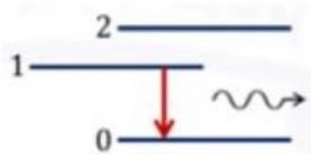**English**

1.

To sustain lasing action in 3 level laser as shown in figure, the

necessary conditions are

   i. Life time of energy level 1 should be greater than that of level 2

   ii. Population of particles in level 1 should be greater than that of

      level 0

   iii. Life time of energy level 2 should be greater than that of level 0

   iv. Population of particles in level 2 should be greater than that of

      level 1

(A) (i) & (iii)

(B) (i) & (ii)

(C) (iii) &(iv)

(D) (ii) & (iii)

Correct Option(s): B

English

2.

State of harmonic oscillator is $\psi = \frac{1}{2}\psi_0 + \frac{1}{4}\psi_2 + \frac{1}{2}\psi_4$. Its energy is

(A) $\frac{3}{2}\hbar\omega$

(B) $\frac{5}{2}\hbar\omega$

(C) $\frac{7}{2}\hbar\omega$

(D) $\frac{9}{2}\hbar\omega$

Correct Option(s): A

3.

For a Gaussian Wave function $\psi(x) = Ne^{-\left(\frac{x^2}{2\sigma^2}\right)}$, $-\infty < x < \infty$, the value of N is

(A) $\dfrac{1}{\pi\sigma^2}$

(B) $\pi\sigma^2$

(C) $\dfrac{1}{\sqrt{\pi\sigma^2}}$

(D) $\sqrt{\pi\sigma^2}$

Correct Option(s): C

4.

The de-Broglie wavelength of a particle having kinetic energy = E is given by

(A) $\lambda = \dfrac{h}{E}$

(B) $\lambda = \dfrac{h}{\sqrt{E}}$

(C) $\lambda = \dfrac{h}{\sqrt{mE}}$

(D) $\lambda = \dfrac{h}{\sqrt{2mE}}$

Correct Option(s): D

5.

Two waves $y_1 = A \sin(\omega t + \phi)$ and $y_2 = 3A \sin(\omega t + \phi + \pi)$. The resultant wave obtained due to interference leads to

(A) $Y_R = 4A \sin(\omega t + \phi)$

(B) $Y_R = -2A \sin(\omega t + \phi)$

(C) $Y_R = 4A \sin(\omega t + \phi + \pi)$

(D) $Y_R = 4A \sin(\omega t + \phi + \pi)$

Correct Option(s): B

English

6.

Twinkling of stars in clear sky during night time can be explained with

------------------------------of light

(A) Refraction

(B) Reflection

(C) Polarization

(D) Diffraction

Correct Option(s): A

English

7.

The radius 'R' of a loop carrying current 'I' is doubled, while the

current is halved. The magnetic moment M of the current loop is

(A) Remains same

(B) Quadrupled

(C) Halved

(D) Doubles

Correct Option(s): D

English

8.

If $\vec{J}$ is current density and ρ is the electric charge density then the

equation $A = \nabla \cdot \vec{J} + \frac{\partial \rho}{\partial t} = 0$ represents

(A) Wave equation

(B) Continuity equation

(C) Poisson's equation

(D) Laplace equation

Correct Option(s): B

9.

The orientation polarizability per molecule in a polyatomic gas is

given by

(A) $\dfrac{\mu_m^2}{3K_BT}$

(B) $\dfrac{\mu_m}{3K_BT}$

(C) $\dfrac{\mu_m^2}{3K_BT^2}$

(D) $\dfrac{T}{3K_B\mu_m}$

Correct Option(s): A

10.

The vector potential in a region is given by $\vec{A}(x,y,z) = -y\hat{\imath} + 2x\hat{\jmath}$.

The associated magnetic induction $\vec{B}$ is.........

(A) $\hat{\imath} + \hat{k}$

(B) $3\hat{k}$

(C) $-\hat{\imath} + 2\hat{\jmath}$

(D) $-\hat{\imath} + \hat{\jmath} + \hat{k}$

Correct Option(s): B

11.

Which of the following arrangement of crystal systems is arranged

with increasing order of symmetry

(A) Cubic, Hexagonal, Trigonal, Tetragonal

(B) Monoclinic, Triclinic, Cubic, Orthorhombic

(C) Trigonal, Tetragonal, Cubic, Hexagonal

(D) Triclinic, Monoclinic, Orthorhombic, Cubic

Correct Option(s): D

English

12.

Choose the correct statement(s)

(i) Primitive unit cell contain only one lattice point

(ii) Non-primitive unit cell has more than one lattice point

(iii) BCC structure is an example for primitive unit cell

(iv) Unit cell is building block of crystal structure

(A) (ii)& (iii)

(B) (iii)& (iv)

(C) (i)& (iv)

(D) (i)&(iii)

Correct Option(s): C

English

13.

Obtain the miller indices of a plane with intercepts a, b/2 and 3c in a

simple cubic unit cell

(A) (3 6 2)

(B) (1 2 3)

(C) (3 2 1)

(D) (1 2 1)

Correct Option(s): A

English

14.

Show that Madelung constant for the infinite line of ions of alternating

signs is equal to

(A) $\ln 2$

(B) $2 \ln 2$

(C) $\frac{1}{2 \ln 2}$

(D) 2

Correct Option(s): B

15.

Electronic contribution to specific heat of metals at low temperature is

proportional to

(A) $T^{3/2}$

(B) T^2

(C) $T^{1/2}$

(D) T^3

Correct Option(s): D

16.

The following is a good conductor of heat but not good conductor of

electricity.

(A) Glass

(B) Wood

(C) Diamond

(D) Gold

Correct Option(s): C

17.

Electronic transition in GaAs require

(A) Phonons alone

(B) Photons necessarily followed by phonons

(C) Photons alone

(D) Phonons necessarily followed by Photons

Correct Option(s): C

18.

High temperature superconductivity is observed at around

(A) 1 K

(B) 100 K

(C) 10K

(D) 500K

Correct Option(s): B

19.

Silicon is not suitable for fabrication of LED because it is

(A) A direct band gap semiconductor

(B) A narrow band gap semiconductor

(C) An indirect band gap semiconductor

(D) Energy band gap < 1.1 eV

Correct Option(s): C

20.

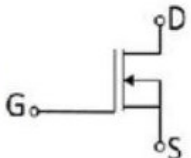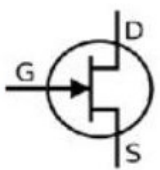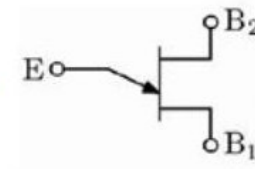According to the definition of Fermi energy, choose the correct the

option

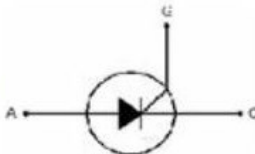(A) Probability of occupancy f(E)= 0.5 at E=E_F at 100K

(B) Probability of occupancy f(E)=1 at E $>$ E_F at 0K

(C) Probability of occupancy f(E)=0 at E $<$ E_F at 0K

(D) Probability of occupancy f(E)= 0 at E=E_F at 100K

Correct Option(s): A

21.

Identify the symbol of MOSFET

(A)

(B)

(C)

(D)

Correct Option(s): A

English

22.

An inductor L, a capacitor C and a resistor R are connected in series to

an AC source, $V = V_0 \sin \omega t$. If the net current is found to depend only on

R

(A) $L = 0$

(B) $\omega = (LC)^{-1/2}$

(C) $C = 0$

(D) $\omega \sqrt{\dfrac{1}{LC} - \dfrac{R^2}{4L^2}} = 0$

Correct Option(s): B

English

23.

Cr^{3+} has 3 electrons in the 3d subshell. The values of S, L respectively

are

(A) 3/2, 3/2

(B) 1/2, 3/2

(C) 1/2, 3

(D) 3/2, 3

Correct Option(s): D

English

24.

Choose the option which is not a characteristic feature of Diamagnetic

material

(A) Diamagnetism is an inherent entity in every material

(B) Diamagnetic susceptibility is negative and small

(C) Diamagnetic susceptibility is always -1

(D) Diamagnetic materials can be easily levitated in the presence of a

strong permanent magnet

Correct Option(s): C

25.

The ability to give same output reading when same input value is

applied repeatedly is known as

(A) Stability

(B) Sensitivity

(C) Accuracy

(D) Repeatability

Correct Option(s): D

26.

Magnetocrystalline anisotropy is the energy necessary to deflect the

magnetic moment in a single crystal from the easy to the hard

direction. Choose the correct choice with respect to the above

statement.

(A) <111>, <100>, <110>

(B) <100>, <110>, <111>

(C) <111>, <110>, <100>

(D) <100>, <111>, <110>

Correct Option(s): C

27.

Meissner effect indicates

(A) Electronic conductivity opposes superconductivity

(B) Thermal conductivity opposes superconductivity

(C) Photoelectrons affect superconductivity

(D) Magnetism opposes superconductivity

Correct Option(s): D

28.

Soft magnetic materials such as iron and its alloys are used in

manufacturing of

(A) Cores of transformers used in power generation

(B) Magnets for toys

(C) Magnets for Galvanometers

(D) Permanent magnets

Correct Option(s): A

29.

A dielectric material undergoes dipolar and atomic polarization in the

frequency range respectively

(A) $\sim 10^3$ Hz and $\sim 10^9$

(B) $\sim 10^9$ Hz and $\sim 10^{12}$

(C) $\sim 10^{12}$ Hz and $\sim 10^9$

(D) $\sim 10^{12}$ Hz and $\sim 10^{15}$

Correct Option(s): B

30.

Frequency range associated with Nuclear Magnetic Resonance (NMR)

is

(A) Radio frequency

(B) Microwave frequency

(C) Optical Frequency

(D) Soft X-Ray frequency

Correct Option(s): A

31.

Decimal equivalent of $10.1011_{(2)}$ is……………..

(A) 2.6875

(B) 3. 6825

(C) 2. 8125

(D) 1.6875

Correct Option(s): A

32.

Simplified form of the Boolean expression Y= AB+A(B+C)+B(B+C)

is.....

(A) AB+ B+C

(B) B+AC

(C) A+BC

(D) AB+A+B

Correct Option(s): B

33.

Simplified version of the expression $Y = \overline{(A+B)} + \bar{C}$ is.....

(A) $A\bar{C} + B\bar{C}$

(B) AB+BC

(C) ABC

(D) AC+BC

Correct Option(s): D

34.

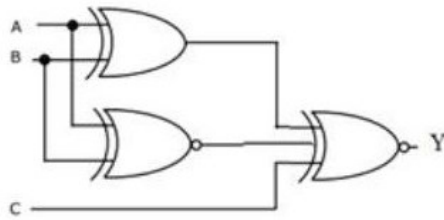The out of the logic circuit is '1' when all inputs are at logic '0;

(A) NAND and XOR

(B) NOR and XOR

(C) NOR and XNOR

(D) AND and XNOR

Correct Option(s): C

35.

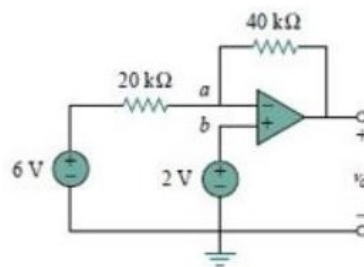What are the values of A, B and C to achieve Y=1 in the following

circuit

(A) A=B=1, C=0

(B) A=1, B=C=0

(C) A=B=0, C=1

(D) A=0, B=1, C=0

Correct Option(s): C

36.

The Output voltage V_0 for the following circuit is......

(A) -40 V

(B) -6 V

(C) -4V

(D) 12 V

Correct Option(s): B

37.

Which of the following is an example of top-down approach for the

preparation of nanomaterials?

(A) Gas phase agglomeration

(B) Molecular self-assembly

(C) Mechanical grinding

(D) Molecular beam epitaxy

Correct Option(s): C

38.

Which of the following equation is incorrect

(A) G= H+TS

(B) TdS= U+PdV

(C) F=U-TS

(D) G=U+PV-TS

Correct Option(s): A

39.

Measurement of Hall coefficient enables the determination of:

(A) Mobility of charge carriers

(B) Type of conductivity and concentration of charge carriers

(C) Specific conductivity

(D) Relaxation time of charge carrier.

Correct Option(s): B

40.

The quantum mechanical operator for the momentum of a particle in

one dimension is given by

(A) $\dfrac{i\hbar}{m}\dfrac{\partial}{\partial x}$

(B) $i\hbar\dfrac{\partial}{\partial t}$

(C) $-i\hbar\dfrac{\partial}{\partial x}$

(D) $-\dfrac{\hbar}{2m}\dfrac{\partial}{\partial x}$

Correct Option(s): C

41.

The Eigen vectors of the matrix $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ are

(A) (-1,-1) and (1,-1)

(B) (1,-1) and (-1 , 1)

(C) (1, 1) and (-1, -1)

(D) (1,1) and (1,-1)

Correct Option(s): D

42.

The general solution of the differential equation $(D^2 + 4D + 3)x = 0$

(A) $x(t) = Ae^{-t} + Be^{-3t}$

(B) $x(t) = Ae^t + Be^{3t}$

(C) $x(t) = Ae^t + Be^{-3t}$

(D) $x(t) = Ae^{-t} + Be^{3t}$

Correct Option(s): A

English

43.

The number of different components for symmetric tensor is

(A) N

(B) N^2

(C) N^2-1

(D) $\frac{N(N+1)}{2}$

Correct Option(s): D

English

44.

The thermodynamic relation PV= Constant represents

(A) Straight line

(B) Parabola

(C) Hyperbola

(D) Ellipse

Correct Option(s): C

English

45.

The electric field inside a hollow sphere of conducting material with

radius R is

(A) Non Zero constant Value

(B) Zero

(C) varies as 1/R

(D) varies as $1/R^2$

Correct Option(s): B

46.

Which of the following statement is wrong

(A) A vector field with zero divergence is said to be irrotational

(B) Divergence of curl is zero

(C) Curl of a gradient is zero

(D) Gradient of a Scalar entity is a vector

Correct Option(s): A

47.

Consider the forces(i) Nuclear force (ii)Electromagnetic force

(iii) Weak force and (iv) Gravitational force.

Arrangement with increase in order of values of their magnitude is

(A) iv, iii, i, ii

(B) iv, iii, ii, i

(C) iii, iv, ii, i

(D) iii, iv, i, ii

Correct Option(s): B

48.

Pure vibrational spectrum of diatomic molecule is observed when

(A) the molecule has center of symmetry

(B) the molecule does not have magnetic moments

(C) the molecule exhibits polarisability due to electronic transition

(D) the molecule has a permanent dipole moment

Correct Option(s): D

49.

If the following functions are plotted which has large value of slope

(A) $Y = x^2$

(B) $Y = e^{2x}$

(C) $Y = 2x$

(D) $Y = \log_{10}(x^2)$

Correct Option(s): B

50.

Piezoelectric constant is

(A) Isotropic and vector quantity

(B) Isotropic and Tensor quantity

(C) Anisotropic quantity and a tensor

(D) Anisotropic quantity and Scalar

Correct Option(s): C