Total number of printed pages–8

1 (Sem–4/FYUGP) CHE 41 MJ

2026

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Acc. No.
Date
Nagaon : Assam

CHEMISTRY

(Major)

Paper : CHE4400104MJ

(Inorganic Chemistry–I)

Full Marks : 45

Time : 2 hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions as directed : 1×5=5

(i) Predict the symmetry point group of H_2S molecule.

(ii) Write the electronic configuration of *Fe* in $[Fe(CN)_6]^{4-}$ in terms of t_{2g} and e_g in an octahedral field when $\Delta_o < P$.

(iii) Write the most stable oxidation state in each of *Cu*, *Ag* and *Au* ?

(iv) Which of the following elements does not show disproportion reaction ?

(a) *Mn*

(b) *Cu*

(c) *Cl*

(d) *K*

(v) How many α and β particles will be released when $_{92}U^{238}$ successfully disintegrates to be transformed to $_{82}Pb^{206}$?

2. Answer ***any five*** from the following questions : 2×5=10

(i) Draw all the symmetry elements present in ammonia molecule.

(ii) What is John Teller effect ? Give the splitting of d orbitals in *z*-in and *z*- out pattern of distortion.

(iii) What is zone refining ? Which type of substances is purified by it ?

(iv) $FeSO_4$ solution is always prepared in dilute sulphuric acid. Explain.

(v) Write the nuclear reaction involved in carbon dating.

(vi) Actinoids have greater tendency to form complexes than actinoids. Explain.

(vii) Calculate the bond order of $[Re_2Cl_8]^{2-}$ and give its magnetic property.

(viii) Why is +3 the common oxidation state for lanthanides ?

(ix) The tendency of a metal ion to form compounds of high coordination numbers decreases across the first-row transition elements. Explain.

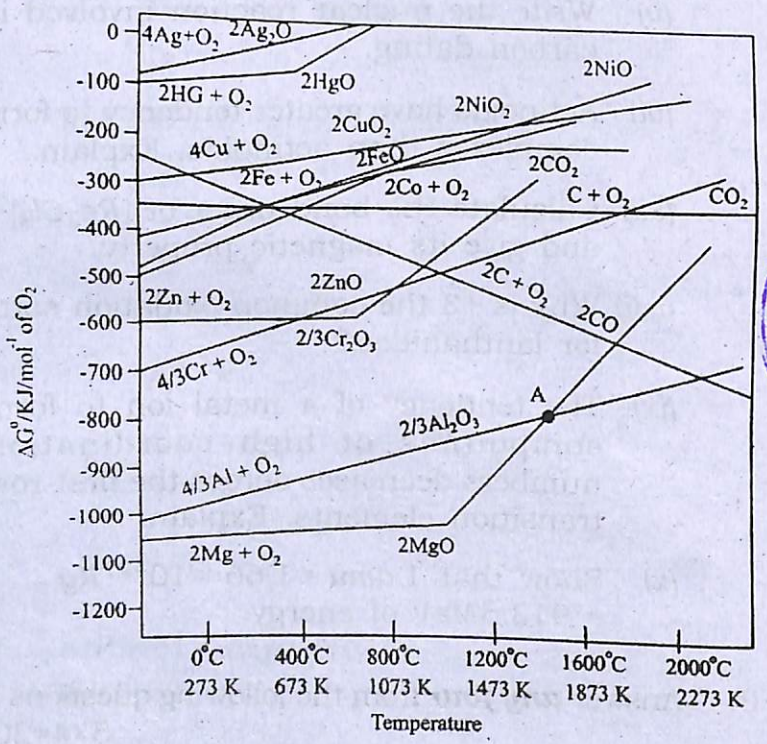
(x) Show that $1\ amu = 1.66 \times 10^{-27} Kg$ $= 913.5 MeV$ of energy.

3. Answer ***any four*** from the following questions : 5×4=20

(i) Find all the symmetry elements in an O_h point group.

(ii) Calculate CFSE in terms of Δ_0 and P for high spin and low spin octahedral complexes of *Fe* (II) and *Co* (II). Predict whether the complexes will be paramagnetic or diamagnetic.

(iii) Consider the following Ellingham diagram for oxides and answer the following questions :



(a) What does the slope of the lines represent ?

(b) $\Delta G^0 = RT\,lnK$. What is the expression for K for the general reaction :

$$2M(s) + O_2(g) \rightarrow 2MO(s)$$

(c) At what temperature can carbon reduce zinc oxide ?

1+2+2=5

(iv) (a) Using the Latimer diagram of oxygen given below :

$$O_2 \xrightarrow{+0.70V} H_2O_2 \xrightarrow{+1.76V} H_2O$$

Draw the Frost diagram of oxygen. From these diagrams indicate (a) which is the most stable species, and (b) which species would undergo disproportion ?

(b) The mass defect for $_7N^{14}$ was found to be $0.112 amu$. Calculate the binding energy per nucleon.

3+2=5

(v) (a) State why the elements of the second transition series show properties which are more similar to those of the third transition series than the first transition series.

(b) Discuss the principles of extraction of nickel from its ore.

2+3=5

(vi) (a) Half life period of a radioactive element is 1×10^{-6} *sec.* How long will it take for 90% disintegration ?

(b) What is a symmetry operation ? How many symmetry operations can be performed by the operator C_3 on BF_3 molecule ?

3+2=5

(vii) (a) Square planar d^8 paramagnetic complexes are extremely rare. Account for this observation with a crystal field argument.

(b) The second ionization energy of *Cu* and *Cr* are sufficiently high. Explain why.

3+2=5

(viii) How many oxides of vanadium are known ? Give preparation, properties and uses V_2O_5. 2+3=5

4. Answer ***any one*** from the following questions : 10

(i) (a) Why are transition metals capable of showing variable oxidation state ? Give a brief description of stable and unstable oxidation states of *V, Cr, Mn* and *Fe.*

1+4=5

(b) Describe Mond's process to purify Nickel. 5

(ii) (a) What is an improper rotational axis of symmetry (S_n) ? Give an example of a molecule with centre of inversion (*i*).

(b) Give the factors affecting the magnitude of Δ_0.

(c) Define electrolytic reduction with an example.

(d) Explain autoxidation with an example.

(e) La^{4+} ion does not exist. Explain.

2×5=10

(iii) (a) Discuss the bonding in an octahedral molecule with the help of molecular orbital theory considering σ-bond only. 5

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(b) Will Hg_2^{2+} ion disproportionate in aqueous solution into Hg^{2+} and Hg^0? Given that

$$E^0\left(Hg_2^{2+}/Hg^0\right) = 0.7960V$$
$$E^0\left(Hg^{2+}/Hg_2^{2+}\right) = 0.9110V$$
$$E^0\left(Hg^{2+}/Hg^0\right) = 0.8535V$$

5

(iv) (a) Derive integrated form of equation for the decay of radioactive element. Deduce the expression for $t_{1/2}$. 3+2=5

(b) Discuss the ion exchange method of separation of lanthanides. 5

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