GOVERNMENT OF SAMOA

STUDENT EDUCATION NUMBER									

Samoa Secondary Leaving Certificate

CHEMISTRY

2024

QUESTION and ANSWER BOOKLET

Time allowed: 3 Hours & 10 minutes

INSTRUCTIONS

1. You have 10 minutes to read **before** you start the exam.
2. Write your **Student Education Number (SEN)** in the space provided on the top right hand corner of this page.
3. **Answer ALL QUESTIONS.** Write your answers in the spaces provided in this booklet.
4. If you need more space, ask the Supervisor for extra paper. Write your SEN on all extra sheets used and clearly number the questions. Attach the extra sheets to the appropriate places in this booklet.

NB: The Periodic Table is attached on page 23 of the exam paper.

STRANDS		Pages	Time (min)	Weighting
STRAND 1	ATOMIC STRUCTURE AND BONDING	2-4	27	15
STRAND 2	QUANTITATIVE CHEMISTRY	5-8	31	17
STRAND 3	ORGANIC CHEMISTRY	9-12	34	19
STRAND 4	INORGANIC CHEMISTRY	13-14	18	10
STRAND 5	PRINCIPLES OF PHYSICAL CHEMISTRY	15-16	18	10
STRAND 6	OXIDATION AND REDUCTION	17-20	36	20
STRAND 7	ENVIRONMENTAL CHEMISTRY	21-22	16	9
TOTAL			**180**	**100**

Check that this booklet contains pages 2-24 in the correct order and that none of these pages are blank.

HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

STRAND 1: **ATOMIC STRUCTURE AND BONDING** **WEIGHTING 15**

1. The position of each atom in a molecule gives the molecule a particular shape. There are FOUR important molecular shapes and ONE of which is linear.

   Name a molecule with a linear shape.

SL 1

_____

2. Describe **ONE** trend of the ionic radius across Period 3 or within Group 17 on the periodic table.

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SL 2

3. Draw the electron dot diagram for the CH_4 molecule.

SL 2

4. Ionic bonds form in chemical reactions between atoms and resulting in the production of ions.

Explain how an atom changes to an ion.

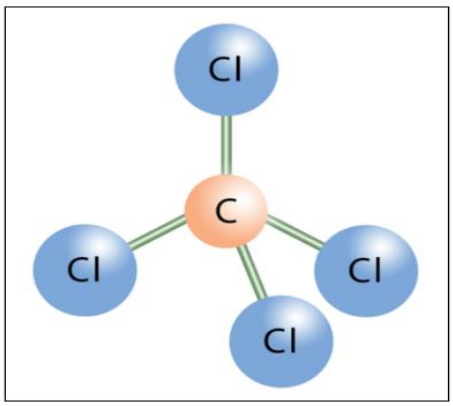
SL 3

5. Copper is an excellent conductor of electricity due to its unique properties.

Explain in terms of structure and bonding, why copper is a good conductor of electricity.

SL 3

6. Discuss why the tetrachloromethane (CCl_4) molecule has polar bonds but the molecule is non-polar as shown in the diagram below:



Source: https://www.chemistrylearner.com/polarity/ccl4-polarity

SL 4

For Questions 7 to 9, choose and write the LETTER of the correct answer in the box provided.

7. The symbol ***"(aq)"*** in chemical equations denotes that the substance is in a/an:

A. gas state.
B. solid state.
C. liquid state.
D. aqueous state.

	SL 1

8. In analytical chemistry, a standard solution is either the titrant or titrator. A standard solution is defined as:

A. solution with a low pH.
B. solution with a high pH.
C. solution for which the concentration is accurately known.
D. solution for which the concentration is accurately unknown.

	SL 1

9. Avogadro's number, which gives the number of units in one mole of a substance, is:

A. 6.02×10^{-23} mol^{-1}
B. 8.314 J/mol·K
C. $6.62607015 \times 10^{-34}$ joule-$hertz^{-1}$
D. 96,485.3399 Coulombs per mole

	SL 1

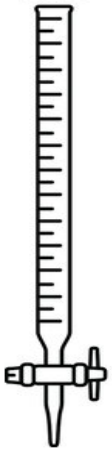
10. A student wishes to prepare 250 mL of a 0.20 mol/L solution of oxalic acid $(COOH)_2.2H_2O$.

Calculate the mass of oxalic acid the student would need to weigh.

$M((COOH)_2.2H_2O) = 126$ g/mol

SL 2

11. The two-glassware given in the diagram below are used in preparing solutions for titrations. Name the **TWO** glassware.



SL 2

_____ _____

12. Magnesium burns in air to form magnesium oxide. The equation for the reaction is:

$$2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$$

A student weighed out 2.4 g of magnesium and burned it in the air.

Calculate the number of moles of magnesium oxide produced.

M(Mg) = 24 g/mol **M(O) = 16 g/mol**

SL 3

13. 10 ml of a solution of hydrochloric acid containing 0.04 mol of solute is diluted to 100 mL by adding 90 mL of water.

Calculate the concentrations of the solution before and after the dilutions.

SL 3

14. Standard solutions can be used for both the qualitative and quantitative analysis of substances.

Discuss **ONE** use of standard solutions in industries.

SL 4

STRAND 3: **ORGANIC CHEMISTRY** **WEIGHTING 19**

For Questions 15 and 16, choose and write the LETTER of the correct answer in the box provided.

15. Which of the following is the functional group for ketones?

A. O-H
B. C=O-O-H
C. C=O-O
D. C=O

SL 1

16. Which of the following is the functional group for aldehydes?

A. O-H
B. C=O-O-H
C. CH=O
D. C=OO

SL 1

17. Ethyl ethanoate is a colourless liquid, has a sweet smell, and is found in glues and nail polish removers.

Describe he laboratory procedure for the preparation of ethyl ethanoate.

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SL 2

18. Polyvinyl chloride is the world's third most widely produced synthetic polymer. List any **TWO** uses of polyvinyl chloride (PVC).

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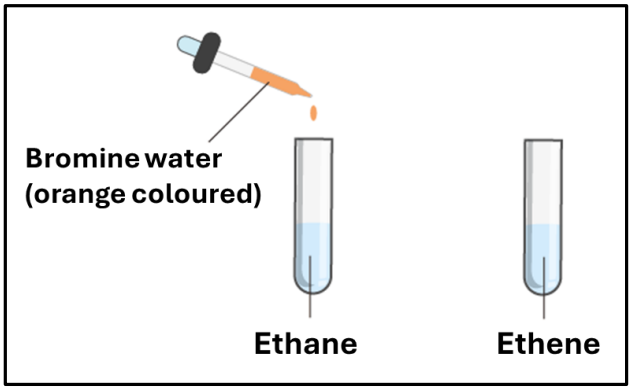
SL 2

The bromine test is a straightforward method used to distinguish between alkanes and alkenes.



Source: https://cdn1.byjus.com/wp-content/uploads/2019/05/bromine-test.png

19. With reference to the diagram above, describe the unsaturation test that distinguishes alkanes from alkenes.

SL 2

20. Glucose is a simple sugar with the molecular formula, $C_6H_{12}O_6$. It is one of the most important carbohydrates, serving as a primary energy source for cells. The structure of glucose can be represented in several ways, including its linear and cyclic forms.

Draw the linear structure of glucose.

SL 3

21. Discuss **ONE** important observation that would be made when propanol is warmed with methanoic acid and in the presence of sulfuric acid.

SL 4

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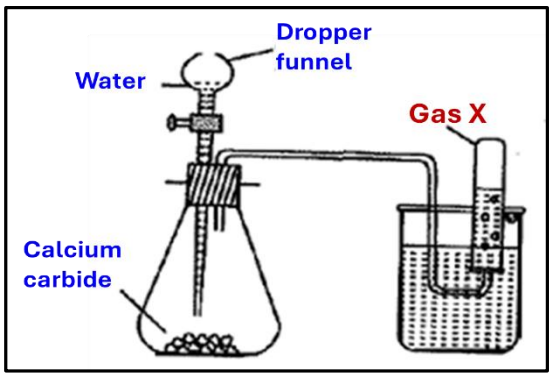
22. When a few drops of water are added to a calcium carbide lump, **Gas X** forms as shown in the diagram below.



Discuss **ONE** observation that can be made when **Gas X** is being produced in the above experiment.

SL 4

For Questions 23 and 24, choose and write the LETTER of the correct answer in the box provided.

23. Which of the following is an example of an acidic oxide?

A. Na_2O
B. CaO
C. MgO
D. SO_2

SL 1

24. The maximum amount of salt that can dissolve in a given solvent under specific conditions refer to its:

A. solubility.
B. volume.
C. salinity.
D. concentration.

SL 1

25. Describe the appearance in solution of these complex ions:

(i) $[Cu(NH_3)_4]^{2+}$

_____

_____

SL 2

(ii) $[Ag(NH_3)_2]^{+}$

_____

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26. Write a balanced equation for the reaction of sodium chloride, NaCl and water, H_2O.

_____

SL 3

Source: https://qph.cf2.quoracdn.net/main-qimg-0c62b84b8704827111e03c3072fd74b7-lq

27. Ice is a solid substance produced by the freezing of water vapour or liquid water.

Explain why ice is less dense than water.

SL 3

For Questions 28 and 29, choose and write the LETTER of the correct answer in the box provided.

28. Amphiprotic is defined as the substance that:

A. can either accept or donate protons.
B. accepts only protons.
C. donates only protons.
D. cannot accept or donate protons.

	SL 1

29. Which of the following is an example of an **exothermic reaction**?

A. Photosynthesis.
B. Making ice cream in a bag.
C. Ice melts.
D. Respiration.

	SL 1

30. Write the equilibrium constant (K_c) expression for the reaction below:

$$N_{2(g)} + O_{2(g)} \leftrightharpoons 2NO_{(g)}$$

SL 2

_____

31. Find the [$\mathbf{H^+}$] and the [$\mathbf{OH^-}$] of a solution with a pH of 3.49.

SL 3

32. Use the information listed below, to find the ΔH, the heat of reaction, when methane burns according to the equation:

$$\mathbf{CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}}$$

I.	$C_{(s)}$	+	$2H_{2(g)}$	$\rightarrow$	$CH_{4(g)}$	$\Delta H = -75$ kJ
II.	$C_{(s)}$	+	$O_{2(g)}$	$\rightarrow$	$CO_{2(g)}$	$\Delta H = -393$ kJ
III.	$2H_{2(g)}$	+	$O_{2(g)}$	$\rightarrow$	$2H_2O_{(g)}$	$\Delta H = -484$ kJ

SL 3

For Questions 33 and 34, choose and write the LETTER of the correct answer in the box provided.

33. The oxidation number of $\mathbf{N}^{-}$ is:

A. -3
B. -2
C. -1
D. 0

	SL 1

34. When a chemical change occurs and when an electric current is passed through an electrolyte, it is called:

A. electrolysis.
B. conduction.
C. refluxing.
D. saponification.

	SL 1

35. Oxidising agents are substances involved in a redox chemical reaction that gains or accepts electrons.

List **TWO** common **oxidizing agents**.

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SL 2

36. A student placed a piece of copper metal in concentrated hydrochloric acid.

Describe **ONE** observation the student would make during this reaction.

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_____
_____
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_____

SL 2

37. Write an overall equation showing iodide ions reducing iron (III) ions to iron (II) ions.

SL 3

38. Arrange the following compounds in ascending order based on the oxidation number of chlorine.

Cl_2 $HOCl_4$ Cl^- $HOCl$

SL 3

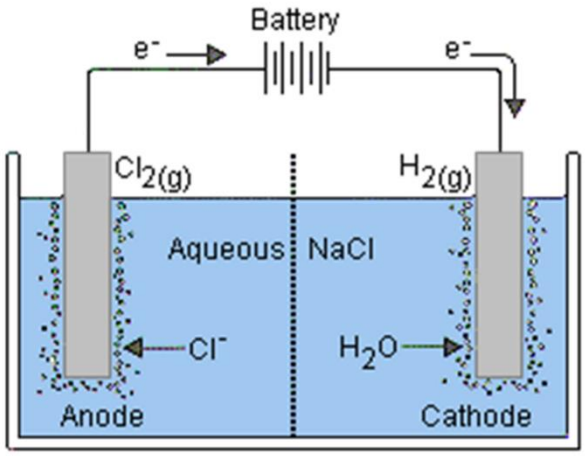
39. Consider the reaction where Sulphur dioxide gas is bubbled through acidified potassium dichromate.

Write the two-electron ion-electron equations for the half-reactions involved in the above redox reaction.

SL 4

Oxidation half equation.

Reduction half equation.



40. Discuss the observations made at the electrodes during the electrolysis of aqueous NaCl, as depicted in the above diagram.

Your response should include the chemical equations for the reactions that occur at both the cathode and anode electrodes.

SL 4

For Questions 41 and 42, choose and write the LETTER of the correct answer in the box provided.

41. The greenhouse effect is a natural process:

A. for producing oxygen.
B. for producing energy.
C. that depletes the ozone.
D. that warms the earth's surface.

	SL 1

42. **Cinder cones** is a type of:

A. biomass energy.
B. volcano.
C. greenhouse gas.
D. natural acids.

	SL 1

43. Energy sources take many forms, including nuclear energy, fossil, wind, solar, geothermal, and hydropower. Some are renewable, others are not.

Distinguish between renewable and non-renewable energy sources.

SL 2

44. The atmosphere consists of several layers, including the troposphere, stratosphere, mesosphere, and thermosphere.

Describe the stratosphere.

SL 2

45. Explain **ONE** importance of renewable energy sources in Samoa.

SL 3

Periodic Table of the Elements

1												13	14	15	16	17	18
1 H Hydrogen 1.008	2																2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305	3	4	5	6	7	8	9	10	11	12	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.933	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.732	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.09	35 Br Bromine 79.904	36 Kr Krypton 84.80
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molibdenum 95.94	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.29
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanides	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103 Actinides	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium unknown	114 Fl Flerovium [289]	115 Uup Ununpentium unknown	116 Lv Livermorium [298]	117 Uus Ununseptium unknown	118 Uuo Ununoctium unknown

57 La Lanthanum 138.906	58 Ce Cerium 140.115	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.966	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]

STUDENT EDUCATION NUMBER									

SSLC CHEMISTRY

2024

(For Scorers only)

STRANDS		Weighting	Scores	Check Scorer	AED check
STRAND 1	ATOMIC STRUCTURE AND BONDING	15			
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	TOTAL	**100**			