C 55963 (Pages : 2) Name..............................

Reg. No..........................

FIRST/SECOND YEAR B.Sc. DEGREE EXAMINATION, MARCH/APRIL 2009

Part III—Chemistry (Main)

Paper **I—THEORETICAL** CHEMISTRY

(Improvement)

[Common with B.Sc. Polymer Chemistry (Main)
Paper I and B.Sc. Industrial Chemistry (Main) [Regular]--Paper I]

Time : Three Hours Maximum : 55 Marks

Section A

Answer any **sixteen** *questions.*
Each question carries 1% marks.

1. Calculate the de Broglie wavelength of an electron travelling at 1 % of the speed of light. (Planck's constant = 6.626 x 10^{-34} JS, Mass of electron = 9.1 x 10 ^^ kg.)
2. What is the uncertainty in momentum if we wish to locate an electron within approximately 100 pm ? (Mass of electron = 9.1 X 10^{-31} kg. and Planck's constant = 6.626 x 10 ^^ JS).
3. What is meant by Laplacian operator ?
4. Determine the term symbol of the ground state of Helium.
5. How many electrons in an atom may have the following quantum numbers ? n = 4, m_s = – V2.
6. Sketch the shapes of d_{xz}, $d_{x^2-y^2}$ and $dz^{\hat{}}$ orbitals.
7. Arrange the following elements in the increasing order of their electron affinity : P, S; CI, F. Justify your answer.
8. Which of the following will have the largest and smallest size ?

   Mg, Mg^', Al, Al^'. Give reason.
9. Arno Na and Mg, which would have the largest difference between first and second ionisation energies. Briefly explain your answer.
10. Give the Born-Lande equation and explain the terms.
11. Why is the dipole moment of NH_3 greater than that of NF_3 ?
12. Which is more stable, O_2^- or OF ? Why ?
13. Dra v the structure .of diborane.
14. State and explain Geiger-Nuttal rule.
15. Three quarters of ^^Sr, a radioactive element, disappeared in 56 years. What is the half-life period of ^^Sr ? What is the rate constant ?
16. What is meant by artificial radioactivity ? Give an example.
17. Which of the following molecules will be microwave active ? CO_2, CO, H_2, HCl. Give reason.

Turn over

18. Sketch the fundamental modes of vibration of H_2O molecule.

19. State the Frank-Condon principle.

20. Give the self ionisation reaction of liquid SO_2.

(16x $1\frac{1}{2}$ = 24 r ks)

Section B

Answer any **four** *questions.*
Each question carries 4 marks.

21. (a) Sketch the radial probability distribution curves of 2s and 2p orbitals.
(b) Calculate the wavelength of the spectral line obtained when the excited electron of the h. rogen atom falls from the third orbit to the second orbit.

(2 + 2 = 4 marks)

22. Give a brief account of the Pauling's and Mullikken's scale of electronegativity.

23. Calculate the lattice energy of LiF given that the enthalpy of (i) sublimatio of Li is 155.2 kJ mol. ; (ii) dissociation of F_2 is 150.6 kJ mol. ; (iii) ionisation of Li(g) is 520 K mol. ; (iv) electron affinity of F *(g) is* – 333 kJ mol. and heat of the reaction is -594.1 kJ mol 1

24. Discuss VSEPR theory. Explain the shapes of XeF_2 and IF_7 on the basis of VSEPR them 7.

25. Explain how moment of inertia and bond length can be determined from rotational spe a.

26. (a) What are protic and aprotic solvents ? Give examples for each.
(b) Explain the Lewis concept of acids and bases. Which of the following can act as is acid BF_3, NH_3, $\bar{F}$, SiF_4. Justify your answer.

(2 + 2 ma

[4 x 4 = 16

Section 'C

Answer any **two** *questions.*
Each question carries 7½ marks.

27. (a) State and explain the Postulates of quantum mechanics.
(b) Calculate the energy of the first two energy levels of an electron confined to a one-dimen box of length 10^{-10} m.

(**4** + 3/2 = $7\frac{1}{2}$ n

28. (a) Draw the MO level diagram of CO molecule. Calculate its bond order and comment on magnetic property.
(b) Give a brief account of inter and intra molecular hydrogen bonding taking suitable examples.

(4 + $3\frac{1}{2}$ = 7½ marks)

29. (a) An archeological sample shows ^{14}C activity of 1.52 disintegrations per minute per gram of carbon. A freshly cut piece of wood shows a ^{14}C activity of 15.2 disintegrations per minute per gram of carbon. Calculate the age of the sample $t_{1/2}$ of ^{14}C is 5760 years.
(b) Explain the principle and working of Aston's mass spectrograph.

(4 + $3\frac{1}{2}$ = $7\frac{1}{2}$ marks)

30. (a) Give a brief account of (i) chemical shift and (ii) spin-spin coupling.
(b) Explain the selection rules of rotational and vibrational spectra.

(4 + 3Y2 = 7Y2 marks)

[2 x 7½ = 15 marks]