

Mid Term Examination  
CHEMISTRY  
MT-2017-11(A)

Time : 3 hrs.

M. Marks : 70

GENERAL INSTRUCTIONS:

- All questions are compulsory.
- Q.no. 1 to 5 are very short answer questions and carry 1 mark each.
- Q.no. 6 to 10 are short answer questions and carry 2 marks each.
- Q.no. 11 to 22 are also short answer questions and carry 3 marks each.
- Q.no. 23 is a value based question and carry 4 marks.
- Q.no. 24 to 26 are long answer questions and carry 5 marks each.
- Use log tables if necessary, use of calculators is not allowed.

- ✓ 1. Critical temperature for  $\text{CO}_2$  and  $\text{CH}_4$  are  $(31.1^\circ\text{C})$  and  $(-81.9^\circ\text{C})$  respectively. Which of two gases will have stronger intermolecular forces and why.
- ✓ 2. Write the resonating structures of  $\text{SO}_3$  molecule.  $\text{N}^{\ominus} \text{S}^{\oplus} \text{N}^{\ominus}$   $\text{N}^{\oplus} \text{P}^{\ominus}$
- ✓ 3. Write the general electronic configuration of p-block elements.
- ✗ 4. What would be the IUPAC name and symbol for the element with atomic number 120. *Unbihilium*
- ✓ 5. Is there any change in the hybridisation of B and N atoms as a result of this reaction?  
 $\text{BF}_3 + \text{NH}_3 \rightarrow \text{F}_3\text{B.NH}_3$
- ✗ 6. Calculate the concentration of an aqueous solution of nitric-acid in moles per litre in a sample which has a density of  $1.41 \text{ gm L}^{-1}$  and mass percent of nitric acid is 69%.  
(at mass of N = 14u, H = 1u, O = 16u)
7. Draw the Lewis structure for the following molecules.
- $\text{H}_2\text{S}$
  - $\text{HCOOH}$
- ✗ 8. The mass of an electron is  $9.1 \times 10^{-31} \text{ kg}$ . If its Kinetic Energy is  $3 \times 10^{-25} \text{ J}$ , Calculate its wavelength. ( $h = 6.626 \times 10^{-34} \text{ Js}$ )
9. Draw the boundary surface diagram of
- $2p_x$
  - $3d_{xy}$

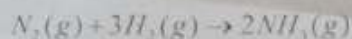
OR

Give the electronic configurations for

(a) Cu (atomic no. of Cu = 29 u)

(b)  $\text{Cl}^-$  (atomic no. of Cl = 17 u)

10. What do you mean by ozone hole? What are its consequences?
11. Although both  $\text{BeF}_2$  and  $\text{H}_2\text{O}$  are triatomic molecules, the shape of  $\text{H}_2\text{O}$  molecule is bent while that of  $\text{BeF}_2$  is linear. Explain on the basis of dipole moment.
12. Dinitrogen and dihydrogen react with each other to produce ammonia as per the following equation:



- (a) Calculate the mass of ammonia produced if  $2 \times 10^3 \text{g}$  dinitrogen reacts with  $1 \times 10^3 \text{g}$  dihydrogen.
- (b) Will any of the two reactants remain unreacted?
- (c) If yes, which one and what would be its mass?  
(atomic mass of N = 14u, H = 1u respectively)
13. (a) Define the term isoelectronic species. Which of the following are isoelectronic to each other  
 $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$  and  $\text{Ca}^{2+}$
- (b) What are transuranic elements? (2+1)
14. (a) Give one difference between sigma and pi bonds.
- (b) What are the total number of sigma and pi bonds in the  $\text{C}_2\text{H}_2$  molecule. Draw the labelled structure of the ethyne molecule depicting hybridisation of carbons showing the sigma and pi bonds. (1+2)
15. Determine the empirical formula of an oxide of iron which has 69.9% iron and 30.1% oxygen by mass.  
(at mass : Fe = 55.8 u, O = 16u)

OR

Calcium carbonate reacts with aqueous HCl to liberate  $\text{CO}_2$  and other products.

- (a) Write the chemical reaction involved.
- (b) What mass of  $\text{CaCO}_3$  is required to react completely with 25mL of 0.75M HCl?

at. mass : Ca = 40u, C = 12u and O = 16u

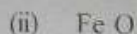
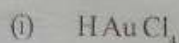
H = 1 u, Cl = 35.5 u

16. (a) Balance the following equation in acidic medium :



Mention the oxidation number, oxidation and reduction steps also.

(b) Using stock notation represent



(2+1)

17. (i) An atomic orbital has  $n=3$ . What are the possible values of  $l$  and  $m$ .

(ii) Using s, p, d notations, describe the orbital with the following quantum numbers :

(a)  $n=1, l=0$

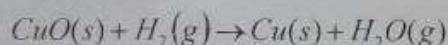
(b)  $n=4, l=2$

(iii) Which of the following orbitals is possible and why.

$1p, 2s$  and  $4f$

18. Pay load is defined as the difference between the mass of the displaced air and the mass of the balloon. Calculate the pay load when a balloon of radius 10m, mass 100kg is filled with helium at 1.66 bar at  $27^\circ\text{C}$  (density of air  $1.2 \text{ kg m}^{-3}$ ) and  $R = 0.0833 \text{ bar dm}^3 \text{ K}^{-1} \text{ mol}^{-1}$  at. mass of He = 4u.

19. Justify that the following reaction is a redox reaction



Also indicate the oxidising and reducing agent respectively.

20. Among the second period elements, the actual ionisation enthalpies are in the order :  $\text{Li} < \text{B} < \text{Be} < \text{C} < \text{O} < \text{N} < \text{F} < \text{Ne}$ .

Explain :

(a) Ionisation enthalpy increases in a period

(b) Be has higher  $\Delta H_i$  than B.

(c) O has lower  $\Delta H_i$  than N and F.

21. Pressure of 1g of an ideal gas A at  $27^\circ\text{C}$  is found to be 2 bar. When 2g of another ideal gas B is introduced in the same flask at same temperature, the pressure becomes 3 bar. Find the relationship between their molecular masses.

2. (a) Comment on the first and second electron gain enthalpies of Oxygen. Justify the formation of oxide ion.

(b) What is the basic difference between the terms electron gain enthalpy & electronegativity. (1+2+1)

23. Long form of Periodic <sup>table</sup> which is also called Bohr's table had removed most of the drawbacks of Mendeleev's table, yet it suffers from some defects. After reading the above lines, answer the following questions :

- (i) What is the basis of classification of elements in long form of periodic table?
- (ii) List two drawbacks of Long Form of Periodic table.
- (iii) What two values were expressed by Bohr while proposing the improved periodic table.

24. (i) The work function for caesium atom is 1.9 eV. Calculate. (3+2)

- (a) The threshold wavelength and threshold frequency of the radiation.
- (b) If the caesium element is irradiated with a wavelength of 500 nm, calculate the kinetic energy.
- (c) and the velocity of the ejected photoelectrons :

$$(1\text{eV} = 1.6 \times 10^{-19} \text{ J}) \quad (h = 6.626 \times 10^{-34} \text{ Js})$$

- (ii) If the position of the electron is measured within an accuracy of  $\pm 0.002 \text{ nm}$ , calculate the uncertainty in the momentum of the electron.

Suppose the momentum of the electron is  $h/(4\pi \times 0.05) \text{ nm}$ , is there any problem in defining this value?

$$(h = 6.626 \times 10^{-34} \text{ Js})$$

OR

- (a) Explain the radii and energy of a stationary state according to Bohr's model of atom.
- (b) How much energy is required to ionise a hydrogen atom if the electron occupies  $n = 5$  orbit? Compare your answer with the ionisation energy of hydrogen atom. (2+3)

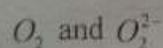
25. (a) Define the term hybridisation.

(b) Describe the hybridisation in case of  $\text{PCl}_5$  with its geometry.

(c) Why are the axial bonds longer as compared to the equatorial bonds in  $\text{PCl}_5$ ? (1+3+1)

OR

(a) Use molecular orbital theory to compare the relative stability of the following species and indicate their magnetic nature and bond order.



(b) Differentiate between bonding and anti bonding orbitals. (two differences)

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26. (a) Define Dalton's Law of partial pressures. Using this law how is the pressure of a dry gas determined.
- (b) What will be the pressure of the gas mixture when 0.5 L of  $H_2$  at 0.8 bar and 0.2 L of oxygen at 0.7 bar are introduced in a 1 L vessel at  $27^\circ C$ ? (2+3)

OR

- (a) Give two differences between real and ideal gases.
- (b) Write the Vander Waals equation for n moles of a gas.
- (c) What are the units of Vander Waals constants?
- (d) What is the significance of each of the constant? (2+1+1+1)