GOVERNMENT ZIRTIRI RESIDENTIAL SCIENCE COLLEGE

Subject : PHYSICS
Paper Name : Atomic, Nuclear Physics-I &Solid State Physics-I
Paper No. : PHY/IV/EC/07
Semester : IV

A. Choose the correct answer :

1. Which of the following is an isotope of Hydrogen?
a) Protium
b) ${}_{1}^{2}H$
c) ${}_{1}^{3}H$
d) all of these

2. Atoms of different elements having the same mass number are called
a) isotopes.
b) isobars.
c) isotones.
d) none of these.

3. The maximum number of electrons in a subshell with orbital quantum number l is
a) $2(2l+1)$
b) $(2l-1)$
c) $(2l+1)$
d) $2(2l-1)$

4. Degenerate orbitals are
a) different orbitals having the different energy.
b) the same orbitals at which electrons from different orbital jump.
c) different orbitals having the same energy.
d) None of these.

5. Moseley's law describes the relationship between atomic number Z and wavelength λ of a spectral line as
a) $\lambda = \frac{Z}{(K-\sigma)^2}$
b) $\lambda = \frac{K}{(Z-\sigma)^2}$
c) $\lambda = \frac{K}{(Z+\sigma)^2}$
d) $\lambda = \frac{K}{(\sigma-Z)^2}$

6. The electron emitted in the radioactive decay process originates from
a) inner orbits of atoms.

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b) free electrons existing inside the nucleus.
c) photons escaping from the nucleus.
d) decay of a neutron to proton and electron inside the nucleus.

7. If the nucleus ${}^{27}_{13}Al$ has a nuclear radius of *3.6fm*, then the nuclear radius of ${}^{125}_{52}Te$ will be
a) 9.6 fm
b) 6.0 fm
c) 4.8 fm
d) 12.0 fm

8.If Δm is mass defect, then Binding energy(*B.E*) of an atom can be calculated by
a) $(\Delta m \times 931)MeV$
b) $(\Delta m \times 931)eV$
c) $\frac{\Delta m}{A}$
d) None of these

9. β-Rays consist of
a) photons.
b) electrons.
c) helium nucleus.
d) none of these.

10. If $T_{1/2}$ is the half life period, then radioactive constant λ is
a) $\frac{\log_e 1}{T_{1/2}}$
b) $\frac{\log_e 2}{2T_{1/2}}$
c) $\frac{0.6931}{T_{1/2}}$
d) none of these

11. The number of lattice points in a primitive cell are
a) 1
b) 1/2
c) 2
d) 3/2

12. The coordination number of *b.c.c* structure is
a) 4
b) 8
c) 6
d) 12

13. The coordination number of *f.c.c* structure is

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a) 6
b) 12
c) 4
d) 8

14. The Miller indices of the plane parallel to *Y* and *Z*-axes are
a) (010)
b) (001)
c) (111)
d) (100)

15. The packing factor of *hcp* structure is
a) 68%
b) 52%
c) 92%
d) 74%

16. X-rays consist of
a) negatively charged particles
b) electromagnetic radiation
c) positively charged particles
d) a stream of neutrons

17. For a lattice given by basis vectors *a, b* and *c*, the reciprocal lattice is given basis vectors a^*,b^* and c^*, then a^* can be calculated by
a) $a^* = \frac{b\times c}{a.(b\times c)}$
b) $a^* = \frac{a\times c}{a.(b\times c)}$
c) $a^* = \frac{a\times b}{a.(b\times c)}$
d) $a^* = \frac{c\times b}{a.(b\times c)}$

18. The minimum energy required to dissociate the two atoms of a molecule(*AB*) into an infinite separation is called
a) Packing fraction
b) Cohesive energy
c) Both a&b
d) None of these.

19. What is the nature of bonding in CH_4?
a) ionic bond
b) covalent bond
c) metallic bond
d) dispersion bond

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20. The value of madelung constant for *NaCl* crystal is
a) 1.54
b) 1.85
c) 1.75
d) 1.65

21. As the temperature approaches absolute zero, the specific heat of solids C_v approaches
a) infinity
b) zero
c) Any value between zero and infinity
d) None of the above

22.According to Einsteins Theory of specific heat, it is considered that the *N* atoms have three degrees of freedom and the mean energy $\bar{E}$ of *3N* independent atomic oscillators is
a) $\frac{h\vartheta}{\left[e^{\frac{h\vartheta}{k_BT}}-1\right]}$
b) k_BT
c) $\frac{k_BT}{2}$
d) $\left[e^{\frac{h\vartheta}{k_BT}}-1\right]$

23. The average kinetic energy of an electron in the ground state in one dimension is equal to
a) $\frac{1}{2}E_f$
b) $\frac{1}{3}E_f$
c) $\frac{1}{4}E_f$
d) E_f

24. The classical expression for the electrical conductivity σ of a metal in terms of mass of the electron, charge of the electron, concentration of electrons and collision time is given by
a) $mne\tau$
b) $(me\tau/n)$
c) $ne^2\tau/m$
d) $m/ne^2\tau$

25. Ohms Law relates to the Electric field E, conductivity σ and current density *J* as
a) $J = E/\sigma$
b) $J = \sigma E^2$
c) $J = \sigma/E$
d) $J = \sigma E$

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B. Fill up the blanks:

1. The rays whose particles are much heavier than electrons and affect a photographic plate, produce fluorescences and penetrate thin aluminium foils and are called ________________
2. The ionisation energy of Hydrogen atom is ________________ eV
3. According to Pauli's Exclusion Principle, no two electrons in the same atom can have identical ________________ numbers.
4. Gamma rays consists of ________________
5. Complete the following reaction: ${}^{239}_{94}Pu \rightarrow {}^{235}_{92}U +$________________
6. A nuclear reaction in which a heavy nucleus splits spontaneously or on impact with another, with the release of energy is called Nuclear ________________ reaction.
7. The coordination number of a simple cubic structure is ________________
8. The atomic packing factor of Body Centred Cubic (bcc) structure is ________________ %
9. The number of molecules present in a unit cell of sodium chloride is ________________
10. When a beam of monochromatic X-rays falls on a crystal, Braggs law gives the relation between λ, interatomic spacing of the crystal d and glancing angle θ as ________________
11. The reciprocal lattice of a face centred cubic lattice is a ________________ lattice.
12. The nature of bonding of Sodium Chloride ($NaCl$) is an example of ________________ bonding.
13. If U is the total energy associated with *one kmol* of a metal and T is absolute temperature, then,the quantity $\left[\frac{dU}{dT}\right]$ is called ________________ of the metal.
14. The classical expression for the mean energy $\bar{E}$ for one-dimensional atomic oscillator is equal to ________________
15. ________________ is a measure of the amount of electrical current a material can carry and is a reciprocal of Electrical resistivity.

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Key Answers

A. Multiple Choice Questions:

1. d) all of these
2. b) isobars
3. a) $2(2l+1)$
4. c) different orbitals having the same energy
5. b) $\lambda = \frac{K}{(Z-\sigma)^2}$
6. d) decay of a neutron to proton and electron inside the nucleus
7. b) 6.0 fm
8. a) $(\Delta m \times 931) MeV$
9. b) electrons
10. c) $\frac{0.6931}{T_{1/2}}$
11. a) 1
12. b) 8
13. b) 12
14. a) (010)
15. d) 74%
16. b) electromagnetic radiation
17. a) $a^* = \frac{b \times c}{a.(b \times c)}$
18. b) Cohesive energy
19. b) covalent bond
20. c) 1.75
21. b) zero
22. a) $\frac{h\vartheta}{\left[e^{\frac{h\vartheta}{k_B T}} - 1\right]}$
23. b) $\frac{1}{3} E_f$
24. c) $ne^2\tau/m$
25. d) $J = \sigma E$

B. Fill up the blanks:

1. positive rays	2. 13.6	3. quantum
4. photons	5. ${}^{4}_{2}He$	6. fission
7. 6	8. 68	9. 4
10. $n\lambda = 2d \sin\theta$	11. body centred cubic (bcc)	12. ionic
13. specific heat	14. K_BT	15. electrical conductivity

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