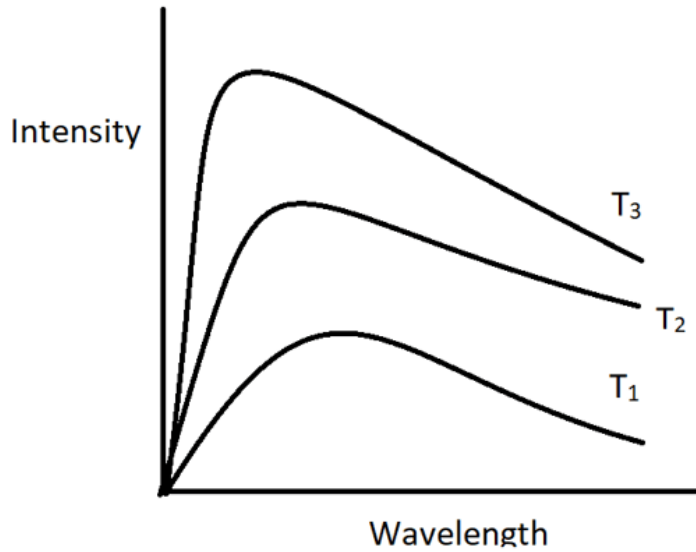


School of Nanoscience and Nanotechnology

CAT Model Question paper for M.Sc. Physics (Nanoscience and Nanotechnology)

1. What is the minimum Energy possessed by the particle in a box?
 - (a) Zero
 - (b) $\pi^2\hbar^2/2mL^2$
 - (c) $\pi^2\hbar^2/2mL$
 - (d) $\pi^2\hbar^2/mL$
2. The speed of cathode ray is , ($C=3\times 10^8$ m/s)
 - (a) Equal to C
 - (b) Greater than C
 - (c) Less than C
 - (d) May be less than, equal to or greater than C
3. The absolute temperature of a gas is increased 3 times. The root mean square velocity of the molecules will be
 - (a) 3 times
 - (b) 9 times
 - (c) 1/3 times
 - (d) $\sqrt{3}$ times
4. The structure sensitive property of a super conductor is
 - (a) Critical magnetic field
 - (b) Transition temperature
 - (c) Critical current density
 - (d) none of the above
5. An electron of mass 'M' kg and charge 'e' coulomb travels from rest through a potential difference of 'V' volts. The final energy is
 - (a) $MeV j$
 - (b) $\frac{e}{v}j$
 - (c) $eV j$
 - (d) $\frac{eV}{M}j$
6. In microwave ovens, water molecules in food are set into resonance when microwaves of fixed frequency are incident upon them. This causes the molecules to receive energy and hence warm up the food. In order to warm up the food faster, one can
 - (a) increase the frequency of the incident microwave while keeping its amplitude fixed.
 - (b) increase the frequency and amplitude of the incident microwave.
 - (c) increase the amplitude of the incident microwave while keeping its frequency fixed
 - (d) keep both frequency and amplitude of the incident microwave the same as before but increase the frequency of the water molecules.

7. From the figure what is the relation between T_1 , T_2 and T_3 ?



- (a) $T_1 > T_2 > T_3$
- (b) $T_3 > T_2 > T_1$
- (c) $T_3 > T_1 > T_2$
- (d) $T_2 > T_1 > T_3$

8. What is the velocity of light in a diamond if the refractive index of diamond with respect to vacuum is 2.5?

- (a) 1.2×10^8 m/s
- (b) 5×10^8 m/s
- (c) 1.2×10^{10} m/s
- (d) 2.5×10^8 m/s

9. How many AND gates are required to realize $Y = CD + EF + G$?

- (a) 4
- (b) 5
- (c) 3
- (d) 2

10. The decimal equivalent of the excess-3 number 110010100011.01110101 is

- (a) 970.42
- (b) 1253.75
- (c) 861.75
- (d) 1132.87

11. The gates required to build a half adder are _____

- (a) EX-OR gate and NOR gate
- (b) EX-OR gate and OR gate
- (c) EX-OR gate and AND gate
- (d) EX-NOR gate and AND gate

12. The gates required to build a half adder are _____

- (a) EX-OR gate and NOR gate
- (b) EX-OR gate and OR gate
- (c) EX-OR gate and AND gate
- (d) EX-NOR gate and AND gate

13. A blackbody at temperature T emits radiation at a peak wavelength λ . If the temperature of the blackbody becomes $4T$, the new peak wavelength is

- (a) $\frac{1}{256}\lambda$
- (b) $\frac{1}{64}\lambda$
- (c) $\frac{1}{16}\lambda$
- (d) $\frac{1}{4}\lambda$

14. Let N_{MB} , N_{BE} , N_{FD} denote number of ways in which two particles can be distributed in two particles can be distributed in two energy states according to Maxwell-Boltzmann, Bose- Einstein and Fermi-Dirac statistics respectively. Then $N_{MB} : N_{BE} : N_{FD}$ is

- (a) 4:3:1
- (b) 4:2:3
- (c) 4:3:3
- (d) 4:3:2

15. A system of two particles was distributed among three single states. In how many ways can the particles be distributed if they obey Bose- Einstein statistics?

- (a) 9
- (b) 3

- (c) 6
- (d) 1

16. An electromagnetic wave of frequency 3 GHz enters a dielectric medium of relative electric permittivity 2.25 from vacuum. The wavelength of this wave in that medium will be _____ $\times 10^{-2}$ cm.

- (a) 667
- (b) 650
- (c) 675
- (d) 657

17. Which of the following is not a thermodynamics co-ordinate?

- (a) P
- (b) T
- (c) V
- (d) R

18. In a typical human body, the amount of radioactive ^{40}K is 3.24×10^{-5} per cent of its mass. The activity due to ^{40}K in a human body of mass 70kg is _____ kBq.

(Roundoff to 2 decimal places)

(Half-life of ^{40}K is 3.942×10^{16} s, Avogadro's number $N_A = 6.022 \times 10^{23} \text{mol}^{-1}$)

- (a) 2×10^{13}
- (b) 2×10^{10}
- (c) 6×10^{13}
- (d) 6×10^{10}

19. What is the missing element from the following equation ${}^6\text{C}^{14} \rightarrow ? + {}_{-1}\text{e}^0$?

- (a) ${}^7\text{N}^{13}$
- (b) ${}^6\text{C}^{12}$
- (c) ${}^8\text{O}^{17}$
- (d) ${}^7\text{N}^{14}$

20. How many atoms per unit cell in a *fcc* lattice?

- (a) 1
- (b) 2
- (c) 4
- (d) 6

21. Point defect in a crystal can be introduced by
- Only thermal vibration of atom
 - Only fast cooling of specimen
 - Fast cooling and fast heating of specimen and by a dose of nuclear irradiation
 - All the process mentioned above
22. If two observers are in relative motion, they will not, in general, agree as to whether two events are simultaneous. If one observer finds them to be simultaneous, the other generally, will not.?
- Light travels in water with speed c
 - Due refraction
 - Due to interaction with water
 - Due to diffraction.
23. Is density relative?
- No
 - Yes
 - May be
 - None of the above
24. The de-Broglie wavelength of material particles which are in thermal equilibrium at temperature T is.....
- $h/\sqrt{2mKT}$
 - $\hbar/\sqrt{2mKT}$
 - \hbar/\sqrt{mKT}
 - $\hbar/\sqrt{2KT}$
25. General solution of differential equation $\frac{d^2y}{dx^2} - y = 0$ is
- $y = ce^x$
 - $y = ce^{-x}$
 - $y = c_1e^x + c_2e^{-x}$
 - None of the these*