TEVETA

Technical Education, Vocational and Entrepreneurship Training Authority

DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY

LEVEL 6 YEAR I EXAMINATION

FINAL INTEGRATED SUMMATIVE EXAMINATION

SITTING: APRIL - MAY 2026

SUBJECT: FOUNDATION CHEMISTRY THEORY

TIME: THREE (3) HOURS **TOTAL MARKS: 100**

PASS MARK: 50

INSTRUCTIONS TO CANDIDATE

1. Write your Examination number and National Registration Card (NRC) number on the answer booklet provided. Ensure you append your signature in the space provided on the answer booklet.
2. Write the ANSWER SCRIPT SERIAL NUMBER on the examination register and on the entry slip.
3. This paper has SEVEN (7) questions. Question ONE (1) is COMPULSORY answer FOUR (4) questions from the remaining SIX (6) questions.
4. Diagrams may be used where necessary to clarify your answer.
5. Cellphones and programmable calculators are not allowed in the examination room.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

QUESTION ONE (COMPULSORY)

Chemistry is the branch of physical sciences that describes matter's properties, the changes it undergoes, and the energy changes that accompany those processes.

(a) Define the following terms clearly and concisely:
- i. Substance; (2 marks)
- ii. Mixture; (2 marks)
- iii. Element; (2 marks)
- iv. Compound. (2 marks)

(b) State two **(2)** branches of chemistry. (2 marks)

(c) Explain the branches organic and inorganic chemistry (4 marks)

(d) Describe the applications of chemistry. (6 marks)

[Total: 20 Marks]

QUESTION TWO

(a) Define:
- i. Limiting reactant. (2 marks)
- ii. Empirical formular. (2 marks)
- iii. Percent yield. (2 marks)

(b) A compound contains 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen by mass. Determine its empirical formula. (4 marks)

(c) In the reaction:

$$Al_{(s)} + Cl_{2(g)} \rightarrow AlCl_{3(s)} \quad \textbf{(unbalanced)}$$

Given that 5.0 g of Al reacts with 6.4 g of Cl_2. Determine:
- i. The mass of $AlCl_3$ formed. (7 marks)
- ii. The percent yield provided that 7.62 g of $AlCl_3$ was actually obtained (3 marks)

[Total: 20 Marks]

QUESTION THREE

(a) In relation to the atomic structure define the following terms:
- i. Aufbau principle (2 marks)
- ii. Heisenberg uncertainty principle (2 marks)
- iii. Hund's rule (2 marks)

(b) Explain the periodic trends of across the period, and down the group in:
- i. Atomic radii. (3 marks)
- ii. Electronegativity. (3 marks)

(c) Determine the Aufbau electronic configuration for the following elements: Zinc. (3 marks)

(d) Calculate the momentum of an electron whose de Broglie wavelength is 6.626×10^{-10} m (5 marks)

[Total: 20 Marks]

QUESTION FOUR

(a) Copper (II) oxide reacts with aqueous sulphuric acid to form Copper (II) sulphate and water:

i. Construct a balanced chemical equation (include state symbols). (3 marks)

ii. Calculate the number of moles of sulphuric acid required to react exactly with 3.5 g of Copper (II) oxide. (3 marks)

(b) An aqueous solution of 25.0 cm^3 sodium hydroxide of concentration 0.025 M is titrated with sulphuric acid. The volume of sulphuric acid required to exactly react with sodium hydroxide is 12.50 cm^3. (3 marks)

i. State the type of reaction. (2 marks)

ii. Construct a balanced chemical equation and include state symbols. (3 marks)

iii. Calculate the number of moles of sodium hydroxide present in the solution of sodium hydroxide. (3 marks)

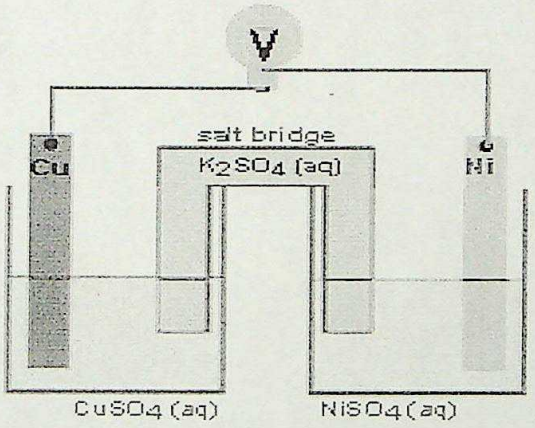
iv. Determine the number of mass of the salt formed. (3 marks)

[Total: 20 Marks]

QUESTION FIVE

(a) State four **(4)** industrial applications of electrochemical cells. (4 marks)

(b) The diagram below shows a simple electrolytic cell.



A cell is prepared by dipping a copper rod in 1 M $CuSO_4$ solution and a nickel rod in 1 M $NiSO_4$ solution. The standard reduction potential of copper electrode and nickel electrode is 0.34 volt and - 0.25 volt respectively.

Determine the:

i. Direction of the flow of electrons in the cell (redraw). (2 marks)

ii. Cell reaction. (2 marks)

iii. Standard EMF of the cell. (4 marks)

(c) Balance the following **redox** reaction in **basic** medium. (8 marks)

$$TeO_3^{2-} + N_2O_4 \rightarrow Te + NO_3^-$$

[Total: 20 Marks]

QUESTION SIX

(a) Distinguish addition polymerization and condensation polymerization, using structural equations. (4 marks)

(b) Distinguish frequency and wavelength. (4 marks)

(c) Write the polymerisation reaction to of form polystyrene from styrene in the laboratory. (4 marks)

(d) Describe a test that could be used to identify the presence of an alcohol group in an organic compound. (4 marks)

(e) Describe the importance of the infrared (IR) region of the electromagnetic in organic chemistry. (4 marks)

[Total: 20 Marks]

QUESTION SEVEN

(a) Define:

i. Half-life. (2 marks)

ii. Chemical kinetics. (2 marks)

(d) The decomposition of ethane to methyl radical is a first order reaction with the rate constant 0.450 s^{-1} at 25°C? Determine

i. the half-life of the reaction. (3 marks)

ii. The concentration of ethane after 10 s, given the initial concentration of 0.5 M (4 marks)

(e) Consider the reaction below:

$$NO_{2\,(g)} + O_{2\,(g)} \longrightarrow 2N_2O_{5(g)}$$

At a particular time during the reaction, nitrogen dioxide is being consumed at the rate of 0.00130 M/s.

i. Write the rate law expression. (3 marks)

ii. Determine the rate of consumption of molecular oxygen. (4 marks)

iii. Determine the rate at which dinitrogen pentoxide is being produced. (3 marks)

[Total: 20 Marks]

Useful data

Avogadro's constant = 6.022×10^{23}

Rydberg's constant = 1.0967×10^{7}

Speed of light 2.998×10^{8} m/s

Planck's h: 6.626×10^{-34} Js

R=0:08206Latm/Kmol

R=0:08314Lbar/Kmol

R=82:06cm3atm=Kmol

R=8:314J/Kmol

R=1:987cal/Kmol

Proton mass : $1.672621637\ 10^{27}$ kg

Molar volume at room temperature and pressure = 2400 dm^3

Molar volume at standard temperature and pressure = 22.4 dm^3

Periodic Table of the Elements

Key:

element name
atomic number
symbol
atomic weight

hydrogen 1 **H** 1.00794																	helium 2 **He** 4.002602
lithium 3 **Li** 6.941	beryllium 4 **Be** 9.012182											boron 5 **B** 10.811	carbon 6 **C** 12.0107	nitrogen 7 **N** 14.00674	oxygen 8 **O** 15.9994	fluorine 9 **F** 18.9984	neon 10 **Ne** 20.1797
sodium 11 **Na** 22.98977	magnesium 12 **Mg** 24.3050											aluminium 13 **Al** 26.981538	silicon 14 **Si** 28.0855	phosphorus 15 **P** 30.97376	sulphur 16 **S** 32.065	chlorine 17 **Cl** 35.453	argon 18 **Ar** 39.984
potassium 19 **K** 39.0983	calcium 20 **Ca** 40.078	scandium 21 **Sc** 44.95591	titanium 22 **Ti** 47.867	vanadium 23 **V** 50.9415	chromium 24 **Cr** 51.9961	manganese 25 **Mn** 54.93805	iron 26 **Fe** 55.845	cobalt 27 **Co** 58.9332	nickel 28 **Ni** 58.6934	copper 29 **Cu** 63.546	zinc 30 **Zn** 65.409	gallium 31 **Ga** 69.723	germanium 32 **Ge** 72.64	arsenic 33 **As** 74.9216	selenium 34 **Se** 78.96	bromine 35 **Br** 79.904	krypton 36 **Kr** 83.798
rubidium 37 **Rb** 85.4678	strontium 38 **Sr** 87.62	yttrium 39 **Y** 88.90585	zirconium 40 **Zr** 91.225	niobium 41 **Nb** 92.90638	molybdenum 42 **Mo** 95.94	technetium 43 **Tc** [98]	ruthenium 44 **Ru** 101.07	rhodium 45 **Rh** 102.9055	palladium 46 **Pd** 106.42	silver 47 **Ag** 107.8682	cadmium 48 **Cd** 112.411	indium 49 **In** 114.818	tin 50 **Sn** 118.710	antimony 51 **Sb** 121.760	tellurium 52 **Te** 127.60	iodine 53 **I** 126.9045	xenon 54 **Xe** 131.293
caesium 55 **Cs** 132.90545	barium 56 **Ba** 137.327	lutetium 71 **Lu** 174.967	hafnium 72 **Hf** 178.49	tantalum 73 **Ta** 180.9479	tungsten 74 **W** 183.84	rhenium 75 **Re** 186.207	osmium 76 **Os** 190.23	iridium 77 **Ir** 192.217	platinum 78 **Pt** 195.078	gold 79 **Au** 196.96655	mercury 80 **Hg** 200.59	thallium 81 **Tl** 204.3833	lead 82 **Pb** 207.2	bismuth 83 **Bi** 208.980	polonium 84 **Po** [209]	astatine 85 **At** [210]	radon 86 **Rn** [222]
francium 87 **Fr** [223]	radium 88 **Ra** [226]	lawrencium 103 **Lr** [262]	rutherfordium 104 **Rf** [261]	dubnium 105 **Db** [262]	seaborgium 106 **Sg** [266]	bohrium 107 **Bh** [264]	hassium 108 **Hs** [269]	meitnerium 109 **Mt** [268]	darmstadtium 110 **Ds** [271]	roentgenium 111 **Rg** [272]	ununbium 112 **Uub** [285]		ununquadium 114 **Uuq** [289]				

lanthanum 57 **La** 138.9055	cerium 58 **Ce** 140.116	praseodymium 59 **Pr** 140.90765	neodymium 60 **Nd** 144.24	promethium 61 **Pm** [145]	samarium 62 **Sm** 150.36	europium 63 **Eu** 151.964	gadolinium 64 **Gd** 157.25	terbium 65 **Tb** 158.9253	dysprosium 66 **Dy** 162.50	holmium 67 **Ho** 164.930	erbium 68 **Er** 167.259	thulium 69 **Tm** 168.934	ytterbium 70 **Yb** 173.04
actinium 89 **Ac** [227]	thorium 90 **Th** 232.038	protactinium 91 **Pa** 231.0359	uranium 92 **U** 238.0289	neptunium 93 **Np** [237]	plutonium 94 **Pu** [244]	americium 95 **Am** [243]	curium 96 **Cm** [247]	berkelium 97 **Bk** [247]	californium 98 **Cf** [251]	einsteinium 99 **Es** [252]	fermium 100 **Fm** [257]	mendelevium 101 **Md** [258]	nobelium 102 **No** [259]