Chapter 1

Q.1. Define physics and give the names of its two main branches.

Ans. Physics: Physics deals with the study of matter and energy and the relationship between them.

Branches:

i. Solid state physics ii. Nuclear physics

Q.2. Define solid state physics and nuclear physics.

Ans: Solid State Physics: This branch of physics which deals with the study of structure and properties of solids is called solid state physics.

Nuclear Physics: This branch of physics which deals with the study of atomic nuclei is called nuclear physics.

Q.3. What are the main frontiers of fundamental science?

Ans. There are three main frontiers of fundamental sciences:

(i) The world of extremely large objects e.g. earth, moon, stars and the universe itself.

(ii) The world of extremely small objects e.g. electron, protons, neutrons etc.

(iii) The world of middle sized objects e.g. cars, table, chair, machines etc.

Q.4. Differentiate between base unit and derived units.

Ans. Base Units: The units of seven base quantities are called base units. Seven base units are given as meter, kilogram, second, ampere, kelvin, candela and mole.

Derived Units: The units which are derived from base units are called derived units. Some of the derived units are newton, watt, joule, etc.

Q.5. What are base units? Draw their table.

Ans.

	Physical Quantity	**SI Units**	
	Symbol		
1.	Length	meter	m
2.	Mass	kilogram	kg
3.	Time	second	s
4.	Electric current	ampere	A
5.	Thermodynamic temperature	kelvin	k
6.	Intensity of light	candela	cd
7.	Amount of substance	mole	
	mol		

Q.6. What do you mean by scientific notation? Give an example.

Ans. Science Notation: Numbers represented in standard form which uses power of ten are called scientific notation. In the internationally accepted form there should be only one non-zero digit to the left of decimal.

Example:

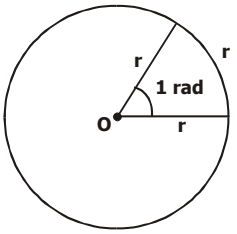
The number 134.7 is written 1.347×10^{2}.

The number 0.0023 is written as 2.3×10^{-3}.

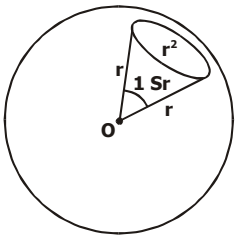
Q.7. Define radian and steradian.

Ans.

i. radian: The radian is the plane angle between two radii of a circle which cut off the circumference by an arc length equal to the radius as shown in figure. Its symbol is rad.



ii. steradian: It is the solid angle (three dimensional angle) made at the centre of a sphere by an area of its surface equal to the square of radius of sphere. Its symbol is sr.



Q.8. Define random error and systematic error.

Ans.

i) **Random error:** Random error occurs when repeated measurements of the quantity give different values of the quantity under the same conditions.

ii) **Systematic error:** It affects all the measurements of a particular quantity equally. It produces the same difference in readings.

Q.9. Explain how can we remove the effect of systematic error and random error?

Ans. i) Removal of random error: Repeating the measurements many times and taking an average can reduce the effect of random error.

ii) Systematic error: It can be reduced by comparing the instrument with other more accurate instrument and a correction factor can be applied.

Q.10. Define significant figures.

Ans: In any measurement, the accurately known digits and the first doubtful digit are called significant figures. e.g. 1.023 have four significant figures

Q.11. Is zero significant or not? Explain.

Ans: i) Zero will be significant when it is either on the right of a nonzero digit or between two nonzero digits. e.g. 25.200 or 205.2

ii) It will be insignificant when it is on the left of first nonzero digit. e.g. .0023050, the first two zeros are insignificant.

Q.12. Define precision and accuracy?

Ans: Precision: A precise measurement is that which has smaller value of absolute uncertainty or smaller value of least count (L.C.). The precision of a measurement depends on the least count of the instrument or device being used.

Accuracy: An accurate measurement is that which has less fractional uncertainty of less percentage uncertainty.

Q.13. Write down the two uses of dimension analysis.

Ans. i) Checking Homogeneity of Equations: To check the correctness of an equation, dimension of the quantities on both sides of the equation must be same. This is called the "Principal of Homogeneity of dimensions"

ii) Deriving a formula: To derive a relation for a physical quantity, the correct guessing of various factors on which the physical quantity depends is important.

Q.14. What are the dimensions and S. I. units of the coefficient of viscosity η in the relation $F = 6\pi\eta rv$.

Ans:

$$[\eta] = [F]/[r][v]$$
$$[\eta] = [MLT^{-2}]/[L][LT^{-1}]$$
$$[\eta] = [M L^{1-2} T^{-2+1}]$$
$$[\eta] = [M L^{-1} T^{-1}]$$

SI unit of $\eta = kg\ m^{-1}\ s^{-1}$

Q.15. Write dimension of work.

Ans:

$$W = F\ d$$
$$[W] = [F][d]$$
$$[W] = [MLT^{-2}][L]$$
$$[W] = [ML^2T^{-2}]$$

Q.16. Show that the equation $S = v_it + 1/2at^2$ is dimensionally correct.

Ans. As we know that:

$[v_i] = [LT^{-1}]$, $[t] = [T]$, $[a] = [LT^{-2}]$

Dim. of R.H.S $= [v_it] + [1/2\ at^2]$

$$= [LT^{-1}][T] + \frac{1}{2}[LT^{-2}][T^2]$$
$$= [LT^{0}] + \frac{1}{2}[LT^{0}]$$
$$= [L] + \frac{1}{2}[L]$$
$$= \frac{3}{2}[L]$$

Dim. of L.H.S $= [S]$

$$= [L]$$

Dim. of L.H.S = Dim. of R.H.S

Hence equation is dimensionally correct.

Chapter 2

Q.1. Briefly explain the multiplication of a vector by a scalar.

Ans. Case I: Multiplication of a vector by a scalar (number):

When a vector is multiplied by a number (n≠0) its magnitude is changed and its direction may or may not change.

(i) When number is positive (n>0):

When a vector $\vec{A}$ is multiplied by with a positive number "n", the new vector is $n\vec{A}$. Its **direction** remains the **same**. Its **magnitude** will increase **n times**.

(ii) When number is negative (n<0):

When the vector is multiplied by a negative number 'n' the new vector will be $-n\vec{A}$. Its **direction** will **change**. Its **magnitude** will increase **n times**.

Case II: Multiplication of a vector by a scalar quantity:

When a vector is multiplied by a scalar quantity, then the product will be a new vector quantity whose dimension will be the same as the product of two quantities which are multiplied. e.g. when velocity is multiplied by scalar mass m, the product is a new vector quantity called momentum. $\vec{P} = m\vec{v}$

Q.2 Define Null vector and equal vectors.

Ans. Null Vector: Null vector is a vector with zero magnitude and arbitrary direction.

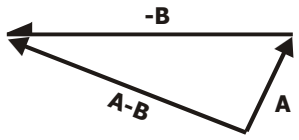
Example: The sum of a vector and its negative vector is a null vector.

Equal vector: The vector $\vec{A}$ and $\vec{B}$ are said to be equal if they have the same magnitude and direction regardless of the position of their initial points.

Example: Parallel vector of the same magnitude are equal to each other.

Q.3 What is negative vector? How B is subtracted from A?

Ans. Negative Vector : A vector whose magnitude remains same but direction reverses is called negative vector. It is obtained by multiplying a vector with -1. Consider two vectors $\vec{A}$ and $\vec{B}$. Suppose $\vec{B}$ is to be subtracted from $\vec{A}$, reverse the direction of $\vec{B}$ and add it to vector $\vec{A}$ by head to tail rule as shown in fig.



$$\vec{A} + (-\vec{B}) = \vec{A} - \vec{B}$$

Q.4. What is the unit vector in the direction of the vector A = 4i +3j

Ans.

$$\vec{A} = 4\hat{i} + 3\hat{j}$$

$$\hat{A} = ?$$

$$\hat{A} = \frac{\vec{A}}{A}$$

$$A = \sqrt{2^2 + 3^2} = \sqrt{25}$$

$$A = 5$$

$$\hat{A} = \frac{4i + 3j}{5}$$

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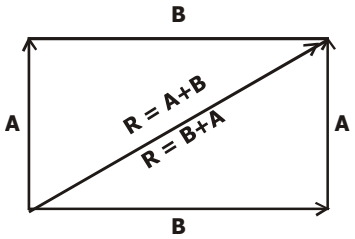
Q.5. Why do you keep your legs far apart when you have to stand in the aisle of a bumpy riding bus?

Ans. We keep our legs far apart on a bumpy riding bus to lower down our centre of gravity so that the chances of falling are reduced.

Q.6. Prove that commutative law holds for addition of vectors.

Ans. Consider two vectors $\vec{A}$ and $\vec{B}$. Add these vectors by head to tail rule and find resultant $\vec{R}$ $=\vec{A}+\vec{B}$ Similarly by reversing the order of two vectors we will find $\vec{R} = \vec{B} + \vec{A}$. It is clear from the figure that two resultants are equal.



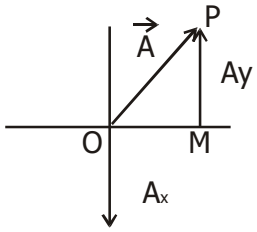
So, **A + B = B + A**

Q.7. You are falling off the edge. What should you do to avoid the fall?

Ans. To avoid the fall, one should lean away (opposite to edge) from the edge. This will shift the centre of gravity back to baseline (between the feet) and in this way one could save himself from falling.

Q.8. How vector is determined when rectangular components are given?

Ans. The magnitude is given by:



In the right angled ΔOMP ,

$$OP^2 = OM^2 + MP^2$$

$$A^2 = A_x^2 + A_y^2$$

$$A = \sqrt{A_x^2 + A_y^2}$$

And direction θ is given by $\tan\theta = \frac{MP}{OM} = \frac{A_y}{A_x}$

$$\theta = \tan^{-1} = \frac{A_y}{A_x}$$

Q.9. Name three conditions that could make A . B=0

Ans: Under following conditions $\vec{A} . \vec{B} = 0$

(i) $\vec{A}$ is a null vector.

(ii) $\vec{B}$ is a null vector.

(iii) These two vectors are perpendicular

$$\vec{A} . \vec{B} = AB\cos 90^o = 0$$

Q.10. Prove that dot product of two vectors is commutative.

Ans. Scalar product is commutative:

$\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{A}$

Proof:

$\vec{A} \cdot \vec{B}$ = AB cosθ ---------- (1)

$\vec{B} \cdot \vec{A}$ = BA cosθ

$\vec{B} \cdot \vec{A}$ = AB cosθ ---------- (2)

Comparing equations (1) and (2), we get

$\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{A}$

This means by changing the order of vectors, the dot product does not change.

Q.11. Prove that vector product do not obey commutative law.

Ans. Vector Product is not Commutative:

i.e. $\vec{A} \times \vec{B} \neq \vec{B} \times \vec{A}$

Proof:

Let **A** and **B** be two vectors their cross product can be can be given as

$\vec{A} \times \vec{B}$ = AB sin $\theta\ \hat{n}$ ----------(1)

$\vec{B} \times \vec{A}$= BA sin $\theta\ (-\hat{n}\ )$

$\vec{B} \times \vec{A}$= -AB sin $\theta\ \hat{n}$

$\vec{B} \times \vec{A}$= = - $\vec{A} \times \vec{B}$ ---------- (2)

Comparing eq. (1)&(2) we get

$\vec{A} \times \vec{B} = - \vec{B} \times \vec{A}$

So, $\vec{A} \times \vec{B} \neq \vec{B} \times \vec{A}$

Q.12. Write two examples of vector product.

Ans. Followings are the examples of cross product.

i. $\vec{F} = q\ (\vec{v} \times \vec{B})$

ii. $\vec{\tau} = \vec{r} \times \vec{F}$

Q.13. Define torque and moment arm. Also give physical significance of torque.

Ans. Torque: Turning effect of force on a body about an axis of rotation is called torque.

Formula: $\vec{\tau} = \vec{r} \times \vec{F}$

Moment Arm: The distance between pivot point and applied force is called moment arm. It is represented by *l*.

Physical Significance: Torque plays same role in rotational motion as force plays in linear motion. Force produces linear acceleration whereas torque produces angular acceleration.

Q.14. Write two conditions for which torque is zero.

Ans. Conditions for which torque is zero.

- If no force is acting on a body and it is at rest than its torque is zero. $\sum F = 0$
- If body is rotating with uniform angular velocity, the angular acceleration will be zero, in this case torque will be zero. $\sum \tau = 0$

- When force is passing through pivot, then moment arm will become zero. Hence torque will be zero.

Q.15. What do you understand by positive and negative torque?

Ans. By convention, the counter (anti clockwise) torques are taken as positive and clockwise torques are taken as negative.

Q.16. Define torque. Write its units and dimensions.

Ans. Torque: Turning effect of force on a body about an axis of rotation is called torque.

Formula: $\vec{\tau} = \vec{r} \times \vec{F}$

$\tau = r F$ when Θ is 90^o

S.I units of τ is N s

Dimension of torque

$$[\tau] = [M L T^{-2}] [L]$$
$$= [M L^2 T^{-2}]$$

Q.17. Define the two conditions of equilibrium.

Ans. First Condition of Equilibrium: The vector sum of all the forces acting on a body must be equal to zero.

$\Sigma \vec{F} = 0$

In terms of x and y components of the forces:

$\Sigma \vec{F_x} = 0$, $\Sigma \vec{F_y} = 0$

Second Condition of Equilibrium: The vector sum of all the torques acting on a body about any arbitrary axis must be equal to zero.

$\Sigma \vec{\tau} = 0$

Sum of anticlock wise torque = Sum of clock wise torque

Q.18. Define dynamic and static equilibrium.

Ans. Dynamic Equilibrium: If the body is moving with uniform velocity having zero acceleration is said to be dynamic equilibrium.

Example: Motion of a paratrooper.

Static Equilibrium: If a body is at rest, it is called static equilibrium.

Example: A book lying on a table.

Chapter 3

Q.1. Differentiate between distance and displacement.
Ans. Distance: Total length between two points is called distance, it can be along a curved path and it is a scalar quantity. **Mathematical representation**: S = v x t
Displacement: The shortest distance between two points is called displacement, its path is a straight line and it is a vector quantity. **Mathematical representation: d** = **v** x t

Q.2. Explain what do you mean by the term velocity?
Ans. Definition: Time rate of change of displacement is known as velocity. It is a vector quantity and its direction is along the direction of displacement.
Formula: **v** = **d** / t
Unit: Its units are m/s.

Q.3. Define instantaneous velocity of a moving body.
Ans. The instantaneous velocity is defined as the limiting value of $\Delta\mathbf{d}/\Delta t$ as the time interval Δt approaches to zero.
Formula: $\mathbf{v_{ins}} = \text{Lim}_{\Delta t \to 0}\ \Delta\mathbf{d}/\Delta t$
Unit: Its units are m/s.

Q.4. What is meant by instantaneous acceleration? Write its formula.
Ans. The acceleration of the body at any particular instant during its motion is said to be the instantaneous acceleration of that body. **OR** The limiting value of $\Delta\mathbf{v}/\Delta t$ as the time interval Δt approaches to zero.
Formula: $\mathbf{a_{ins}} = \text{Lim}_{\Delta t \to 0}\ \Delta\mathbf{v}/\Delta t$
Unit: Its units are m/s^2.

Q.5. How is distance calculated from velocity-time graph?
Ans. The area between the velocity time graph and the time axis is numerically equal to the distance covered by the object. It is calculated by calculating the area under the velocity time graph by the rules of calculus.

Q.6. State Newton's second and third law of motion?
Ans. Second Law of Motion: When a force acts on a body the acceleration produced is directly proportional to the force and inversely proportional to the mass of the body.
Mathematically, it is described as, **F** = m **a**
Third Law of Motion: Action and reaction are equal in magnitude and opposite in direction e.g. firing of a bullet, bouncing ball, etc

Q.7. Why the first law of motion is also called the law of inertia.
Ans. According to the first law of motion a body remains at rest or in continuous motion with uniform velocity unless acted upon by some unbalanced force. It is also a property of a body that it opposes any change in its state of rest or of uniform motion, this property of the body is known as inertia. As the first law of motion and the definition of inertia states the same thing hence the first law of motion is also known as the law of inertia.

Q.8. Show that the rate of change in momentum for an object is equal to the applied force.
Ans. Time rate of change of momentum of a body equals to applied force, this is the second law of motion in terms of linear momentum.
Mathematically: $\mathbf{a} = (\mathbf{v_f} - \mathbf{v_i}) / t$ -------- (i)
From Newton's second law we have:
$\mathbf{F} = m\mathbf{a}$, therefore, $\mathbf{a} = \mathbf{F}/m$ ------- (ii)
Equation both equations we have
$\mathbf{F}/m = \mathbf{v_f} - \mathbf{v_i} / t$
$\mathbf{F} = m\mathbf{v_f} - m\mathbf{v_i} / t$
$\mathbf{F} = m\Delta\mathbf{v}/t$
$\mathbf{F} = \Delta\mathbf{P}/t$
From the above equation it can be concluded that the rate of change of momentum is equal to the applied force.

Q.9. Does a moving object have impulse?
Ans. No, a moving object does not have impulse.
Reason: As long as there is no force, a body is moving with uniform velocity, it has no impulse. The concept of impulse is applied to cases where the applied force is not constant.
$\mathbf{F} = m\mathbf{a}$, therefore, $\mathbf{a} = \mathbf{F}/m$ ------- (ii)
$\mathbf{F} = m\Delta\mathbf{v}/t$
$\mathbf{F} = m(\mathbf{v_f} - \mathbf{v_i}) / t$
Impulse = I = $\mathbf{F} \times t = m(\mathbf{v_f} - \mathbf{v_i})$
If, $\mathbf{v_f} = \mathbf{v_i}$
$\mathbf{F} \times t = m(\mathbf{0})$
Therefore, $\mathbf{I} = \mathbf{F} \times t = \mathbf{0}$

Q.10. Why motor cycle's safety helmet is padded?
Ans. Motor cycle safety helmet is used for safety purposes. A motor cycle's safety helmet is padded so as to extend the time of any collision to prevent serious injury. Mathematically, $\mathbf{F} = \Delta m\mathbf{v}/t$
Helmet extends the time of collision and hence reduces the acting force on head in case of an accident.

Q.11. Find the relation of force due to the water flow.
Ans. The force can be calculated from the product of mass of the water striking the wall normally per second and change in velocity. Mathematically it is represented by $\mathbf{F} = (-m\mathbf{v})/t$

Q.12. How would you find the momentum of an explosive force? Explain with one example.
Ans. There are many examples in which momentum changes that are produced by explosive forces with in an isolated system, remains constant. e.g. when shell explodes its fragments fly off in different directions. The total momentum of all its fragments is equal to the initial momentum of the shell.

Q.13. Show that range of projectile s maximum when projectile is thrown at an angle

of 45^o with the horizontal.

Ans. As we know that the range of the projectile is given by,

$R = v_i \sin 2\theta / g$

For the range to be maximum the factor $\sin 2\theta$ should have maximum value that is, 1.

As, $\sin 2\theta = \sin 2 (45^o) = \sin (90^o) = 1$

Therefore, the value of $\boldsymbol{\theta = 45^o}$.

Q14. What is ballistic flight? Explain

Ans. A flight in which the projectile is given an initial push and is then allowed to move freely due to inertia and under the action of gravity is called a ballistic flight.

Explanation: Ballistic flight is the application of projectile motion which is used in ballistic missile. Ballistic missiles are unpowered and unguided missiles which are short ranged.

Q.15. Write down two characteristics of ballistic missile.

Ans. Following are the characteristics of ballistic missiles

(i) Ballistic missile is an unpowered and unguided missile

(ii) It follows the path of the projectile motion, that is called its trajectory.

Q.16. Derive the relation for maximum height reached by the projectile.

Ans. In order to determine the maximum height to which the projectile attains , we use the third equation of motion,

$2aS = v_f^2 - v_i^2$ ---------(i)

As a body moves upward, so $a = -g$, The initial vertical velocity, $v_{iy} = v_i \sin\theta$ and $v_{fy} = 0$, because the body comes to rest after reaching the highest point. Since S = height = h, now equation (i) becomes

$2(-g)h = (0^2) - (v_i \sin\theta)^2$

$-2gh = - v_i^2 \sin^2\theta$

$2gh = v_i^2 \sin^2\theta$

$h = v_i^2 \sin^2\theta / 2g$

Chapter 4

Q.1. What do you understand by work and energy? Give their units.
Ans. Work: The work done on a body by constant force is defined by the product of the magnitude of the displacement and the component of force in the direction of the displacement.
Formula: $W=F.d = Fd\cos\theta$
Unit: SI unit of work is Nm known as joule J.
Energy: The ability of a body to do work is called energy.
Unit: The SI unit of energy is joule J.

Q.2. What do you mean by variable force? Give its two examples.
Ans. The force whose magnitude, direction or both changes when it acts on certain body with the passage of time.
Example:

(i) When the rocket moves upwards from the earth in this case work is done against the force of gravity.
(ii) In case of spring, the stretch in the spring is directly proportional to the force so work done will be different at different position of the spring.

Q.3. Define conservation field. Give its two examples.
Ans. The field in which total work done of the body along a close path is zero is called conservative field.
Example: Examples of conservative field are gravity and static electric and magnetic fields.

Q.4. Define the term power and its S.I. units.
Ans. Power is the measure of the rate at which work is being done. OR
The ratio between work done to time is called power.
Formula: $P_{av} = \Delta W/\Delta t$
Unit: The SI unit of power is watt W, defined as one joule of work done in one second.

Q.5. Derive the relation between power and velocity.
Ans. From the relation of instantaneous power, we have:

$P = \lim_{\Delta t \to 0} \Delta W/\Delta t$
We know, $\Delta W = F.\ \Delta d$
So, $P = \lim_{\Delta t \to 0} F.\ \Delta d/\Delta t = F.\lim_{\Delta t \to 0} \Delta d/\Delta t$
Since, $v_{ins} = \lim_{\Delta t \to 0} \Delta d/\Delta t$
$P= F.v$ (proved)
Conclusion: With respect to above relation, it is concluded that
(i) Power is a scalar quantity
(ii) The dot product of force and velocity is called power.

Q.6. Define kilowatt hour. Show that $1kWh = 3.6x10^6$ J.
Ans. The kilowatt hour is the work done in one hour by an agency whose power is one kilowatt.
Mathematical relation:
$1kWh = 3.6x10^6$ J

L.H.S.
1kWh = 1 KW x 1h
= 1000w x 3600 s
= 1000 J/S x 3600 s
= $3.6x10^6$ J

Q.7. Write power in terms of force and velocity?
Ans. Power: The dot product of force and velocity is called power.
Formula: P = F.V
Scalar quantity: Power is a scalar quantity.

Q.8. Define work energy principle. Also write down its equations.
Ans. Work Energy Principle Statement: Work done on the body equals the change in its kinetic energy, this is called work energy principle.
Mathematical derivation: From equation of motion:
$2ad = v_f^2 - v_i^2$
$d = 1/2a\ (v_f^2 - v_i^2)$ ------ (i)
From second equation of motion:
$F = ma$ ------ (ii)
Multiply eq. (i) and (ii)
$F.d = ma\ 1/2a\ (v_f^2 - v_i^2)$
$F.d = 1/2\ m\ (v_f^2 - v_i^2)$
$F.d = 1/2\ mv_f^2 - 1/2\ mv_i^2$ (W= F.d)
$K.E_f = 1/2\ mv_f^2$
$K.E_i = 1/2\ mv_i^2$
$W = K.E_f - K.E_i \rightarrow W = \Delta(K.E)$

Q.9. What is escape velocity of an object? Write its mathematical expression.
Ans. The initial velocity of an object with which it goes out of the Earth's gravitational fields is known as escape velocity.
Mathematical expression: Escape velocity for earth is given by expression:
$V_{esc} = \sqrt{2}gR$
Where, V_{esc} = escape velocity
R = radius of the earth
g = gravitational acceleration
Value of escape velocity: By putting the respective values of g and R for the earth, the value of v_{esc} comes out to be approximately 11km/s.

Q.10. State the law of conservation of energy.
Ans. This law states that, energy cannot be destroyed. It can be transformed from one kind to another, but that total amount of energy remains constant.
Mathematically: Total energy = P.E. + K.E. = constant

Q11. How electrical energy can be obtained by using tides?
Ans. Kinetic energy is possessed by a body due to its motion. Kinetic energy of tides is used to produce electrical energy.

Procedure: Gravitational force on the moon gives rise to tides in the sea. The tides raise the water in the sea roughly twice a day. If the water at the high tide is trapped in a basin the constructing a dam, then it possible to use this as a source of energy. The dam is filled at high tide and the water is released in a controlled way at low tide to drive the turbines. At the next high tide, the dam is filled again and the in-rushing water also drives turbines and generates electricity.

Q.12. Write down two sources of energy which are renewable.

Ans. Renewable energy: Such energy from a source which does not deplete when used is called renewable energy. OR The sources of energy which can be renewed are called renewable sources.

Renewable source of energy:

(i) Energy from tides
(ii) Energy from waves
(iii) Solar energy
(iv) Geothermal energy

Q.13. Name some non-conventional energy sources.

Ans. Following are the non-conventional energy sources:

(i) Energy from tides
(ii) Energy from waves
(iii) Solar energy
(iv) Energy from biomass
(v) Energy from waste products
(vi) Geothermal energy

Q.14. How electrical energy be obtained by sunlight by indirect conversion method?

Ans. The sunlight can be converted into electricity indirectly by using concentrated solar power (CSP)

Concentrated Solar Power: Concentrated solar power systems generate solar power by using mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy, onto a small area. Electricity is generated when the concentrated light is converted to heat, which drives a engine that is connected to an electrical power generator. In this way, electricity obtained by indirect by indirect conversion of sunlight.

Q.15. What is geo-thermal energy?

Ans. The heat energy that is extracted from inside the earth in the form of hot water or stream is called geothermal energy.

Processes of geothermal energy generation:

(i) Radioactive decay
(ii) Residual heat of the earth
(iii) Compression of materials

Q.16. Explain briefly about residual heat of the earth.

Ans. At some places hot igneous rocks, usually within 10km of the earth's surface are in a

molten or partly molten state. They conduct heat energy from the earth's interior which is still very hot. The temperature of these rocks is about 200 ^{o}C or more.

Q.17. How energy is obtained from direct combustion and fermentation?

Ans. Direct combustion: Direct combustion method is usually applied to get energy from waste products commonly known as solid waste.

Fermentation: Bio fuel such as ethanol (alcohol) is a replacement of gasoline. It is obtained by the fermentation of biomass using enzymes and by decomposition through bacterial action in the absence of air (oxygen).

Q.18. How many most common methods used for the conservation of biomass, into fuel write their names?

Ans. There are many methods used for the conversion of biomass into fuels. But most common are:

(i) Direct combustion: This method is usually applied to get energy from waste products commonly known as solid waste.

(ii) Fermentation: Bio fuel such as ethanol (alcohol) is a replacement of gasoline. It is obtained by the fermentation of biomass using enzymes and by decomposition through bacterial action in the absence of air (oxygen).

Chapter 5

Q.1. Differentiate between degree and radian?
Ans. Degree: a unit of measurement of plane angles. It is the angle subtended by one three-hundred-and-sixtieth of the circumference of a circle.
Radian: It is the SI unit for measurement plane angles. It is the angle between two radii of a circle which cut off on the circumference an arc equal in length to the radius. Mathematically defined as the ratio of arc length to radius.

$$\theta = S/r$$

$$1\ rad\ (radian) = \frac{360^o}{2\pi} = 57.3^O$$

Q.2. Find the velocity of a disc rolls down along an inclined plane of height 10m?
Ans. The velocity of the disc will be calculated as follows:

$$v = \sqrt{\frac{4gh}{3}} = \sqrt{\frac{4\ (9.8\ ms^{-1})(10\ m)}{3}} = 130.7\ ms^{-1}$$

Q.3. Show that v = r ω
Ans. As we know, $\Delta\theta = \ \Delta S/r$ or $\Delta S = r\Delta\theta$
Dividing both sides by Δt, we get: $\Delta S/\Delta t = r\ \Delta\theta/\Delta t$
Which becomes: $v = r\omega$

Q.4. Show that a = r α
Ans. As we know, $\Delta v = r\Delta\omega$
Dividing both sides by Δt, we get: $\Delta v/\Delta t = r\ \Delta\omega\ /\Delta t$
Which becomes: a $= r\alpha$

Q.5. Can a body move along a circle without centripetal force?
Ans. No, a body cannot move along a circle without centripetal force because it is the centripetal force that bends the normally straight path of a body in a circular path. So without it circular motion is not possible.

Q.6. Is any work done by centripetal force?
Ans. No. The net work done by centripetal force is zero as the net displacement of a body due to centripetal force is zero.

Q.7. What does "INTELSAT" stands for?
Ans. INTELSAT stands for International Telecommunication Satellite Organization.

Q.8. Define real weight and apparent weight.
Ans. Real Weight: The real weight of an object is the gravitational pull of the Earth on the object.
Apparent Weight: The apparent weight of an object is equal and opposite to the force required to

stop it from falling in a particular frame of reference. In an accelerating system it is not equal to the real weight of the object.

Q.9. An object revolving around the earth is said to be a freely falling body. Why?
Ans. An object revolving around the earth is acted upon by a centripetal force which is the earth's gravitational pull. This means that the centripetal acceleration acting on the object is the acceleration due to gravity 9.8 ms^{-1}. Due to this reason the object is said to be a free falling body.

Q.10. State right hand rule to find the direction of angular displacement?
Ans. The right hand rule states that if we grasp the axis of rotation in right hand with fingers curling in the direction of rotation, our thumb points in the direction of angular displacement.

Q11. Show that 1 radian = 57.3º
Ans. As $360^0 = 2\pi$ radian for one complete rotation/revolution, 1 radian would be equal to $360^0/2\pi$, which is equal to 57.3^o

Q.12. Describe what should be the minimum velocity for a satellite to orbit close to the Earth around it.
Ans. The minimum velocity for a satellite to orbit close to the Earth, known as critical velocity can be calculated from the expression of centripetal acceleration, as follows:

$$v = \sqrt{gR} = \sqrt{(9.8\ ms^{-1})\ (6.4 \times 10^6\ m)} = 7.9\ km^{-1}$$

Q.13. A lift is ascending with the acceleration "a". Derive the expression for apparent weight of the body of mass "m" in it.
Ans. If the object is being weighed by a spring balance in the lift, the tension in the string of the balance (T) will be its apparent weight and will be given as: $w - T = ma$ or $T = w - ma$
This shows that the apparent weight (T) is less than the real weight (w) by an amount (ma).

Q.14. Define weightlessness and gravity free system.
Ans. Weightlessness: The condition in which the apparent weight of an object becomes zero inside a system accelerating under gravity or free falling.
Gravity Free System: Space crafts or satellites that orbit around the earth are acted upon by the acceleration under gravity and so considered free falling systems. Due to it all objects inside them appear weightless. Thus no force is required to hold an object from falling inside such systems and so they are called gravity free systems.

Q.15. What is geostationary satellite?
Ans. A geostationary satellite is one whose orbital motion is synchronized with the rotation of the earth. In this way the synchronous satellite remains always over the same point on the equator as the Earths spins about its axis. Such a satellite is very useful for worldwide communication, weather observations, navigation and other military uses.

Q.16. Write down applications of communication satellite.
Ans. Communication satellites are geostationary satellites that seem to hover over one place on the earth, so continuous communication with any place on the earth's surface can be made. Stations on earth transmit signals to these satellites and receive signals via satellites from other

countries. These signals can be picked also by dish antennas on our homes. INTELSAT VI satellite alone, has a capacity of 30, 000 two way telephone circuits plus three TV channels.

Q.17. What is meant by centripetal force? How is it converted in terms of angular velocity?
Ans. Centripetal force is the force needed to bend the normally straight path of a body into a circular path. It is given as: $F = \frac{mv^2}{r}$
Now as, $v = r\omega$, $F = mr\omega^2$

Q.18. Why banked tracks are needed for turns?
Ans. Banked tracks are needed for turns that are taken so quickly that friction alone cannot provide energy for centripetal force.

Q.19. Show that $L = mr^2\omega$
Ans. $\mathbf{L} = \mathbf{r} \times \mathbf{p}$ and for $\theta = 90^o$, $L = rp$
As, $p = mv$, so $L = rmv$
Now, $v = r\omega$, so $L = mr^2\omega$

Q.20. Define artificial gravity. Write down expression for its frequency.
Ans. Artificial gravity is created in spaceships that become a gravity free system, by setting them into rotation around their own axis. The astronauts and objects inside get pressed towards the outer rim and exert a force on floor of the spaceship like on earth. This is to avoid harmful effects of weightlessness over longer periods of time.
The artificial gravity can be provided if spaceship rotates with this frequency:

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{R}}$$

Here R is the outer radius of the spaceship.

Chapter 6

Q.1. Define and explain briefly drag force.
Ans. An object moving through a fluid experiences a retarding force called a drag force. The drag force increases as the speed of the object increases. For a spherical object of radius 'r' moving in a fluid at speed 'v', it is mathematically given as: $F = 6\pi\eta r v$
Where η is the fluid viscosity.

Q.2. Briefly explain viscous drag and Stoke's law.
Ans. Fluids (liquids and gases) have non-zero viscosities, i.e. they exert retarding force on objects travelling through them. This is known as the viscous drag or drag force. The viscous drag or drag force acting on a spherical object of radius 'r' moving in a fluid at speed 'v', can be mathematically given with the help of Stokes' law as follows: $F = 6\pi\eta r v$
Where η is the fluid viscosity.

Q.3. Briefly explain terminal velocity.
Ans. Terminal velocity is the constant speed that a free falling object has when its weight becomes equal to the drag force exerted by air, making net force acting on it zero.
Mathematically for a spherical object of radius 'r', it is described as: $v^t = \frac{2gr^2\rho}{9\eta}$
Where $\boldsymbol{\rho}$ is the density and η is the viscosity.

Q.4. How an aeroplane is lifted up in the air?
Ans. The wing of an aeroplane is designed to deflect the air so that streamlines are closer together above the wing than below it. Where the streamlines are forces together, the speed is faster. Thus, air is travelling faster on the upper side of the wing than on the lower. The pressure will be lower at the top of the wing, and the wing will be forced upward. In this way the aeroplane is lifted.

Q.5. State the Stoke's law and write its formula.
Ans. The Stoke's law is an expression describing the resisting or drag force on a particle moving through a viscous fluid. The viscous drag or drag force acting on a spherical object of radius 'r' moving in a fluid at speed 'v', can be mathematically given with the help of Stokes' law as follows: $F = 6\pi\eta r v$
Where η is the fluid viscosity.

Q.6. Explain the term viscosity? What is its unit?
Ans. Viscosity is the frictional effect between different layers of a flowing fluid. Viscosity measures how much force is require to slide one layer of the liquid over another layer. Substances that do not flow easily, such as thick tar and honey, have large coefficients of viscosity (η). Substances which flow easily, like water, have small coefficients of viscosity. The unit of viscosity or coefficient of viscosity (η) is 'Nsm^{-2}'.

Q.7. What is the Venturi's effect? Write only its mathematical form.
Ans. Venturi's effect is the decrease in pressure of a fluid when it flows through a pipe portion which is much smaller in diameter to the initial one. Bernoulli's equation is written in a more convenient form in this case and becomes the Venturi's relation which is as follows: $P_1 - P_2 =$

$\frac{1}{2}\rho v_2^2$

Q.8. Show that for a fluid where the speed of the fluid is high the pressure will be low.

Ans. Bernoulli's Theorem is given as: $P + \frac{1}{2}\rho v^2 + \rho gh = constant$

Simplifying it for a situation where height of fluid flow is same and $\boldsymbol{\rho}$gh=0

We will have, $P + \frac{1}{2}\rho v^2 = constant$, which clearly shows that the pressure will be low where the speed of fluid is high.

Q.9. How a chimney works the best?

Ans. A chimney works best when it is tall and exposed to air currents, which reduces the pressure at the top and force the upward flow of smoke.

Q.10. State Bernoulli's equation and Torricelli's theorem.

Ans. Bernoulli's equation states that for an incompressible, non-viscous fluid flowing in steady state, the sum of its pressure, kinetic energy per unit volume and potential energy per unit volume remains constant.

$$P + \frac{1}{2}\rho v^2 + \rho gh = constant$$

Torricelli's theorem is an application of Bernoulli's theorem and states that the speed of efflux of such an ideal fluid is equal to the velocity gained by it in falling through the distance (h_1-h_2) under the action of gravity.

$$v_2 = \sqrt{2g\ (h_1 - h_2}$$

Q.11. Define systolic and diastolic pressure.

Ans. Systolic pressure is the higher blood pressure in arteries during the contraction of heart muscle. It is around 120 torr.

Diastolic pressure is the lower blood pressure when heart muscle is between beats and relaxes. It is around 75 to 80 torr.

Chapter 7

Q.1. Define Hooke's law. Write it in mathematical form?
Ans. According to Hook's Law, within elastic limit, the restoring force is directly proportional to the displacement.
Mathematically, $\vec{F} \propto \vec{x}$
$\vec{F} = k\vec{x}$
Where *k* is constant of proportionality, known as spring constant.

Q.2. If a heavy and light masses of same size are set to vibration which of them will stop first?
Ans. As we know that the damping force on lighter body will be larger than heavier one so lighter body will stop first than heavier body.

Q.3. What is difference between displacement and amplitude?
Ans. The displacement of a body at any instant from the mean position is called instantaneous displacement or simply displacement. It is denoted by x
OR
It is the distance of a particle of a wave from its equilibrium position at any particular time.
Amplitude: It is the maximum displacement of the body on either side from the mean position. It is denoted by x_0

Q.4. What is effect of amplitude on frequency and period of simple pendulum?
Ans. There is no effect of amplitude on frequency and period of simple pendulum. As we know that frequency is reciprocal of time period and time period is equal to $2\pi\sqrt{l/g}$.

Q.5. What is meant by phase and initial phase?
Ans. The angle$(\theta = wt)$ which gives the displacement as well as the direction of the motion of point executing simple harmonic motion is known as phase.
Initial Phase: $\theta = wt + \phi$
At time t = 0, $\theta = \phi$, ϕ is called the initial phase.

Q.6. State the total energy of the vibrating mass and spring is constant. Differentiate between free and forced oscillations?
Ans. The total energy of the vibrating mass and spring remains constant at any instant in its path. This is called as law of conservation of energy in SHM.
At any position, the total energy is sum of party P.E. and party K.E.

$$E_{total} = P.E + K.E$$
$$= \frac{1}{2} Kx^2 + \frac{1}{2}Kx^2{}_0 \left[1 - \frac{x^2}{x^2{}_0}\right]$$
$$\text{Total Energy} = \frac{1}{2} Kx^2$$

Thus the total energy of vibrating mass and spring is constant. When the K.E of the mass is maximum, the P.E of the spring is zero. Conversely when the P.E of the spring is maximum the K.E of the mass is zero.
Free Oscillation: A body is said to be executing free vibrations if it oscillates with its natural

frequency without the interference of an external force.
Forced Oscillation: A body is said to be executing forced vibrations if it oscillates with the interference of an external force.

Q.7. What is driven harmonic oscillator?
Ans. The physical system that oscillates under the action of applied force is known as driven harmonic oscillator.

Q.8. Write an advantage and a disadvantage of resonance.
Ans. Advantage: The application of resonance phenomenon in tuning a radio. When we turn the knob of the radio, it changes the natural frequency of electrical circuit of receiver until it becomes equal to the frequency of transmitter. The resonance is produced, and energy absorption is maximum. This is how station is tuned.
Disadvantage: On a long span bridge, the soldiers crossing the bridge are ordered to break their steps. If the frequency of the steps coincides with natural frequency of the bridge. Then there is a chance to collapse the bridge due to resonance.

Q.9. Describe the condition under which a vibrating body resonates with other body.
Ans. When the frequency of both vibrating bodies are matched. Then the vibrating body resonates with other body.

Q.10. Define sharpness of resonance?
Ans. Sharpness of the resonance is inversely proportional to the damped force. Smaller the damped force, sharp is the amplitude frequency curve.

Q.11. Write three uses of simple pendulum.
Ans. i) It is use for time measurement and length.
ii) Simple pendulum is used in seismometer to predict the earthquakes.
iii) Pendulum is also used in a metronome, which helps to maintain the speed of music.
iv) Used to measure the value of g.

Q.12. How resonance is produced in tuning of radio set?
Ans. When we turn the knob of the radio it changes the natural frequency of electrical circuit of receiver until it becomes equal to the frequency of transmitter. The resonance is produced and energy absorption is maximum. In this way station is tuned.

Q.13: Define frequency and time period and relation in them.?
Ans. Time period: The time required to complete one vibration is called time period.
Frequency: The number of vibrations completed by a body in one second is called frequency.
Relation between frequency and time period: $f = \frac{1}{T}$

Q.14: What is second's pendulum? Find its length and frequency.
Ans. The pendulum whose time period is 2 second is called second pendulum.
T=2sec
Frequency: $f = \frac{1}{T}$, $f = {}^{1}/_{2}$, $f = 0.5\ Hz$.

Length: $T = 2\pi\sqrt{\frac{l}{g}} \implies T^2 = 4\pi^2 \left[\frac{l}{g}\right] \implies l = \frac{gT^2}{4\pi^2}$

As T=2 sec, $l = \frac{9.8\times(2)2}{4\times(3.14)^2} = 0.992m$

$l = 99.2\ cm$

Q.15: Define damping and resonance?

Ans. Damping: Damping is the process by which energy is lost by the oscillating system. Resonance: Resonance occurs when the frequency of the applied periodic force is equal to one of the natural frequencies of the vibration of the forced or driven harmonic oscillator.

Q.16. Why soldiers are advised to break their steps while marching on a bridge?

Ans. If there is a long span of a bridge, then the columns of soldiers are advised to break their steps. Their rhythmic march might set up oscillations of dangerously large amplitude in the bridge structure. Due to resonance the amplitude grows so high that it may collapse.

Q.17: Write and explain electrical application of resonance?

Ans. Tuning a radio is an electrical application of the resonance. When we turn the knob of the radio, to tune a station, we are changing the natural frequency of electrical circuit of receiver, to make it equal to the transmission frequency of the radio station. When the two frequencies match energy absorption is maximum, and this is the only station we hear.

Q.18. Differentiate between frequency and angular frequency?

Ans. Frequency: The number of vibrations completed by a body in one second is called frequency.

$$f = {}^{1}/_{T}$$

Angular Frequency: The frequency of a periodic circular motion is equal to 2π times the number of cycles per second. $\omega = 2\pi f$

Q.19. Define the term Oscillations.

Ans. The to-and-fro motion of a body about a mean position is called oscillatory motion or vibratory motion.

Example: A mass suspended from a spring, when pulled and released, it starts oscillating.

Q.20.Briefly explain restoring force?

Ans. The force which brings the system back to its stable equilibrium position is called elastic restoring force or simply the restoring force. Or

The force which tends to move the body back to its original position when the applied force is removed.

Q.21. Describe the function of microwave oven.

Ans. Another good example of resonance is the heating and cooking of food by microwave oven. The waves produced in this type of oven have a wavelength of 12cm at a frequency of 2450MHz. At this frequency the waves are absorbed due resonance by water and fat molecules in the food, heating them up and so cooking the food.

Q22. How does the mass change the time period of mass spring system.

Ans. As we know that the time period of the mass is

$$T = 2\pi \sqrt{\frac{m}{k}}$$

Mass is directly proportional to the Time period so if we increase the mass time period will also be incrased

Q.23. Evaluate the frequency of a simple pendulum whose length is 9.8 m.

Ans. $f = \frac{1}{T}$

Given l=9.8m

$$T = 2\pi \sqrt{\frac{l}{g}}$$

$$= 2\pi \sqrt{\frac{9.8}{9.8}} \implies 2\pi \sqrt{1} \implies T = 2\pi$$

As we know that $f = \frac{1}{T}$, by putting values we get

$$f = \frac{1}{2\pi} = \frac{1}{2 \times 3.14} = 0.15 \text{ Hz}$$

Chapter 8

Q.1. Why sound travel faster in hydrogen than in oxygen?

Ans. Oxygen and Hydrogen have nearly identical elastic properties and at the same temperature and pressure:

$$v \propto \frac{1}{\sqrt{\rho}}$$

where 'v' is the the speed of sound and 'ρ' is the density of the gas. As the density of oxygen is 16 times that of hydrogen so the speed of sound in hydrogen is four times greater than its speed in oxygen.

Q.2. What is the effect of density on speed of sound?

Ans. The speed of sound is related to the density of a gas according to the following relation:

$$v \propto \sqrt{\frac{\gamma P}{\rho}}$$

At the same temperature and pressure, the speed of sound varies inversely as the square root of density of a gas i.e. $v \propto \frac{1}{\sqrt{\rho}}$. Hence, sound travels faster in gases which are less denser as compared to gases having greater densities.

Q.3. Why can microwave not detect underwater object?

Ans. Microwaves are strongly absorbed by sea water within feet of their transmission which is the reason why radar techniques cannot be utilized in detection of underwater objects. For underwater detection, light detection and ranging method (LIDAR) is used.

Q.4. Explain the term red shift and blue shift in Doppler's effect?

Ans. A blue shift is any decrease in wavelength with a corresponding increase in frequency of an electromagnetic wave. In visible light, this means a shift of color from red end of the spectrum to the blue end. The opposite effect is referred as red shift.

Q.5. Define waves and progressive waves.

Ans. The disturbances produced in a medium which transport energy from one place to another without transporting matter are called **waves**. e.g. water waves, sound waves, waves produced in a string.
The waves which transfer energy by moving away from the source of disturbance are called **progressive waves** e.g. waves produced in a string.

Q.6. Write characteristic of stationary waves.

Ans. i) They have same frequency but opposite direction.
ii) They do not transfer energy.
iii) They produce nodes and antinodes.

Q.7. Write formula of speed of sound at 0^0C.

Ans. The formula is: $\mathbf{v_t = v_0 + 0.61\ t}$
where $\mathbf{v_t}$ = speed of sound at a temperature t^0C, $\mathbf{v_0}$ = speed of sound at 0^0C, **t** = Celsius temperature t^0C.

Q.8. State the principle of superposition.

Ans: If two or more waves superpose each other, then the resultant displacement '**Y**' will be equal to the algebraic sum of all the displacements i.e. $\mathbf{Y = y_1 + y_2 + y_3 + \ldots + y_n}$

Q.9. How the velocity of a wave will change if "tension" is made 16 times?

Ans. The speed of stationary waves in a stretched string is given by

$$v = \frac{1}{2l}\sqrt{\frac{F}{m}}$$

$$v = \frac{1}{2l}\sqrt{\frac{16F}{m}} = \sqrt{16} \times \frac{1}{2l}\sqrt{\frac{F}{m}} = 4 \times \frac{1}{2l}\sqrt{\frac{F}{m}}$$

$$\therefore v = 4v$$

Q.10. Define mechanical and electromagnetic waves.

Ans. Mechanical Waves: The waves which need material medium for their propagation e.g. water waves, sound waves etc.
Electromagnetic Waves: The waves which do not require material medium for their propagation e.g. light waves, microwaves etc.

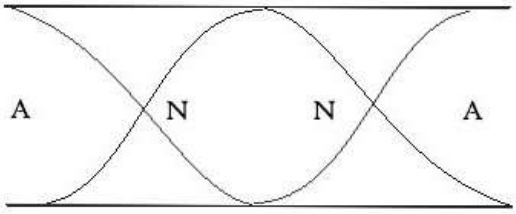
Q.11. Write any two applications of Doppler's effect.

Ans. i) **Radar System:** Radar is a device which transmits and receives radio waves. If an aeroplane is approaching the radar, the frequency of the reflected waves from the aeroplane is increased and if it is moving away the frequency of reflected waves is decreased.
ii) **Sonar:** Sonar is acronym of "sound navigation and ranging". It is a technique for detecting the presence of objects under water by acoustical echo. The apparent frequency of waves, produced by the moving objects under water, is calculated using Doppler shift. It is used for detection and location of submarines, control of antisubmarine weapons, mine hunting and depth measurement of sea.

Q.12. Differentiate between "an open organ pipe" and "a closed organ pipe".

Ans.

Open Organ Pipe	Closed Organ Pipe
• It is open at both ends.	• It is closed at one end.
• It has anti-nodes at both the ends.	• It has anti-node at open and node at closed end.
• It is richer in harmonics.	• It has only odd harmonics.



Q.13. Define Beats. Write its two uses.

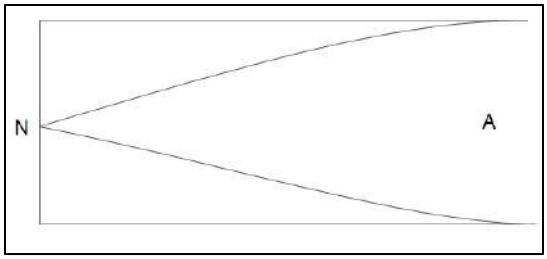
Ans. The phenomena in which two waves of slightly different frequencies ($\leq$ 10 Hz) travelling in the same direction superpose is called beats.

Q.14. Define interference of waves. Write the conditions for interference.

Ans. When two waves having same frequency and travelling in the same direction superpose, the phenomena is called interference.
Conditions: i) Sources producing sound waves should be coherent.
ii) The waves must be monochromatic.

Q.15. Write down effects of variation of pressure and density on the speed of sound.

Ans. Effect of Pressure: Density is directly proportional to the pressure. Hence, their ratio remains constant. Therefore, speed of sound is not affected by variation in the pressure of gas.



Mathematically, $v = \sqrt{\frac{\gamma P}{\rho}}$

Effect of density: At the same temperature and pressure of a gas, the speed 'v' is inversely proportional to the square root of the density. Therefore, an increase in density means that speed decreases and vice versa.

Q.16. Briefly describe principle of superposition.

Ans. If two or more waves superpose each other, then the resultant displacement '**Y**' will be equal to the algebraic sum of all the displacements i.e.

$$\mathbf{Y = y_1 + y_2 + y_3 + \ldots + y_n}$$

Phenomena of Superposition: The following interesting phenomena occur due to superposition of waves:

- Interference
- Beats
- Stationary Waves

Q.17. What are stationary waves and how are they produced?

Ans. Definition: When two waves of equal frequency travelling in the opposite direction on a same path superpose each other, they give rise to stationary waves.

Production: Plucking a stretched string of length 'L' from an appropriate position such as middle or quarter of

its length produces stationary waves.

Q.18. Which is richer in harmonics, an open organ pipe or a closed organ pipe?

Ans. Open organ pipe is richer in harmonics as compared to a closed organ pipe.
Mathematically:
For an organ pipe that is open at both ends:

$$f_n = \frac{nv}{2l}, \; n = 1,2,3,\ldots$$

For a closed pipe:

$$f_n = \frac{nv}{4l}, \; n = 1,3,5,\ldots$$

Q.19. Define Doppler's shift. Also write its formula.

Ans. The amount of compression or expansion of waves due to motion of source towards or away from the observer is called Doppler's shift. It is represented by $\Delta\lambda$..
Formula: $\Delta\lambda = {}^{u_s}/_{f}$, where u_s is the speed of source.

Q.20. What is radar?

Ans. Radar is a device which transmits and receives radio waves.
Working Principle: Radar works on the Doppler effect.
Application: It is used to determine the speed and elevation of an aeroplane.

Q.21. What is velocity of sound in air, if temperature of air is 20^0C?

Ans. According to the relation
$\mathbf{v_t = v_0 + 0.61\ t}$
$\mathbf{v_t = 332 ms^{-1} + 0.61(20)}$
$\mathbf{v_t = 344\ ms^{-1}}$

Q.22. How the velocity of stationary waves in string is affected by changing its tension?

Ans. The speed of stationary waves in a stretched string is given by

$$v = \frac{1}{2l}\sqrt{\frac{F}{m}}$$

Thus, $v \propto \sqrt{F}$ i.e. it increases as the tension in a stretched string increases and vice versa.

Q.23. Can Doppler's effect be applied to electromagnetic waves? Give an example.

Ans. Yes, Doppler's effect is applicable to electromagnetic waves.
Example: An important application is the radar system which uses radio waves to determine the elevation and speed of an aeroplane. If an aeroplane approaches towards the radar, then the wavelength of the wave reflected from aeroplane decreases and if it moves away then the wavelength increases.

Q.24. What is apparent change in frequency when source is moving away from stationary observer?

Ans. In this case, the apparent frequency decreases in accordance with
$\mathbf{f_A = {v}/{(v + u_s)} \times f}$
As $\mathbf{{v}/{(v + u_s)} < 1}$ **, so** $\mathbf{f_A < f}$

Q.25. What is apparent change in frequency when source is moving towards stationary observer?

Ans. In this case, the apparent frequency increases in accordance with
$\mathbf{f_A = {v}/{(v - u_s)} \times f}$
As $\mathbf{{v}/{(v - u_s)} > 1}$ **, so** $\mathbf{f_A > f}$

Q.26. What is apparent change in frequency when observer is moving away from stationary source?

Ans. In this case, the apparent frequency decreases in accordance with
$\mathbf{f_A = {(v - u_o)}/{v} \times f}$
As $\mathbf{{(v - u_o)}/{v} < 1}$ **, so** $\mathbf{f_A < f}$

Q.27. What is apparent change in frequency when observer is moving towards stationary source?

Ans. In this case, the apparent frequency increases in accordance with
$\mathbf{f_A = {(v - u_o)}/{v} \times f}$
As $\mathbf{{(v + u_o)}/{v} > 1}$ **, so** $\mathbf{f_A > f}$

Chapter 9

Q.1. Define Light and Physical Optics.

Ans. Light is a type of energy which produces sensation of vision. In **physics**, **physical optics is the** branch of **optics** that studies interference, diffraction, polarization.

Q.2. Define wave front also differentiate spherical and plane wave front?

Ans. Such a surface on which all the points have the same phase of vibration is known as **wavefront**. In case of a point source, the wavefront is **spherical** in shape. With time, the wave moves farther giving rise to new wavefronts. All these wavefronts will be concentric spheres of increasing radii. It can be seen that as we move away at greater distance from the source, the wavefronts are parts of spheres of very large radii. A limited region taken on such a wavefront can be regarded as a **plane wavefront**.

Q.3. State Huygen's principle and its two steps.

Ans. Huygen's principle enables us to determine the shape and location of the new wavefront at a later time $t + \Delta t$. This principle consists of two parts:

(i) Every point of a wavefront may be considered as a source of secondary wavelets which spread out in forward direction with a speed equal to the speed of propagation of the wave.
(ii) The new position of the wavefront after a certain interval of time can be found by constructing a surface that touches all the secondary wavelets.

Q.4. Define interference of light and its conditions.

Ans. Superposition of two waves having the same frequency and travelling in the same direction results in a phenomenon called interference. The following conditions must be met, in order to observe the phenomenon.

1. The interfering beams must be monochromatic, that is, of a single wavelength.
2. The interfering beams of light must be coherent.

Q.5. What are the conditions for dark and bright fringes in Young double slit experiment of interference?

Ans. For bright fringe, the path difference i.e. $d \sin \theta$ must be an integral multiple of wavelength.

$d \sin \theta = m\lambda$. where m = 0 ,1 ,2… The central bright fringe is obtained when m = 0.
For dark fringe $d \sin \theta = [m+1/2] \lambda$. The first dark fringe, in this case, will obviously appear for m = 0 and second dark for m = 1.

Q.6. Explain thin films and also explain the darkness of central fringe of Newton ring.

Ans. A thin film is a transparent medium whose thickness is comparable with the wavelength of light. In case of the experiment of Newton rings, at the point of contact of the lens and the glass plate, the thickness of the film is effectively zero but due to reflection at the lower surface of air film from denser medium, an additional path difference of $\lambda/2$ is introduced. Consequently, the centre of Newton rings is dark due to destructive interference.

Q.7. Define diffraction of light.

Ans. The property of bending of light around obstacles and spreading of light waves into the geometrical shadow of an obstacle is called diffraction of light.

Q.8. What is diffraction grating?

Ans. A diffraction grating is a glass plate having a large number of close parallel equidistant slits mechanically ruled on it. The transparent spacing between the scratches on the glass plate act as slits. A typical diffraction grating has about 400 to 5000 lines per centimeter.

Q.9. Define X-ray diffraction? Also write its two uses.

Ans. X-rays is a type of electromagnetic radiation of much shorter wavelength, typically of the order of 10^{-10} m. X-ray diffraction has been very useful in determining the structure of biologically important molecules such as

1) hemoglobin which is an important constituent of blood,
2) double helix structure of DNA.

Q.10. Define polarization and plane polarized light?

Ans. If the vibrations are confined only in one plane, the light is said to be polarized. The phenomenon is called polarization. If un-polarized light is made incident on a sheet of polaroid, the transmitted light will be plane polarized.

Q.11. Define optical rotation?

Ans. When a plane polarized light is passed through certain crystals, they rotate the plane of polarization. Quartz and sodium chlorate crystals are typical examples, which are termed as optically active crystals. A few millimeter thickness of such crystals will rotate the plane of polarization by many degrees. Certain organic substances, such as sugar and tartaric acid, show optical rotation when they are in solution. This property of optically active substances can be used to determine their concentration in the solutions.

Q.12. What is the meaning of fringe spacing and on which factors it depends upon?

Ans. The distance between two adjacent bright or dark fringes is called fringe spacing.

$$\Delta y = \lambda L/d$$

The fringe spacing varies directly with distance L between the slits and screen and inversely with the separation d of the slits. It also reveals that fringe spacing increases if red light (long wavelength) is used as compared to blue light (short wavelength).

Q.13. What is sugar solution process in polarization?

Ans. Sugar solution rotates the plane of polarization of incident light so that it is no longer horizontal but at an angle. The analyzer thus stops the light when rotated from the vertical (crossed) positions.

Q.14. When white light projected through the diffraction grating and produces interference? What colors are between the bands of interference?

Ans. If the incident light contains different wavelengths, the image of each wavelength for a certain value of n is diffracted in a different direction. Thus, separate images are obtained corresponding to each wavelength or color.

$$d \sin \theta = n\lambda$$

It shows that the value of θ depends upon n, so the images of different colours are much separated in higher orders.

Chapter 10

Q.1. Define least distance of vision and what is the minimum value of human distance of vision?

Ans. The minimum distance from the eye at which an object appears to be distinct is called the least distance of distinct vision or near point. This distance represented by *d* is about 25 cm from the eye.

Q.2. Define magnification and resolving power?

Ans. The ratio of the size of the image to the size of the object is called **magnification.**
The **resolving power** of an instrument is its ability to reveal the minor details of the object under examination.

Q.3. Differentiate linear and angular magnification?

Ans. The ratio of the size of the image to the size of the object is called **linear magnification**
The magnifying power or **angular magnification** is defined as the ratio of the angles subtended by the image as seen through the optical device to that subtended by the object at the unaided eye.

Q.4. How can we measure the magnification of simple microscope?

Ans. The image formed by the object, when placed at a distance *d,* on the eye, a lens is placed just in front of the eye and the object is placed in front of the lens in such a way that a **virtual image of the object is formed at a distance *d* from the eye.** The size of the image is now much larger than without the lens.
Hence the magnification of a convex lens (simple microscope) can be expressed as

$$M=1+d/f$$

Q.5. Write down the formula for compound microscope magnification?

Ans. $M=q/p(1+d/f_e)$

where d=near point, f_e= focal length of eye-piece

Q.6. What is astronomical telescope; explain its working with a diagram?

Ans. Astronomical telescopes: Initially the extensive use of the telescopes was for astronomical observations. These telescopes are called astronomical telescopes. A simple astronomical telescope consists of two convex lenses, an objective of long focal length f_o and an eye piece of short focal length f_e.
Working: The objective forms a real, inverted and diminished image A'B'of a distant object AB . This real image A ' B ' acts as object for the eye piece which is used as a magnifying glass. The final image seen through the eye-piece is virtual, enlarged and inverted.

Q.7. What are the meaning of eye piece and objective lenses?

Ans. The **objective lens** of a microscope is the one that is near to the sample. The **eyepiece lens** is so named because it is usually the **lens** that is closest to the eye when someone looks through the device. The **objective lens** collects light and brings it to focus creating an image.

Q.8. How can we measure the magnification of an astronomical telescope?

Ans. Working: The objective forms a real, inverted and diminished image A'B'of a distant object AB. This real image A ' B ' acts as object for the eye piece which is used as a magnifying glass. The final image seen through the eye-piece is virtual, enlarged and inverted.

$$M= f_o / f_e$$

Where f_o = focal length of the objective, f_e = focal length of the eye-piece.

Q.9. Define spectrometer and write down its essential parts?

Ans. A spectrometer is an optical device used to study spectra from different sources of light. With the help of a spectrometer, the deviation of light “by a glass prism and the refractive index of the material of the prism can be

measured quite accurately. Using a diffraction grating, the spectrometer can be employed to measure the wave length of the light. The essential components of a spectrometer are:

1. Collimator 2. Turn table 3. Telescope

Q.10. What is the use of spectrometer?

Ans. With the help of a spectrometer, the deviation of light "by a glass prism and the refractive index of the material of the prism can be measured quite accurately. Using a diffraction grating, the spectrometer can be employed to measure the wave length of the light.

Q.11. If an astronomer wants to study the stars which are million years away, which type of telescope they will use?

Ans. The astronomer will use the Astronomical telescope because it is an optical device used for viewing distant objects. The image of a distant object viewed through it appears larger because it subtends a bigger visual angle than when viewed with the naked eye. Also Initially the extensive use of the telescopes was for astronomical observations.

Q.12. Write down the formula of time and speed for measuring the speed of light?

The time taken by the mirror M to rotate through an angle 2π /8 is:

$$T = 1/8f$$

$$c = 16fd$$

$$c = 2.99792458 \text{ x} 1\ 0^8 \text{ m/s}$$

Q.13. What is an optical fiber? Define its types.

Ans. During the recent past the idea of transmission of light through thin optical fibres has been revived and is now being used in communication technology. They have much wider bandwidth capability and immunity from electromagnetic interference. It is its ability to transmit thousands of telephone conversations, several television programs and numerous data signals between stations through one or two flexible, hair - thin threads of optical fibre There are three types of optical fibres which are classified on the basis of the mode by which they propagate light. These are:

1. **Single mode step index** 2.**Multi mode step index** 3**. Multi mode graded index.**

Q.14. What is the principle of fiber optics?

Ans. This may be done by two ways:

a) Total internal reflection b) Continuous refraction.

Q.15. Explain total internal reflection?

Ans. In Total internal reflection the light rays striking the internal surface of the glass at angles of incidence greater than (**critical angle)** will be reflected back into the same medium.

Q.16. Write down the uses of optical fibers?

Ans. The use of light as a transmission carrier wave in fibre optics has several advantages over radio wave carriers such as.

1) It is its ability to transmit thousands of telephone conversations, several television programs and numerous data signals between stations through one or two flexible, hair - thin threads of optical fibre.
2) It is also used to transmit light around corners and into inaccessible places so that the formerly unobservable could be viewed.
3) The use of fibre optic tools in industry is now very common, and their importance as diagnostic tools in medicine has been proved

4) These systems also allow word processing, image transmitting and receiving equipment to operate efficiently.

Q.17. Differentiate cladding and jacket?

Ans. In fibre optics where central core has high refractive index (high density) and over it is a layer of a lower refractive index (less density). This layer is called **cladding**. Such a type of fibre is called multi-mode step index fibre. The optical fibre is also covered by a **plastic jacket** for protection.

Q.18. Define refractive index?

Ans. The index of refraction is merely the ratio of the speed of light *c* in vacuum to the speed of light v in that material. **n=c/v**

Chapter 11

Q.1. Define Thermodynamics and describe the kinetic theory of gases?

Ans. Thermodynamics is a branch of physics that deals with relationships and conversion between heat and other forms of energy.

Kinetic theory of Gases:

- A **finite Volume of gas** consists of very large number of molecules.
- Gas molecules are **random** in motion.
- Collisions between the gas molecules are **perfectly elastic**.
- Molecules exert **no force** on each other except during collision.

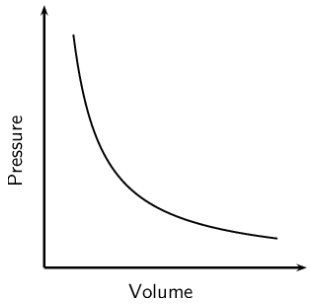
Q.2. Describe the relation of temperature and kinetic energy?

Ans. Absolute temperature of an ideal gas is directly proportional to average translational kinetic energy of gas molecules.

$$T \alpha < K.E >$$

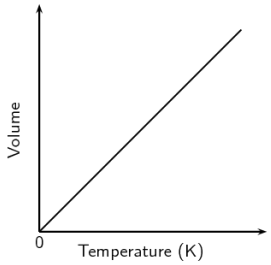
Q.3. Define Boyle's law with graph?

Ans. The volume of given mass of gas at constant temperature is inversely proportional to the pressure applied to the gas.



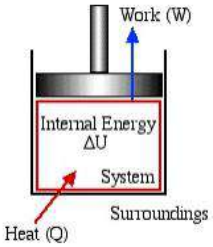
Q.4. Define Charles's law, with graph?

Ans. The volume of given mass of gas is directly proportional to the absolute temperature when the pressure is kept constant.



Q.5. What is the meaning of internal energy?

Ans. The sum of all the form of energies (such as kinetic and potential energy) of a substance is called internal energy.



Q.6. Differentiate work and energy, derive formula for work done ?

Ans. Both heat and work correspond to transfer of energy by some means.

$$P = F/A$$

Or $$F = PA$$

$$W = F\Delta y$$
$$W = PA\Delta y$$
$$W = P\Delta V \qquad (A\Delta y = \Delta V)$$

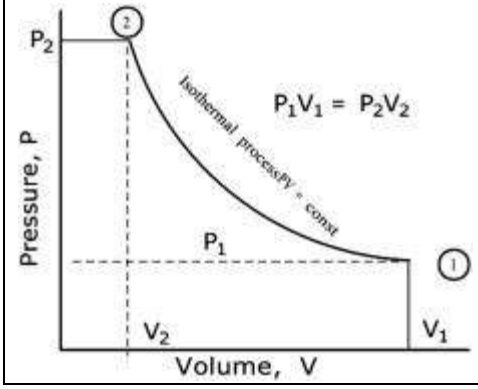
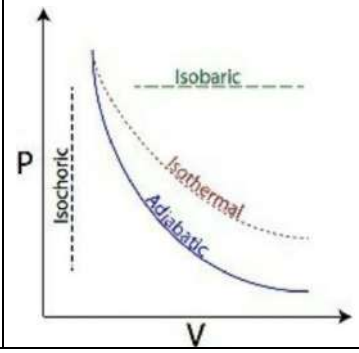
Q.7. Explain first law of thermodynamics with equation.

Ans. When the heat Q is added to a system, this energy appears as an increase in the internal energy ΔU stored in the system plus work done W by the system on the surroundings.

$$Q = \Delta U + W$$

Q.8. Differentiate isothermal and adiabatic processes with graphs.

Ans.

Isothermal	Adiabatic
A process in which the temperature of the system is constant is called isothermal process.	A process in which no heat enters or leaves the system is called adiabatic process.
	

Q.9. Define molar specific heat. What is the difference in molar specific heat at constant volume and constant pressure?

Ans. Molar specific heat of substance is defined as the heat required to rise the temperature of one mole of a substance through 1 K.

Molar specific heat at constant Volume	Molar specific heat at constant pressure
Molar specific heat of substance at constant Volume is defined as the heat required to Rise the temperature of one mole of Substance through 1 K at constant Volume.	Molar specific heat of substance at constant pressureis defined as the heat required to Rise the temperature of one mole of Substance through 1 K at constant pressure.

$Q_v = C_v \Delta T$	$Q_p = C_v \Delta T$

Q.10. Differentiate reversible and irreversible process.

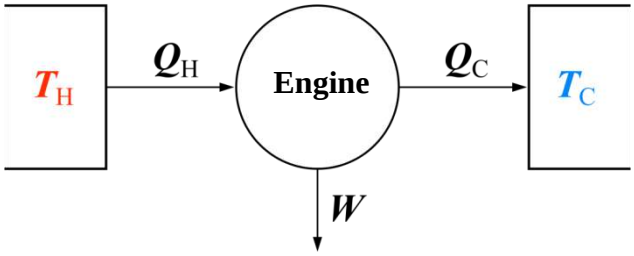
Ans. A reversible process is one which can be retraced in exactly reverse order, without producing any change in the surroundings.

A irreversible process is one which can not be retraced in exactly reverse order, without producing any change in the surroundings

Q.11. Define second law of thermodynamics and heat engine.

Ans. It is an impossible to make a heat engine which converts all the heat absorbed from a hot reservoir into work without rejecting any heat to sink. OR

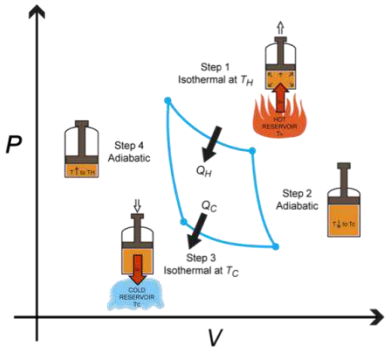
There is no perfect heat engine.



Q.12. What is Carnot theorem and how Carnot engine works on the theorem?

Ans. A carnot engine is Hypothetical engine that operates on the reversible carnot cycle. Sadi Carnot in 1824 proposed this ideal engine using only isothermal and adiabatic process.

- Isothermal expansion
- Adiabatic expansion
- Isothermal compression
- Adiabatic compression



Q.13. What is the meaning of efficiency of Carnot engine?

Ans. Efficiency of carnot engine tell us about work done (output) as compare to heat entered (input). Efficiency of engine depends on the temperature of hot and cold resorvior.

$$\eta = 1 - \frac{T_{cold}}{T_{hot}}$$

$$\eta = \left[1 - \frac{T_{Cold}}{T_{Hot}}\right] \times 100\%$$

Q.14. Define second law of thermodynamics in terms of Entropy.

Ans. A system undergoes a natural process, it will go in the direction that the entropy of system plus the environment increase.

Q.15. Define absolute temperature.

Ans. A temperature measured from absolute zero in kelvins. To convert from the Celsius scale into the **absolute**

temperature, you add 273.15 and change °C to K. To get a **temperature** on the **absolute** scale to the Celsius scale, subtract 273.15 and change K to °C.

Q.16. Define Diesel engine how works.

Ans. No spark plug is needed in diesel engine. Diesel is sprayed into cylinder at maximum compression. Because air is at high temperature after compression the fuel mixture ignites on contact with air in cylinder & pushes the piston outward.

Q.17. Define petrol engine and its working?

Ans. Petrol engine is a engine that based on carnot engine consist of **four strokes**.

1. Intake stroke
2. Compression Stroke
3. Power stroke
4. Exhaust stroke