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# Samoa School Certificate

# CHEMISTRY

# 2021

## 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 at the appropriate places in this booklet.

**NB:** Periodic Table is inserted as a separate sheet.

STRANDS		Pages	Time (min)	Weighting
STRAND 1	ATOMIC STRUCTURE AND BONDING	2	18	10
STRAND 2	QUANTITATIVE CHEMISTRY	3	22	12
STRAND 3	ORGANIC CHEMISTRY	6	43	24
STRAND 4	OXIDATION AND REDUCTION	10	18	10
STRAND 5	INORGANIC CHEMISTRY	12	50	28
STRAND 6	PRINCIPLES OF PHYSICAL CHEMISTRY	17	29	16
TOTAL			180	100

Check that this booklet contains pages 2-20 in the correct order and that none of these pages are blank.

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

1. Draw the electron arrangement for the chlorine atom and its ion, in the space below.

SL 2

2. Explain why ionic compounds generally have high melting and boiling points.

SL 3

3. Draw the Lewis dot diagram for the CH<sub>4</sub> molecule in the space below.

SL 3

4. Identify TWO isotopes of carbon.

1. \_\_\_\_\_

2. \_\_\_\_\_

SL 2

For Questions 5 to 7, choose and write the LETTER of the correct answer in the box provided.

5. The molar mass of  $\text{CH}_3\text{OH}$  is:

$$M(\text{C}) = 12 \text{ g/mol}$$

$$M(\text{H}) = 1 \text{ g/mol}$$

$$M(\text{O}) = 16 \text{ g/mol}$$

- A. 2
- B. 12
- C. 22
- D. 32

SL 1

6. The relative atomic mass of an element is the:

- A. average mass of a molecule relative to a standard mass.
- B. number of particles in 1 mole of a substance.
- C. average mass for atoms of an element relative to a standard mass.
- D. measurement of small amounts of solids or powders.

SL 1

7. What is the number of moles of carbon atoms in 116 g of butane ( $\text{C}_4\text{H}_{10}$ )?

$$M(\text{C}) = 12 \text{ g/mol},$$

$$M(\text{H}) = 1 \text{ g/mol}$$

- A. 4
- B. 8
- C. 12
- D. 16

SL 1

8. A hydrocarbon containing 82.7% carbon and 17.3% hydrogen by weight has a molar mass of 58 g/mol. Calculate the **empirical** and **molecular** formula for the hydrocarbon.

$$M(\text{C}) = 12 \text{ g/mol}, \quad M(\text{H}) = 1 \text{ g/mol}$$

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SL 4

9. A student wishes to prepare 250 mL of a 0.20 mol/L solution of hydrochloric acid (HCl). Calculate the mass of hydrochloric acid the student would need to weigh for the preparation of the solution.

$$M(\text{HCl}) = 36.5 \text{ g/mol}$$

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SL 2

10. When 6.15 g of hydrated magnesium sulfate ( $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ ) were heated, 3.00 g of anhydrous salt was obtained. Calculate the percentage composition of water in the hydrated sample.

$$M(\text{Mg}) = 24 \text{ g/mol}$$

$$M(\text{O}) = 16 \text{ g/mol}$$

$$M(\text{S}) = 32 \text{ g/mol}$$

$$M(\text{H}) = 1 \text{ g/mol}$$

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SL 3

For Questions 11 to 13, choose and write the LETTER of the correct answer in the box provided.

11. An example of a saturated compound is:

- A. propyne.
- B. butane.
- C. ethane.
- D. pentene.

SL 1

12. In an homologous series of hydrocarbons, all the members have the same:

- A. number of carbon atoms.
- B. molecular formula.
- C. empirical formula.
- D. general formula.

SL 1

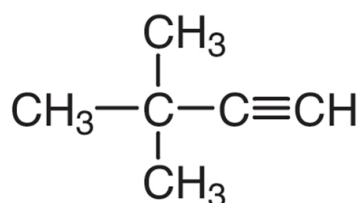
13. Which functional group do alcohol molecules contain?

- A. CH group.
- B. COOH group.
- C. OH group.
- D. COO group.

SL 1

14. What is the name of this compound?

- A. 2,3 methyl butyne.
- B. 2,3 dimethyl butyne.
- C. 3,3 methyl butyne.
- D. 3,3 dimethyl butyne.



SL 1

15. List any TWO physical properties of Alkanes.

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_

SL 2

16. Draw a structural formula for **propan-2-ol**.

SL 2

17. Describe properties or tests you could use to distinguish *ethene* from *ethane*.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SL 2

18. Explain what is meant by "*low density polyethene*."

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_  
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SL 3

19. Explain the reactions of alkynes through an Addition reaction.

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SL 3

20. Discuss the observation that would be made when **propanol** is warmed with **methanoic acid**, in the presence of sulfuric acid, and name the organic product formed.

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SL 4



21. A few drops of water are added to a lump of calcium carbide,  $\text{CaC}_2$ , in a test tube. Discuss the observation that would be made. Include in your discussion a balanced equation to show the chemical reaction that takes place.

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SL 4

For Question 22, choose and write the LETTER of the correct answer in the box provided.

22. The oxidation number of the nitrogen atom in  $\text{HNO}_3$  is:

- A. -5
- B. 0
- C. +5
- D. +10

SL 1

23. List any TWO reducing agents.

- 1. \_\_\_\_\_  
\_\_\_\_\_
- 2. \_\_\_\_\_  
\_\_\_\_\_

SL 2

24. Calculate the oxidation number of chromium in  $\text{Cr}_2\text{O}_7^{2-}$


SL 3

25. Write an **overall equation** showing copper metal reacting with concentrated nitric acid producing nitrogen dioxide,  $\text{NO}_2$ , a brown gas. Show the oxidation-reduction equations and half equations in your working out.

For Questions 26 to 28, choose and write the LETTER of the correct answer in the box provided.

26. Which one is an allotrope of sulfur?

- A. Silica
- B. Diamond
- C. Monoclinic
- D. Buckminsterfullerene

SL 1

27. What is the chemical formula of ozone?

- A.  $O^{2-}$
- B.  $O_3$
- C.  $O_2$
- D.  $OH^-$

SL 1

28. What is the colour of the precipitate of  $Cu(OH)_2$ ?

- A. Pale green
- B. Pale purple
- C. Pale pink
- D. Pale blue

SL 1

29. Name the following compounds:

$K_2CO_3$ : \_\_\_\_\_

$CuCO_3$ : \_\_\_\_\_

SL 2

30. List any TWO physical properties of metals.

1.

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SL 2

2.

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31. Describe the structure of graphite.

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SL 2

32. List any TWO uses of carbon dioxide.

1.

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SL 2

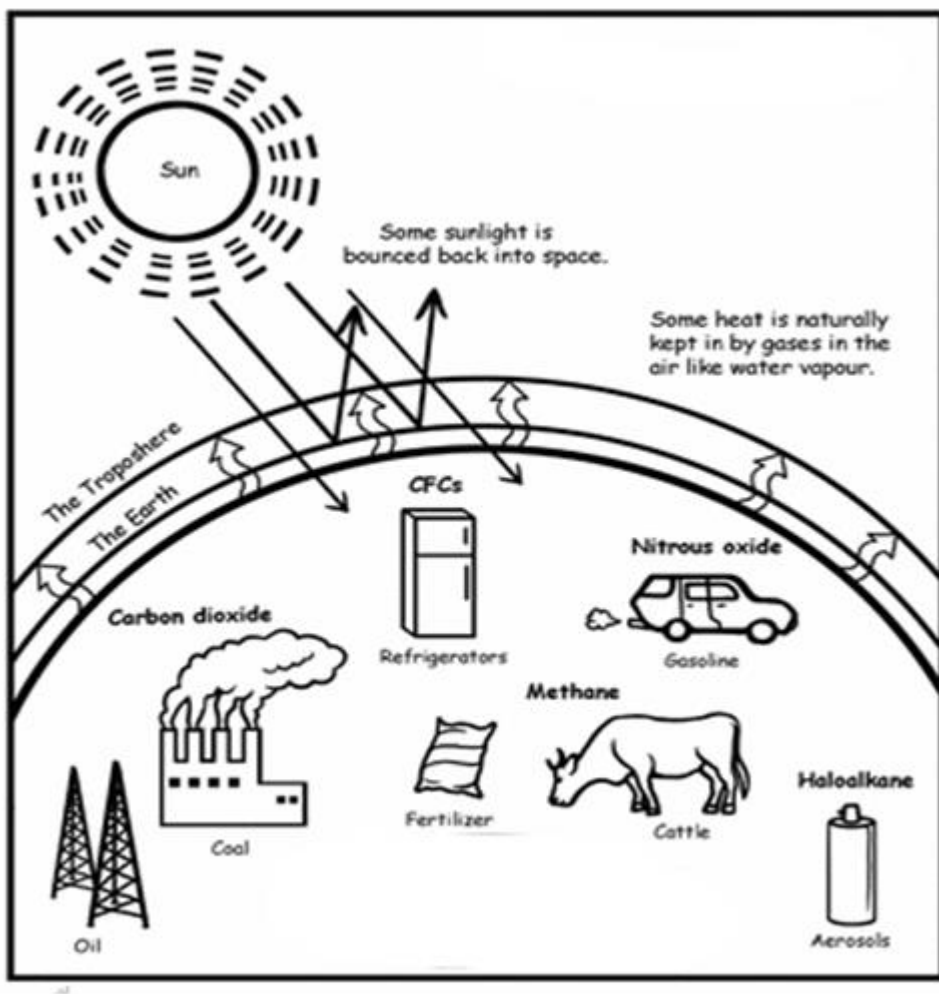
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33.



Explain the relationship between the different processes involved in the diagram above.

[illegible]

SL 3

34. Some sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) solution is added to a magnesium chloride ( $\text{MgCl}$ ) solution.

Write the ionic equation for the reaction and name the final product.

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SL 3

35. Use your knowledge of the rusting process to explain why zinc dust is added to some roofing paints.

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SL 3

36. Draw a schematic diagram for the preparation of hydrogen gas in a school laboratory. Label all glassware and solutions.

37. Discuss how the properties of sulfuric acid influence its uses in real life situations.



For Question 38, choose and write the LETTER of the correct answer in the box provided.

38. Which of the following is an example of an exothermic reaction?

- A. Photosynthesis
- B. Respiration
- C. Ice melting
- D. Iodine sublimation

SL 1

39. Describe how you would show experimentally that aluminum hydroxide is amphoteric.


SL 2

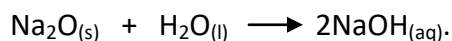
40. Rank the following chemical reactions in order of increasing rate of reaction.

- (a) Calcium reacting with water.
- (b) Boiling an egg.
- (c) Paper yellowing with age.

SL 2

Order: \_\_\_\_\_

41. Consider the following reaction between sodium oxide and water:



Describe the test that can be carried out to determine the acidity or alkalinity of the solution.

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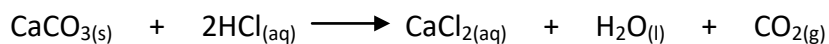
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SL 2

42. To investigate the rate of a chemical reaction, a student used the reaction between a lump of calcium carbonate and hydrochloric acid.



Three experiments in which the concentration of HCl was gradually increased were carried out at a constant temperature using the quantities and concentrations set out in the table below:

Experiment No	Mass of $\text{CaCO}_3$ (g)	Volume of HCl (mL)	Concentration of HCl (mol/L)
1	5	20	0.1
2	5	20	1.0
3	5	20	2.0

Explain how increasing the concentration of HCl would affect the rate of the reaction.

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SL 3

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43. The pH of a 0.01 mol/L nitric acid is found to be approximately 2 whereas the pH of a 0.01 mol/L ethanoic acid solution is found to be approximately 5.

Explain why these two acids of the same concentration have different pH values.

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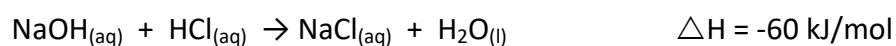
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SL 3

44. The following reaction between hydrochloric acid and sodium hydroxide is an exothermic reaction:



Explain why the reaction is an exothermic one.

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SL 3

STUDENT EDUCATION NUMBER									

## CHEMISTRY

2021

*(For Scorers only)*

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STRAND 1	ATOMIC STRUCTURE AND BONDING	10			
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<b>TOTAL</b>		<b>100</b>			