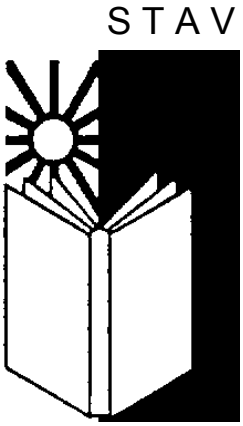

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UNIT 4 Trial Examination

Name:……..

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2001
CHEMISTRY
UNIT 4 Trial Examination
ANSWER SHEET

Student name: **……**

INSTRUCTIONS: USE PENCIL ONLY

Write your name in the space provided above.
Use a PENCIL for ALL entries.
If you make a mistake, ERASE it—DO NOT cross it out.
Marks will NOT be deducted for incorrect answers.
NO MARK will be given if more than ONE answer is completed for any question
Mark your answer by placing a CROSS through the letter of your choice.

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

SECTION A:

Specific instructions for Section A

Section A consists of 20 multiple choice questions. Section A is worth approximately 28 per cent of the marks available. You should spend approximately 25 minutes on Section A.

Choose the response that is **correct** or **best answers the question** and mark your choice on the multiple choice answer sheet according to the instructions on that sheet.

A correct answer is worth 1 mark, an incorrect answer is worth no marks. No mark will be given if more than one answer is shown for any question. Marks will **not** be deducted for incorrect answers.

You should attempt every question.

Question 1
The boiling of water may be represented by the following thermochemical equation:

$$H_2O(l) \rightarrow H_2O(g) \qquad \Delta H = +44.0 \text{ kJ mol}^{-1}$$

The activation energy for this reaction is 52.0 kJ mol^{-1}
The activation energy for the reaction:

$$H_2O(g) \rightarrow H_2O(l) \qquad \Delta H = -44.0 \text{ kJ mol}^{-1}$$

is:

A –8.00 kJ mol^{-1}
B +8.00 kJ mol^{-1}
C –96.0 kJ mol^{-1}
D +96.0 kJ mol^{-1}

Question 2
Solutions of hydrochloric acid and sodium hydroxide react according to the equation:

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l) \qquad \Delta H = -57.2 \text{ kJ mol}^{-1}$$

When 50.0 mL of 0.100 M HCl is added to 20.0 mL of 0.500 M NaOH the energy released would be:

A 286 J
B 572 J
C 2.86 kJ
D 5.72 kJ

Question 3
A galvanic cell is constructed by linking a standard hydrogen half-cell to a half-cell consisting of a graphite electrode dipping into 1.0 M aqueous solutions of iron(III) nitrate and iron(II) nitrate. In this galvanic cells:

A oxidation occurs at the graphite electrode.
B reduction occurs at the electrode in the hydrogen half-cell.
C the pH of the solution in the standard hydrogen half-cell is decreasing.
D the pH of the solution in the standard hydrogen half-cell is increasing.

Questions 4 and 5 refer to the following information

The half equations below represent the reduction reactions of three substances A^{3+}, B^{2+}, and C_2.

$$A^{3+}_{(aq)} + e^- \rightarrow A^{2+}_{(aq)}$$
$$B^{2+}_{(aq)} + 2e^- \rightarrow B_{(s)}$$
$$C_{2(aq)} + 2e^- \rightarrow 2C^-_{(aq)}$$

Pairs of the six species, $A^{3+}_{(aq)}$, $A^{2+}_{(aq)}$, $B^{2+}_{(aq)}$, $B_{(aq)}$, $C_{2(aq)}$, $C^-_{(aq)}$, were mixed in test tubes and if any observable reaction occurred the results were noted. **Some** of these results are given in the table.

Reductant

Oxidant	$A^{2+}_{(aq)}$	$B_{(s)}$	$C^-_{(aq)}$
$A^{3+}_{(aq)}$	—	#	*
$B^{2+}_{(aq)}$	*	—	**I**
$C_{2(aq)}$	**II**	—	—

* an observable reaction occurs

no observable reaction occurs

— not tested

Question 4
The order of strength of the oxidants, from weakest to strongest is:

A $C_2 < B^{2+} < A^{3+}$
B $B^{2+} < C_2 < A^{3+}$
C $B^{2+} < A^{3+} < C_2$
D $C_2 < A^{3+} < B^{2+}$

Question 5
In which of the combinations **I** and **II** would it be expected that an observable reaction would occur?

A I and II only
B I only
C II only
D Neither I nor II

Question 6
The electrode with a positive polarity during the discharging process of a secondary cell will become, during the recharging process, the:

A positive anode.
B negative anode.
C positive cathode.
D negative cathode.

Question 7
Mercury oxide-zinc batteries are used in many low power applications, such as watches and calculators. The cell reaction is:

$$HgO(s) + Zn(s) + H_2O(l) \rightarrow Hg(l) + Zn(OH)_2(s)$$

The half-cell reaction at the positive electrode of the battery is:

A $HgO\ (s) + H_2O(l) + 2e^- \rightarrow Hg(l) + 2OH^-_{(aq)}$
B $Hg(l) + 2OH^-(aq) \rightarrow HgO(s) + H_2O(l) + 2e^-$
C $Zn(OH)_2(s) + 2e^- \rightarrow Zn(s) + 2OH^-(aq)$
D $Zn(s) + 2OH^-(aq) \rightarrow Zn(OH)_2(s) + 2e^-$

Question 8
An aqueous solution containing a mixture of 0.1 M $Ca(NO_3)_2$, 0.1 M $Cu(NO_3)_2$ and 0.1 M $AgNO_3$ is electrolysed using graphite electrodes. After all the possible reactants have been consumed, the outermost coating on the cathode will be:

A silver followed by copper.
B calcium, copper then silver.
C silver, copper then calcium.
D copper followed by silver.

Question 9
Many naturally occurring carbohydrates are condensation polymers of glucose, $C_6H_{12}O_6$. When three of these molecules undergo a condensation reaction the product has the molecular formula:

A $C_{18}H_{36}O_{18}$
B $C_{18}H_{18}O_9$
C $C_{18}H_{32}O_{16}$
D $C_{18}H_{30}O_{15}$

Question 10
The concentration of nitrate ions present in soil can be decreased by the:

A action of lightning.
B action of denitrifying bacteria.
C action of nitrifying bacteria in legumes.
D death and decay of plants and animals.

Question 11
When polyunsaturated vegetable oils are hydrogenated the product(s) will be:

A glycerol and fatty acids.
B glycerol and water.
C carbon dioxide and water.
D solid fats.

Question 12
During digestion the enzymes present in the small intestine are mostly involved in:

A addition reactions.
B condensation reactions.
C hydrolysis reactions.
D combustion reactions.

Question 13
Identify the molecule that can form proteins via condensation reactions.

A NH_2CHCH_3COOH
B $C_{16}H_{33}COOH$
C $(NH_2)_2CO$
D NH_4OH

Question 14
The chemical formula of an alcohol formed by the hydrolysis of triglycerides is:

A CH_3COOH
B $CH_2OHCHOHCH_2OH$
C CH_3CH_2OH
D NH_4OH

Question 15
Aluminium is normally manufactured by passing an electric current through a molten mixture of Al_2O_3 and Na_3AlF_6, using carbon electrodes. The gas discharged to the atmosphere in the largest amount during this process is:

A F_2
B O_2
C HF
D CO_2

Question 16
Which one of the following represents the electronic configuration of an atom of $^{50}_{22}Ti$ in an excited state?

A $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$
B $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$
C $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^2$
D $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$

Questions 17 and 18 refer to the following information

In the production of nuclear energy, ^{235}U is bombarded with neutrons, initiating the following reaction sequence:

$$^{235}_{92}\text{U} + ^{1}_{0}\text{n} \rightarrow ^{236}_{92}\text{U} \rightarrow ^{91}_{36}\text{Kr} + ^{142}_{56}\text{Ba} + 3X + \text{energy}$$

Question 17
The particles represented by *X* in this reaction are:

A helium nuclei
B electrons
C protons
D neutrons

Question 18
In this nuclear reaction:

A ^{142}Ba is produced by nuclear fusion.
B ^{142}Ba is produced by nuclear fission
C the energy released is equivalent to the nuclear binding energy of ^{235}U.
D the energy released is equivalent to the nuclear binding energy of ^{142}Ba.

Question 19
Which one of the following species is **not** able to act as a ligand?

A ammonia
B ammonium ion
C chloride ion
D carbon monoxide

Question 20
An element, *E*, forms the following compounds E_2O_5 and Na_3EO_4. In the periodic table, element *E* would appear in the same group as:

A carbon
B fluorine
C nitrogen
D oxygen

END OF SECTION A

SECTION B:

Specific Instructions for Section B

Section B consists of seven short answer questions, numbered 1 to 7.

You must answer **all** questions. This section is worth 51 marks or approximately 72 per cent of the total. You should spend approximately 65 minutes on this section.

The marks allotted to each question and suggested times are shown at the end of the question.

Questions should be answered in the spaces provided in this book.

To obtain full marks for your response you should:

* give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full marks.
* show all working in your answers to numerical questions. No credit can be given for an incorrect answer unless it is accompanied by details of the working.
* make sure all chemical equations are balanced and that the formulas for individual substances include an indication of state (for example, $H_{2(g)}$; $NaCl_{(s)}$).

Question 1

Methanol, CH_3OH, has been suggested as an alternative fuel to petrol (octane, C_8H_{18}) in cars. The enthalpy (heat) of combustion for methanol is 727 kJ mol^{-1} and that of octane is 5450 kJ mol^{-1}.

(a) Write balanced chemical equations to represent the complete combustion of each of these fuels.

_____

_____

(b) Determine the enthalpy (heat) of combustion for each fuel, expressed as kJ g^{-1}.

(c) (i) If the fuel tank of an average car takes 60 kg of fuel, which fuel potentially would allow the car to travel further? Justify your answer.

_____

_____

_____

_____

(ii) State one assumption that you made in answering part (i).

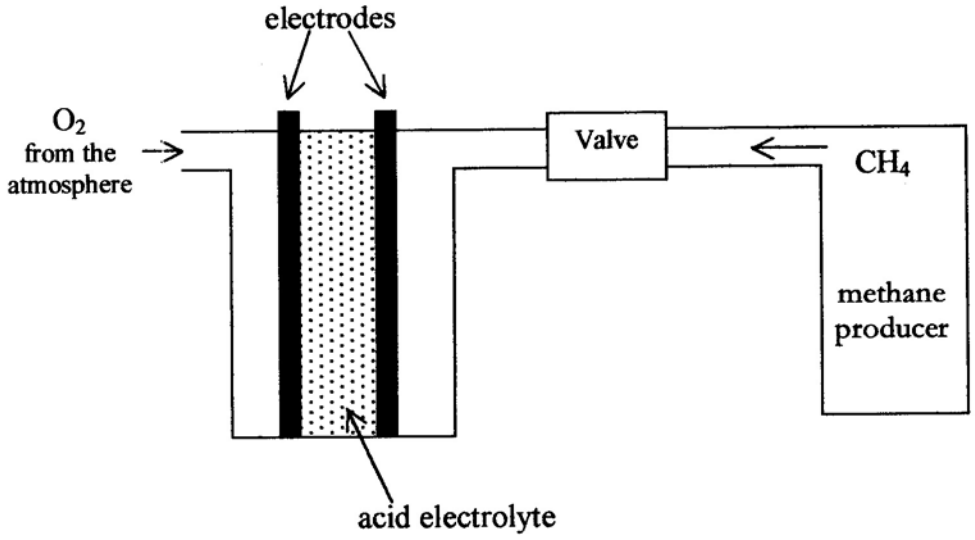
_____

_____

_____

(2 + 2 + 3 = 7 marks)
Suggested time: 9 minutes

Question 2
It has been suggested that in the future some homes could obtain their electricity from an acidic electrolyte fuel cell which consumes methane and oxygen. The methane would be supplied by the decomposition of organic material produced in the home. A possible arrangement is shown below:



The overall equation for such a fuel cell is:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

(a) What compound is oxidised in the reaction? Explain your answer.

_____

_____

(b) Write a partial ionic equation for the oxidation reaction.

_____

_____

(c) Suppose the current drawn by a household connected to this fuel cell averages 5.00 A. What volume of methane, measured at SLC, is consumed by the cell each day if 70% of the energy produced by the cell is converted into electricity?

(d) Give one major difference between the operation of a fuel cell and the operation of a galvanic cell such as a simple dry cell battery.

_____

_____

_____

_____

(2 + 1 + 5 + 1 = 9 marks)
Suggested time: 11 minutes

Question 3
Soybean oil contains stearic acid, oleic acid and eleostearic acid.

Stearic acid
$CH_3(CH_2)_{16}COOH$

Oleic acid
$CH_3(CH_2)_7CH=CH(CH_2)_7COOH$

Eleostearic acid
$CH_3(CH_2)_7CH=CHCH=CHCH=CH(CH_2)_3COOH$

(a) These three fatty acids combine with glycerol to form triglycerides.
State which one or more of the fatty acids would be expected to form a saturated triglyceride. Explain your selection(s).

_____

_____

_____

(b) Explain why soybean oil is a liquid rather than a solid.

_____

_____

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_____

(c) These three fatty acids all contain 18 carbon atoms. Suggest an experimental method, which could be performed in a school laboratory, to distinguish between oleic acid and eleostearic acid.

_____

_____

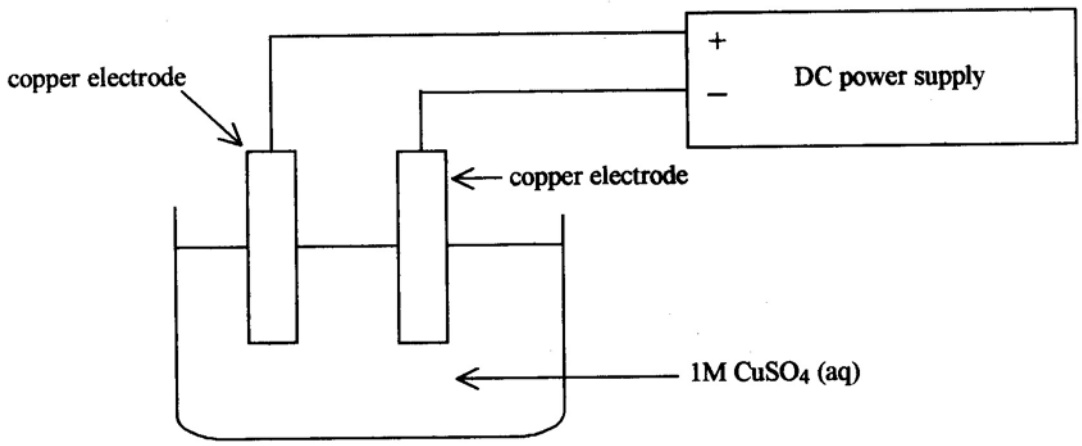
_____

_____

_____

(1 + 2 + 2 = 5 marks)
Suggested time: 6 minutes

Question 4
In an experiment to determine the value of the Avogadro constant, N_A, a Chemistry student carries out an electrolysis using the equipment shown in the diagram.



The voltage is adjusted so that no gas is observed at either of the two electrodes. After a time of 12.0 minutes at an average current of 1.40 A, the electrodes are removed, carefully rinsed, dried and weighed. The mass of the negative electrode is found to have increased by 0.393 g.

(a) Determine the charge which flowed through the circuit in the 12.0 minutes.

(b) Determine the amount, in mol, of copper that has been deposited on the negative electode.

(c) Use your answers to parts (a) and (b) to calculate a value for the Faraday constant, F.

(d) Calculate a value for the Avogadro constant, N_A, given that the charge on one electron is 1.60×10^{-19}C.

(2 + 1 + 2 + 1 = 6 marks)
Suggested time: 9 minutes

Question 5
A teacher wished to demonstrate the fading of a green cobalt(II) sulfate solution to form a colourless solution and solid cobalt. Several reagents were readily available. These included:

- lithium bromide(aq)
- calcium chloride(aq)
- iron(II) iodide(aq)
- copper(s)
- sodium(s)
- zinc(s)

(a) Choose a reagent from the six available substances that would be suitable for the demonstration.

_____

(b) (i) Explain the choice of reagent you made in part (a).

_____

_____

_____

_____

(ii) Write an **ionic** equation for the reaction producing solid cobalt.

_____

_____

_____

(c) Explain why the ionic compounds of many transition elements are coloured.

_____

_____

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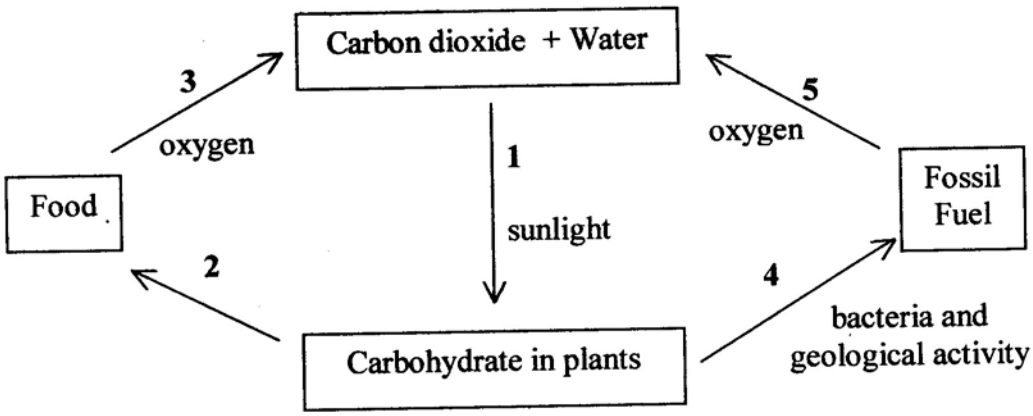
_____

(1 + 2 + 2 = 5 marks)
Suggested time: 6 minutes

Question 6
A simplified carbon-oxygen cycle is shown in the diagram.



(a) Name the process in step **1** and write a balanced equation to represent the process.

_____

_____

(b) Name the process in step **3** and state whether it is an endothermic or exothermic reaction.

_____

_____

(c) In step **4** the polymer, cellulose, in plants is changed into fuel.

(i) What kind of chemical reaction is involved in forming cellulose?

_____

_____

(ii) Name the monomer from which it is formed.

_____

(d) (i) What type of reaction possibly occurs in step **5**?

_____

(ii) Describe an advantage and a disadvantage of this reaction.

_____

_____

_____

_____

_____

_____

(e) State two foods obtained from plants that contain significant amounts of digestible carbohydrates.

_____

_____

_____

(2 + 1 + 1 + 3 + 1 = 8 marks)
Suggested time: 10 minutes

Question 7
The following questions refer to elements of Period 3.

(a) Solid sodium has a melting temperature of 98°C and solid chlorine has a melting temperature of –101°C.

(i) Describe the structure and bonding in each of these solids.

(ii) Use your description of the bonding to explain the reason for the difference in melting temperatures.

(b) A sodium atom is larger than a chlorine atom, although the chlorine atom has 17 electrons while a sodium atom has only 11. Give an explanation of this observation.

(c) Write a balanced equation for the reaction between an oxide of a Period 3 element and water, resulting in a basic solution.

_____

_____

(d) Write a balanced equation for the reaction between an oxide of a Period 3 element and water, resulting in an acidic solution.

_____

_____

(7 + 2 + 1 + 1 = 11 marks)
Suggested time: 14 minutes

END OF QUESTION AND ANSWER BOOK