UNIT-I
WAVES AND OSCILLATIONS

1. What are the two basic characteristics of a simple harmonic motion?
2. When will the motion of a simple pendulum be simple harmonic?
3. What is the ratio of maxmimum acceleration to the maximum velocity of a simple harmonic oscillator?
4. What is the ratio between the distance travelled by the oscillator in one time period and amplitude?
5. In Fig. 14.9, what will be the sign of the velocity of the point P ′ , which is the projection of the velocity of the reference particle P . P is moving in a circle of radius R in anticlockwise direction.

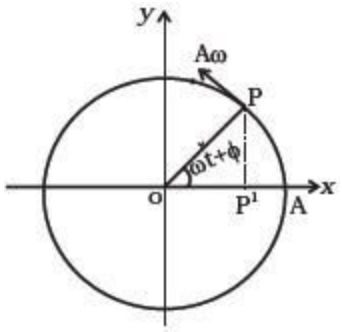

Fig. 14.9

6. Show that for a particle executing S.H.M, velocity and displacement have a phase difference of π/2.
7. What do you meant by free oscillations? Give suitable example.
8. What do you meant by damped oscillations? Give suitable example.
9. What do you meant by undamped oscillations? Give suitable example.
10. Define damping coefficient. Give its unit.
11. Define force constant. Give its unit.
12. State different forces acting on the system if it executes the damped oscillations.
13. Write down the differential equation of the damped oscillations. Explain the meaning of each term involved in it.
14. Show graphically the concept of over-damped motion, critically damped motion and damped harmonic motion.
15. Due to damping effect the frequency of oscillations decreases. Comment.
16. Write down an equation of damped oscillatory motion. How amplitude decreases?.
17. Define ‘logarithmic decrement.’
18. Write down the equation of energy of the damped harmonic oscillator.
19. Define quality factor of a damped harmonic oscillator.
20. Write down the differential equation of the damped oscillations. State only all the three cases.
21. By giving suitable formulae, compare the frequencies of undamped oscillations and damped oscillations. Give suitable examples.
22. Write down the differential equation of the damped oscillations. Also write its

solution. Hence discuss the condition of critical damping.
23. The frequency of a damped oscillator of mass 5 gm is 2 Hz. If the coefficient of damping is 0.157 dyne.s/cm, what is its Q factor? Also determine the logarithmic decrement.
24. A damped harmonic oscillator of mass 0.5 kg is oscillating in a medium having coefficient of damping is 1.0 N.s/m. If the period of oscillations is 0.5 second, find the logarithmic decrement.
25. The restoring force per unit displacement of magnitude 7 N/m acts on an oscillator of mass 30 gm. The coefficient of damping is 0.5 Ns/m. Determine whether the motion is over damped or critically damped or damped oscillatory.

UNIT –II
LASERS

1. What does the acronym LASER stand for?
a) Light Absorption by Stimulated Emission of Radiation
b) Light Amplification by Stimulated Emission of Radiation
c) Light Alteration by Stimulated Emission of Radiation

2. What does the acronym MASER stand for?
a) Microwave Amplification by Stimulated Emission of Radiation
b) Molecular Absorption by Stimulated Emission of Radiation
c) The name of Albert Einstein's dog

3. What is one way to describe a Photon?
a) Solid as a rock
b) A wave packet
c) A torpedo

4. What determines the color of light?
a) its intensity
b) its wavelength
c) its source

5. Which scientist first came up with the idea of stimulated emission ?
a) Alexander Graham Bell b) Isaac Newton
c) Arthur Schalow d) Albert Einstein

6. Which laser is considered "eye safe"?
a) Laser bar-code scanners
b) The eximer laser
c) Communications lasers

7. Why are lasers used in fiber optic communications systems

a) The government has mandated it
b) They can be pulsed with high speed data
c) They are very inexpensive

8. What type of laser is used in CD and DVD players?
a) Semiconductor
b) YAG
c) Alexandrite

9. Why are lasers used in "Laser Printers" ?
a) They can be focused down to very small spot sizes for high resolution
b) They are cheap c) They are impossible to damage

10. As wavelength gets longer, the laser light can be focused to...
a) Larger spot sizes b) Smaller spot sizes

11. Which color of light has the shortest wavelength ?
a) Yellow b) Blue c) Red d) Green

12. What property of laser light is used to measure strain in roadways?
a) Intensity b) Power c) Coherence

13. What is the type of laser used most widely in industrial materials processing applications?
a) Dye Laser b) YAG laser
c) Ruby Laser d) Carbon Dioxide Laser

14. Why are lasers used for cutting materials ?
a) It never gets dull d) Smoother cuts
b) It has a small "heat affected zone" e) Repeatability
c) Accuracy f) All of the above

15. The Eximer laser produces light with what wavelength?
a) Visible
b) Ultraviolet
c) Infrared

16. Laser energy is used to break up kidney or gallstones in process called?
a) Trbecularplasty
b) Lithotripsy
c) Viscocanalostomy

17. The National Ignition Facility will use what type of laser for fusion power experimentation?
a) Neodymium-glass
b) Argon gas
c) Rhodamine Dye

18. Most lasers are electrically inefficient devices.
a) True b) False

19. Chemical lasers use____ to produce their beams.
a) Excessive amounts of electrical power
b) Small amounts of electrical power
c) No electrical power

20. What type of laser could cause skin cancer if not used properly?
a) Red semiconductor laser b) Blue semiconductor
c) Eximer laser d) YAG laser

21. What do you mean by optical pumping?

22.Calculate he coherence length of a Laser beam for which the band

width = 3000 Hz. Speed of light = $3x10^8$ m/s

23. Explain the terms: i) Stimulated absorption
ii) Population inversion
iii) Pumping
24.Explain the principle of Laser action.
25. Why is a four level Laser more efficient than a three level laser?

26. What is an optical resonator?

27. Draw schematic diagram of a febry-perot resonator.

28. Draw schematic diagram of a four level laser.
29. Describe the construction and working of a Ruby laser with necessary diagram.

30. Describe the construction and working of a Nd-YAG laser with necessary diagram.

31.Draw a neat diagram of He-Ne laser and describe its working. What are the characteristics of output laser beam from He-Ne laser?
32. Draw a neat diagram of CO_2 laser and explain its working.

UNIT-III
QUANTAM MECHANICS

1 What are matter waves?
2 What is wave particle duality?
3 Explain the de-Broglie's concept of matter waves.
4 Calculate the de-Broglie wavelength of an electron moving with velocity 10,0000m/s.
5 Calculate the de-Broglie wavelength of neutron of energy 28.8eV. (Given mass of neutron= 1.67x10-27 Kg, Plank's constant=6.62x10-34 J.S).
6 What do you meant by group velocity?
7 Define phase velocity.

8 State the importance of Davisson and Germer Experiment.
9 Calculate the de-Broglie wavelength associated with electrons accelerated from rest by potential difference of 200V.
10 What are different forms of Heisenberg's uncertainty relation?
11 Give the statement of Heisenberg's uncertainty principle.
12 Deduce an expression for the de-Broglie wavelength 'λ' of moving particle.
13 Explain the term wave packet.
14.Show that for particle moving with relativistic velocity, group velocity is equal to the particle velocity.
15. Show that de-Broglie wavelength $\lambda = h/mv$.
16.If the uncertainty in position of an electron is 4x10-10 m, calculate the uncertainty in its momentum.
17.If the uncertainty in the location of a particle is equal to its de-Broglie wave length, what is the uncertainty with velocity?
18.Find out the wavelength of wave associated with a marble ball of mass 20gm moving with a velocity 30m/s.
19. Define the term: i) Phase velocity ii) Wave packet iii) Group velocity.
20.Calculate the energy in electron volt of an electron wave of de-Broglie wavelength 3x10-2m. (Given Plank's constant=6.62x10-34 J.S).
21.Using de-Broglie hypothesis, calculate the wavelength associated with an electron with K.E. of 100 eV. (Given mass of electron= 9.1x10-31 Kg, Plank's constant=6.625x10-34 J.S).
22. Derive uncertainty relation $\Delta x.\ \Delta p \geq h$.
23. Write note on de-Broglie hypothesis of matter waves.
24. Obtain the relation between group velocity and phase velocity.
25. Explain the wave particle duality.
26. Explain one of the applications of Heisenberg's uncertainty principle.
27.Find the de-Broglie wavelength of a electron having 5keV energy.

UNIT-IV
INTRODUCTION TO SOLIDS AND SEMICONDUCTORS

1. Give the postulates of free electron theory.
2. Write down any four drawbacks of classical free electron theory.
3. Mention any two important features of quantum free electron theory of metals.
4. Define Fermi level and Fermi energy in metals with its importance.
5. Define electrical conductivity.
6. Distinguish between relaxation time & Collision time.
7. Define "mobility" of free electrons with unit.
8. Define mean free path.
9. Define drift velocity of electron. How is it different from thermal velocity of an electron?
10. Give microscopic form of ohm's law and state whether the ohm's law is true at all temperatures?
11. Write the Fermi Dirac distribution function and explain it for the electrons in a metal.
12. What are the sources of electrical resistance in metals?
13. StateWiedemann- Franz law?

14. What is Lorentz number?
15. What is density of states in metals? What are its uses?
16. How does the Fermi function vary with temperature?
17. What are the uses of Fermi distribution function?
18. Calculate the conduction electron density in Cesium, if its Fermi energy is 1.55 eV.
19. Fermi temperature of a metal is 24600K. Calculate the Fermi velocity of electrons. Given: k=1.38×10-23JK-1, m= 9.1×10-31 kg.
20. The Fermi energy for silver is 5.1 eV. If the temperature is 300 K, what is the probability that the states with energies 5.0 eV and 5.2 eV be occupied?
21. Discuss the drawbacks of classical free electron theory of metals.
22. What are the basic assumptions of classical free electron theory? Based on the assumptions derive an expression for electrical and thermal conductivity of metals. What are the success and failures of thistheory? Derive widemann- Franz law.
23. i) Explain the concept of density of energy states.
ii) Derive an expression for density of electron states in a metal. Hence deduce the expression for Fermi energy at 0 K.
24. Write down the Fermi Dirac distribution function. Explain how the function varies with temperature?
25. What are the properties of semiconductors?
26. State the law of mass action in semiconductors.
27. Distinguish between conductor and semiconductor on the basis of their electrical conductivity.
28. What are direct and indirect bandgap semiconductors?
29. With increase of temperature, the conductivity of a semiconductor increases. Why?
30. Write the expression for band gap of an intrinsic semiconductor.
31. Define Fermi level in the case of semiconductors. Mention its position in intrinsic and extrinsic semiconductors at 0 K.
32. What are the differences between intrinsic & extrinsic semiconductorS. What is Fermi level in a semiconductor?
33. Write the expression for the electrical conductivity of an intrinsic semiconductor
34. Give the carrier concentration of an intrinsic semiconductor.