1. Which one of the following is correct in respect of an electron and a proton having the same de-Broglie wavelength
   (a) Both have same kinetic energy
   (b) Both have same velocity
   (c) Both have same momentum
   (d) The kinetic energy of proton is more than that of electron
2. An X- ray beam of wavelength 0.16nm is incident on a set of planes of a certain crystal. The first Bragg reflection is observed for an incidence angle of 30°. What is the corresponding inter planar spacing?
   (a) 0.16 nm
   (b) 0.67 nm
   (c) 1.02 nm
   (d) 0.89nm
3. If the doping concentration in a Si- Zener diode is increased, the Zener breakdown voltage
   (a) Decreases
   (b) Increases
   (c) Remains unchanged
   (d) Becomes broader
4. The white dwarf stars are stable due to
   (a) electron degeneracy pressure
   (b) gravitational attraction
   (c) heat generated by fusion against gravitational collapse
   (d) fission
5. What is the velocity of conduction electron of silver having Fermi energy 5.52 eV
   (a) 1.39×10^8 m/s
   (b) 3.39×10^8 m/s
   (c) 13.9×10^8 m/s
   (d) 1.39×10^7 m/s
6. A meter stick is at an angle of 45° to the x- axis in its rest frame. The rod moves with a speed of $\frac{c}{\sqrt{2}}$ along the +x-direction w.r.t. a frame S. The length of the rod in S is
   (a) $\frac{\sqrt{3}}{2}$ m
   (b) $\frac{\sqrt{5}}{2}$ m
   (c) $\frac{\sqrt{2}}{3}$ m
   (d) $\frac{1}{3}$ m
7. In a multi-stage R-C coupled amplifier, the coupling capacitor
   (a) limits the low frequency response
   (b) limits the high frequency response
   (c) reduces the amplitude of input signal
   (d) blocks d.c. component without affecting the frequency response
8. Which one of the following is an example of doubly magic nuclei?
   (a) ^{18}O
   (b) ^{48}Ca
   (c) ^{124}Sn

(d)^{204}Pb

9. The rank of the following matrix $\begin{pmatrix} 1 & 5 & 1 \\ 2 & 1 & 1 \\ 3 & 6 & 2 \end{pmatrix}$ is,
   (a) 1
   (b) 2
   (c) 3
   (d) 4
10. A single photon of energy 100 MeV decays into an electron and a positron. Which of the following statements is true?
   (a) It does not violate any of the above conservation laws.
   (b) This process violates energy momentum conservation
   (c) This process violates angular momentum conservation
   (d) This process violates lepton number conservation
11. An electrical device operates on 9V and has a resistance of 21Ω. It is connected to a power supply of $120V$ output through a transformer. The current in the primary of the transformer is
   (a) 0.032
   (b) 0.042
   (c) 0.23 A
   (d) 2.32 A
12. In which quadrants of the complex plane, is the function $f(z) = |x| - i|y|$ analytic?
   (a) Only in the fourth quadrant
   (b) Only in the first and third quadrants
   (c) Only in the second and fourth quadrants
   (d) In all the quadrants
13. The entropy of the system in statistical mechanics is defined as (k is the Boltzmann constant and Ω is the number of microstates accessible to the system)
   (a) $S = kln\Omega$
   (b) $S = \frac{kln\Omega}{2}$
   (c) $S = 2kln\Omega$
   (d) $S = k^2 ln\Omega$
14. A linearly polarized electromagnetic wave is incident on a quarter wave plate. The emerge wave will in general be
   (a) linearly polarized
   (b) elliptically polarized
   (c) unpolarized
   (d) mixture of linearly polarized and unpolarized wave.
15. Which of the following statements is true for a square matrix A?
   (a) If $A^2 = 0$, it necessarily implies that $A = 0$.
   (b) If A is real and orthogonal, its eigenvalues will always be real.
   (c) If A is hermitian, its diagonal entries are always real.
   (d) If A is anti-hermitian (skew-hermitian), its diagonal entries are always zero.
16. The probability of electrons being captured by the nucleus is maximum for
   (a) K shell electrons
   (b) L shell electrons
   (c) M shell electrons

(d) Electrons in outermost orbits, independent of which shell they come from

17. A sphere rolls on a horizontal plane without slipping. The percentage of kinetic energy which is rotational is about
    (a) 58%
    (b) 50%
    (c) 18%
    (d) 28%
18. When a test charge is brought in from infinity along the perpendicular bisector of an electric dipole, the work done is
    (a) positive
    (b) negative
    (c) zero
    (d) infinity
19. During inelastic collision of two bodies, which of the following is conserved?
    (a) total linear momentum only
    (b) total kinetic energy only
    (c) both linear momentum and kinetic energy
    (d) neither linear momentum nor kinetic energy
20. Assume that each copper atom contributes one free electron to the electron gas. The density of copper is $8.94 \times 10^3\ kg/m^3$ and its atomic mass is $63.5\ amu$. The Fermi energy (in joule) in copper is of the order of
    (a) 10^{-18}
    (b) 10^{-13}
    (c) 10^{18}
    (d) 10^{13}