BSJE JOINT EXAMINATION

- 2024 -

Kenya Certificate of Secondary Education

233/2 **CHEMISTRY** **PAPER 2**

June, 2024 **TIME: 2½ Hrs**

Name: …… Admission No: ……

Stream: …….. Signature: ……..

CODE - SUBJECT
Monday, 3rd June, 2024
Afternoon
2.00-4.30pm

Instructions

(a) Write your ***name, admission number, date, stream and signature*** *in the spaces provided above.*

(b) Non programmable silent electronic calculators may be used.

(c) All answers must be written in the spaces provided in the booklet.

(d) This paper consists of 9 printed pages with 7 questions. Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing

(e) Candidate should answer the questions in ***English***

FOR EXAMINERS'USE ONLY

Question	Maximum Score	Candidate's Score
1	12	
2	12	
3	12	
4	12	
5	12	
6	10	
7	10	

Total Score	80	

1. The grid below represents a section of the periodic table. Study it and answer the questions that follow

								Q
A				C	N	H	J	
B	X		R		E	P	D	
M							F	

(a) Give the formula of the compound formed between X and N (1 mark)

X_3N

(b) Which element forms a stable trivalent cation? (1 mark)

R

(c) Identify the least reactive element (1 mark)

Q

(d) Explain how the melting point of D and F compare (2 marks)

F has higher melting point than D (1mk). F has a stronger intermolecular force of attraction than D (1mk).

(e) Explain the difference in atomic and ionic radius of F (2 marks)

Ionic radius of F is bigger than its atomic radius (1mk). F reacts by gaining an electron increasing repulsion among the electrons (1mk).

(f) How do atomic radii of X and D compare? Explain (2 marks)

D has a smaller atomic radius than X (1mk). D has stronger nuclear attraction pulling electrons towards the nucleus (1mk).

(g) Write the electron arrangement of X^{2+} (1 mark)

(h) What would be the pH of aqueous solution of chloride of M? (1 mark)

$p^H 7$

(i) Identify an element which;

(I) is the strongest reducing (½ mark)

M

(II) is the most electronegative (½ mark)

J

2. (a). What is meant by rate of reaction? (1 mark)

A measure of how fast the reaction takes place (1mk).//A measure of how fast reactants are consumed or products are formed.

(b) Define activation energy (E_A) (1 mark)

It is the minimum amount of kinetic energy that the reacting particles must have to form products (1mk).

(c) An experiment was carried out to measure the volume of hydrogen gas produced when 1.0 g of Zinc chippings (excess) is reacted with 25cm^3 of dilute sulphuric (VI) acid. Give two other ways of speeding up the reaction apart from addition of catalyst. (2 marks)

-Warm the reagents (1mk)

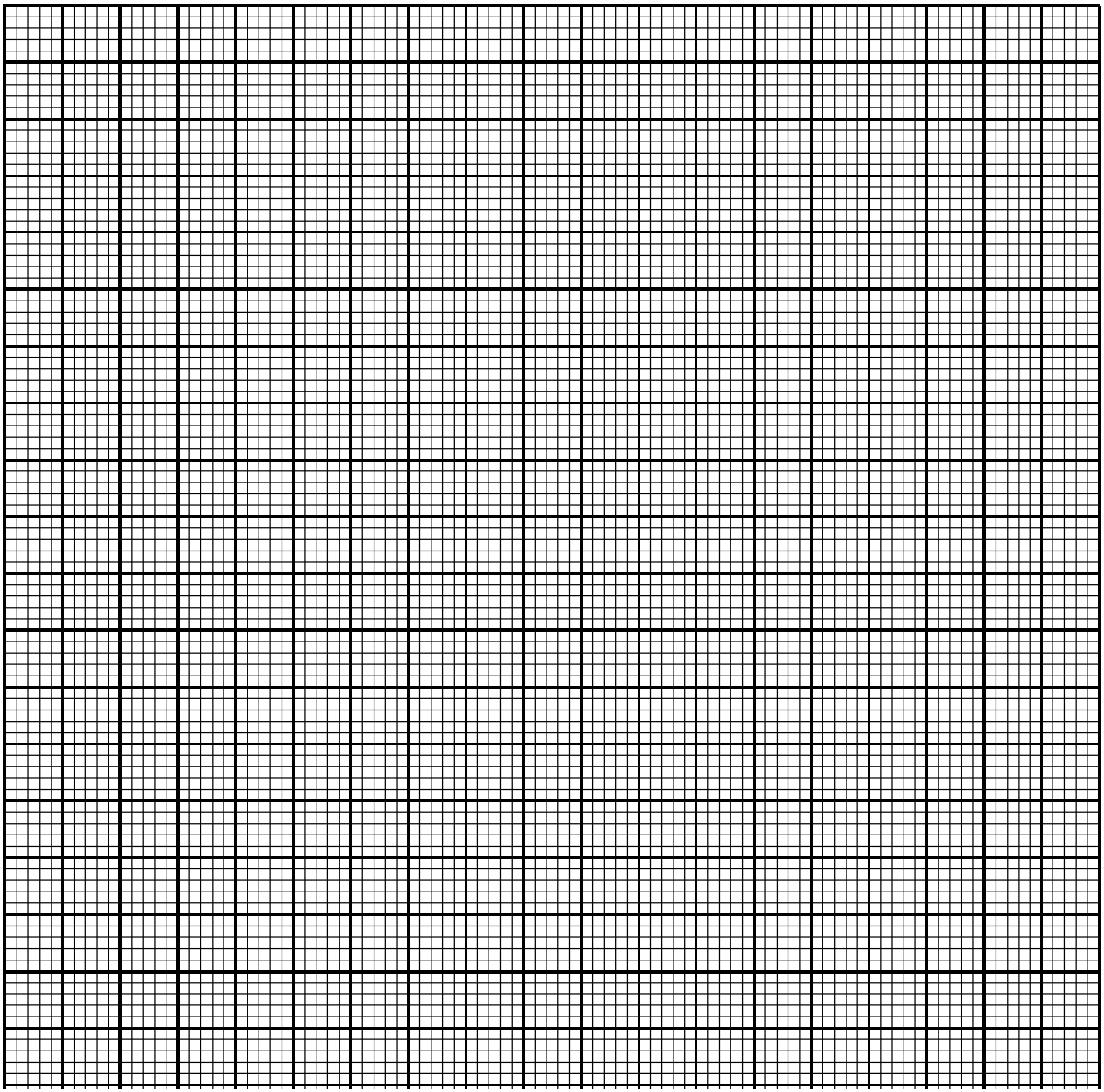
-Increasing the concentration of sulphuric (vi) acid (1mk).

(d) The decomposition of a compound M carried out at 30^0C was monitored by measuring the concentration of the compound remaining at different time intervals and recorded as shown below.

Time (min)	0	1.0	2.0	3.0	4.0	5.0
Concentration	1.20	0.54	0.36	0.26	0.17	0.10

(mol|litre)						

(i) Plot a graph of the concentration of compound M (vertical axis) against time (3 marks)



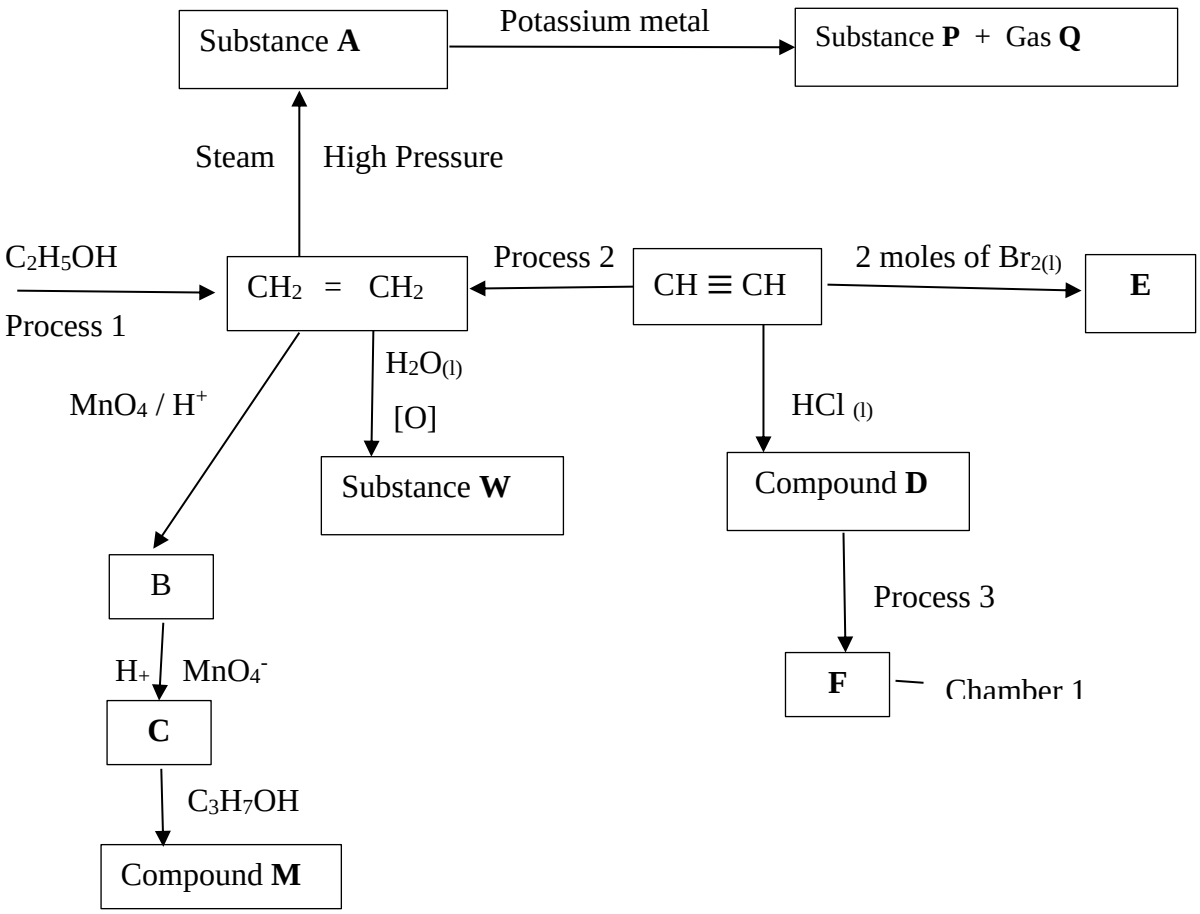
(ii) From the graph, determine the rate of decomposition of M at 2.5 minutes (2 marks)

Rate of decomposition = $\frac{\Delta Y}{\Delta X}$ $(1/2mk) = \frac{0.5-0.1}{0.6-4.3}$ $(1mk) = \frac{0.4}{-3.7} = -0.10811M/minute$ $(1/2mk)$

(iii) On the same axis, sketch the curve that would be obtained if the decomposition was carried out at 15^0C, label the curve A and give a reason for your answer. (3 marks)

Lower temperature <u>reduces the kinetic energy of particles</u> (1mk), thus <u>lowers the rate of decomposition (1mk)</u>.

3. Study the flow chart and use it to answer the questions that follow



(a) Identify substances: (3 marks)

A –**Ethanol/CH_3CH_2OH (1/2mk)**

W- **Ethan-1,2-diol/CH_2OHCH_2OH (1/2mk)**

P- **Potassium ethoxide/CH_3CH_2OK (1/2mk)**

E- **1,1,2,2-tetrabromoethane/$CHBr_2CHBr_2$ (1/2mk)**

D- **CH_2=CHCl/1-Chloroethene (1/2mk)**

Gas Q – **Hydrogen gas (1/2mk)**

(b) State the conditions and reagents that are required for processes:

1: Reagent - **Concentrated sulphuric (vi) acid // Al_2O_3** **(½ mark)**

Condition – **Temperature of 180℃…** **(½ mark)**

2: Reagent- **Hydrogen gas** (½ mark)

Condition – Nickel catalyst, Temp. of 150℃ (½ mark)

3: Reagent - **Chloroethene** (½ mark)

Condition – **High temperature, high pressure** (½ mark)

(c) (i) Write the formula and the name of the compound formed in chamber 1. (2marks)

Polychloroethene/Polyvinylchloride

(ii) Give the uses of the compound in **c (i)** above (2 marks)

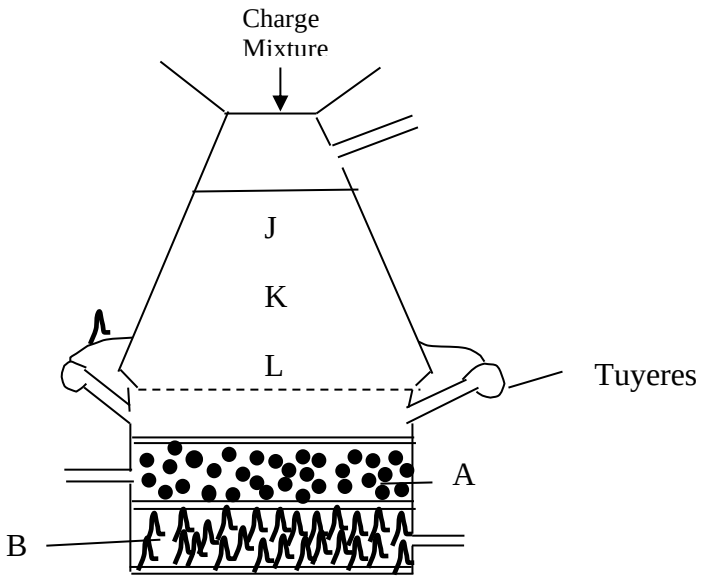
-Used to manufacture carpets (1/2mk)

-Used to make electric cables insulators (1/2mk)

(d) State the physical property of compound M and write its structural formula (2 marks)

It has a sweet/fruity smell

4. The diagram below represents a blast furnace used for extraction of iron.



(a) Name three substance contained in the charge mixture (3 marks)

-Iron ore/Haematite (1mk)

-Coke (1mk)

-Limestone (1mk)

(b) Name substances labelled A and B (2 marks)

A- Molten slag (1mk)

B- Molten iron (1mk)

(c) Arrange regions J, K and L in order of decreasing temperature (1 mark)

L, K, J

(d) Write an equation for the reaction that occurs in region L (1 mark)

$C(s) + O_2(g) \longrightarrow CO_2(g)$

(e) What is the function of the tuyeres? (1 mark)

Used to blow hot air into the furnace.

(f) Distinguish between cast iron and wrought iron (1 mark)

Cast Iron contains 2.1% to 4.5% carbon while wrought iron has a very low carbon content of less than 0.05%.

(g) Write an equation for the reaction between heated iron and chlorine (1 mark)

$2Fe(s) + 3Cl_2(g) \longrightarrow 2FeCl_3(s)$

(h) Iron -60 is a radio isotope of iron (half - life 2.6 x 10^6 years). Its ultimate decay product is nickel -60. Write a nuclear equation for this process. (Atomic numbers Fe=26, Ni=28) (1 mark)

$$^{60}_{26}Fe \longrightarrow {}^{60}_{28}Ni + 2\,{}^{0}_{-1}e$$

(i) State one use of stainless steel (1 mark)

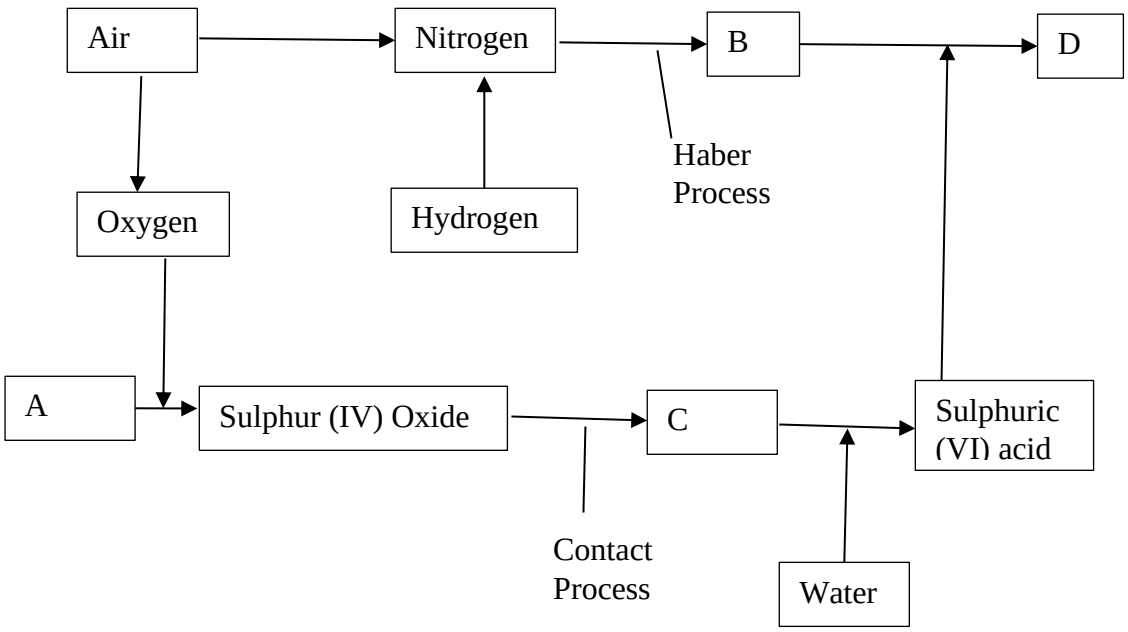
-Making cookers

-Making grills

-Making sinks

-Making Sauce pans

5. The flow chart below illustrates two industrial processes, Haber and Contact processes, each with air as one of the starting materials and other chemical reactions



(a) (i) Give the name of the process by which air is separated into oxygen and nitrogen (1 mark)

Fractional distillation of liquid air

(ii) Apart from oxygen and nitrogen gases produced in **a(i)** above , name any other gas produced in the process above. (1 mark)

Argon

(b) Name the substances which are represented by the letter (2 marks)

A- Sulphur/Zinc sulphide/any other metal sulphide

B- Ammonia

C- Sulphur (VI) Oxide

D- **Ammonium sulphate**

(c) Name the catalyst used in

(i) Haber process (1 mark)

Finely divided Iron

(ii) Contact process (1 mark)

Vanadium (V) Oxide / Platinum

(iii) Explain the role of the catalyst in both the Haber and Contact processes. (2 marks)

Haber Process**: Increases the rate of reaction between nitrogen and hydrogen gases to form ammonia.**

Contact Process: **Speeds up the reaction between Sulphur (iv) oxide and oxygen to form sulphur (vi) oxide.**

(d) (i) Write a balanced equation for the formation of compound D (1 mark)

$$2NH_3(g)+H_2SO_4(aq) \longrightarrow (NH_4)_2SO_4(aq)$$

(ii) Calculate the percentage by mass of nitrogen present in compound D

(N=14, H=1, S=32, O=16) (2marks)

$$\frac{28}{132} \times 100\% = 21.21\%$$

(iii) .Give one use of compound D (1 mark)

Used as a fertilizer.

6. The following are reduction potential of some element , study them and answer the questions that follow.

Half Reaction	Electrode Potential (Volts)
$R^{2+}_{(aq)} + 2e \longrightarrow R_{(S)}$	-0.34
$G^{2+}_{(aq)} + 2e \longrightarrow R_{(S)}$	+1.32
$^{1}/_{2}L_{2\,(aq)} + e \longrightarrow L_{(aq)}$	+2.07
$J^{+}_{(aq)} + e \longrightarrow {}^{1}/_{2}J_{2\,(g)}$	0.00
$Q^{2+}_{(aq)} + 2e \longrightarrow Q_{(S)}$	-2.70
$S^{2+}_{(aq)} + 2e \longrightarrow S_{(S)}$	-1.20

(a) What is the reduction potential of the strongest reducing agent? (1 mark)

-2.70v

(b) Which element is most likely to be substance J? Explain your answer (1 mark)

Hydrogen. Reference electrode/electrode potential 0.00v.

(c) (i) Draw a well labeled diagram for the electrochemical cell that would be formed when elements G and S are combined (3marks)

(c) (ii) Calculate the electromotive force of cell formed above (1 mark)

$E_{cell} = E_{reduction} - E_{oxidation}$

$= +1.32 - -1.20$

$= +2.52v$

(d) During electrolysis of dilute sodium chloride solution using graphite electrodes, a current of 0.8 amperes was passed through the cell for two and a half hours.

(i) Write an ionic equation for the reaction that occurred at the cathode (1 mark)

$H^+(aq) + 2e \longrightarrow H_2(g)$

(ii) Calculate the volume of the gas produced at the anode in cm ^{3}. (Faraday=96500C, 1 mole of gas at r.t.p = 24dm^3) (3 marks)

$4OH^-(aq) \longrightarrow O_2(g) + 2H_2O(l) + 4e$ (1mk)

Q= It

$0.8 \times 2.5 \times 3600$

= 7200C

386000C = 24 dm^3

7200C = $\frac{7200 \times 24}{386000}$

= 0.44767 dm^3 OR 447.67 cm^3

7. The following results were obtained when the molar heat of neutralization between hydrochloric acid and sodium hydroxide was determined. 100cm^3 of 1.0M hydrochloric acid was reacted with 50cm^3 of 2M sodium hydroxide solution.

   Initial temperature of the base was 25^{0}C

   Initial temperature of the acid was 27^{0}C

   The final stable temperature when the acid and base were mixed was 34^{0}C

   (a) Write an ionic equation for the reaction (1 mark)

$H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$

(b) Calculate the,

(i) Change in temperature (1 mark)

Initial temperature = $\frac{25+27}{2} = 26℃$ (1/2mk)

Change in temperature, $\Delta T = 34 - 26 = 8℃$ (1/2mk)

(ii) Heat change for the reaction (specific heat capacity= 4.2KJ|g|k and density of solution=1.0g|cm^3). (1 mark)

Heat change = mcΔT = $150 \times 4.2 \times 8$ (1/2mk)

= 5040J

= 5.04Kj (1/2mk)

(iii) Molar heat of neutralization of hydrochloric acid (2 marks)

Moles of HCl= $\frac{100 \times 1}{1000} = 0.1\ moles$

0.1 moles = 5.04kj

1 mole = $\frac{1 \times 5.04}{0.1} = 50.4kJ$

Molar heat of neutralization = -50.4kJmole^{-1}

(c) Draw an energy level diagram for the reaction (2 marks)

(d) Account for the heat loss (1 mark)

-Heat lost to the surroundings and also absorbed by the apparatus. (1/2mk)

-Error in measurement and taking of reading of volume and temperature

(e) How can the heat loss be minimized? (1 mark)

- By wrapping glass beaker with rags

-Use of plastic beaker

-Using smaller beaker.

(f) Write the thermochemical equation for the reaction (1 mark)

$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l) \quad \Delta Hneut = -50.kJmole - 1$

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