Victorian Certificate of Education
CHEMISTRY 2026 Unit 1 and 2
End of Year Examination
Reading time: 10 minutes
Writing time: 120 minutes

Student's Name: _____

Teacher: _____

Structure of booklet

Section	Question to be answered	Total marks
Multiple choice	20	25
Short answer	12	72
	Total	97

Directions to students

Materials

- Students are permitted to bring into the examination room: pencils, highlighters, erasers, sharpeners, **rulers**, and an approved scientific calculator.
- Students are NOT permitted to bring into the examination room:
white out liquid/tape, phones or electronic devices, including smart watches.
- Students are provided with the following: Question and answer book of 24 pages and VCAA Data booklet.

The task

- Please ensure that you write your name and teacher's name on this booklet. This paper consists of Part A (25 multiple choice questions) to be answered on the answer sheet found on page 9 and Part B (12 short answer questions)
- There are a total of 97 marks available.
- Be sure to include states with all chemical equations.
- All numerical answers need to be quoted to the correct number of significant figures.
- All working out must be shown in the space provided for marks to be awarded

Section A – Multiple Choice Questions

Question 1
Which of the following atoms has the greatest number of neutrons?

a) ^{56}Mn
b) ^{56}Ni
c) ^{57}Co
d) ^{58}Fe

Question 2
The element nitrogen is able to form the nitride ion $^{15}N^{3-}$. Which of the following statements about this ion is **incorrect**?

a) There are more neutrons than protons in the ion
b) The number of neutrons in the ion is greater than the number of electrons
c) The uncharged nitrogen atom has the same number of protons as the ion.
d) The number of electrons in the ion is greater than the ion's atomic number.

Question 3
All alkenes have

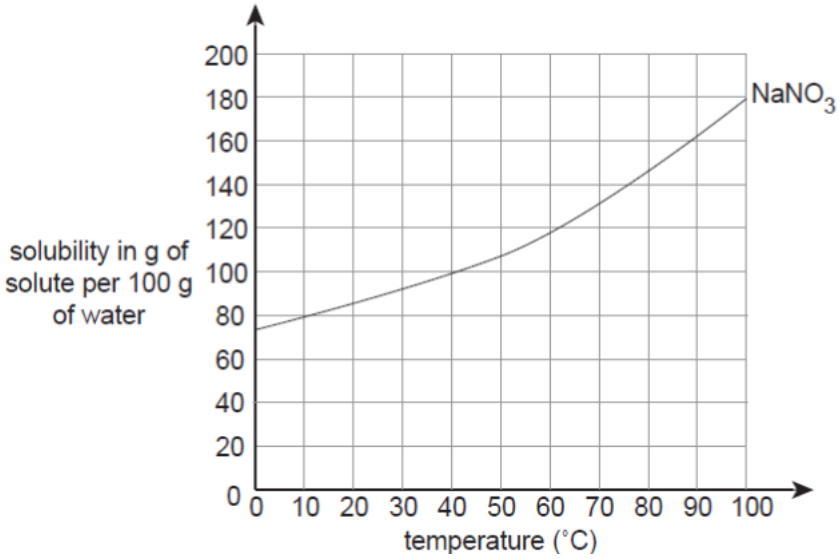
a) only single covalent bonds
b) one or more C=C double covalent bonds
c) similar size and shaped molecules
d) no more than one double bond

Question 4
Methanol dissolves completely in water. This is best attributed to:

a) the formation of ion-dipole interactions that result when methanol ionises in water.
b) hydrogen bonds forming between the water molecules and the methyl groups in methanol.
c) the formation of dispersion forces between the water and methanol molecules.
d) the hydroxyl groups in methanol forming hydrogen bonds with the water molecules.

Question 5

The graph below shows the solubility curve for $NaNO_3$.



A 70.0mL saturated solution of $NaNO_3$ was cooled from 90°C to 40°C.
The mass of $NaNO_3$ (in grams) expected to crystallise from the solution is closest to:

a) 40
b) 60
c) 70
d) 100

Question 6

A student added an unknown aqueous solution to an aqueous solution of barium chloride ($BaCl_2$) and observed the formation of a precipitate. The unknown aqueous solution could have contained:

a) copper(II) nitrate.
b) lithium ethanoate.
c) ammonium sulfate.
d) potassium iodide.

Question 7
Carbonic acid, H_2CO_3, can react with water in two stages:

$$H_2CO_{3\,(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + HCO_3^-{}_{(aq)}$$
$$HCO_3^-{}_{(aq)} + H_2O_{(l)} \leftrightarrow H_3O^+_{(aq)} + CO_3^{2-}{}_{(aq)}$$

From the equations above it is evident that

a) H_3O^+ is the conjugate base of H_2CO_3.
b) H_2CO_3 is amphiprotic as it reacts in two stages.
c) HCO_3^- is diprotic as it is involved in two reactions.
d) H_2CO_3 is diprotic

Question 8
If this unbalanced equation ___$C_2H_5OH_{(l)}$ + ___$O_{2\,(g)}$ → ___$CO_{2\,(g)}$ + ___$H_2O_{(g)}$ is balanced, the coefficients in order from left to right would be

a) 2, 7, 4, 6
b) 1, 3, 2, 3
c) 2, 3, 2, 3
d) 1, 2, 2, 2

Question 9
A solution of NaOH, is to be used to neutralise the contents of three beakers.

Beaker A: 10 mL of 1.0 M HCl
Beaker B: 1.5 mL of 10 M HCl
Beaker C: 1000 mL of 0.0001 M HCl

From **lowest** to **highest**, what will be the volume of NaOH required to neutralise each beaker?

a) beaker C, beaker B, beaker A
b) beaker B, beaker A, beaker C
c) beaker C, beaker A, beaker B
d) Not able to be determined as the concentration of the NaOH is not known.

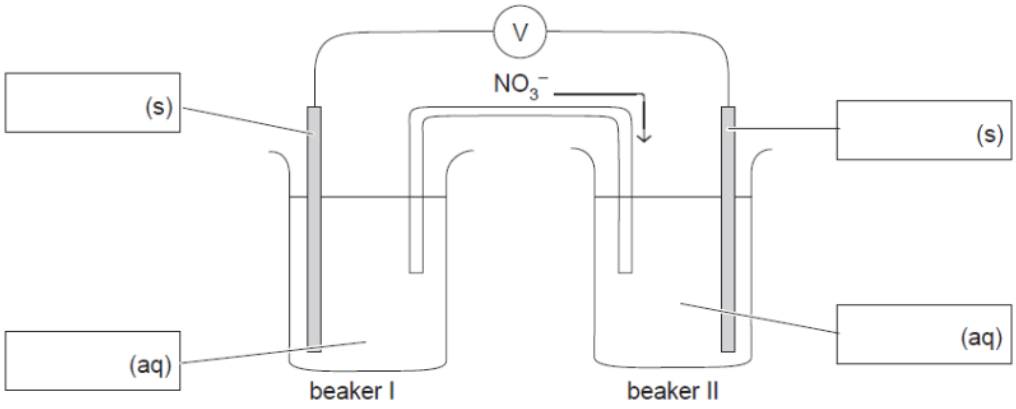
Question 10
Which one of the following is an example of a solution of a strong acid that is dilute?

a) 2mL of 0.005 M HNO_3
b) 2L of 5M NaOH
c) 500 mL of 2M CH_3COOH
d) 10mL of 5M H_2SO_4

Question 11
The number of hydrogen atoms present in 2.0g of methane is

a) 7.5×10^{22}
b) 3.0×10^{23}
c) 1.2×10^{24}
d) 4.8×10^{24}

The following information relates to Question 12 and 13.
An electrochemical cell used to produce an electric current was constructed using two standard half-cells $Pb^{2+}_{(aq)}/Pb_{(s)}$ and $Fe^{2+}_{(aq)}/Fe_{(s)}$. The two half-cells were joined by a salt bridge soaked in a solution of potassium nitrate. The arrangement is shown in the diagram below.



Question 12
It was found that when a current was generated, nitrate ions from the salt bridge flowed into Beaker II, as shown in the diagram above.
The species reacting in beaker I when the current is flowing is

a) $Fe_{(s)}$
b) $Pb^{2+}_{(aq)}$
c) $Pb_{(s)}$
d) $Fe^{2+}_{(aq)}$

Question 13
The electrode in Beaker II in this galvanic cell is

a) the positively charged anode.
b) the positively charged cathode.
c) the negatively charged cathode.
d) the negatively charged anode.

Question 14
The reaction that occurs when a piece of clean magnesium metal is placed in water can be described by the chemical equation:

$$Mg_{(s)} + 2H_2O_{(l)} \rightarrow Mg(OH)_{2(s)} + H_{2\,(g)}$$

In this reaction the magnesium is acting as the:

a) reductant because it is donating electrons.
b) reductant because it is accepting electrons.
c) oxidant because it is donating electrons.
d) oxidant because it is accepting electrons.

Question 15
The oxidation number of the vanadium in the compound K_2VF_6 will be:

a) –6
b) –4
c) +4
d) +6

Question 16
Consider the following reactions below:

Equation 1: $2AgNO_3 + MgCl_2 \rightarrow Mg(NO_3)_2 + 2AgCl$
Equation 2: $2FeCl_2 + Cl_2 \rightarrow 2FeCl_3$
Equation 3: $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

Which one of the following statements about these reactions is correct?

a) Equation 1 is a redox reaction because the oxidation number of the Cl has changed.
b) Equation 2 is a redox reaction because oxidation number changes are evident.
c) Equation 3 is a precipitation reaction because $NaNO_3$ will be insoluble.
d) Equation 2 is a precipitation reaction because $FeCl_3$ is insoluble.

Question 17
Calculate the pH of an 0.0100 M calcium hydroxide, $Ca(OH)_2$ solution, at 25°C.

a) 0.3
b) 2.0
c) 12.0
d) 12.3

Question 18
The mass (in grams) of 0.150 mol of butanoic acid is

a) 9.00
b) 11.1
c) 11.4
d) 13.2

Question 19
The **amount**, in mol of sodium ions in 1.64g of sodium phosphate, Na_3PO_4 is closest to:

a) 0.0100
b) 0.0300
c) 1.00
d) 3.00

Question 20
Some enthusiastic CGS Year 11 students set out to determine the empirical formula of black copper oxide. They started with 2.65g of black copper oxide which was converted in a series of reactions to metallic copper. The mass of dry copper obtained was 2.12g. The empirical formula of the oxide is:

a) CuO
b) Cu_2O
c) Cu_3O_4
d) CuO_2

Question 21
Electronegativity is best described as

a) the ability of an ion to attract protons.
b) the ability of an atom to become a charged ion.
c) the ability of an atom to attract electrons.
d) the ability of an ion to conduct electricity.

Question 22
Which of the following identifies the nature of the bonds in a molecule of CCl_4 and the overall level of polarity of the molecule?

a) polar bonds and polar molecule
b) polar bonds and non-polar molecule
c) non-polar bonds and polar molecule
d) non-polar bonds and non-polar molecule

Question 23
10.0g of sodium hydroxide is dissolved in 400mL of water. What will the NaOH concentration, in M be?

a) 0.10
b) 0.625
c) 6.25×10^{-4}
d) 2.500

Question 24
A saline solution that is used as an emergency eyewash is made by adding 0.95 g of sodium chloride, NaCl, to water and making the volume up to 10 mL with water. In this solution, the NaCl concentration can be expressed as:

a) 9.5% m/v
b) 0.95% m/v
c) 9.5% v/v
d) 95% m/v

Question 25
Which of the following shows the volume of water, in mL, which must be **added** to 150 mL of a 0.340M NaCl solution in order to produce a 0.204M NaCl solution?

a) 54
b) 90
c) 100
d) 250

End of Section A

Multiple choice answer sheet.
Circle one correct response for each question.
Do not remove from the examination paper.

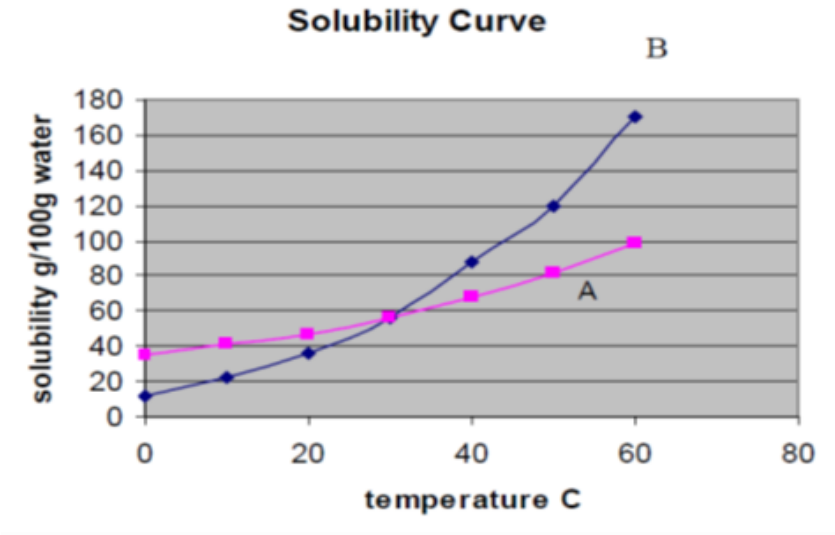
Name _____

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

Section B – Short Answer Questions

Question 1 (6 marks)

The solubility curves for two ionic substances, A and B, are drawn below.



a. A saturated solution of substance B contains 170g of solid in 100g of water. What temperature is the solution?

_____*60 °C*_____

(1 mark)

b. A saturated solution contains 40 g of solid in 200 g of water at 10°C. Which substance, A or B, must be in the solution? Justify your answer.
*1-----mark => **B***
1-----mark => 20g per 100g on the saturation line = 40g/200g at 10° C

c. What mass of substance B could be dissolved in 1.0 kg of water at 50°C?
1-----mark => 120/100 x 10
1-----mark =>1200g of substance B (accept 1.2kg)

d. A saturated solution of substance A at 60°C contains 40 g of compound A. What mass of water was used to prepare this solution?
1-----mark => 40g of water (must include units)

Question 2 (10 marks)

The ability to write balanced chemical equations is very important in Unit 2 Chemistry. Each topic of the course requires equations to explain the reactions that are occurring.

a. Scientists often dip fossils in hydrochloric acid, HCl. If a gas is produced, the fossil probably contains calcium carbonate, $CaCO_3$. Write a balanced chemical equation for the reaction between HCl and $CaCO_3$. Include states.
1-----mark => for correct formulas and states
1-----mark => for balanced equation
$2HCl\ (aq) + CaCO_3\ (s) \rightarrow CaCl_2\ (aq) + H_2O\ (l) + CO_2\ (g)$

b. Sulfuric acid, H_2SO_4, can be neutralised by potassium hydroxide solution. Write a balanced **ionic** chemical equation, **with states,** for the reaction between H_2SO_4 and potassium hydroxide solution.

1-----mark => for correct formulas and states

1-----mark => for balanced equation for elements and charge

$H^+(aq) + OH^-(aq) \rightarrow H_2Ol)$

c. The reaction between lithium metal, $Li_{(s)}$ and fluorine gas, $F_{2(g)}$, to form $LiF_{(aq)}$ is a redox reaction.

i. Write the two half-equations, with states occurring during this process.

1-----mark => $F_2(g) + 2e^- \rightarrow 2F^-(aq)$

1-----mark => $Li(s) \rightarrow Li^+(aq) + e^-$

ii. Identify the oxidant from part **i**.

Oxidant: *1-----mark => $F_2(g)$*

iii. Write a balanced half equation for $SO_4^{2-}{}_{(aq)} \rightarrow SO_{2\,(g)}$ in acidic conditions.

1-----mark => correct formula and states

1-----mark => balanced for elements and charge

$SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow SO_2(g) + 2H_2O(l)$

iv. The reaction in part **iii** is: oxidation / reduction. **Circle** the correct term.

1-----mark => reduction

Question 3 (10 marks)

The chemical formula of rust is Fe_2O_3. Rust can be removed from an iron object by washing the object with sulfuric acid. The reaction occurring is:

$$Fe_2O_{3(s)} + 3H_2SO_{4(aq)} \rightarrow Fe_2(SO_4)_{3(aq)} + 3H_2O_{(l)}$$

a. The volume of 4.0 M H_2SO_4 required to remove all brown traces from a piece of iron piping is 7.30 mL. Calculate the mass of rust that reacted with the sulfuric acid.

1-----mark => $n(H_2SO_4) = 4.0 \times 0.0730 = 0.0292$ mol

1-----mark => $n(Fe_2O_3) = 0.0292 \times 1/3 = 0.00973$ mol

1-----mark => $m(Fe_2O_3) = 0.00973 \times 159.6 = 1.55344$ g

= 1.6 g – must include units and 2 sig figs to get final mark

b. 0.568 moles of sulfuric acid is available to try and remove 0.195 moles of rust from a child's bicycle. Which chemical is in excess in this reaction? You must show a calculation to prove this.

1-----mark => 0.568 mol acid / 3

1-----mark => 0.195 rust / 1

=>0.189 < 0.195 => acid is in excess

Any other relevant calculation to show mole ratio compared to what is available was accepted

In the formation of rust, the iron goes through the following stages.

A → B → C → D → E

$Fe_{(s)} \rightarrow Fe^{2+}_{(aq)} \rightarrow Fe(OH)_{2\,(s)} \rightarrow Fe(OH)_{3\,(s)} \rightarrow Fe_2O_{3\,(s)}$

c. Complete the table to show the oxidation number of iron in each stage (5 marks) *1-----mark => for each correct answer*

Stage	A	B	C	D	E
Oxidation no. of iron	*0*	*2+*	*2+*	*3+*	*3+*

Continue over the page

Question 4 (12 marks)

a. The hydrogen sulfate ion, HSO_4^-, is amphiprotic (amphoteric). Write an equation to show hydrogen sulfate acting as a base. States are not required.

1-----mark => $HSO_4^- + H_2O \rightarrow H_2SO_4 + OH^-$
can be shown using any other reactant acting as an acid e.g H_3O^+ or HCl as long as products are correct for their equation

b. What would be the chemical formula for the conjugate **acid** of water?

1-----mark => __ H_3O^+_____

(1 mark)

c. Calculate the pH of a 0.02500M aqueous sulfuric acid solution.

[H+] = 0.02500 x 2 = 0.0500
pH = -log(0.0500)
= 1.3

d. The reaction between aqueous solutions of hydrochloric acid and sodium hydroxide can be represented by the chemical equation:

$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

Some enthusiastic yr 11 chemistry students used titration to determine the concentration of HCl in a commercial cleaning product. The students took a 5.00 mL sample of the brick cleaner and carefully diluted it with deionised water in a 500.0 ml volumetric flask. 20.00ml of this diluted HCl cleaner solution was pipetted into a conical flask. An average titre of 12.14 mL of a 0.187M aqueous sodium hydroxide solution was required to neutralise the diluted HCl solution.

i) Calculate the number of mole of sodium hydroxide added to the diluted acid.

1-----mark => n (NaOH)= 0.187 x 0.01214
= 0.00227 mol

ii) Calculate the number of mole of diluted hydrochloric acid reacting with the hydroxide

1-----mark => n(HCl) = n(NaOH) = 0.00227mol
Consequential marks were awarded

iii) Calculate the concentration, in mol / L of hydrochloric acid in the **diluted** solution **if** the number of mole reacting with the hydroxide is 0.00310 mole.

1-----mark => [HCl diluted] = 0.00310 / 0.02 = 0.155M

iv) Using your answer from part **iii**, Calculate the number of mole of hydrochloric acid in the 500.0mL volumetric flask.

1-----mark => n (HCl)= 0.155 x 0.5000
= 0.0775 mol (consequential mark from iii)

v) Using your answer from part **iv**, Calculate the molar concentration, of hydrochloric acid in the original brick cleaner sample.

1-----mark => [HCl original sample] = 0.0775 / 0.005 = 15.5 M (consequential mark from iv)

vi) How would your calculation of the original HCl concentration differ if the burette was rinsed with distilled water only? Explain.

1-----mark => Lower concentration of NaOH in burette = increased titre needed to reach endpoint
1-----mark => Therefore increased calculated conc of HCl

vii) What should be done in such an experiment to improve the precision of the results?

1-----mark => Repeat until 3 concordant results found (accept other reasonable answer for precision)

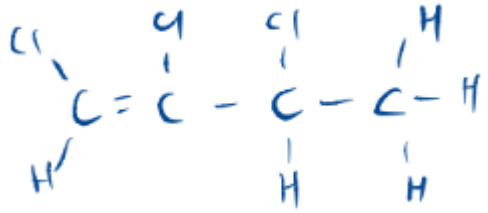
viii) What dangerous goods label should be on the container of brick cleaner?

1-----mark => Corrosive

Question 5 (6 marks)

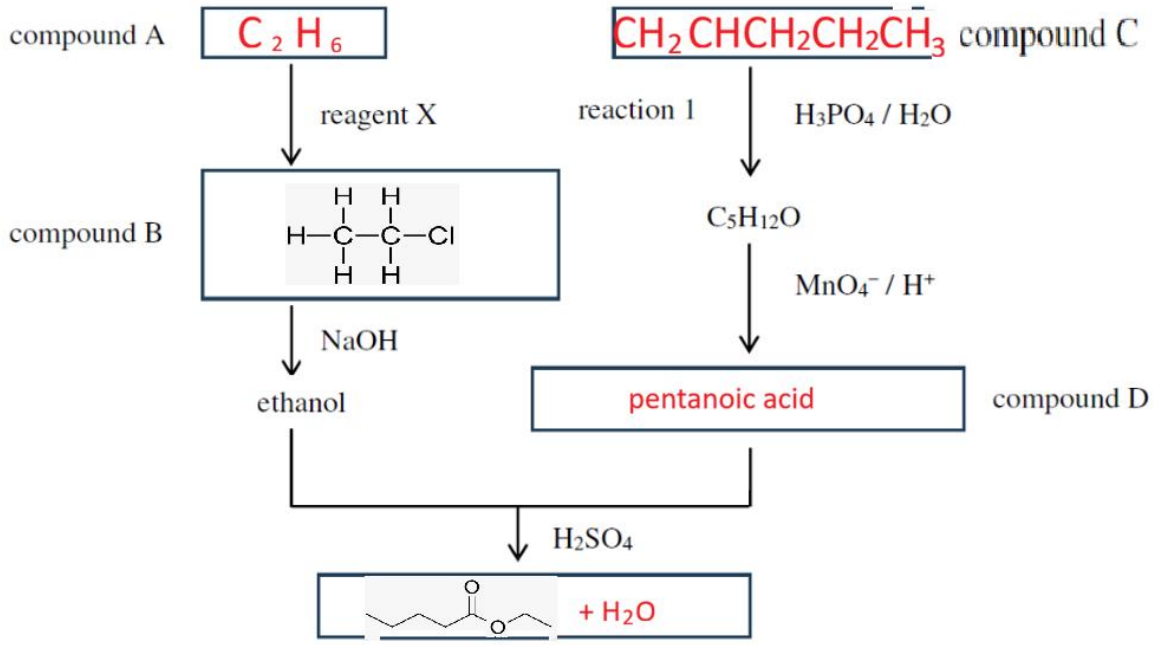
Complete the following table:

Name of compound	Formula of compound
Propan-1-amin	$CH_3CH_2CH_2NH_2$
2-methylbutane	$CH_3CH_2CH(CH_3)CH_3$
But-1-ene	$CH_2CHCH_2CH_3$

2 – methylbutanoic acid	*$CH_3CH_2CH(CH_3)COOH$* (Semi-structural formula required)
2-bromobutane	$CH_3CH_2CHBrCH_3$
1,2,3-trichlorobut-1-ene	 (full structural formula required)

Question 6 (10 marks)

Below is a reaction pathway used for the synthesis of a volatile organic compound that gives off a fruity aroma.



Compound E

a. Identify reagent X ___*$Cl_2(g)$/UV light*_____ (1 mark)

b. In the appropriate boxes above, write the

i. molecular formula for compound A.
ii. full structural formula for compound B.
iii. the systematic IUPAC name for compound D
iv. semi-structural formula for compound C
v. skeletal structure for compound E.

(5 marks)

c. State what type of reaction is undertaken when producing the following.

Compound B: _____*Substitution*_____

Compound D: _____*Oxidation*_____

Compound E: _____*Esterification / condensation*_____

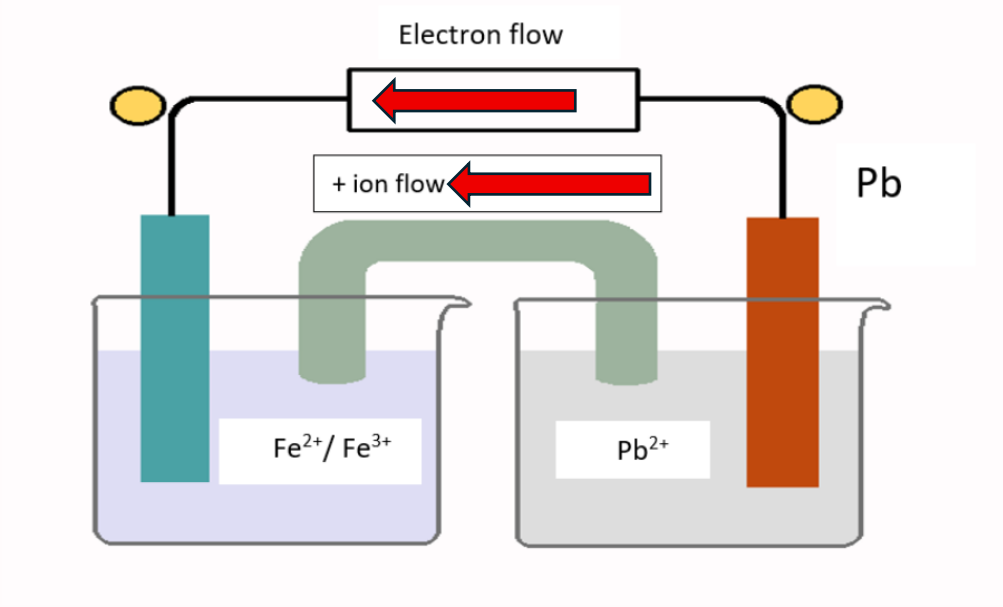
(3 marks)

d. Give the systematic IUPAC name for compound E

_____*ethyl pentanoate + water*_____

Question 7 (6 marks)

Below is a diagram of an Fe^{2+}/Fe^{3+} // Pb/Pb^{2+} electrochemical cell.



a. In the box on the diagram above, indicate the direction of the flow of positive ions through the salt bridge. (1 mark)

b. In the box on the diagram, indicate the direction of the flow of electrons in the external circuit. (1 mark)

c. Give a balanced half-equation for the reaction occurring at the **cathode**.

_____*$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$*_____

(1 mark)

d. What would be a suitable choice of material for the electrode on the left?

_____*Graphite/ C(s) or Pt (s)*_____

(1 mark)

e. This cell should produce and e.m.f of 0.90 V. In one set-up the e.m.f produced was only 0.35V. Give a possible reason for this discrepancy.

Conditions not at SLC. (accept other reasonable)
or
reaction too slow.
or
any other valid reason eg. Internal resistance too high

f. Write the overall equation for the galvanic cell on the previous page. No states are required.

$2Fe^{3+}(aq) + Pb(s) \rightarrow 2Fe^{2+}(aq) + Pb^{2+}(aq)$

(1 mark)

Question 8 (6 marks)

It is argued that ethanol produced from the naturally occurring glucose polymer, cellulose, found in high amounts in corn and wood could be considered renewable compared to other fuels such as petroleum (petrol).

a. **i. Explain** why this is so.

1-----mark => Petrol found in crude oil takes millions of years to form and cannot be replenished at the rate of consumption,
1-----mark => whereas corn crops/ trees can be replenished at a rate that does not deplete the fuel.
(accept other reasonable answers but must address 'renewable')

ii. Discuss one advantage **and** one disadvantage of using energy resources such as bioethanol.

1-----mark => Advantage- e.g less net Co2 released/ renewable
1-----mark => Disadvantage - e.g lower energy content/ crop availability/ use of water

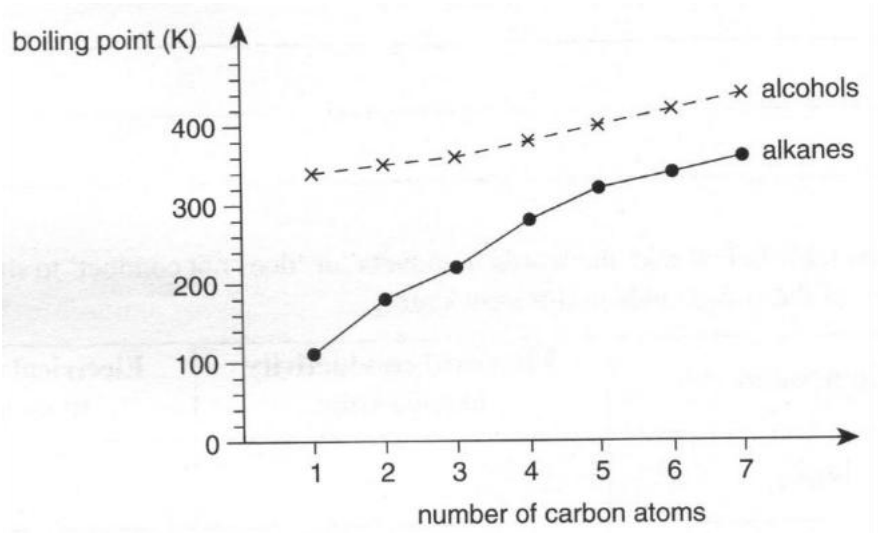
b. The cellulose found in corn and wood can be broken down into glucose. This glucose can then be fermented into ethanol by the following reaction

$$C_6H_{12}O_{6(aq)} \xrightarrow{yeast} 2C_2H_5OH_{(aq)} + 2CO_{2(aq)}$$

Explain how the production and use of ethanol using this method would help to fulfil the United Nations Sustainability goal 13.

1-----mark => Production difference
e.g Although producing CO2 during combustion, corn crops/ trees take in the same volume of CO2 released when combusted.
1-----mark => Link to goal 13
e.g Lower CO2 emissions compared to non-renewable = lower impact on climate
Accept other reasonable options but must connect to how that achieves the goal

Question 9 (2 marks)
The boiling points of the first seven alkanes and alcohols are shown in the graph:



Comparing the boiling point of an alcohol with its corresponding alkane, why do alcohols boil at a higher temperature?

1-----mark => Increased intermolecular forces due to hydrogen bonding. (accept alcohols have hydrogen bonding)
1-----mark => Increased energy required to break bonds (hydrogen bonds are stronger so more energy to break)

Question 10 (4 marks)

When concentrated nitric acid is added to copper metal, nitrogen dioxide gas is produced. The equation for the reaction is:

$$Cu_{(s)} + 4HNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2NO_{2(g)} + 2H_2O_{(l)}$$

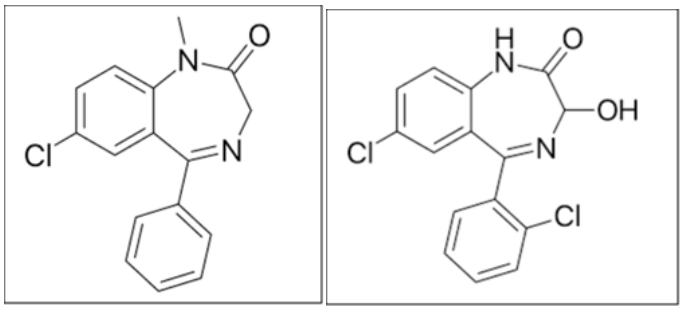
What volume of nitrogen dioxide will be produced at 105 kPa and 30.0°C if 80.0g of copper is consumed in the reaction? *Be sure your answer is to the correct number of significant figures.*

1-----mark => n(Cu) = 80.0/63.5 = 1.26mol
1-----mark => n(NO2) = n(Cu) x 2 = 2.52mol
1-----mark => Working for gas equation e.g V(NO 2)= n(2.52) x R(8.31) x T (303) / P (105)
1-----mark => = 60.4 L (must have correct sig figs)

(4 m

Question 11 (4 marks)

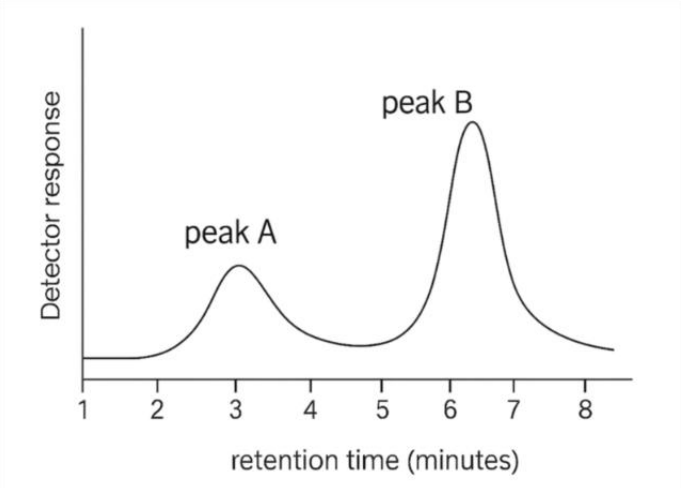
While working in a pharmaceutical quality-control laboratory, a chemist was asked to verify the identity and purity of a mixture containing two benzodiazepine medicines: diazepam and lorazepam. Both drugs are used to relieve anxiety but differ in their polarity and how long they act in the body.



Lorazepam

Diazepam

A small sample of the mixture was analysed using high performance liquid chromatography, which uses a non-polar stationary phase and a polar mobile phase. The chromatogram obtained is shown to the right →



a. **Determine** whether 'Peak A' represents lorazepam or diazepam. **Justify** your response using the chemistry theory you have studied this year.

1-----mark => Diazepam

1-----mark => More polar, as mobile phase is polar this will desorb from the stationary phase better to have a lower retention time.

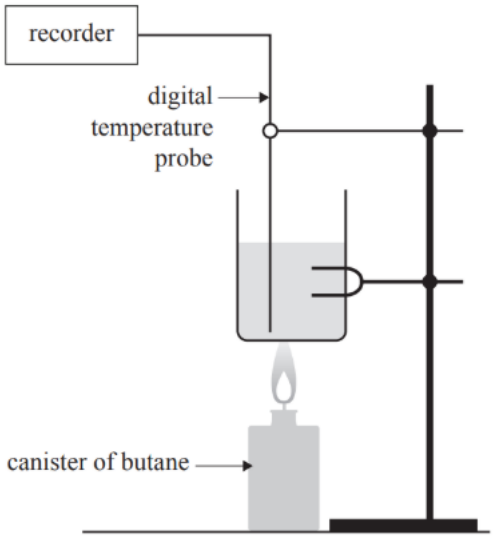
b. After the initial testing a pharmacist found a left over, unknown, sample. They were not sure whether the sample was lorazepam or diazepam. Using HPLC, describe how the pharmacist could determine which of the two medicines the unknown sample is?

1-----mark => Run unknown sample through HPLC under the same conditions

1-----mark => Will have the same time as either peak b or a to determine which it is

Question 12 (8 marks)

A physical Chemist set out to determine how much energy in kJ can be produced from 1 mole of butane gas. She chose to use the set-up and procedure below.



1. Measure the initial mass of a butane canister.
2. Measure the mass of a metal can, add 250 mL of water and re-weigh.
3. Set up the apparatus as in the diagram and measure the initial temperature of the water.
4. Burn the butane gas for five minutes.
5. Immediately measure the final temperature of the water.
6. Measure the final mass of the butane canister when cool.

Results table from the experiment: →

Quantity	Measurement
mass of empty can	52.14 g
mass of can + water before combustion	303.37 g
mass of butane canister before heating	260.15 g
mass of butane canister after heating	259.79 g
initial temperature of water	22.1 °C
final temperature of water	32.7 °C

a. Write a balanced chemical equation, with states, for the complete combustion of butane.

1-----mark => correct formula and states

1-----mark => balanced for element

$2C_4H1_0$ (g) + $13O_2$ (g) → $8CO_2$ (g) + $10H_2O$ (l)

b. Using the results table calculate the number of moles of butane gas burnt in the 5 minutes.

1-----mark => m(C4H10 used) = 260.15 – 259.79 = 0.36g

1-----mark => n(C4H10 used) = 0.36/ 58.0 = 0.006207 mol = 0.0062

c. Using the results table on the previous page, calculate the energy absorbed by the water in kilojoules (KJ).

m(H2O) = 251.23g

1-----mark => Working for equation q= 251.23 x 4.18 x (32.7 – 22.1)
= 11,131.4988J

1-----mark => q = 11.13kJ (units not required but don't accept if left in J)

d**.** Use your answers to **b.** and **c.** to calculate the energy content of butane per mol in kJ / mol.

1-----mark => q= 11.13 / 0.006206

= 1793.407 kJ/ mol =1,790 for rounding or accept 1.8 x 10^3 (don't need sig. figs. or units but whatever rounding done still needs to be correct for their answer)

e**.** What could the Chemist do to improve the level of accuracy of the experiment?

1-----mark => Reduce heat loss via – a Lid / smaller distance between flame and can/ using a stirrer (*accept any that are reasonable)*