**NAME: …………………………………………………………… ADM NO: ……………….**

**SCHOOL: ……………………………………………CANDIDATE SIGN: ………………… DATE: ……………………..……………**

**233/2**

**CHEMISTRY PAPER 2**

**THEORY**

**APRIL-2023**

**TIME: 2 HRS**

**MOMALICHE 2 CYCLE 10-2023.**

***Kenya Certificate of Secondary Education (KCSE)***

**INSTRUCTIONS TO CANDIDATES**

* Write your **Name, Admission Number** and **School** in the spaces provided above.
* Answer **all** the questions in the spaces provided after each question.
* Mathematical tables and non-programmable electronic calculators may be used.
* **ALL** working must be clearly shown where necessary.

**FOR EXAMINER’S USE ONLY**

|  |  |  |
| --- | --- | --- |
| **QUESTIONS** | **MAX SCORE** | **CANDIDATE’S SCORE** |
| 1 | 12 |  |
| 2 | 10 |  |
| 3 | 13 |  |
| 4 | 11 |  |
| 5 | 13 |  |
| 6 | 10 |  |
| 7 | 9 |  |
| **TOTAL** | **80** |  |

1. The grid below forms part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements

**P**

**Q**

**R**

**S**

**T**

**U**

**V**

**W**

**X**

**Y**

**Z**

**M**

1. Write the general name given to the element P belong. **(1mark)**

……………………………………………………………………………………

1. An element N has an atomic number of 15. Write down its electronic arrangement and hence fix it in its right position on the grid above. **(1mark)**

Electronic arrangement

…………………………………………………………………………

1. Compare the size of the atom of R and that of its ion. Explain your answer.

**(2mks)**

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1. Give the formula of the compound formed between **(1mark)**

1. P and W …………………………………………………………………………
2. T and Y …………………………………………………………………………..
3. Compare the melting points of element Q and S. Explain **(2Mks)**

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1. State the least reactive element in the grid. Give a reason for your answer **(1mk)**

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1. Give two advantages that element S has over element Q in making electric cables

**(2mks)**

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1. Draw (a) dot (.) and cross (x) diagram to represent the bonding in compound formed between T and Y **(2 marks)**

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1. a) Study the table below and answer the questions that follow

Bond type bond energy kJmol-1

C-C 346

C = C 610

C-H 413

C-Br 280

Br-Br 193

i) Calculate the enthalpy change for the following reaction **(3 marks)**

C2H4(g) + Br2(g) C2H4Br2(g)

…………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

ii) Name the type of reaction that took place in (a) above **(1mark)**

………………………………………………………………………………………………

b) Butane C4H10 cannot be prepared directly from its elements but its standard heat of formation () can be obtained indirectly.

The following heats of combustion are given.

(Carbon) = -393kJ/mol

(Hydrogen) = -286kJ/mol

(Butane) =-2877kJ/mol

* + 1. Draw an energy cycle diagram linking the heat of formation of butane with its heat of combustion and the heat of combustion of its constituents elements.

**(2mk)**

**……………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………**

* + 1. Calculate the heat of formation of butane (C4H10) **(2mks)**

**…………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………**

c) Given that the lattice enthalpy of potassium chloride is +690kJ/mol and hydration enthalpies of K+ and Cl- are -322kJ and -364kJ respectively. Calculate the enthalpy of solution of potassium chloride. **(3 mks)**

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1. The diagram below represents the Haber process for the manufacture of ammonia. Study it and answer the questions that follow.

Nitrogen Hydrogen

Purifier

Unreacted Compressor

Gases 500 atmosphere

Condenser Heat

Exchanger

Liquid ammonia 10%

Ammonia

Catalytic

Chamber

a) Name any two impurities removed by the purifier. (1mark)

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b) The catalyst used in the process is finely divided iron. Why iron is finely divided? (1mk)

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c) In the Haber process the conversion of nitrogen and hydrogen into ammonia is only 10%.

The remaining unreacted gases are recycled. What is the advantage of this? (1mk)

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d) A part from iron catalyst and pressure of 500 atmospheres, name any other condition required for this process. (1mk)

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e) Give any two uses of ammonia (1mk)

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f) In the manufacture of nitric (v) acid from ammonia and air, ammonia is catalytically oxidized to nitrogen (ii) oxide

(i) Name the catalyst used in this reaction (1mk)

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(ii) Write a balanced chemical equation for the reaction between ammonia and air. (1mk)

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(iii) State one environmental problem likely to be faced in an area where nitric (v) acid manufacturing plant is located. (1mark)

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g) (i) In the preparation of chlorine gas in a school laboratory, either manganese (IV) oxide or potassium manganate(VII) may be used on concentrated hydrochloric acid. State one advantage of potassium manganate (VII) over manganese (IV) oxide in this reaction. (1mark)

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(ii) State and explain what would be observed when dry litmus papers are dipped in a gas jar of chlorine. (1mark)

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(iii) Freshly prepared chlorine water bleaches but chlorine water exposed to sunlight for sometime does not bleach. Explain. (2marks)

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(iv) When preparing hydrogen chloride gas from sodium chloride and sulphuric (VI) acid, two conditions are necessary. State the conditions. (1mark)

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1. A label on the bottle containing Sulphuric (IV) acid has the following information

* Density = 1.836 g/cm3
* Percentage purity = 98%
* Relative formula mass = 98

1. Calculate:
2. The concentration of the acid (3 mks)

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

1. The volume of concentrated sulphuric (IV) acid that should be diluted to produce 2 litres of 2 M Sulphiric (IV) acid (2 mks)

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(b) A solution of sodium hydroxide was found to contain 12.4g/dm3 of sodium hydroxide. 25cm3 of this solution reacted with 15cm3 of a solution of sulphuric (VI) acid. (Na=23.0, H=1.0, S=32.0, O=16.0)

(i) Find the molarity of the sodium hydroxide solution. (1 mark)

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

(ii) Calculate the number of moles of sodium hydroxide solution used. (1 mark)

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(iii) Calculate the number of moles of the acid used. (1 mark)

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

(iv) Determine the concentration of the sulphuric (VI) acid solution in g/dm3. . (3marks)

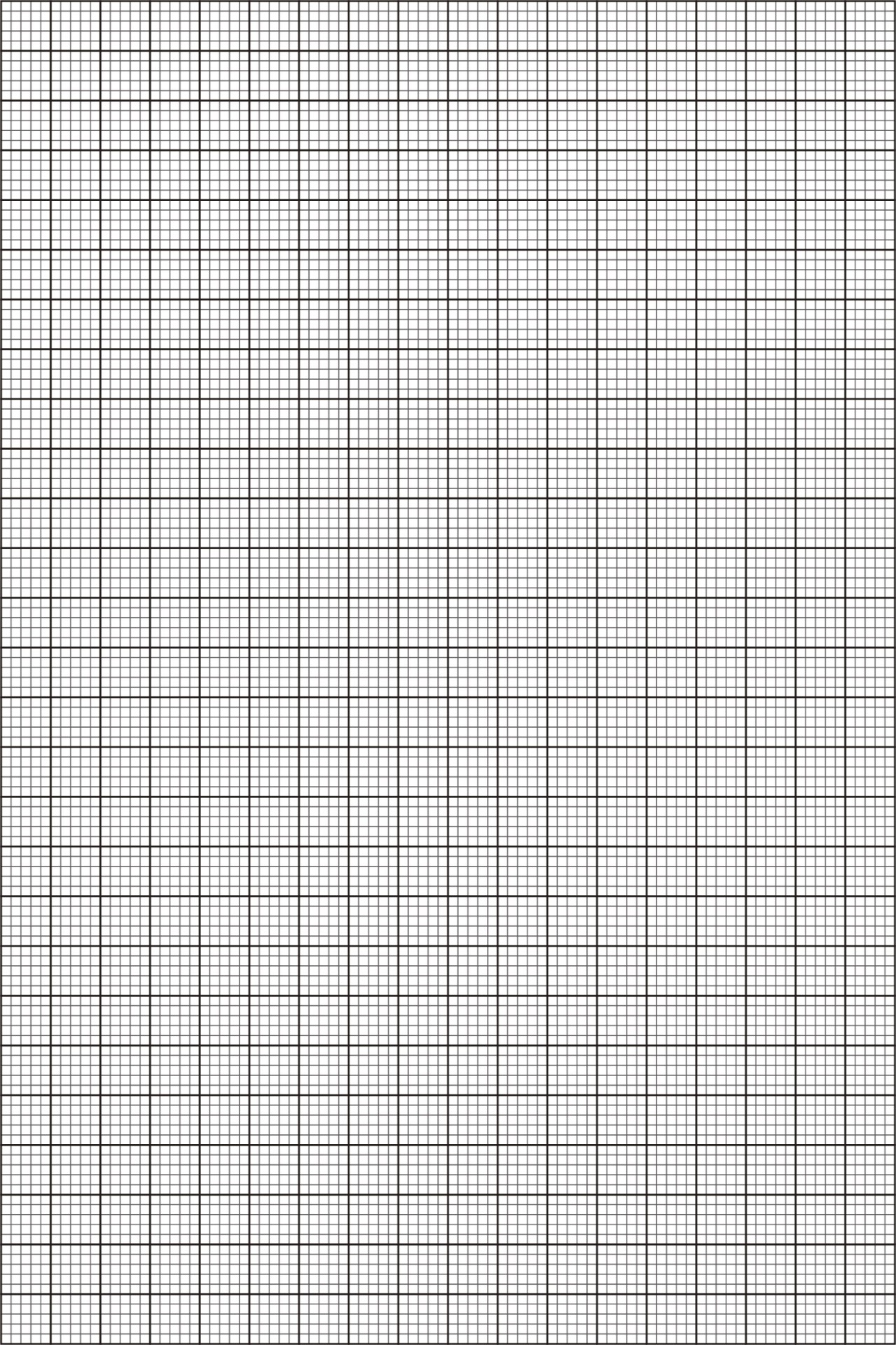
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1. Define a saturated solution. (1 mark)

(b) The table below represent the solubilities of sodium nitrate and Sulphur (IV) oxide at different temperatures.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Temp ( oC) | 10 | 18 | 26 | 34 | 42 |
| Solubility of Sodium Nitrate ( g/ 100g of water) | 20 | 29 | 40 | 53 | 68 |
| Solubility of Sulphur (IV) Oxide ( g/ 100g of water) | 78 | 55 | 45 | 40 | 36 |

On the grid provided below, plot a graph of solubilities of sodium nitrate and Sulphur (IV) oxide against temperature. (4 marks)



Using the graph;

1. Determine the solubility of Sulphur (IV) oxide at 16oC. (1 mark)

………………………………………………………………………………………………………..

1. The concentration, in moles per litre, of sodium nitrate at 16 oC. (assume density of solution is 1 g/cm3) (Na=23, 0=16, N=14). (3 marks)

………………………………………………………………………………………………………

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1. Mass of crystals formed when a solution of sodium hydroxide is cooled from 40oC to 26oC. (2 marks)

………………………………………………………………………………………………………

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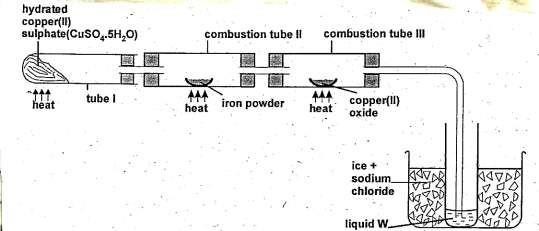
1. What is the relationship between solubility of sodium nitrate and temperature? (1 mark)

………………………………………………………………………………………………………

(c) Give one advantage of hard water. (1 mark)

………………………………………………………………………………………………………

6.The diagram below shows the apparatus for the preparation of gas A and investigate on its properties . Study it and answer the questions that follow.



a) (i) Name gas A. (1 mark)

(ii)suggest property of gas A under investigation (1mark)

(iii) Write chemical equations for the reactions in the;

Boiling tube I (1 mark)

Combustion tube II (1 mark)

b) (i) State and explain the observation made in

Tube I. (1 mark)

Combustion tube II (1 mark)

1. (i)What is the use of hydrated copper (II) sulphate in the experiment? (1 mark)

(ii)Name one other substance that comes out of tube III. (1 mark)

(iii)Name liquid W. (1 mark)

(iv)What is the role of sodium chloride in the ice (freezing mixture) (1 mark)

1. Study the condensed formulae below and answer the questions that follow

(a) I CH3CH (CH3) CH2CHCH2

II CH3CHCH(CH3)CH3

1. Draw the structural formula of each of the compounds I and II (2mks)
2. .
3. Give the systematic name of each of the compounds represented by the formulae above (2mks)

I\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

II\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. To which homologous series does the compound represented by I belong (1/2 mk)

……………………………………………………………………………………

(b) The flow chart below shows some reactions starting with a long chain alkane. Study it and answer the questions that follows.



1. Name substance (11/2 mks)

A\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

B\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What is the name given to the process represented by

Step I\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( ½ mk)

Step III\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( ½ mk)

Step IV\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( ½ mk)

Step VI\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (½ mk)

1. Write down the chemical equation represented by the reaction in step VI (1mk)

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