

Physics (Hons.) Paper-V

Answer any two questions each from Group-B and Group-C.

Group-A

1. Select the correct answer from the following options :
- (a) If the numerical value of the kinetic energy of the electron of H-atom be K, then the total energy E of the electron is :
 (i) $E = K$ (ii) $E = -K$ (iii) $E = -2K$ (iv) $E = 2K$
- (b) If the elements with principal quantum number $n > 4$ were not allowed in nature the number of possible elements would be :
 (i) 60 (ii) 32 (iii) 4 (iv) 64
- (c) The n and l values of the last electron in the sub-shell for ^{17}Cl are :
 (i) $n = 2, l = 2$ (ii) $n = 3, l = 0$ (iii) $n = 3, l = 1$ (iv) None of these
- (d) The g-factor for the state $3P_1$ is :
 (i) $3/2$ (ii) $5/2$ (iii) $1/2$ (iv) None of these
- (e) The selection rule for the transition in rotational spectra is :
 (i) $\Delta J = 0$ (ii) $\Delta J = 1$ (iii) $\Delta J = 2$ (iv) None of these
- (f) The rotational energy levels of a molecule are :
 (i) Equally spaced (ii) Unequally spaced
 (iii) Mixture of both
- (g) Which one of the following is a symmetric molecule ?
 (i) H_2 (ii) O_2 (iii) N_2 (iv) CO
- (h) Light amplification on by stimulated emission of radiation is known as :
 (i) Light amplifier (ii) Maser (iii) Laser (iv) None of these
- (i) The ratio of Einstein's A, B Coefficients, i.e. A_{21}/B_{21} say, is proportional to :
 (i) ν (ii) ν^2 (iii) ν^3 (iv) ν^4
- (j) Metastable state has a mean life time of more than :
 (i) 10^{-3} s (ii) 10^{-5} s (iii) 10^{-4} s (iv) 10^{-2} s

Group-B

2. Deduce Moseley's law and show how it has been utilized in removing some of the defects of the periodic table.
3. Describe the essential elements that characterize the vector atom model. Discuss the various quantum numbers associated with the model.
4. Discuss briefly with theory, the Stern-Gerlach experiment. Discuss critically the results in case of some typical atoms.
5. Write short notes on any two of the following :
 (a) Spin orbit interaction (b) Characteristic X-ray spectra (c) Zeeman effect
 (d) Lande's g-factor

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6. Obtain an expression for rotational energy levels of diatomic molecule and the frequency rotational spectra. State clearly the selection rules. Show the energy levels of the rotational spectrum of a diatomic molecule.
7. What do you mean by Einstein's A and B coefficients ? Show that the ratio :

$$\frac{A_{nm}}{B_{nm}} = \frac{8\pi^2\nu^3}{c^3}$$

the symbols used having their usual significance.

8. Discuss with suitable schematic diagrams, the construction and the working of a Ruby Laser.
9. Write short notes on any two of the following : LNMUonline.com
 (a) Applications of Raman effect
 (b) Isotope effect on rotational and vibrational energies
 (c) Population Inversion
 (d) Applications of Raman effect