1. What is the priciple of Air Wedge?

a) The principle on which a wedge works is the principle of an inclined plane. An inclined plane is a sloping surface in which a small force acting along the slope can produce a larger force. That is why we are able to split hard objects using wedges.

(or)

b) Two plane glass plates are inclined at an angle (θ) by introducing a thin material (eg. hair) forming a wedge shaped air flim. This flim is illuminated by sodium light. Interference occurs between two rays, one reflected from the front surface and the other by internal reflection at the back surface. Therefore straight lines fringes parallel to the edge of the wedge are obtained. Using the theory of airwedge the thickness of the material can be determined.

2. Give conditions for total internal reflection.

(a) The light should be incident from denser medium to rarer medium
(b) The angle of the incidence i in denser medium should be greater than critical angle θ_c.

3. How will you test the flatness of the given surface of the material by air wedge method?

If two surfaces are perfectly flat, then the air fill gradually varies in thickness. The fringe will be of equal thickness because; each fringe is the locus of the points at which the thickness of the film has constant value. If the fringes are not equal in thickness, it means the surfaces are not flat.

4. What is Air Wedge?

A wedge shaped (V – shaped) air film enclosed in between two glass plates is called air wedge.

5. Write the differences between spontaneous emission and stimulated emission.

Spontaneous Emission	Stimulated Emission
Emission of light radiation is not triggered by external influence	Induced emissions of light radiations caused by incident photons
Emitted photon travels in random direction	Emitted photon travels in particular direction
Emitted photons cannot be controlled	Emitted photons can be controlled
This process is a key factor for ordinary light	This process is a key factor for laser operation

6. What is meant by population inversion and how it is achieved?

The establishent of a situation in which the number of atoms in higher energy level is more than that in lower energy level is called population inversion. It is an essential requirement for producing a laser beam. It is achieved by pumping action.

7. What are the methods commonly used for pumping action?

(i) Optical pumping (excitation of photons)
(ii) Electrical discharge method (excitation of electrons)
(iii) Direct conversion
(iv) Inelastic collision between atoms

8. What are the charateristics of laser? (or) What are the properties of laser beam?

- Laser light is hight coherent.
- It is highly powerful and intense.
- It is directional and monochromatic.
- It is capable of travelling over long distance without any energy loss
- It is extremely bright.
- Laser beam is not easily absorbed by the water.

9. Compare the characteristics of laser with ordinary light.

Ordinary Light Source	Laser Source
Light emitted is not monochromatic	Light emitted is highly monochromatic
Light emitted does not have high degree of coherence	It has high degree of coherence
Emits light in all directions (not directional)	Emits light only in one direction (directional)
Light is less intense and less bright	Laser light is much intense and bright.

10. What are the three important components of any laser device?

(i) Active medium
(ii) Pumping source
(iii) Optical resonator

11. What are matter waves?

The waves which are associated with moving particle of matter (e.g., electrons, photons, etc) are known as matter waves or de-broglie waves.

12. State the properties of the matter waves.

(i) Lighter is the particle, greater is the wavelength ... associated with it.
Iii) Smaller is the velocity of the particle, greater is wavelength associated with it.
(iii) These waves are not electromagnetic waves.
(iv) The velocity of de Broglie wave is equal to the velocity of the material particle.

13. Mention some physical significance of the wave function.

(i) The wave function (ψ) relates the particle and wave nature of matter statistically.
(ii) It is a complex quantity and hence we cannot measure it.
(iii) If the particle is certainly to be found somewhere in a space of dimension *dx, dy, dz*, then the probability value is equal to one.
i.e., $P = \iint_V \int |\psi|^2 \, dx \, dy \, dz = 1$

14. What is Schrodinger wave equation?

The equation that describes that wave nature of a particle in mathematical form is known as Schrodinger wave equation.

15. What is the significance of zero point energy in a harmonic oscillator?

For lower (ground) state, = 0

$E_o = 1/2 \, hv$

This is the lowest value of energy, called zero point energy. Even if the temperature reduces to absolute zero, the oscillator would still have an amount of energy *1/2 hv*.
In old equation mechanics, the energy of n^{th} level.

$E_n = nhv$

Whereas in wave mechanics

$E_n = (n + 1/2)hv$

16. What is quantum tunneling?

The phenomenon of transmission of a particle through a potential barrier of finite width and height, even when its energy is less that the barrier is called quantum tunneling.

17. Define resonance tunneling.

The transmission probability of the double symmetric barrier is maximum. The tunneling current reaches peak value when energy of electron wave is equal to quantised energy state of the well. This phenomenon is known as resonance tunneling.

18. State Bloch Theorem.

If an electron in a linear lattice of lattice constant '*a*' characterised by potential function *V(x) = V(x+a)* satisfies the Schordinger equation.
$d^2\psi(x)/dx^2 + 2m/\hbar^2 [E - V(x)] (x) = 0$

then the wave functions ψ(x) of electron (with energy E) obtained as a solution of Schrodinger equatiion are of the from

$\psi(x) = u_k (x) \, e^{\pm ika}$

with $u_k (x) = u_k(x+a)$

19. What is an energy band?

A set of closely spaced energy levels is called an energy band.

20. Distiguish between Homo-junction and Hetero-junction semiconductor lasers.

Homo-junction semiconductor laser	Hetero-junction semiconductor laser
Same semiconductor material on both side of the active region.	Differnet semiconductor materials on either side of the active region.
Active region is not well defined.	Active region well defined.
Operates at high forward current.	Operates at low forward current.
Can not operate continuously at room temperature.	Can operate continuously at room temperature
Refractive index is almost constant throughout the device.	Refractive indices are differnt in different regions of the device.
Light diffuses from active region to the surrounding.	Light is more confined to the active region.
Cavity loss is more.	Cavity loss is less.
Efficiency is less.	Efficiency is more.

21. Distinguish between particle in a well and harmonic oscillator (One dimensional)

Particle in 1D well	Harmonic Oscillator
Energy Eigen value is $E_n = n^2h^2/8ml^2$	Energy Eigen value is $E_n = [n+1/2]hv$
The minimum energy (n=0) is zero	The minimum energy (n≠0) is not zero
The energy values are not equal distance	The energy values are at equal distance
Energy levels are shown in Fig	Energy levels are shown in Fig