DEPARTMENT FOR CURRICULUM,
LIFELONG LEARNING AND EMPLOYABILITY
Directorate for Learning and Assessment Programmes
Educational Assessment Unit

Track 3

Annual Examinations for Secondary Schools 2022

YEAR 11 CHEMISTRY TIME: 2 hours

Name: _____ **Class:** _____

Useful Data Atomic numbers and relative atomic masses are shown in the Periodic Table printed below.
One mole of any gas occupies 22.4 dm^3 at standard temperature (0 °C) and pressure (1 atm.).

PERIODIC TABLE

1	2											3	4	5	6	7	0
							1 H 1										4 He 2
7 Li 3	9 Be 4											11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
23 Na 11	24 Mg 12											27 Al 13	28 Si 14	31 P 15	32 S 16	355 Cl 17	40 Ar 18
39 K 19	40 Ca 20	45 Sc 21	48 Ti 22	51 V 23	52 Cr 24	55 Mn 25	56 Fe 26	59 Co 27	59 Ni 28	63.5 Cu 29	65 Zn 30	70 Ga 31	73 Ge 32	75 As 33	79 Se 34	80 Br 35	84 Kr 36
85 Rb 37	88 Sr 38	89 Y 39	91 Zr 40	93 Nb 41	96 Mo 42	99 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86

Key: *a* **X** *b* — relative atomic mass, symbol, atomic number

Marks Grid [For Examiner's use only]

Question Nº.	Section A									Section B			
	1	2	3	4	5	6	7	8	9	10	11	12	
Max Mark	12	6	6	6	6	6	6	6	6	20	20	20	Theory Total
Actual Mark													

Theory Paper: 85%	Practical: 15%	Final Score: 100%

Section A: Answer ALL questions in the spaces provided.
This section carries 60 marks.

1. An unknown element is found to exist as the following two isotopes:

$$^{35}_{17}X \qquad\qquad ^{37}_{17}X$$

a. What is represented by the numbers in the symbols above?

_____

_____ (2)

b. Describe what is meant by the term isotopes.

_____

_____ (2)

c. Explain how the two isotopes given are different from each other.

_____ (1)

d. In experiments, both isotopes were found to show the same chemical behaviour. Explain why.

_____

_____

_____ (2)

e. A naturally occurring sample of X was found to contain 75% of X-35 and 25% of X-37. Calculate the relative atomic mass of element X.

_____

_____

_____ (2)

f. Element X is found in nature as covalent diatomic molecules, X_2. Draw a dot and cross diagram to show the bonding in a molecule of X_2. Show outer shells only.

(3)

Total: 12 marks

2. This question is about the Periodic Table.
   a. Using the Periodic Table provided, give:
      i. the name of the most reactive non-metal. _____ (1)

      ii. the symbol of a metalloid found in period 3. _____ (1)

      iii. the name of a transition metal that can form ions with a +2 or a +3 charge.

_____ (1)

   b. An ionic compound is formed between two elements having the following electron configurations:

      Element 1: **2, 8, 1** Element 2: **2, 6**

      Draw a dot and cross diagram showing all electron shells, to show the bonding in the compound formed. Label the two elements with their proper chemical symbol.

(3)

Total: 6 marks

3. This question is about group 1 and group 2 metals.
   a. Arrange the group 2 metals according to their decreasing reactivity, starting with the most reactive metal. Use the chemical symbols in your answer.

_____ (1)

   b. Explain why the reactivity in group 2 changes in the order you gave in part (a).

_____

_____

_____ (2)

   c. Write a balanced chemical equation for the reaction of calcium with water.

_____ (2)

   d. Would potassium react less or more vigorously than calcium with water?

_____ (1)

Total: 6 marks

4. The following question is about the effect of heat on substances.
   a. Two students were investigating the effect of heat on various solid substances. They placed a small sample of each solid in a test-tube and proceeded to heat the substances over a Bunsen flame. They recorded their observations in the table below.

Solid substance	**Observations on heating**
A: dark purple-black crystals	Quickly changes to a purple gas.
B: white crystalline	Brown gaseous mixture that relights a glowing splint evolved; yellow solid residue that turns white on cooling.
C: white crystalline	A dense white smoke produced.
D: blue-green powder	Black residue left behind; colourless droplets formed at the test-tube's mouth.

From the following list of substances, choose the correct substance that you think best fits the observations recorded. Each substance in the list can be used once or not at all.

sugar	lead(II) nitrate	copper(II) carbonate
zinc nitrate	iodine	calcium hydroxide
copper(II) hydroxide	potassium nitrate	ammonium chloride

Write your answers in the following table:

Solid A	
Solid B	
Solid C	
Solid D	

(4)

   b. Calcium hydrogencarbonate [$Ca(HCO_3)_2$] decomposes on heating to give limestone, a gas that turns limewater milky, and water. Write a balanced equation for this thermal decomposition.

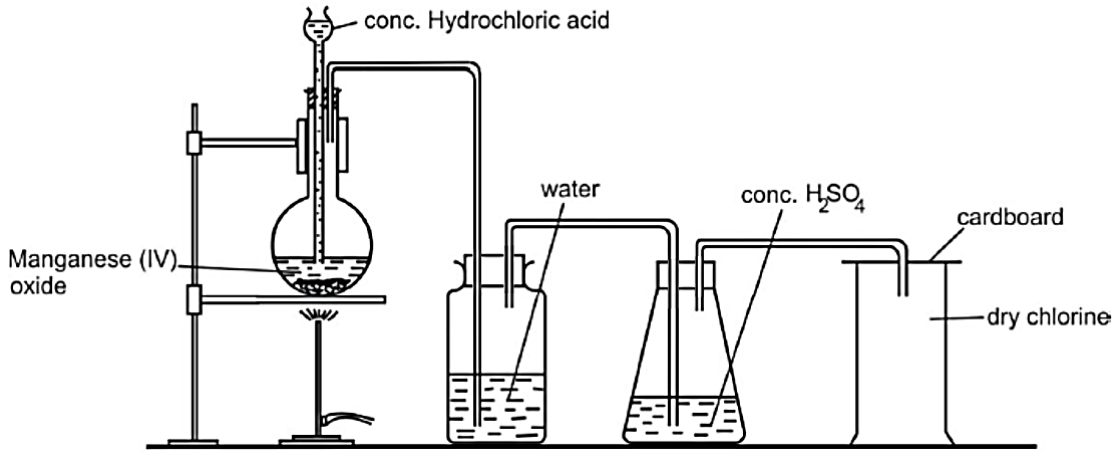
_____

_____ (2)

Total: 6 marks

5. This question is about group 7 elements.
   a. In the lab, chlorine can be prepared by the reaction of manganese(IV) oxide with concentrated hydrochloric acid. Following are the balanced equation and the apparatus used.

$$4HCl(l) + MnO_2(s) \rightarrow MnCl_2(aq) + Cl_2(g) + 2H_2O(l)$$



   i. Give a reason why the gaseous mixture produced is passed through water.

_____

_____ (1)

   ii. Why is the remaining gaseous mixture then passed through conc. sulfuric acid?

_____ (1)

   iii. Why is dry chlorine collected using the method shown in the diagram?

_____ (1)

   b. When chlorine is bubbled through a solution of sodium bromide, a reddish-brown liquid is produced. However, when iodine crystals are added to a solution of sodium bromide, no reaction occurs.
      i. Write an ionic equation, omitting spectator ions, for the reaction of chlorine with sodium bromide solution.

_____

_____ (2)

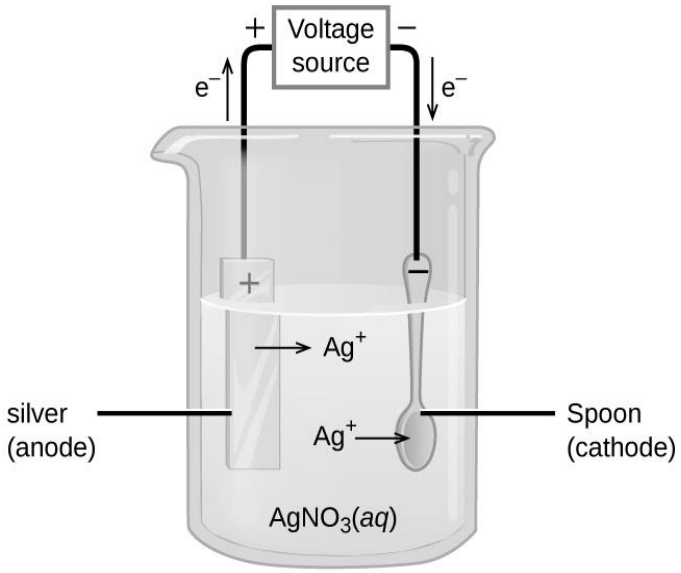
   ii. From the above observations, what do you conclude about the reactivity of iodine, bromine, and chlorine?

_____

_____ (1)

Total: 6 marks

6. The following question is about electrolysis. The diagram shows the setup used in order to electroplate a metal spoon with silver.



a. Give the ionic half equation that occurs at the anode.

_____ (2)

b. Give the ionic half equation that occurs at the cathode.

_____ (2)

c. In another experiment, the silver anode is replaced by another made of graphite. Name the product that would be given off at the graphite anode.

_____ (1)

d. Mention another industrial application that uses active electrodes as in the case of electroplating.

_____ (1)

Total: 6 marks

7. Propane, propene, and propyne are all hydrocarbons but they belong to different homologous series.
   a. Explain why these organic compounds are classified as hydrocarbons.

_____

_____ (1)

b. State why propene is known as an alkene.

_____

_____ (1)

c. Draw the structural diagrams of propene and propyne.

Propene	Propyne

(2)

d. Propane is commonly used as a fuel. Give a balanced equation for the complete combustion of this gas.

_____

_____ (2)

Total: 6 marks

8. During the Haber Process the following dynamic equilibrium reaction occurs.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

a. Explain the meaning of the term dynamic equilibrium.

_____ (1)

b. State an important condition related to the setup which is required for such an equilibrium to be established.

_____ (1)

c. State whether the amount of ammonia will increase or decrease when:

i. Pressure is decreased: _____ (1)

ii. Hydrogen is added: _____ (1)

d. In industry a catalyst in the form of finely divided iron is added. State the effect of the catalyst, if any, on the equilibrium position.

_____

_____ (1)

e. Name a crystalline substance made from ammonia which is used to increase crop production in the world.

_____ (1)

Total: 6 marks

9.

a. Fill in the blanks:

i. When water is added to anhydrous copper(II) sulfate powder it changes colour from _____ to blue. The blue substance is known as _____ copper(II) sulfate. (1)

ii. When sodium hydroxide solution is added to a solution containing lead(II) ions, a _____ precipitate forms which is _____ in excess sodium hydroxide solution. Since other ions including _____ give the same result, a confirmatory test is performed whereby adding a few drops of potassium iodide solution give a _____ precipitate. (2)

iii. A flame test on sodium chloride crystals gives a _____ flame while a similar test on potassium chloride gives a _____ flame. (1)

b. The presence of halide ions can be detected by addition of acidified silver nitrate solution. Write an ionic equation to show what happens when bromide ions are present.

_____

_____ (2)

Total: 6 marks

Section B: Answer any TWO questions only on the foolscaps provided. This section carries 40 marks.

10. Two students carried out an experiment to find the concentration of a solution of sulfuric acid. They transferred 25.00 cm^3 of sulfuric acid solution into a conical flask, added a few drops of indicator and carried out a titration using a burette. The acid was neutralized by exactly 30.00 cm^3 of potassium hydroxide solution of concentration 2.0 mol dm^{-3}.
    a. Write a balanced chemical equation including state symbols for the reaction taking place. (3)
    b. Describe the experimental procedure for the titration carried out by the student starting from the cleaning steps required. (6)
    c. Draw a diagram of the burette which is normally used in this experiment. (1)
    d. Calculate the concentration of the sulfuric acid in mol dm^{-3}. (4)
    e. State whether sulfuric acid is a strong or weak acid and explain your reasoning. (2)
    f. When sulfuric acid is added to magnesium, a colourless odourless gas is evolved.
        i. Name and draw the part of the apparatus setup which can be used to collect and measure the volume of the gas produced. (2)
        ii. Name the gas produced and describe a simple test which is used to identify it. (2)

Total: 20 marks

11. Iron is a very important transition metal. It is extracted from ores by reduction in a Blast Furnace.
    a. Give **two** properties of transition metals. (2)
    b. Name the ore from which iron is extracted. (1)
    c. Draw a labelled diagram of the Blast Furnace. Show clearly from where iron and slag are removed. (4)
    d. Write an equation to show the reduction of iron(III) oxide to iron by means of carbon monoxide. (2)
    e. Explain in terms of oxidation states (oxidation numbers), why the reaction in part (d) is a redox reaction. (2)
    f. Rust is an example of oxidation. Name **two** other substances besides iron which are required for rusting to occur. (1)
    g. Mention a method of rust prevention and explain how it works. (2)
    h. When in solution Fe^{2+} ions can be converted to Fe^{3+} ions by adding an oxidizing agent.
        i. State the colour of Fe^{2+} ions in aqueous solution. (1)
        ii. Explain the meaning of oxidizing agent. (1)
        iii. Write a balanced ionic half equation for this reaction. (2)
        iv. Explain why a solution of iron(II) sulfate becomes brown when the bottle was left open. (2)

Total: 20 marks

12. An experiment was carried out to find the rate at which hydrogen peroxide decomposes in the presence of manganese(IV) oxide catalyst. A conical flask containing 25 cm^3 of 2.0 mol dm^{-3} hydrogen peroxide solution was placed on a digital weighing balance. 2.0 g of solid catalyst in large pieces was added, and the neck of the flask was covered with cotton wool. The mass of the flask and its contents was measured at the start of the reaction and then at 2-minute intervals for 12 minutes. The results are shown in the table below.

Time (minutes)	0	2	4	6	8	10	12
Mass of flask and contents (grams)	102.00	101.64	101.50	101.44	101.41	101.40	101.40

a. Plot these results on the graph paper provided on page 11. (6)
b. Write a balanced chemical equation for the catalytic decomposition of hydrogen peroxide. (2)
c. What mass of gas is formed? (1)
d. How long does the reaction take to be completed? (1)
e. How long does it take for half the total mass of gas to be given off? (2)
f. By referring to the collision theory, explain why the time taken in part (e) is different from half the time in part (d)? (2)
g. On the graph plotted in part (a), sketch the curve you would expect to obtain if 25 cm^3 of 1.0 mol dm^{-3} hydrogen peroxide solution was used in a similar experiment. Label it 'G'. (2)
h. By referring to the collision theory, explain why curve G is different from the original curve. (1)
i. On the graph plotted in part (a), sketch the curve you would expect to obtain if 2.0 g of powdered manganese(IV) oxide catalyst were used in the original experiment. Label it 'H'. (2)
j. What factor was changed in part (i). (1)

Total: 20 marks