraction between Ca^{2+}, PO_4^{3-} and OH^- ions, requires much energy to overcome

(ii) Explain, by reference to equilibrium 2, how saliva behaves as a buffer solution.

....

....

....

....[2]

added acids are neutralised by PO_4^{3-}

position of equilibrium 2 shifts right and hydrogen ion concentration decreases

added bases are neutralised by HPO_4^{2-}

position of equilibrium 2 shifts left and hydrogen ion concentration increases

(hence these prevent large changes in pH)

(iii) Bacteria present in the mouth break down food residues on the teeth surface, producing acids. Consuming sodas would also increase acid content in the mouth.

Using equilibria 1 and 2, explain how a high acid content would eventually corrode enamel and result in tooth decay.

....

....

....

....

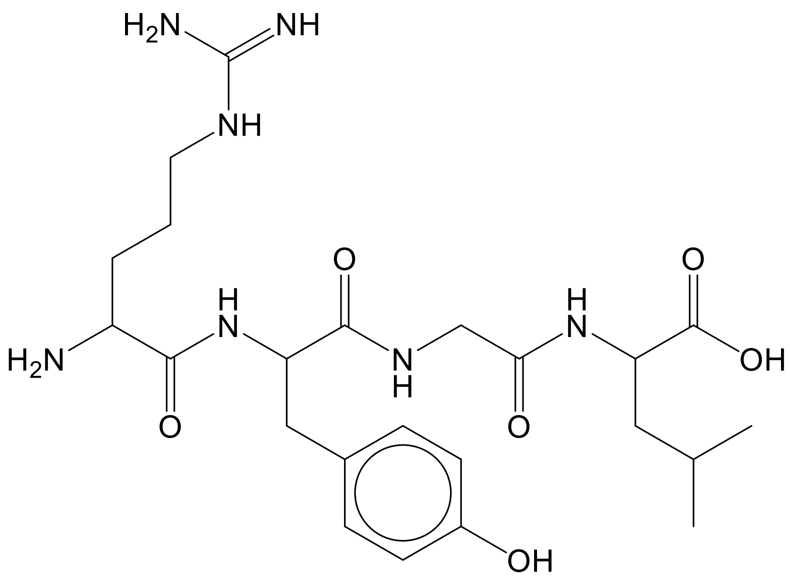
....[2]

equilibrium 2 position shifts right
to offset high H^+ ion concentration
hence PO_4^{3-} ion concentration decreases

As a result, equilibrium 1 position shifts right to increase the concentration of PO_4^{3-}, hence hydroxyapatite dissolves

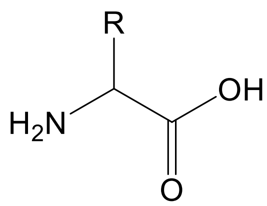
[Total: 11]

3 **(a)** Milk contains casein molecules.



casein

A casein molecule is a polyamide, and is made of amino acid molecules joined together to form numerous amide bonds, –CONH–.



amino acid molecule
where R represents a side group

(i) State the type of reaction when amino acids react to form a casein molecule.

………[1]

condensation

(the functional groups in amino acids are: amine and carboxylic acids)

(ii) The bonds holding the amino acid molecules together in casein can be broken by hydrolysis.

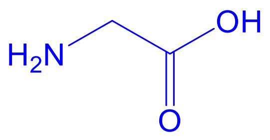
Suggest the reagent and condition required to hydrolyse casein and release the separate amino acid molecules.

………[1]

$H_2SO_4(aq)$, heat /

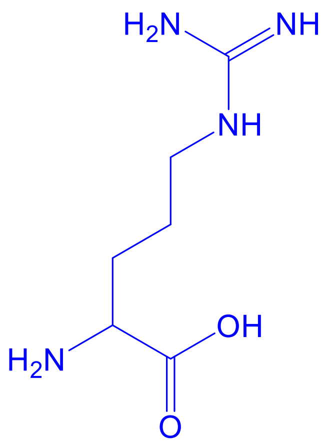
$NaOH(aq)$, heat

(iii) Draw the structure of the amino acid molecule from the hydrolysis of casein that has the lowest M_r.



[1]

(iv) Draw the structure of the amino acid molecule from the hydrolysis of casein that can form the most hydrogen bonds with water per molecule.



[1]

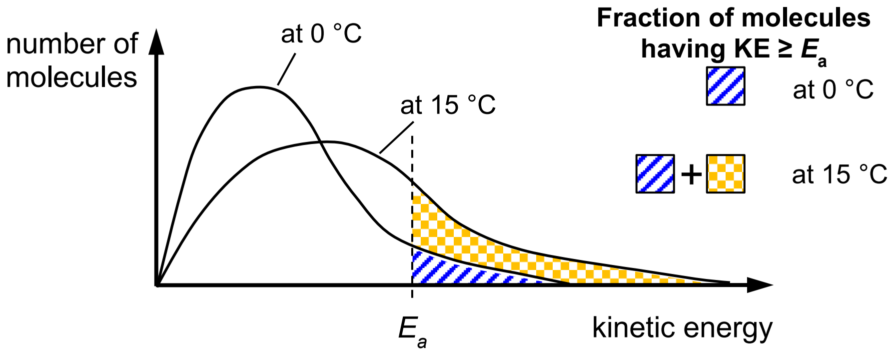
(b) Milk turns sour and expires after some time. This process is a chemical reaction.

Table 3.1 shows the time taken for milk to expire when stored at various temperatures.

Table 3.1

temperature / °C	15	10	7	4	0
number of days	1	2	5	10	24

Using appropriate Boltzmann distribution curves, explain the trend shown in Table 3.1.



at higher temperatures,
the molecules in milk have higher average kinetic energy
hence a larger proportion of molecules have energy equal to or higher than activation energy

hence there will be more frequent effective collisions
resulting in increased rate of reaction
hence milk takes shorter to sour

(label the graph clearly, indicate whether T_1 or T_2 is at the higher temperature.)

(c) Milk turns sour over time due to bacteria present fermenting milk sugars to form acids. These bacteria would also multiply, causing the milk to become unsafe for consumption.

The acids also cause the casein molecules to curdle and clump together.

In some parts of the world, milk is adulterated by unscrupulous producers by adding various substances. This is done to increase their own profit margins, extend the shelf life of the milk, or to make expired milk appear fresh.

One possible adulterant is water, which dilutes the milk. Other possible adulterants are hydrogen peroxide, sodium carbonate, and starch.

A department in a food safety agency is responsible for detecting adulterants in milk. Aqueous potassium iodide is used to detect the presence of hydrogen peroxide, while aqueous iodine is used to detect starch.

The results of the testing for five samples of milk are shown in Table 3.2.

Table 3.2

sample	test with KI(aq)	test with I_2(aq)	pH	density / g cm^{-3}
1	no gas formed	dark blue colour obtained	6.9	1.105
2	no gas formed	no colour change	4.2	1.346
3	no gas formed	no colour change	6.4	1.032
4	effervescence of colourless gas formed	no colour change	6.5	1.029

5	no gas formed	no colour change	7.0	1.001

(i) Write a balanced chemical equation for the decomposition of hydrogen peroxide to form a gas.

....[1]

$H_2O_2 \longrightarrow H_2O + \frac{1}{2}O_2$

(question stated only one gas is produced)

(ii) Suggest one possible reason for adding each of the following adulterants into milk.

hydrogen peroxide ....

....

starch ....

....

[2]

hydrogen peroxide:
kill bacteria / act as preservative / extend shelf life

starch:
increase density

(obtain data from question stem to answer question)

(iii) Sodium carbonate is basic and would increase the pH of milk.

Write an ionic equation to show how sodium carbonate behaves as a base.

....[1]

$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$

(question required ionic equation, hence spectator ions like Na^+ are not included)

(iv) Sample 3 was found to be safe for consumption.

Samples 1, 4 and 5 were found to contain adulterants.

State what the results in Table 3.2 show about the adulterants found in the milk samples 1, 4 and 5.

sample 1 ....

....

sample 4 ....

....

sample 5 ....

....

[3]

sample 1:
has starch

sample 4:
has hydrogen peroxide

sample 5:
water added / was diluted /
has sodium carbonate

(v) Although sample 2 was not found to have any adulterants, it was still deemed unsafe for consumption.

Using Table 3.2, explain what could have happened to the milk.

....

....

....

....[2]

pH low due to acids formed by fermentation of milk sugars
density high due to casein curdling

(obtain data from question stem to answer question)

(d) The acid formed from fermentation, RCO_2H, was isolated, purified, and dried.

11.1 g of RCO_2H was added into a volumetric flask and dissolved in water to form 250 cm^3 of solution.

To the solution of $RCO_2H(aq)$, 25.0 cm^3 was pipetted out and titrated with 0.500 mol dm^{-3} aqueous sodium hydroxide.

24.65 cm^3 of sodium hydroxide was required to reach end-point.

(i) Suggest a suitable indicator for this titration. Explain your answer.

....

....

....

....[2]

thymolphthalein

since weak acid reacted with strong base
end-point pH will be above 7

(ii) Calculate the relative molecular mass of RCO_2H.

$\eta_{NaOH} = \frac{24.65}{1000}$ $dm^3 \times 0.500$ mol dm^{-3} = 0.012325 mol

since $\frac{\eta_{RCO_2H}}{\eta_{NaOH}} = \frac{1}{1}$

hence η_{RCO_2H} in 25.0 cm^3 = 0.012325 mol

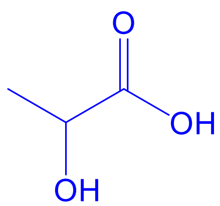
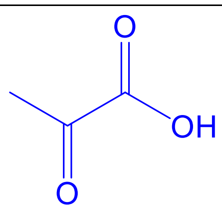
hence η_{RCO_2H} in 250 cm^3 = 0.012325 mol × 10 = 0.12325 mol

hence M_r of RCO_2H = $\frac{11.1\ g}{0.12325\ mol}$ = 90.1

(iii) When RCO_2H was heated with acidified potassium manganate(VII), the purple solution turned colourless, and RCO_2H was converted into **K**.

K could be reduced by alcoholic sodium borohydride to reform RCO_2H.

Using this information and the relative molecular mass you have calculated in **(d)(ii)**, deduce the structures of RCO_2H and **K**.

RCO_2H	**K**
	

[2]

[Total: 22]

4 **(a)** **(i)** State and explain the trend in first ionisation energy of the elements down Group 1 of the Periodic Table.

....

....

....

....[2]

First I.E decreases down the group.
(although nuclear charge increases with increasing proton number)
more electron shells, shielding increases
effective nuclear charge remains constant
distance between valence electron and nucleus also increase
weaker attraction / requires less energy to remove the valence electron

(ii) Sodium is a Group 1 metal that can undergo a combustion reaction with oxygen.

Write a balanced chemical equation for the reaction between sodium and oxygen.

....[1]

$4Na + O_2 \longrightarrow 2Na_2O$

(iii) State the role of sodium in its reaction with oxygen in **(a)(ii)** and explain your answer.

....

....

....[2]

reducing agent

reduce oxygen to Na_2O
oxidation number of O decreased from 0 to -2

(iv) Lithium is another Group 1 metal. It can also undergo a combustion reaction with oxygen.

State how the rate of reaction between lithium and oxygen will differ from the rate of reaction between sodium and oxygen. Explain your answer.

....

....

....[1]

lithium reacts slower (due to higher ionisation energy than sodium)
lose electron less easily / weaker reducing agent

(b) Alcohols can be combusted in oxygen.

An alcohol, C_xH_yO, was vapourised and 10 cm^3 of it reacted with 60 cm^3 oxygen to form 40 cm^3 carbon dioxide. All volumes were measured at the same temperature and pressure.

Write a balanced chemical equation for the combustion of C_xH_yO, and hence state the molecular formula of C_xH_yO.

chemical equation ....

molecular formula of alcohol ....
[2]

$C_xH_yO + 6O_2 \longrightarrow 4CO_2 + 5H_2O$

molecular formula is $C_4H_{10}O$
(hint: reduce volume ratio to whole number ratio)

[Total: 8]

Section B

Answer **one** question from this section in the spaces provided.

5 **(a)** Tritium, ^{3}H, is an isotope of hydrogen.

(i) Define *isotopes*.

....

....[1]

atoms having the same number of protons but different number of neutrons

(ii) State the number of protons, neutrons and electrons in an atom of tritium, ^{3}H.

protons	neutrons	electrons
1	2	1

[1]

(iii) Tritium is radioactive and undergoes beta-decay.

During the process, one neutron is converted into one proton and one electron.

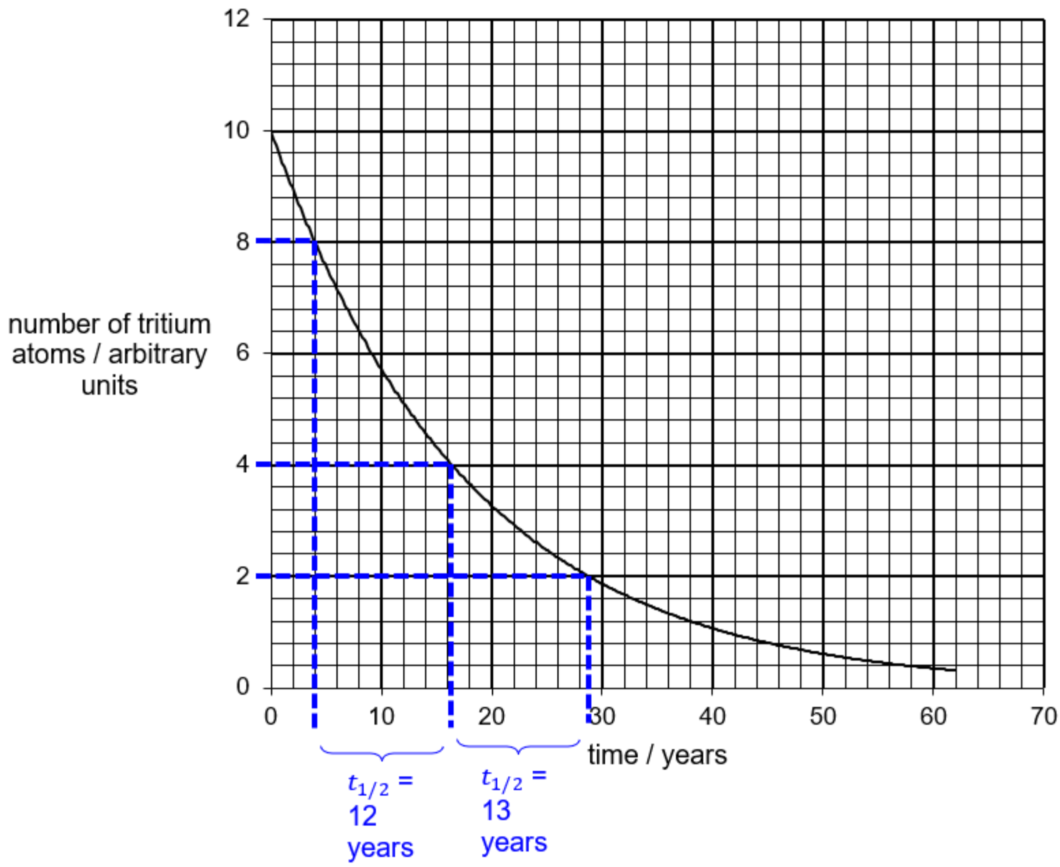
Write the nuclide notation for the resultant atom in the form $^{A}_{Z}X$.

....[1]

$^{3}_{2}He$

(question asked for resultant atom, hence answer needs to be in the form of an atom)

(b) The radioactive decay of a sample of tritium was followed over time.



(i) Explain what is meant by the term half-life of a reaction.

....

....[1]

time taken for sample to decrease to half the concentration

(ii) Use the graph to determine the half-life of this reaction.

Show your working on the graph.

....

....[1]

$t_{1/2}$ = 12.5 years (show construction lines on the graph clearly with labels)

(iii) Deduce the order with respect to tritium.

Explain how you arrived at your answer.

....

....[2]

first order, constant half-life obtained

(iv) Another sample of tritium contains two times the number of atoms.

State how the half-life of this sample of tritium will differ from that calculated in **(b)(ii)**.

....

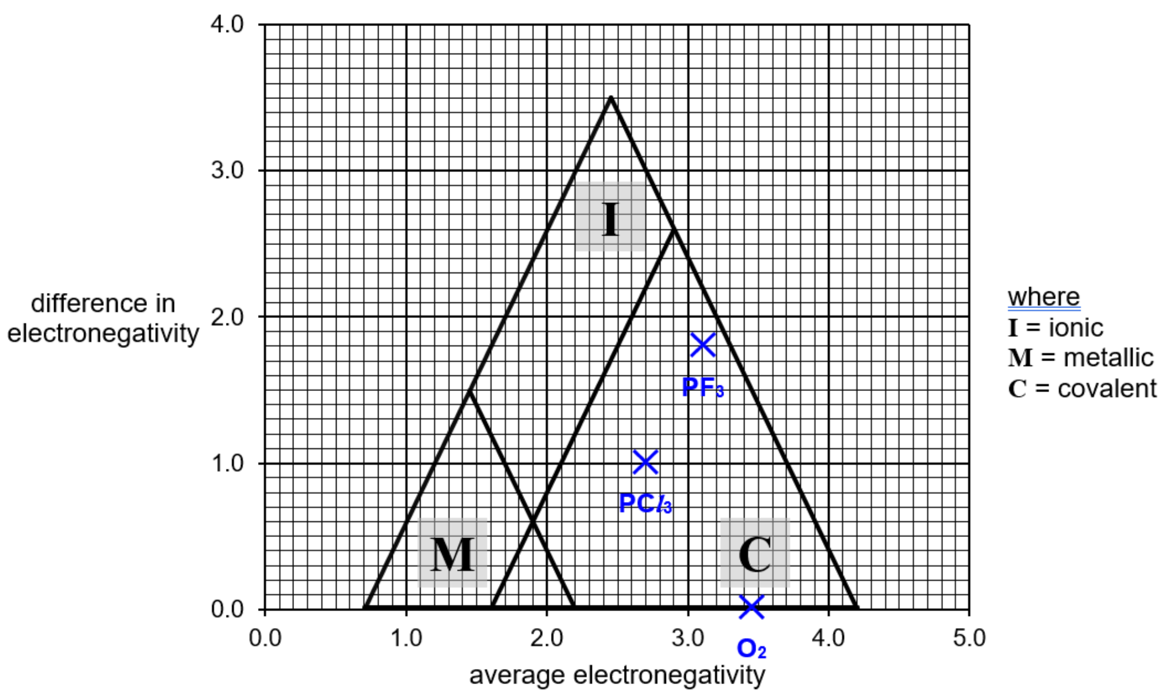
....[1]

half-life remains the same.

(c) The van Arkel triangle is used to predict the type of bonding between two elements in a compound.

The type of bonding depends on the average electronegativity of the two elements, and the electronegativity difference between the two elements.

The average electronegativity and difference in electronegativity are not affected by the number of atoms present in the compound.



(i) The electronegativity values of some elements are shown.

chlorine	fluorine	phosphorus
3.2	4.0	2.2

On the van Arkel diagram above, place **two** crosses ×, one for phosphorus trichloride, PCl_3, and one for phosphorus trifluoride, PF_3.

Label your two crosses clearly with the compounds they represent. [2]

compound	average electronegativity	difference in electronegativity
PCl_3	2.7	1.0
PF_3	3.1	1.8

Determine the values and plot the points accordingly

(ii) The P–F bond is more polar than the P–C*l* bond.

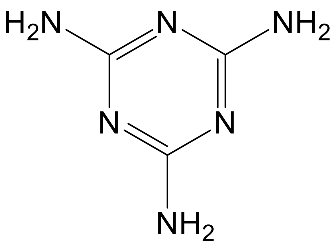
State how your answer in **(c)(i)** shows this.
PF_3 is higher in position on the graph than PCl_3
(answer has to be in reference to the graph)

(iii) On the van Arkel diagram above, place a **third** cross × for oxygen gas, O_2.

Label your cross clearly with 'O_2'. [1]

oxygen has an electronegativity of 3.44
(electronegativity of O is higher than C*l* but lower than F)

(d) Melamine is used to manufacture dinnerware.



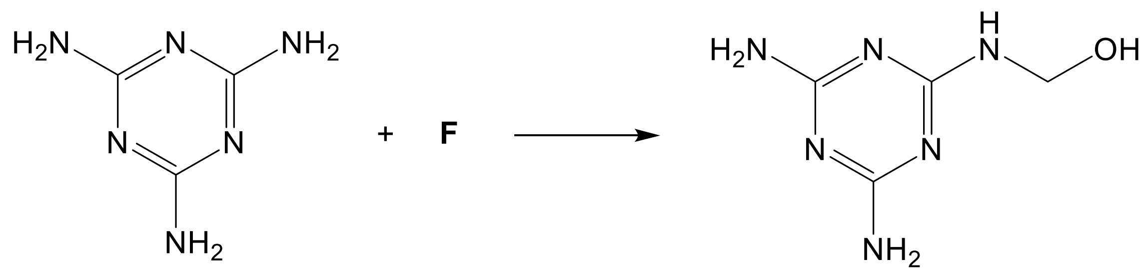
melamine

(i) State the number of σ bonds and π bonds in one molecule of melamine.

....

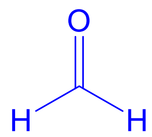
....[1]
$\sigma = 15$
$\pi = 3$

(ii) Melamine, $C_3H_6N_6$, is combined with a small molecule **F** to form a monomer, $C_4H_8N_6O$.



monomer
($C_4H_8N_6O$)

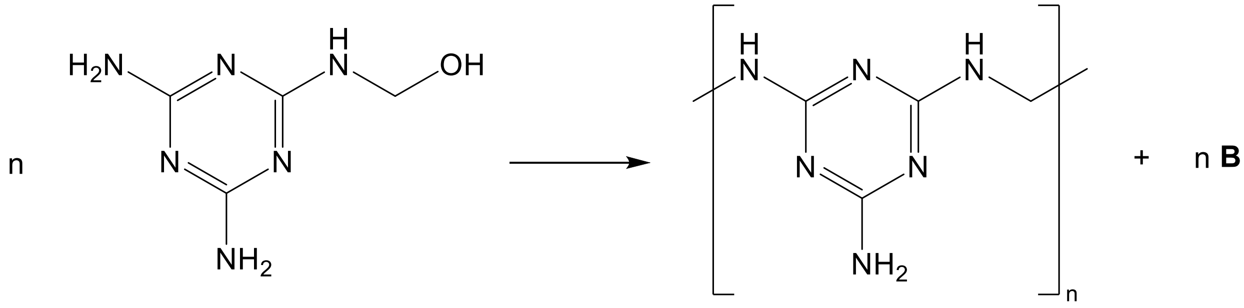
Using the formulas of melamine and the monomer, deduce the structure of **F**.



(hint from question: compare molecular formula)

[1]

(iii) The monomers are polymerised to form melamine resin.

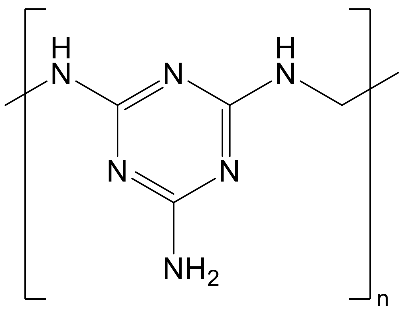


melamine resin

Molecules of **B** are eliminated as a byproduct. Identify **B**.

....[1]
H_2O

(iv) Each melamine resin polymer chain has an average relative molecular mass of 1800.



melamine resin

Calculate the average number of repeating units of melamine resin that is present in one polymer chain. Leave your answer to 3 significant figures.

molecular formula of repeat unit = $C_4H_6N_6$
M_r of repeat unit = 48.0 + 6.0 + 84.0 = 138.0

average number of repeating units = $\frac{1800}{138}$ = 13.0

[2]

(v) Melamine resin is a thermoset polymer.

With reference to the structure of melamine resin, explain how it becomes a thermoset polymer during the polymerisation process.

....

....

....[1]
(–OH) group forms crosslinks with $-NH_2$ group of another chain

(vi) Melamine resin is used to make Melmac, a brand of dinnerware and kitchenware.

Describe one advantage and one disadvantage of using melamine resin in dinnerware.

advantage ....

....

disadvantage ....

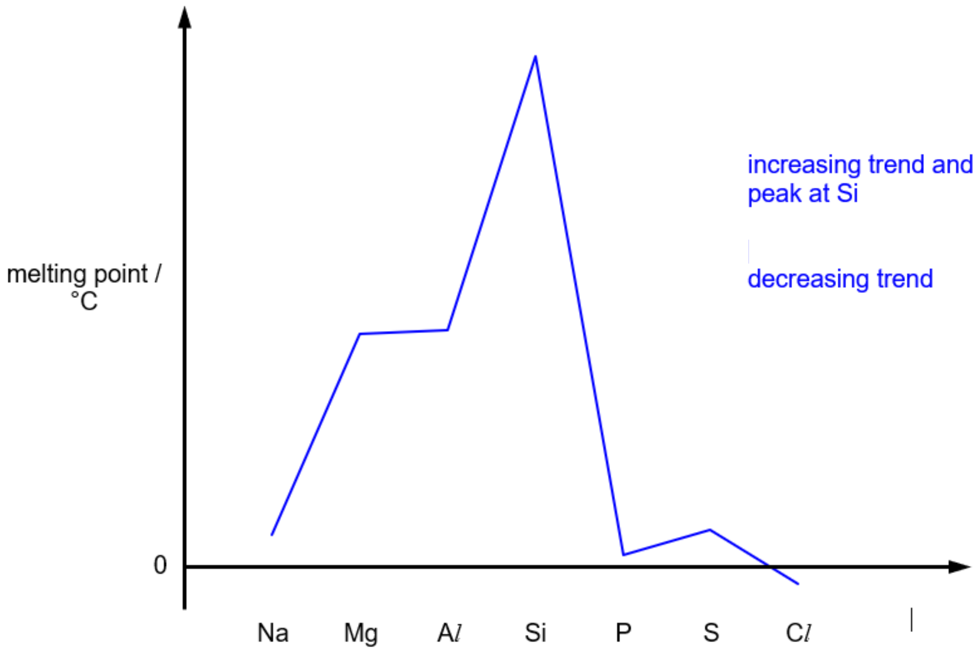
....
[2]

advantage:
rigid / hard / stiff
strong / does not break easily

disadvantage:
not heat-safe / heating breaks down the material
cannot recycle

[Total: 20]

6 **(a)** **(i)** On the axes below, sketch a graph showing the relative melting points of the period 3 elements.



[2]

(ii) Describe what happens when $MgCl_2$ and PCl_5 are each added separately to water.

State the pH of the resultant solutions.

Include equations for any reactions that occur.

$MgCl_2 + 6H_2O \longrightarrow [Mg(H_2O)_6]^{2+} + 2Cl^-$

$[Mg(H_2O)_6]^{2+} \rightleftharpoons [Mg(H_2O)_5(OH)]^+ + H^+$

Mg^{2+} hydrolyses H_2O

pH 6.5

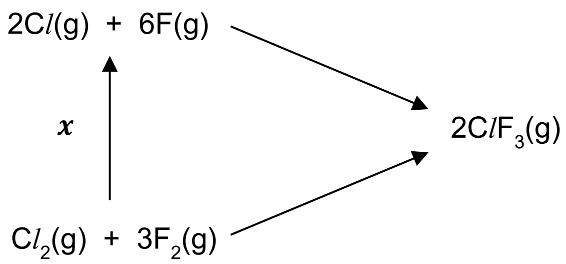
$PCl_5 + 4H_2O \longrightarrow H_3PO_4 + 5HCl$ or $PCl_5 + H_2O \longrightarrow POCl_3 + 2HCl$

PCl_5 hydrolyses H_2O

pH 2

(for such periodic table questions, writing equations is sufficient)

(b) An energy cycle is shown.



(i) Use bond energy values from the *Data Booklet* to calculate the value of x.

x = BE(C*l*–C*l*) + 3BE(F–F)
= +244 + 3(158) = +718 kJ mol^{-1}
(note: sign is required)

[1]

(ii) The standard enthalpy change of formation of C*l*F_3(g) is –163 kJ mol^{-1}.

Calculate the average bond energy of the C*l*–F bond in C*l*F_3.

by Hess' law,
–6BE(C*l*–F) = –718 –2(163) = –1044 kJ mol^{-1}

hence BE(C*l*–F) = $\frac{1044}{6}$ = +174 kJ mol^{-1}

(note: sign is required)

[2]

(iii) State the number of electron bond pairs and electron lone pairs around the chlorine atom of the chlorine trifluoride, C*l*F_3, molecule.

Hence, name the shape of the chlorine trifluoride molecule based on the Valence Shell Electron Pair Repulsion Theory.

....

....[2]

3 bond pairs and 2 lone pairs
T-shaped

(c) Two different methods were used to determine the percentage purity of a sample of aluminium metal.

0.175 g of the metal sample was added to 100 cm^3 of hydrochloric acid. The acid was added in excess.

$$2Al(s) + 6HCl(aq) \longrightarrow 2AlCl_3(aq) + 3H_2(g)$$

In method **1**, the hydrogen gas produced was collected and its volume measured.

In method **2**, the maximum temperature increase of the solution was measured.

(i) In method **1**, 213 cm^3 of hydrogen gas was collected.

The volume of hydrogen gas was measured at r.t.p.

Calculate the percentage by mass of aluminium in the metal sample.

$\eta_{H_2} = \frac{213\ cm^3}{24000\ cm^3\ mol^{-1}}$ = 0.008875 mol

since $\frac{\eta_{Al}}{\eta_{H_2}} = \frac{2}{3}$

hence $\eta_{Al} = \frac{2}{3} \times$ 0.008875 mol = 0.005917 mol

mass of Al present = 0.005917 mol $\times$ 27.0 g mol^{-1} = 0.15975 g

hence % mass of Al = $\frac{0.15975\ g}{0.175\ g} \times$ 100% = 91.3%

[2]

(ii) In method **2**, the maximum temperature increase was 6.7 °C.

For every 1 mol of aluminium reacted, the enthalpy change was –525 kJ.
The specific heat capacity of the solution was 4.18 J g^{-1} K^{-1}.

Calculate the percentage by mass of aluminium in the metal sample.

$q = mc\Delta T$

= 100 $\times$ 4.18 $\times$ 6.7 = 2800.6 J

$\eta_{Al} = \frac{2.8006\ kJ}{525\ kJ\ mol^{-1}}$ = 0.005334 mol

mass of Al present = 0.005334 mol $\times$ 27.0 g mol^{-1} = 0.1440 g

hence % mass of Al = $\frac{0.1440\ g}{0.175\ g} \times$ 100% = 82.3%

(iii) Suggest a reason why the results of percentage purity of aluminium calculated from method **1** and method **2** are different.

....

....[1]

method **2** lower
due to heat loss to surroundings
hence lower ΔT / lower q

(d) The standard enthalpy change of neutralisation, ΔH_n^θ, would be different for different acids being used to react with sodium hydroxide.

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l) \qquad \Delta H_n^\theta = -57.3\ kJ\ mol^{-1}$$
$$CH_3CO_2H(aq) + NaOH(aq) \longrightarrow CH_3CO_2Na(aq) + H_2O(l) \qquad \Delta H_n^\theta = -55.2\ kJ\ mol^{-1}$$

(i) Define *standard enthalpy change of neutralisation*.

....

....[1]

energy released when 1 mol of H_2O is formed from acid-base reaction at 298 K and 1 bar

(ii) Explain why the reaction of ethanoic acid, CH_3CO_2H, with sodium hydroxide will give a different ΔH_n^θ from the reaction using hydrochloric acid, HCl.

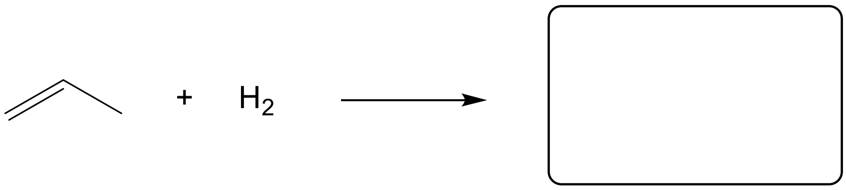
....

....[1]

Ethanoic acid is a weak acid
energy must be absorbed to complete dissociation, resulting in a more endothermic enthalpy change.

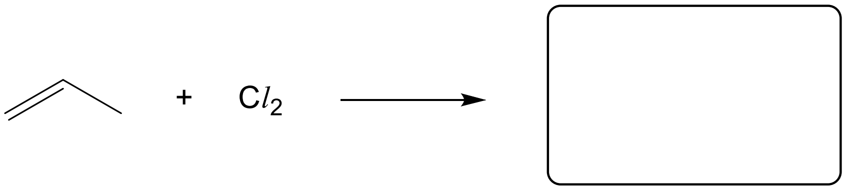
(e) Hydrogen and chlorine can react with alkenes to form new compounds.
Draw the structures of the products formed from the following reactions.

(i)



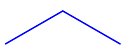
[1]

(ii)



[1]

[Total: 20]

(i) 

(ii)