

BINDURA UNIVERSITY OF SCIENCE EDUCATION
SCIENCE AND MATHEMATICS EDUCATION DEPARTMENT
DC002/ DCH004: INORGANIC CHEMISTRY

Time:

2Hours

ANSWER QUESTION 1 AND FOUR (4) OTHER QUESTIONS TWO (2) FROM EACH OF THE SECTIONS "A" AND "B". EACH QUESTION CARRIES 20 MARKS

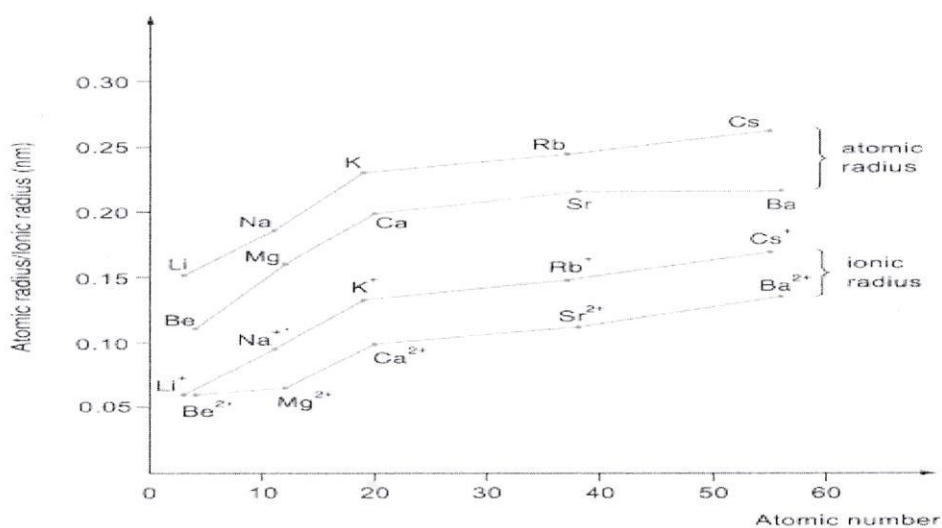
1. (a) Define the following:
- (i) Ionization energy.
 - (ii) Electronegativity.
 - (iii) Effective nuclear charge.
 - (iv) Ionic radius.
 - (v) Inert pair effect. [5 × 2 marks]
- (b) The products of burning lithium and potassium in oxygen are Li_2O and KO_2 respectively. How do you explain the different behavior of the metals? [4 marks]
- (c) (i) Give the properties that make d-block elements good construction materials. [3 marks]
- (ii) Give the property of transition metals that makes alloying common. [3 marks]

JUN 2023

SECTION A: ANSWER TWO QUESTIONS FROM THIS SECTION

2. (a) All Group I oxides react with H_2O to form metal hydroxides. Give general equations of the following Group I oxides with water
- (i) Peroxide [3 marks]
 - (ii) Superoxide [3 marks]
 - (iii) Oxide [2 marks]
- (b) Which ion has a greater ionic radius, potassium ion or calcium ion? Give reasons for your choice. [2 marks]

- (c) Study the Figure below and answer the questions that follow.



- (i) Explain the difference in Group 1 atomic and ionic radii. [5 marks]
- (ii) Explain the difference between Group 1 and 2 atomic radii. [5 marks]
3. Hydrogen can be classified as Group 1, 4 and 7. Outline the chemistry of hydrogen that makes it typical and unlike Group 1, 4 and 7 elements. [20 marks]
4. (a) Part of the periodic table is shown below.

						B	C	N	O	F	Ne
Na	Mg					Al	Si	P	S	Cl	
		Ti	V	Cr	Mn	Cu				Br	
						Ag		Sn		I	
Cs							Pb				Rn

From the elements shown in the table, identify one which:

- Has the lowest first ionisation energy.
- Has the highest first ionisation energy.
- Has a hydride that forms the strongest hydrogen bonds.
- Has a nitrate of formula $X(\text{NO}_3)_2$ that gives a brown gas when heated.

- (v) Has a trifluoride with molecules of trigonal shape.
 - (vi) Is likely to have the most exothermic reaction with fluorine.
 - (vii) Has an insoluble chloride.
 - (viii) Is the most electronegative element. [8 marks]
- (b) The six elements in the third period from sodium to sulphur show a change in properties based on structure and bonding. State and explain the change in:
- (i) metallic character. [3 marks]
 - (ii) melting point. [3 marks]
- (c) Choose one metallic and one non-metallic element from these six and for each chosen element describe what you would observe when:
- (i) The element reacts with oxygen. [2 marks]
 - (ii) The oxide reacts with water containing universal indicator. [4 marks]

SECTION B: ANSWER ANY TWO QUESTIONS FROM THIS SECTION

5. (a) Describe the variation in group 4 elements' catenation ability. [2 marks]
- (b) Outline the differences between:
- (i) Elemental silicon and carbon. [8 marks]
 - (i) Oxides of silicon and carbon [10 marks]
6. (a) Discuss the trends of Group 6 hydrides under the following sub-headings:
- (i) Reducing character. [3 marks]
 - (ii) Thermal stability. [3 marks]
- (b) Oxygen can be prepared from heating some metallic oxides. Illustrate this with an equation. [2 marks]
- (c) Outline the manufacture of sulphuric acid in the Contact process. [12 marks]
7. (a) Explain the following:
- (i) Transition metals are used as catalysts. [3 marks]
 - (ii) Transition metal ions form colored compounds in solution. [3 marks]
 - (iii) Transition metals are better electrical conductors than s-block metals. [3 marks]
 - (iv) Melting points of transition metals are higher than the melting points the s-block metals. [3 marks]
- (b) Copy and complete the following table.

d-block element	Catalyst formula	Reaction catalyzed
V		
Fe		
Ni		
Pt		

[8 marks]

END OF PAPER

PERIODIC TABLE OF ELEMENTS

PERIODIC TABLE OF ELEMENTS																		Noble gases ↓ 18 8A	
Alkali metals		Alkaline earth metals										Halogens ↓ 17 7A							
1 1A	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	18 8A		
1 H 1.008																	2 He 4.003		
3 Li 6.941	4 Be 9.012											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	3	4	5	6	7	8	9	10	11	12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95		
Transition metals																			
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	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)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3		
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)		
87 Fr (223)	88 Ra 226	89 Ac** (227)	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub								
												metals				nonmetals			

* Lanthanides

** Actinides

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)