GOVERNMENT OF SAMOA
MINISTRY OF EDUCATION, SPORTS AND CULTURE

Samoa Secondary Leaving Certificate

CHEMISTRY

2020

QUESTION and ANSWER BOOKLET

Time allowed: 3 hours and 10 minutes

INSTRUCTIONS:

1. You have 10 minutes to read **before** you start writing.
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 for answers, 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		Page	Time (min)	Weighting
STRAND 1:	ATOMIC STRUCTURE AND BONDING	2	31	17
STRAND 2:	QUANTITATIVE CHEMISTRY	5	31	17
STRAND 3:	INORGANIC CHEMISTRY	10	18	10
STRAND 4:	ORGANIC CHEMISTRY	12	40	22
STRAND 5:	PRINCIPLES OF PHYSICAL CHEMISTRY	16	18	10
STRAND 6:	OXIDATION AND REDUCTION	18	42	24
TOTAL			**180**	**100**

Check that this booklet contains pages 2-22 in the correct order and that none of these pages is blank.
HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

1.   Name a molecule with a tetrahedral shape.

SL 1

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2.   Explain why ionisation energy tends to increase across groups.

SL 3

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3.   Draw a diagram of the bonding continuum.

SL 1

4.   Define *atomic radius*.

SL 1

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5. Consider the following solids, each of which is listed with one physical property.

   (i)   Diamond is extremely hard.
   (ii)   Copper is a good conductor of electricity.
   (iii)   Graphite is used as a solid lubricant.

Select **ONE** solid and discuss how the property associated with the solid can be explained in terms of structure and/or bonding in the solid.

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SL 4

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6. The symbol $^{31}_{15}P$ represents an atom which has: *(Circle the best answer).*

SL 1

   A. 15 protons and 31 neutrons.

   B. 31 protons and 15 neutrons.

   C. 15 protons and 15 neutrons.

   D. 15 protons and 16 neutrons.

7. Which of the following compound is a polar molecule? Explain why.

   A. NH_3

   B. CH_4

SL 2

   C. SiH_4

   D. O_2

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8. Define the term *electronegativity*.

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SL 1

9. State the Octet Rule that applies to small atoms.

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SL 1

10. Describe the features of covalent bonds.

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SL 2

11. The equation for the combustion of methane is:

$$CH_{4(g)} \ + \ 2O_{2(g)} \ \longrightarrow \ 2H_2O_{(g)} \ + \ CO_{2(g)}$$
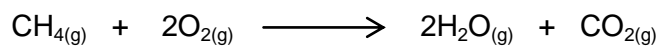
The amount or moles of water vapour formed when 32 g of methane burned is:
(Circle the best answer).

SL 2

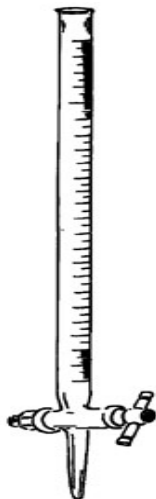   A. 1

    B. 2

    C. 4

    D. 8

    E. 16

Name the pieces of glassware below for Questions 12 and 13.

12.

SL 1

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13.

_____

14. A 7.02 mg sample of a hydrocarbon X gave 21.99 mg of carbon dioxide and 8.95 mg of water on combustion.

Calculate the percentage composition of the elements in the hydrocarbon.

M(C) = 12 g/mol   M(H) = 1 g/mol   M(O) = 16 g/mol

SL 4

15. During the preparation of a standard solution of sodium carbonate (Na_2CO_3), a student obtained the following results:

Mass of beaker = 111.93 g
Mass of beaker and anhydrous sodium carbonate = 114.05 g

The sodium carbonate was dissolved in enough water to make up 250 mL of standard solution.

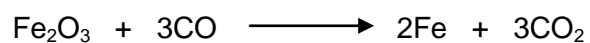Calculate the concentration of the solution.

M(Na) = 23 g/mol   M(C) = 12 g/mol   M(O) = 16 g/mol

SL 3

16. Define the *concentration of a solution.*

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SL 1

17. Iron oxide is converted into iron by carbon monoxide according to the equation:

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

Calculate the mass of iron which could be obtained from 1.6 g of iron oxide.

M(Fe) = 56 g/mol   M(O) = 16 g/mol   M(C) = 12 g/mol

SL 2

18. Define the term *standard solution*.

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SL 1

19. Zinc and iodine react to form zinc iodide, according to the equation:

$$Zn_{(s)} + I_{2(s)} \longrightarrow ZnI_{2(g)}$$
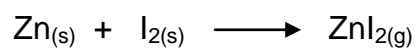
A student weighs out exactly 0.65 of zinc and allows it to react with excess iodine.

What mass of zinc iodide would be formed?

M(Zn) = 65 g/mol   M(I) = 127 g/mol

SL 2

20. Discuss how you remove silver ions, but not copper (II) ions, from a solution containing both silver nitrate and copper nitrate.

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SL 4

21. Which type of elements generally forms cations? _(Circle the best answer)._

    A. Transitional elements

    B. Metals

    C. Non-metals

    D. Noble gases

    E. Halogens

SL 1

22. Explain how sodium sulfate reagent can be used to distinguish between magnesium ions and a solution containing barium ions.

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SL 3

Using the data table below for the oxides of the third period to answer Question 23 below.

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Formula of oxide	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_6	SO_2	Cl_2O_7	-
Melting point of oxide (°C)	1275	2800	2045	1700	24	-73	-92	-

23. Describe TWO trends that can be determined from the table.

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SL 2

24. Describe any characteristic property of esters.

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SL 2

Define the following terms for Questions 25 and 26.

25. Polymerisation

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SL 1

26. Hydrolysis

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_____

SL 1

27. Draw the open and cyclic structures of glucose.

SL 3

28. Write the equation for the reaction between ethanoic acid and ethanol to form an ester. Name the ester produced.

Name of ester:_____

29. Consider the following steps in the oxidation of alcohols A and B.

Alcohol $\xrightarrow{\text{oxidation}}$ $CH_3 - \underset{\underset{O}{\|}}{C} - H$ $\xrightarrow{\text{oxidation}}$ $CH_3 - \underset{\underset{O}{\|}}{C} - OH$

(A)   (P)   (Q)

Alcohol $\xrightarrow{\text{oxidation}}$ $CH_3 - \underset{\underset{O}{\|}}{C} - CH_3$

(B)   (R)
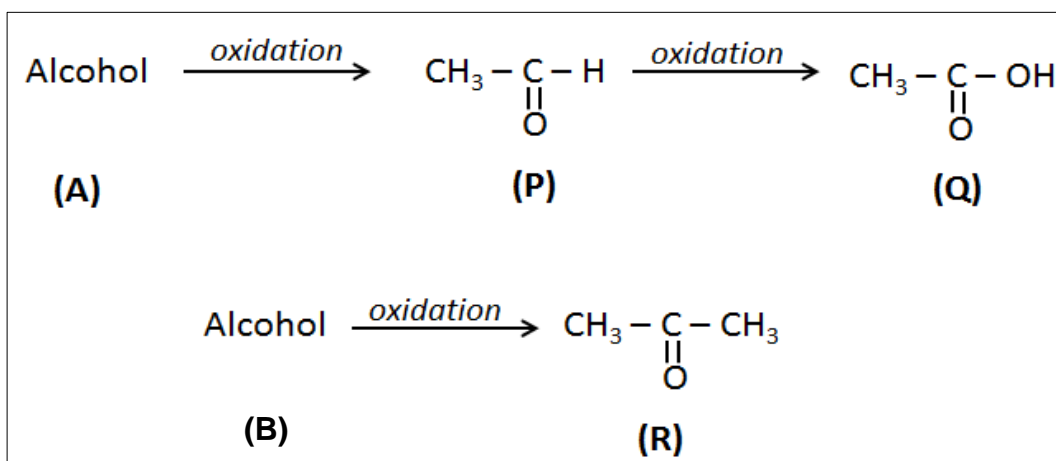
Draw the structures of A and B. What is the difference in these structures which leads to the different oxidation products obtained from each?
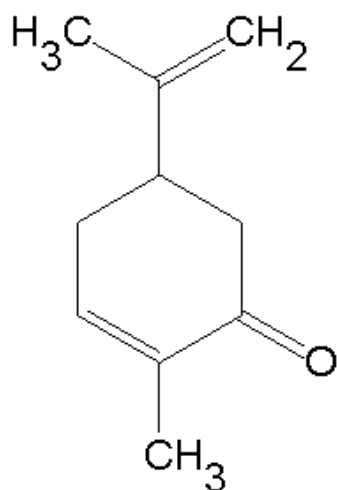
Structure A   Structure B

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30. Discuss why ethanol is easily separated from an original reaction mixture of ethanol and acidified dichromate.

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31. *Carvone* is found in essential oils extracted from plants. It has a sweet and spearmint flavor. Spearmint-flavoured chewing gun gets its flavor from this compound.
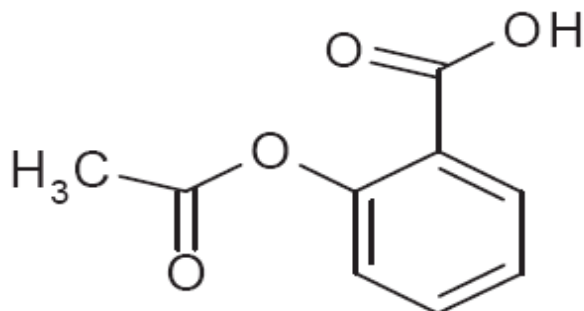
   Circle the **ketone** functional group.

32. *Aspirin* is a medication used to reduce pain, fever or inflammation. Aspirin is also known as acetylsalicyclic acid (ASA).
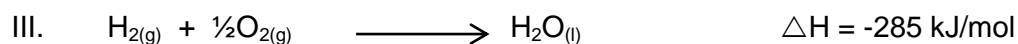
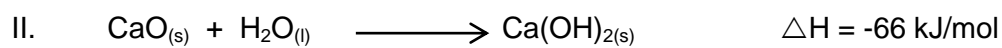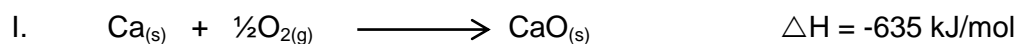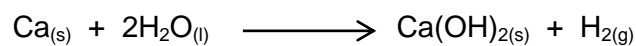**Circle** the **ester** functional group.

SL 1

33. List any uses of PVC.

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SL 2

34. List all factors affecting the rate of reaction.

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SL 2

35. Use the enthalpy changes of the three reactions, I, II and III below to calculate the enthalpy of the reaction:

$$Ca_{(s)} + 2H_2O_{(l)} \longrightarrow Ca(OH)_{2(s)} + H_{2(g)}$$

I. $Ca_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow CaO_{(s)}$ $\triangle H = -635$ kJ/mol

II. $CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_{2(s)}$ $\triangle H = -66$ kJ/mol

III. $H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$ $\triangle H = -285$ kJ/mol
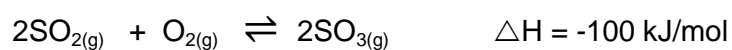
SL 3

36. Write the chemical equation given its equilibrium constant for the reaction:

$$K_c = \frac{[PCl_5]}{[PCl_3][Cl_2]}$$

37. For the equilibrium process which occurs during the production of sulfuric acid:

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \qquad \triangle H = \text{-100 kJ/mol}$$

State how the amount of $SO_{3(g)}$ would alter with the following changes:

(i)   Total pressure of the system is decreased.

_____

_____

(ii)   The temperature is increased.

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(iii) $O_{2(g)}$ is removed.

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38.   Write the ion-electron half equation for the reduction of dichromate ions.

SL 3

39.   Write the ion-electron half equation for the oxidation of sulfate ions.

SL 3

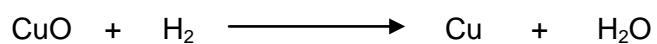**40.**   Define the term *electrolysis.*

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SL 1

41. Write an overall equation showing copper metal reacting with concentrated nitric acid producing nitrogen dioxide, NO_2, a brown gas.

SL 4

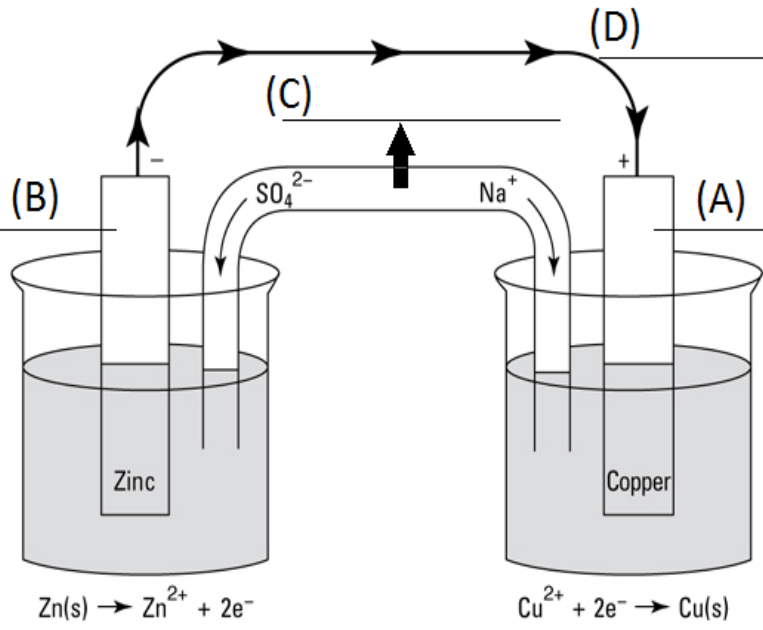**42.** Put circles around the oxidants, and square around the reductants in the following equation:

SL 1

$$CuO \ + \ H_2 \ \longrightarrow \ Cu \ + \ H_2O$$

43. Calculate the oxidation number of phosphorus in H_3PO_4.

SL 1

44. Label on the lines provided, in the electrolysis diagram below the names for (A) to (D).

(D) _____

(C) _____

(B) _____   (A) _____

SO_4^{2-} Na^+

Zinc   Copper

$Zn(s) \rightarrow Zn^{2+} + 2e^-$ $Cu^{2+} + 2e^- \rightarrow Cu(s)$

SL 4

45. Explain the corrosion of metals in vehicles, buildings and bridges in terms of oxidation and reduction.

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SL 3

46. A colourless solution of potassium iodide is added to a purple solution of potassium permanganate acidified with hydrochloric acid. The purple colour disappears to leave a light amber solution of Iodine, $I_{2(aq)}$.

Write the overall equation.

SL 4

CHEMISTRY

2020

For scorers use only

STRANDS	Weighting	Scores	Chief Scorer	Double Entry (AED)
STRAND 1: Atomic Structure and Bonding	17			
STRAND 2: Quantitative Chemistry	17			
STRAND 3: Inorganic Chemistry	10			
STRAND 4: Organic Chemistry	22			
STRAND 5: Principles of Physical Chemistry	10			
STRAND 6: Oxidation and Reduction	24			
TOTAL	**100**			