*Candiates are required to give their answer in their own
words as far as practicable.*
*The figures in the margin indicate full marks.*

Answer any *three* from the following questions : 3×20

1. (a) Define smelting. Give a clear distinction between 'metal sulphide smelting' and 'metal oxide smelting'.

(b) Melting point of alumia is very high but Al is obtained by the electrolysis of aliumina at much lower temperature.

(c) Draw a neat and labelled sketch to illustrate an iron-carbon equillibrium diagram.

(d) What do you meant by allotropy of iron ? (2+3)+5+(3+4)+3

2. (a) What are the basic metallurgical principles ? Name with proper reasons the metals which are extracted by those metallurgical process. 2+3

(b) Describe with flow diagram the process for manufacture of metallic iron from its ore with reference to Indian context. 3+4

(c) Silver is 300 times more soluble in molten zinc than molten lead. Draw Ellingham diagram. 4

(d) Eplain the reaction with equation involved in the following processes. 2×2

(i) Mexican process of extraction of Silver.

(ii) Cyanide process of extraction of Silver.

3. (a) What are 'Stokes' and 'anti-Stokes' lines in Raman spectrum ? Why 'Stokes' lines are more intense than 'anti-Stokes' lines. 4+2

(b) Symmetric stretch mode of vibration of carbon dioxide molecule is Raman active but infrared inactive. Explain. 2

(c) Derive the expression for rotational energy for the $j^{th}$ level of a diatomic molecule considering the rigid rotor model. 4

(d) What do you mean by Frank-Condon principle. ? 2

(e) The rotational spectrum of $^{79}Br^{19}F$ shows a series of equivalent lines spaces 0.714333 cm$^{-1}$ apart. Calculate the rotational constant $B$, the moment of inertia and bond length of the molecule. 4

(f) Why intensity or Rayleigh lines is more than Stoke's line ? 2

4. (a) Write down the underlying principles of rotational and vibrational spectroscopy. 4

(b) The rotational spectrum of HF has lines which are 41.9 cm$^{-1}$ apart. Calculate the bond length of HF. [Given At. Wt. of H = 1, F = 19, $N_A$ = 6.022×10$^{23}$ mol$^{-1}$. 4

(c) Write a short note on Fluorescence. 4

(d) Write a short note on Jablonski diagram. 4

(e) Write a short note on Hot band and mutual exclusion, principle. 4

5. (a) A linear molecule has the formula $AB_2$. Discuss how would you ascertain whether the molecule has the structure BAB and ABB, using its Raman and IR spectra together. 4

(b) Write a short note on point defects. linear defects,. surface defects. 6

(c) The first order reflection from a crystal plane in a cubic lattice occurs at $13°41'$. Find the Miller indices of the plane. Given, edge length a = 5.63Å, $\lambda = 1.54$Å $(Sin^2 13°41' = 0.056)$. 4

(d) Write a short note on Bravais lattice. 4

(e) What do you mean by voids in solid state ? 2

6. (a) State and explain Bragg's law. 4

(b) Determine the Miller indices of the plants that intersect the crystal axis at (i) $a$, $2b$, $3c$ and (ii) $a$, $b$, $-c$. 2+2

(d) Draw planes with Miller indices (111) and (210). 2+2

(e) Sodium crystallizes in b.c.c. structure with $a$ = 4.24 Å. Calculate (i) theoretical density and (ii) radius of 'Na' atom. 4

(f) KCl has an f.c.c lattice but from X-ray diffraction experiment it appear to be a simple cube. Explain. 4

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