

**SRM INSTITUTE OF SCIENCE AND TECHNOLOGY,
RAMAPURAM CAMPUS, CHENNAI**

DEPARTMENT OF PHYSICS

QUESTION BANK – I YEAR B.Tech.

18PYB103J- SEMICONDUCTOR PHYSICS

UNIT 3

PART A-ONE MARK QUESTIONS

1. _____ is the process where the energy due to recombination is dissipated as photons.

- (A) Radiative transition
- (B) Non-radiative transition
- (C) Absorption
- (D) Radiation

Because Non-radiative \rightarrow Phonon

Radiative \rightarrow Photon

2. The maximum voltage generated across the terminals of solar cell when they are kept open is called _____.

- (A) Short circuit voltage
- (B) Open circuit voltage
- (C) Fill factor
- (D) Drift Voltage.

Maximum Voltage \rightarrow Open circuit
Minimum Voltage \rightarrow Short circuit.

$V = \frac{nkT}{q} \ln(1 + I_L/I_s)$ $V = 0$

3. The _____ process is in which the electron-hole pairs are created and recombined radiatively.

- (A) Luminescence
- (B) Photon emission
- (C) Phonon emission
- (D) Radiation.

Optical process

- 1) Luminescence $\rightarrow e^-/e^+$ created
 - 2) Photoluminescence $\rightarrow e^-/e^+$ created by light
 - 3) Cathodoluminescence $\rightarrow e^-/e^+$ created by e^- bombardment
 - 4) Electroluminescence \rightarrow recombination by injection with pn-junction
- } created and recombined

4. The average velocity acquired by the electrons in a particular direction during the presence of electric field is called _____.

- (A) Relaxation time
- (B) Drift velocity
- (C) Collision time
- (D) Diffusion current

5. The photons of energy value _____ that of the band gap values do not get absorbed in photovoltaic cell.

(A) Greater than

(B) Less than

(C) Nearly equal than

(D) Zero

6. _____ is the process where the excess energy due to recombination is usually imported to phonons and dissipated as heat.

(A) Radiative transition

(B) Non-radiative transition

(C) absorption

(D) Radiation.

7. The radiative recombination of electron-hole pair created by injection of photons is called _____.

(A) Photoluminescence

(B) Photon emission

(C) Phonon emission

(D) Radiation

8. The maximum current flows in solar cell when its P-side & N-side terminal are **shorted**, such a current is called _____.

(A) Drift current

(B) Diffuse current

(C) Short-circuit current

(D) Alternative current

9. The ratio between E_g and charge of electron in photovoltaic cell is called _____.

(A) Current loss

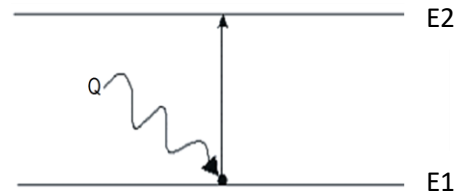
(B) Voltage loss

(C) loss due to metal

(D) Optical loss.

10. The given diagram represents

- (A) Spontaneous emission
- (B) Stimulated emission
- (C) Absorption process**
- (D) Temperature inversion



11. Which of the following is responsible for electrical conduction in metal?

- (A) Electrons**
- (B) Protons
- (C) Neutrons
- (D) Positrons

12. The given diagram represents

- (A) Photovoltaic Cell**
- (B) Fuel cell
- (C) Two probe
- (D) DMS



13. The _____ does not require any external energy for process to take place.

- (A) Stimulated emission
- (B) Spontaneous emission**
- (C) Stimulated absorption
- (D) Stimulated radiation.

14. The light amplification is achieved by _____ from an atomic or molecular system.

- (A) Spontaneous emission
- (B) Stimulated emission**
- (C) Time inversion
- (D) Temperature inversion

by Stimulated Emission of
L A S E R Radiation
Light Amplification

15. _____ is the process of radiative recombination of electron-hole pairs created by electron bombardment.

- (A) Photoluminescence
- (B) photon emission
- (C) Phonon emission
- (D) Cathodoluminescence**

16. The open circuit voltage of a solar cell increases with _____.

- (A) Increase in bandgap**
- (B) Decrease in band gap
- (C) Increase of in holes
- (D) Decrease in holes

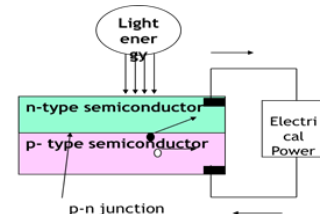
17. The current density is directly proportional to the _____.

- (A) Rest mass of electron
- (B) Applied electric field**
- (C) density of core electron
- (D) Collision time.

$$J = E \sigma_n$$

18. The given diagram represents effect.

- (A) Photovoltaic effect**
- (B) Compton effect
- (C) Raman effect
- (D) Zeeman Effect.



19. The ratio of the maximum power that can be extracted from a solar cell to the ideal power is called ____.

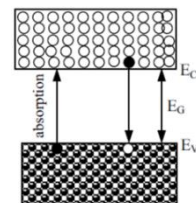
- (A) Short circuit voltage
- (B) Open circuit voltage
- (C) Fill factor**
- (D) Drift Voltage

20. The sun light can be converted to electricity due to the _____.

- (A) Photovoltaic effect**
- (B) Compton effect
- (C) Raman effect
- (D) Zeeman Effect.

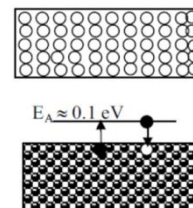
21. Which one of the following is related to the diagram?

- (A) Band to band transition**
- (B) Impurity to band transition
- (C) Free carrier Transition
- (D) Photonic transition



22. Which one of the following is related to the diagram?

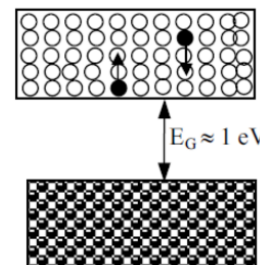
- (A) Band to band transition
- (B) Impurity to band transition**
- (C) Free carrier Transition
- (D) Photonic transition



23. Which one of the following is not a postulate of Classical free electron theory?
- (A) The valence electrons are freely moving about the whole volume of the metals
(B) The energy levels of the electrons moving inside the metal are discrete.
 (C) The free electrons collide with each other positive ions
 (D) When the electric field is applied all the valence electrons a drifted

24. Which one of the following is related to the diagram?

- (A) Band to band transition
 (B) Impurity to band transition
(C) Free carrier Transition
 (D) Photonic transition



25. Illustrate the properties of Photoluminescence

- (I) The Principle of this method is based on the absorption of ultraviolet light or visible light by chemical compounds, which results in the production of distinct spectra. **Spectroscopy** is based on the interaction between light and matter.
- (II) It is a process in which a molecule absorbs a photon in the visible region, exciting one of its electrons to a higher electronic excited state, and then radiates a photon as the electron returns to a lower energy state.
- (III) This method is routinely used in **analytical chemistry** for the quantitative determination of different analytes, such as transition metal ions, highly **conjugated organic compounds**, and biological macromolecules.
- (IV) It is the spontaneous emission of light from a material following optical excitation. It is a powerful technique to probe discrete energy levels and to extract valuable information about semiconductor sample composition, quantum well thickness or quantum dot sample mono dispersity.
- (A) All the four Incorrect
 (B) Both II and III correct
 (C) Both III and I correct
(D) Both II and IV correct

26. The direct band to band absorption and emission can take place only at frequencies for which photon energy _____.

- (A) $h\nu > E_g$**
 (B) $h\nu < E_g$
 (C) $h\nu = E_g$
 (D) $h\nu = 0$

27. The ratio between spontaneous and stimulated emission coefficients is called _____.

- (A) Lorenz number
- (B) Lorentz coefficient
- (C) Absorption coefficient
- (D) Einstein's coefficient**

28. Analyse the device Photovoltaic Cell

- I) The single photovoltaic cell constitute the *n*-type layer sandwiched with p-type layer.
- II) This is an electrical device that converts the energy of light into electricity.
- III) The operation of all optoelectronic devices is based on creation or annihilation of electron hole pairs.
- IV) These are the class of vacuum tubes, and more specifically vacuum phototubes, are extremely sensitive detectors of light.

(A) Both I and II correct

- (B) Both I and III correct
- (C) Both II and IV correct
- (D) Both I and II correct

29. Analyse recombination process

- I) simplest way to achieve this phenomenon is to irradiate the semiconductor
- II) Recombination maybe radiative or non radiative.
- III) Pair formation essentially involves raising an electron in energy from the valence band to conduction band leaving hole behind in valence band.
- IV) The energy levels of the electrons moving inside the metal are discrete.

(A) Both I and IV correct

(B) Both I, II and III correct

- (C) Both II and IV correct
- (D) Both III and IV correct

30. Efficiency of single crystalline Silicone is about -----

(A) 14 – 17

- (B) 1-7
- (C) 13 – 15
- (D) 5 - 7

General Statement!

?

Atleast by
newer laws WKT
-they are Continuous.

TRUE

31. Which one of the following is **not a drawback** of Classical free electron theory?

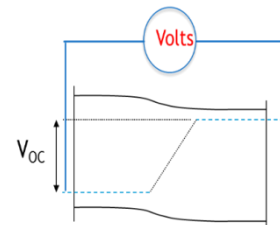
- (I) It could not explain photoelectric effect and Compton effect.
 - (II) It verifies ohms law.
 - (III) Electrical conductivity of semiconductors and insulators could not explain.
 - (IV) Ferromagnetism could not explain by this theory.
- (a) Both I and III correct
 (b) All the four Incorrect
(c) II - correct
 (d) Both I and IV correct

32. The average velocity acquired by the free electrons of a metal in a particular direction by the application of electric field equal to -----.

- (I) $eE\tau / m$** → *Drift Velocity*
- (II) $eE\tau$
- (III) eE / m
- (IV) $e\tau / m$

33. Which one of the following is related to the diagram?

- (A) Open circuit voltage**
- (B) Short circuit voltage
- (C) Short circuit current
- (D) Open circuit Current



34. Which one of the following is related to this expression?

$$W_{abs} = \frac{2\pi}{\hbar} |\langle f | H_{int} | i \rangle|^2 \delta(E_f - E_i - \hbar\omega)$$

- (A) Joint density of states
- (B) Fermi's Golden Rule**
- (C) Energy density
- (D) Fermi Energy

35. Fill factor of PV cell equal to -----

- (A) $(I_{mp}) / (I_{sc} \cdot V_{oc})$
- (B) $(I_{mp} \cdot V_{mp}) / (I_{sc} \cdot V_{oc})$**
- (C) $(V_{mp}) / (I_{sc})$
- (D) $(I_{mp} \cdot V_{mp}) / (V_{oc})$

36. Calculate the electrical resistivity of sodium at 0° C. It has 25.33×10^{27} unit volume and has a mean free time of 3.2×10^{14} s.

$$V = IR$$

$$R = \frac{V}{I}$$

$$\rho = ?$$

$$\Omega \cdot m = \frac{m^2}{m} T^{-3} I^{-2}$$

$$\frac{T}{K}$$

$$\frac{V}{m^3}$$

$$\frac{T}{s}$$

(A) $4.532 \times 10^{-36} \Omega \text{ m}$

(B) $5.431 \times 10^{-36} \Omega \text{ m}$

(C) $6.81 \times 10^{-36} \Omega \text{ m}$

(D) $3.12 \times 10^{-36} \Omega \text{ m}$

37. Efficiency of Amorphous Silicone is about -----

(A) 14 – 17

(B) 1-7

(C) 13 – 15

(D) 5 - 7

38. The spectral region where the material changes from being relatively transparent to strongly absorbing is known as -----.

(A) **Absorbing edge**

(B) Conduction edge

(C) Valance edge

(D) Annihilation edge

39. In stimulated emission, the state at which the life time of atoms is extended is -----.

(A) **Metastable state**

(B) Stable state

(C) Excited state

(D) Ground state

40. The absorption coefficient of semiconducting materials strongly depends on the.....

(A) Properties of material

(B) **Wavelength**

(C) Amount of light

(D) Amplitude