JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN WATER RESOURCE ENGINEERING

1ST YEAR 1ST SEMESTER 2021/2022 ACADEMIC YEAR

MAIN REGULAR

COURSE CODE: SPB 9107

COURSE TITLE: INORGANIC CHEMISTRY

EXAM VENUE: **STREAM: (BEd. Science)**

DATE:

TIME: **EXAM SESSION:**

INSTRUCTIONS:

1. **Answer question 1 (Compulsory) in section A and ANY other 2 questions in Section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**
4. **Some important information/formulas are found on the last page of this question paper**

SECTION A

Question 1

a) Define the following terms

i. An atom (2 marks)

ii. An element (2 marks)

iii. An orbit (2 marks)

b) Briefly discuss the four quantum numbers that fully describes the electronic configuration of an atom. (8 marks)

c) Describe the electronic configurations (*spdf*) of the following atoms. (8 marks)

i. Zinc (Z = 30)

ii. Chromium (Z = 24)

iii. Copper (Z = 29)

iv. Platinum (Z = 78)

d) Briefly discuss the following principles: The aufbau principle, The Pauli exclusion principle, degenerate orbitals, and The hunds rule. (8 marks).

SECTION B answer any two questions

Question 2

a) Use the Bohr equation to determine the Bohr radius of H atom at n = 1. (4 marks)

b) Describe the shapes of atomic orbitals in an *s* orbital, *p* orbital and *d* orbital (16 marks)

Question 3

a) Describe the energy level diagram for the following atoms (see the periodic table at the end of question paper for their atomic numbers)

   i. Potasium (5 marks)

   ii. Magnesium (5 marks)

   iii. Iron (5 marks)

b) An increase in the principal quantum number from n = 1 to n = ∞ corresponds to the ionization of the atom and the ionization energy can be determined. Given that one mole of a substance contains 6.022 x 1023mol-1 particles, determine the first ionization energy for H. (5 marks)

Question 4

a) Brirfly discuss electron transitions that make up the Lyman and Balmer series in the emission spectrum of atomic hydrogen (use of a diagram is prefered). (10 marks)

b) Use the first 30 elements in the periodic table to demonstrate why they are lebelled as *s* block, *d* block, and *p* block elements. (10 marks)

Question 5

Briefly discuss the importance of learning inorganic chemistry in your career

(20 marks)

Periodic table

Key:

1 **H** 1.008

- Atomic number, Z
- Element symbol
- Relative atomic mass, A_r

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 **H** 1.008																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.01	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.54	30 **Zn** 65.41	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.91	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** 98.91	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.40	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.30
55 **Cs** 132.91	56 **Ba** 137.34	**La–Lu**	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.37	82 **Pb** 207.19	83 **Bi** 208.98	84 **Po** 210	85 **At** 210	86 **Rn** 222
87 **Fr** 223	88 **Ra** 226.03	**Ac–Lr**	104 **Rf** [261]	105 **Db** [262]	106 **Sg** [266]	107 **Bh** [264]	108 **Hs** [277]	109 **Mt** [268]	110 **Ds** [271]	111 **Rg** [272]	112 **Uub** [285]						

Lanthanoids	57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** 146.92	62 **Sm** 150.35	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.92	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
Actinoids	89 **Ac** 227.03	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** 237.05	94 **Pu** 239.05	95 **Am** 241.06	96 **Cm** 244.07	97 **Bk** 249.08	98 **Cf** 252.08	99 **Es** 252.09	100 **Fm** 257.10	101 **Md** 258.10	102 **No** 259	103 **Lr** 262

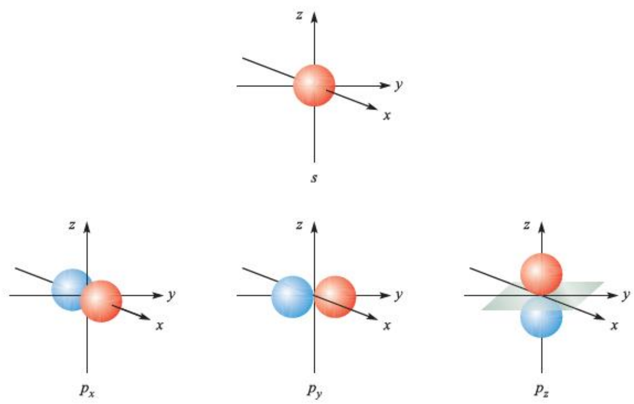

Fig. 1.9 Boundary surfaces for the angular parts of the 1*s* and 2*p* atomic orbitals of the hydrogen atom. The nodal plane shown in grey for the $2p_z$ atomic orbital lies in the *xy* plane.

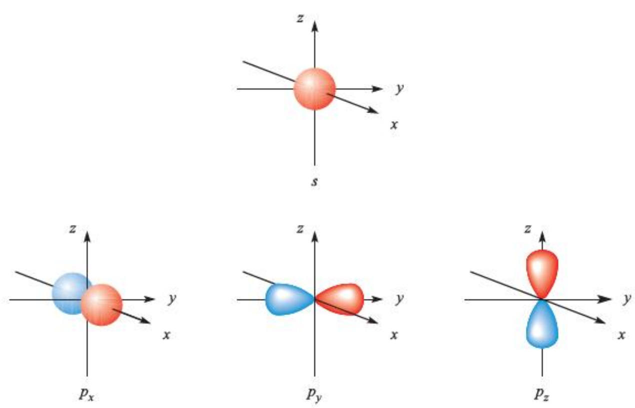

Fig. 1.10 Representations of an *s* and a set of three degenerate *p* atomic orbitals. The lobes of the p_x orbital are elongated like those of the p_y and p_z but are directed along the axis that passes through the plane of the paper.

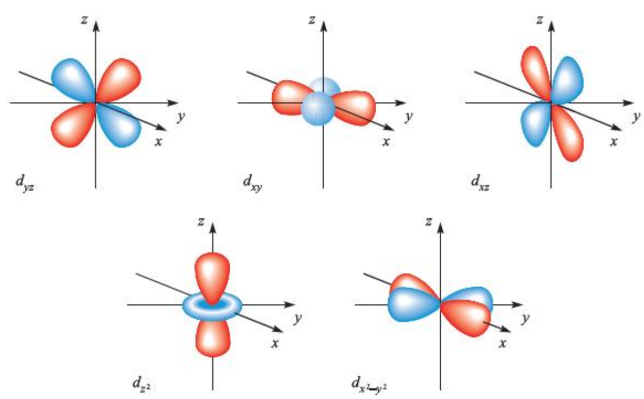

Fig. 1.11 Representations of a set of five degenerate *d* atomic orbitals.

a) R = Rydberg constant for hydrogen = 1.097 x 10^7 m^{-1} or 1.097 x 10^5 cm^{-1};

b) Speed of light C = 2.998 x 10^8 ms^{-1}

c) Bohr radius (r_{un}), $r_n = \frac{\varepsilon_0 h^2 n^2}{\pi m_e e^2}$

ε_0 = permittivity of vacuum = 8.854 x 10^{-12} Fm^{-1}

h=Planks constant = 6.626 x 10^{-34} Js

n = 1, 2, 3, …. describing a given orbit

m_e = electron rest mass = 9.109 x 10^{-31} kg

e = charge on an electron (elementary charge) = 1.602 x 10^{-19}C