Chapter 1

Measurements

Short Answers

Q.1 ***Name several repetitive phenomenon occurring in nature which could serve as reasonable time standards.***

Ans. 1) Revolution of earth around sun.
2) Revolution of the moon around the earth.
3) Heart beat.
4) Human pulse rate.
5) Characteristic vibrations of quartz crystals.

Q.2 ***Give the draw backs to use the period of a pendulum as a time standard.***

Ans. Time period of the pendulum is given by the formula

$$T=2\pi\,(l/g)^{1/2}$$

Following are the draw backs to use the period of a pendulum as time standard:

i. The environmental changes may affect its length.
ii. The value of g is not constant every where due to change of height.
iii. The point of suspension can never be frictionless.
iv. The frictional effects due to air currents.

Q.3 ***Why do we find it useful to have two units for the amount of substance, the kilogram and the mole?***

Ans. Kilogram measures quantity of a substance having relatively large mass. Mole is used to count the number of atoms/molecules in a substance. One mole of every substance has same number of atoms/molecules whereas one kg has different number of atoms / molecules in every substance.

Q.4 ***Three students measured the length of a needle with a scale on which minimum division is 1mm and recorded as (i) 0.2145 m (ii) 0.21 m (iii) 0.214 m which record is correct and why?***

Ans. 1 mm = 1 / 1000 m = 0.001 m. Answer (iii) 0.214 m is correct because the scale's precision is up to 3 decimal point of the meter.

Q.5 ***An old saying is that "A chain is only as strong as its weakest link". What analogous statement can you make regarding experimental data used in a computation?***

Ans. The analogous statement regarding experimental data may be "The experimental result is as accurate as the least accurate measurement in the experimental data".

Q.6 ***The period of simple pendulum is measured by a stop watch. What types of errors are possible in the time period?***

Ans. The following errors are possible:

1) The zero error due to faulty apparatus (systematic error).
2) The error due parallax.
3) The human reflections or inexperience or negligence.
4) Frictional effects due to air and support.

Q.7 ***Does a dimensional analysis give any information about constant of proportionality that may appear in an algebraic expression? Explain.***

Ans. No dimensional analysis does not give any information about constant of proportionality. It is used to derive the physical quantities appearing in the algebraic expression. The numerical value of the constant of proportionality can be determined by experiments. For example in deriving the formula for time period of simple pendulum, $T=2\pi\,(l/g)^{1/2}$ 'l' and 'g' is given by dimensional analysis.

Q.8 ***Write the dimensions of (i) Pressure, (ii) Density***

Ans. (i) Dimensions of Pressure = dimensions of Force / dimensions of area

$[F] = [m\,a] = [M\,L\,T^{-2}]$
$[A] = [L^2]$

$$[P] = [F]/[A] = [M\,L\,T^{-2}]/[L^2] = [M\,L^{-1}\,T^{-2}]$$

(ii) dimensions of density = dimensions of mass /dimensions of volume

$[D] = [\text{mass}]/[\text{vol}]$
$= [M\,L^{-3}]$

Q.9 ***The wavelength λ of a wave depends on the speed v of the wave and its frequency f. Knowing that***
$[\lambda] = [L]$, $[v] = [L\,T^{-1}]$ and $[f] = [T^{-1}]$
Decide which of the following is correct, $f = v\lambda$ or $f = v/\lambda$

Ans. Applying dimensional analysis:

Dimensions of f = $[T^{-1}]$ … (1)
Dimensions of $v\lambda = [LT^{-1}] \times [L] = [L^2\,T^{-1}]$ … (2)
From equation (1) and (2)
$[T^{-1}] \neq [L^2\,T^{-1}]$
So it is dimensionally not correct.

Now dimensions of f = $[T^{-1}]$ ….. (3)
And dimensions of $v / \lambda = [LT^{-1}] / [L] = [T^{-1}]$ … (4)
From equation (3)&(4)
$[T^{-1}] = [T^{-1}]$
So it is dimensionally correct.

Chapter 2
Vector and Equilibrium

Q.1 ***Define the terms (i) Unit vector, (ii) Position vector and (iii) Components of a vector.***

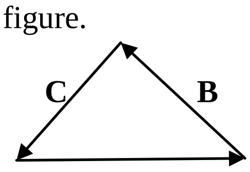
Ans. **i) Unit vector:** A vector whose magnitude is one and it is used to indicate the direction of any vector.

ii) Position vector: A vector that describes the location of a point or particle with respect to the origin is called position vector and represented by **r**.

iii) Components of a vector: A component of a vector is its effective value in a given direction.

Q.2 ***The vector sum of three vectors gives a zero resultant. What can be the orientation of the vectors?***

Ans. If three vectors are drawn in such a way that they make a closed triangle then their vector sum will be zero. As shown in the figure.



Q.3 ***Vector A lies in the xy plane. For what orientation will both of its rectangular components be negative? For what orientation will its components have opposite signs?***

Ans. When vector **A** lies in 3rd quadrant both of its rectangular components will be negative.
When the vector will lie in 2nd or 4th quadrant both of its rectangular components will have opposite signs that is one is positive and other is negative.

Q.4 ***If one of the components of a vector is not zero, can its magnitude be zero? Explain***.

Ans. No. Its magnitude cannot be zero.

e.g. if $Ax \neq 0$ & $Ay = 0$

then $A = \sqrt{Ax^2 + (0)^2}$

$= \sqrt{Ax^2} = Ax$

$\neq 0$

Q.5 ***Can a vector have a component greater than the vector's magnitude?***

Ans. No. A vector cannot have a component greater than the vector's magnitude because the component is an effective part of a vector in specific direction and part cannot be greater than the whole.

Q.6 ***Can the magnitude of a vector have a negative value?***

Ans. No. The magnitude of a vector has always positive value;
$A = \sqrt{A_x^2 + A_y^2}$

Q.7 ***If A + B = 0. What can you say about the components of the two vectors?***

Ans. If **A** + **B** = **0,** then there are two possibilities.

a. The corresponding components of both **A** and **B** are equal and opposite.
b. The vectors **A** and **B** are null vectors.

Q.8 ***Under what circumstances would a vector have components that are equal in magnitude?***

Ans. We know that $A_x = A \cos\theta$ and $A_y = A \sin\theta$
Since the sine and cos have equal value for an angle of 45^o. Therefore, when a vector makes an angle of 45^o with X-axis, then its components will have equal magnitude.

Q.9 ***Is it possible to add a vector quantity to a scalar quantity? Explain.***

Ans. No. It is not possible to add a vector quantity to a scalar quantity. Because scalar quantities are added by simple algebraic rule but vector quantities have separate rules for their addition. Hence scalar quantities will be added in scalar quantities and vector quantities will be added in vector quantities.

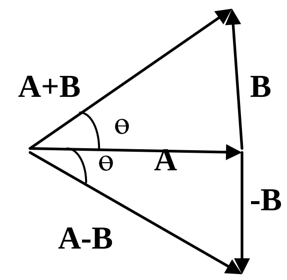
Q.10 ***Can you add zero to a null vector?***

Ans. No. We cannot add zero to a null vector. Because zero is a scalar quantity and null vector is a vector quantity. According to rule scalar quantities will be added in scalar quantities and vector quantities will be added in vector quantities.

Q.11 ***Two vectors have unequal magnitudes. Can their sum be zero? Explain.***

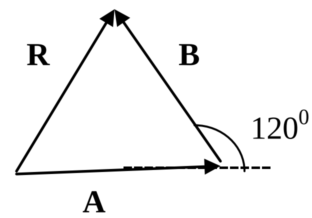
Ans. No. The sum of two unequal vectors cannot be zero. For the sum of vectors to be zero, the vectors must have equal magnitude with opposite directions.

Q.12 ***Show that the sum and difference of two perpendicular vectors of equal lengths are also perpendicular and of the same length.***



Ans. In the figure,
Vectors **A** and **B** are perpendicular to each other having equal lengths. From ɵ=45 the configuration of the figure ɵ=45^0, we have
(A + B) ⊥ **(A - B)**
i.e. sum and difference of the vectors are perpendicular to each other.
Also ɵ=45^0 for both **A+B** and **A-B** with the X-axis, hence they are equal in length.

Q.13 ***How would the two vectors of the same magnitude have to be oriented, if they were to be combined to give a resultant equal to a vector of the same magnitude?***

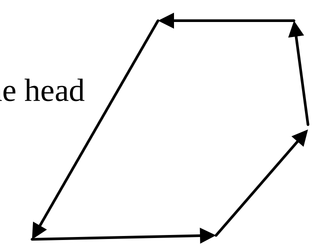


Ans. When the angle between two vectors of same magnitude is 120^o, the magnitudes of the resultant will be same to that of magnitude of each vector.

Q.14 ***The two vectors to be combined have magnitudes 60 N and 35 N. Pick the correct answer from those given and tell why is it the only one of the three that is correct.***
i) 100 N ii) 70 N iii) 20 N

Ans. $\mathbf{A_1}$ = 60N and $\mathbf{A_2}$ = 35N
Answer (ii) 70 N is correct.
For maximum value, both vectors must be in same direction, $A_1 + A_2 = 60 + 35 = 95$ which is less than 100 therefore (i) 100 N cannot be the correct.
For minimum value, both vectors must be in opposite direction, $A_1 - A_2 = 60 - 35 = 25$ which is greater than 20, therefore (iii) 20 N cannot be the correct.

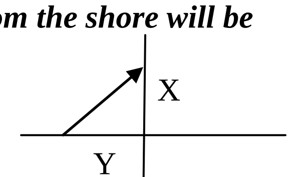
Q.15 ***Suppose the sides of a closed polygon represent vector arranged head to tail. What is the sum of these vectors?***



Ans. The sum will be zero. Because the tail of first vector meets the head of last vector as shown in figure.

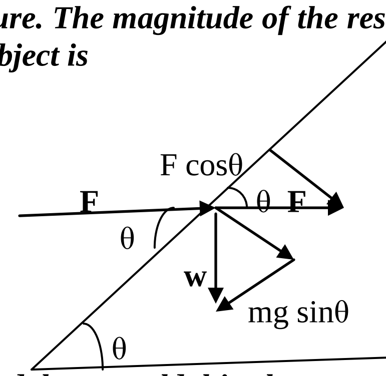
Q.16 ***Identify the correct answer;***

i) ***Two ships X and Y are travelling in different directions at equal speeds. The actual direction of motion of X is due north but to an observer on Y, the apparent direction of motion of X is north-east. The actual direction of motion of Y as observed from the shore will be***
(A) East (B) West (C) South-East (D) South-West



Ans. ***i) The correct answer is (B) West.***

ii) ***A horizontal force F is applied to a small object P of mass M at rest on a smooth plane inclined at an angle θ to the horizontal as shown in the figure. The magnitude of the resultant force acting up and along the surface of the plane, on the object is***
A) F cos θ - mg sin θ
B) F sin θ - mg cos θ
C) F cos θ + mg cos θ
D) F sin θ + mg sin θ
E) mg tan θ



Ans. (ii) The correct answer is (A) F cos θ - mg sin θ

Q.17 ***If all the components of the vectors, A1 and A2 were reversed, how would this alter $A_1 \times A_2$?***

Ans. When all the components are reversed then vector is reversed i.e. $\mathbf{A_1} = -\mathbf{A_1}$ & $\mathbf{A_2} = -\mathbf{A_2}$

Therefore, $\mathbf{A_1} \times \mathbf{A_2} = -\mathbf{A_1} \times -\mathbf{A_2} = \mathbf{A_1} \times \mathbf{A_2}$

Therefore, there will be no effect on the cross product of $\mathbf{A}_1$ and $\mathbf{A}_2$, if all the components of the vectors **A1** & **A2** are reversed.

Q.18 ***Name the three different conditions that could make A1 x A2 = O.***

Ans. **A1 x A2** could be null vector, if

i) $\mathbf{A_1}$ is null vector i.e. $\mathbf{0 \times A_2} = O$
ii) $\mathbf{A_2}$ is null vector i.e. $\mathbf{A_1 \times 0} = O$
iii) $\mathbf{A_1 \times A_2}$ are parallel or anti-parallel, i.e. $\mathbf{A_1 \times A_2} = (A_1 A_2 \sin 0^o)\,\mathbf{n} = (A_1 A_2 \sin 180^o)\mathbf{n} = \mathbf{O}$

Q.19 ***Identify true or false statements and explain the reason.***

a) A body in equilibrium implies that it is not moving nor rotating.

b) If coplanar forces acting on a body form a closed polygon, then the body is said to be in equilibrium.

Ans. a) It is false because a body in equilibrium may move and rotate with uniform velocity.

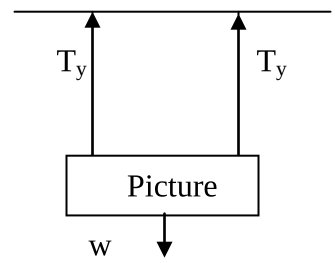
b) It is true. The vector sum will be zero, for the coplanar forces forming a closed polygon and it fulfils the 1st condition of equilibrium.

Q.20 ***A picture is suspended from a wall by two strings. Show by diagram the configuration of the strings for which the tension in the strings will be minimum.***

Ans. The configuration shown in the figure will have minimum tension.

For tension to be minimum, θ = 90o

$\Sigma F_y = 0$
$T_y + T_y - w = 0$
$2T_y - w = 0$
$2\,T \sin\theta = w$
$T = w / 2 \sin\theta$
$T = w / 2 \sin 90^o = w / 2$



Q.21 ***Can a body rotate about its centre of gravity under the action of its weight?***

Ans. No. A body cannot rotate about its centre of gravity under the action of its weight. Because weight acts at the centre of the body so moment arm will be zero. Therefore torque or turning effect will also be zero.

Chapter 3
Motion and Force
Short Answers

Q.1 ***What is the difference between uniform and variable velocity. From the explanation of variable velocity, define acceleration. Give SI units of velocity and acceleration.***

Ans. **Uniform velocity (or constant velocity)**:

If a body covers equal distances in equal intervals of time, however small the intervals may be, in a particular direction, it is said to move with uniform velocity.

Variable velocity:

When a body covers unequal distances in equal intervals of time, or when its direction of motion changes, it is said to move with a variable velocity.

Difference:

In uniform velocity, equal distances are covered in equal intervals of time, but in variable velocity, unequal distances are covered in equal intervals of time. Also in uniform velocity the direction of motion does not change, but in variable velocity the direction may change.

Acceleration:

The time rate of change of velocity is called acceleration. The change in velocity can occur due to change in speed or in direction or in both—defined as variable velocity.

SI units of velocity and acceleration:

Velocity: m / s (m s^{-1})

Acceleration: m / s^2 (m s^{-2})

Q.2 ***An object is thrown vertically upward. Discuss the sign of acceleration due to gravity, relative to velocity, while the object is in air.***

Ans.

When an object is thrown vertically upward its direction of initial velocity is upward. So ‘g’ will be negative relative to velocity. For downward motion, ‘g’ is positive with reference to the direction of initial velocity.

Q.3 ***Can the velocity of an object reverse direction when acceleration is constant? If so, give an example.***

Ans. Yes, for freely falling bodies in air, velocity of an object reverses direction when acceleration is constant. . If a body moves upward, at top is motion it reverse direction and moves downward. The acceleration due to gravity is constant for both upward and downward motion.

Q.4 ***Specify the correct statement:***

a. An object can have a constant velocity even its speed is changing.

b. An object can have a constant speed even its velocity is changing.

c. An object can have a zero velocity even its acceleration is not zero

d. An object subjected to a constant acceleration can reverse its velocity.

Ans. Statement (a) is incorrect because speed is the magnitude of velocity so when speed changes velocity also changes.

Statement (b) is correct because magnitude of velocity may be constant but its direction may change. e.g. a body moving in circle with constant speed changes its direction at each instant.

Statement (c) is correct because when an object is thrown vertically upward, at the top of its height, its velocity becomes zero but acceleration is not zero.

Statement (d) is correct because when an object is thrown vertically upward, at the top of its height, its velocity reverses direction under constant acceleration due to gravity.

Q.5 ***A man standing on the top of a tower throws a ball straight up with initial velocity vi and at the same time throws a second ball straight downward with the same speed. Which ball will have larger speed when it strikes the ground? Ignore air friction.***

Ans. Both the balls will strike the ground with same speed because when the ball thrown vertically upward will come down at the level from where it has been thrown, its speed will be equal to the speed of the ball thrown vertically downward.

Q.6 ***Explain the circumstances in which the velocity v and acceleration a of a car are***

(i) Parallel (ii) Anti-parallel (iii) Perpendicular to one another (iv) v is zero but a is not

(v) a is zero but v is not zero

Ans. (i) The car moving with increasing speed.

(ii) The car moving with decreasing speed.
(iii) Moving a curved or circular path.
(iv) When sudden brakes are applied.
(v) Moving with uniform velocity.

Q.7 ***Motion with constant velocity is a special case of motion with constant acceleration. Is this statement true? Discuss.***

Ans. Yes the motion with constant velocity is a special case of motion with constant acceleration. When a body moves with constant velocity its acceleration is zero and zero is a special constant.

Q.8 ***Find the change in momentum for an object subjected to a given force for a given time and state law of motion in terms of momentum.***

Ans. From Newton's 2nd law

F = m a

But $a = (v_f - v_i) / t$

F = m (vf - vi)/t

$= (mv_f - mv_i) /t$ = time rate of change of momentum

So, 2nd law of motion in terms of momentum is stated as:

"Time rate of change of momentum of a body equals the applied force".

Q.9 ***Define impulse and show that how it is related to linear momentum.***

Ans. Impulse:

The product of large force and short interval of time for which it acts on a body is called Impulse.

$I = F \times \Delta t$

But $F = \Delta p/\Delta t$

Therefore, $I = (\Delta p/\Delta t) \times \Delta t$

$= \Delta p$

It shows that impulse equals the change in linear momentum of a body.

Q.10 ***State the law of conservation of linear momentum, pointing out the importance of isolated system. Explain, why under certain conditions, the law is useful even though the system is not completely isolated?***

Ans. i) Law of conservation of linear momentum:

The total linear momentum of an isolated system remains constant.

$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$

$(m_1 v_1 + m_2 v_2) - (m_1 v_1' + m_2 v_2') = 0$

An isolated system is free from external forces. External influence may effect the mutual interaction.

ii) If a system is not completely isolated but external forces are very small comparing with mutual interacting forces, the law is useful. e.g. Pressure of a gas can be calculated by applying law of conservation of linear momentum we neglect '*g*', which is the external force.

Q.11 ***Explain the difference between elastic and inelastic collisions. Explain how would a bouncing ball behave in each case? Give plausible reasons for the fact that K.E. is not conserved in most cases?***

Ans. Elastic collision: The collision in which both momentum and kinetic energy are conserved.

Inelastic collision: The collision in which kinetic energy does not conserve.

Difference: In elastic collision law of conservation of momentum and kinetic energy holds but in inelastic collisions law of conservation of kinetic energy does not hold.

Bouncing ball: In elastic collision, the bouncing ball should rebound to the original height. In inelastic collision, the bouncing ball will not rebound or will rebound to a smaller height from where it is dropped.

Plausible reasons: In most collisions, some K.E change into heat, sound and in the deformation of the colliding objects.

Q.12 ***Explain what is meant by projectile motion. Derive expressions for a. the time of flight. b. the range of projectile. Show that the range of projectile is maximum when projectile is thrown at an angle of 45o with the horizontal.***

Ans. It is long question. Pl. see the article in your text book.

Q.13 ***At what point or points in its path does a projectile have its minimum speed, its maximum speed?***

Ans. A projectile will have minimum speed at the highest point (maximum height).
It has maximum speed at the launching and landing points.

Q.14 ***Each of the following questions is followed by four answers, one of which is correct answer. Identify that answer.***

i. ***What is meant by a ballistic trajectory?***

a. The paths followed by an un-powered and unguided projectile.
b. The path followed by the powered and unguided projectile.
c. The path followed by un-powered and guided projectile.
d. The path followed by powered and guided projectile.

ii. ***What happens when a system of two bodies undergoes an elastic collision?***

a. The momentum of the system changes.
b. The momentum of the system does not change.
c. The bodies come to rest after collision.
d. The energy conservation law is violated.

Ans. (i) The correct answer is (a). A ballistic trajectory means the paths followed by an un-powered and un-guided projectile.

(ii) The correct answer is (b). In elastic collision, the momentum of the system does not change.

Chapter 4
Work and Energy
Short Answers

Q.1 ***A person hold a bag of groceries while standing still, talking to a friend. A car is stationary with its engine running. From the standpoint of work, how are these two situations similar?***

Ans. In both cases work is zero, as there is no displacement;

$W = F\, d \cos\theta = F \times 0 \times \cos\theta = 0$

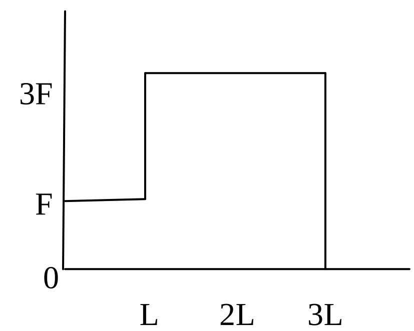
Q.2 ***Calculate the work done in kilo joules in lifting a mass of 10 kg (at a steady velocity) through a vertical height of 10 m.***

Ans. m= 10 kg, h=10 m, $\theta = 0^0$

$W = F\, d \cos 0^o$
$= F\, d$
$= m\, g\, h$
$= 10 \times 9.8 \times 10$
$= 980\ J = 0.98\ KJ$

Q.3 ***A force F acts through a distance L. the force is then increased to 3 F, and then acts through a further distance of 2 L. Draw the work diagram to scale.***

Ans. The following is the work diagram.



$W = F \times L + 2L \times 3F$
$= FL + 6\ FL$
$= 7\ FL$

Q.4 ***In which case is more work done? When a 50 kg bag of books is lifted through 50 cm, or when a 50 kg crate is pushed through 2 m across the floor with a force of 50 N?***

Ans. **In case of books**:

$W = F\, d \cos\theta$
$= mgh \cos 0^o$
$= mgh$
$= 50 \times 9.8 \times 0.5 = 245\ J$

In case of crate:

$W = F\, d \cos\theta$
$= F\, d \cos 0^o$
$= F\, d = 50 \times 2 = 100\ J$

Therefore, more work is done in lifting bag of books.

Q.5 ***An object has 1 J of potential energy. Explain what it means?***

Ans. $PE_g = m\, g\, h = w\, h = (1/9.8) \times 9.8 \times 1 = 1\ (N) \times 1(m) = 1\ N\, m = 1\ J$

It means a force of one N is applied to a body to raise it through 1 m height. It also means that it can do a work of one joule when it is released from height of one meter.

Q.6 ***A ball of mass m is held at a height h_1 above a table. The tabletop is at a height h_2 above the floor. One student says that the ball has potential energy mgh_1 but another says that it is $mg(h_1 + h_2)$. Who is correct?***

Ans. Both the students are correct. One student is taking the reference from the top of the table and other is taking the reference from the floor.
PE with respect to table = mgh_1

PE with reference to floor = $mg(h_1 + h_2)$

Q.7 ***When a rocket re-enters the atmosphere, its nose cone becomes very hot. Where does this heat energy come from?***

Ans. Work is done by the rocket against the air friction and the friction of the dust particles in the air. This work done produces the heat which makes the nose cone of the rocket very hot.

Q.8 ***What sort of energy is in the following:***
a) Compressed spring
b) Water in a high dam
c) A moving car

Ans. a) Elastic PE in compressed spring.
b) Gravitational PE in water in a high dam.
c) Kinetic energy in a moving car.

Q.9 ***A girl drops a cup from a certain height, which breaks into pieces. What energy changes are involved?***

Ans. Potential energy is converted into kinetic energy and kinetic energy is converted into sound energy, heat energy, work done in breaking the cup and kinetic energy of the pieces.

PE→ gain in KE→ (sound energy +heat energy +work done in breaking the cup + KE of the pieces)

Q.10 ***A body uses a catapult to throw a stone, which accidentally smashes a green house window. List the possible energy changes.***

Ans. Elastic potential energy is converted into kinetic energy and kinetic energy is converted into sound energy, heat energy, work done in breaking the window and kinetic energy of the pieces.
Elastic PE → gain in KE→ (sound energy + heat energy + Work done in breaking + kinetic energy of the pieces)

Chapter 5
Circular Motion
Short Answers

Q.1 ***Explain the difference between tangential velocity and the angular velocity. If one of these is given for a wheel of known radius, how will you find the other?***

Ans. **Tangential velocity (*v*)**

"The linear velocity of body along the direction of the tangent at any point on that curve path along which it is moving is called tangential velocity".

Angular velocity (ω): The rate of change of angular displacement of a particle moving along a curved path is called angular velocity.

Difference: Both are related as: $\mathbf{v} = \mathbf{r} \times \boldsymbol{\omega}$

The direction of ω is perpendicular to the plane of motion and the direction of ***v*** is along tangent of the curved path.

To find: If one quantity is given with known radius, the other can be found from $v = r\,\omega$

Q.2 ***Explain what is meant by centripetal force and why it must be furnished to an object if the object is to follow a circular path?***

Ans. **Centripetal force (F_c)**: The force needed to bend the normally straight path of the particle into a circular path is called centripetal force. Mathematically,

$F_c = mv^2 / r = m\,r\,\omega^2$

Since the direction of the body, moving in a circular path of constant radius, is to be changed at every point, so we need to furnish centripetal force which does the same.

Q.3 ***What is meant by moment of inertia? Explain its significance.***

Ans. **Moment of inertial (I)**: The product of mass of the object and square of its distance from the axis of rotation is called moment of inertia.

Mathematically,

$I = m\,r^2$, where m is the mass of an object at distant r from the axis of rotation.

Significance: It is a quantitative property of a solid which represent its resistance to change in state of rotation about a fixed axis. It plays the same role in angular motion as that of mass in linear motion. As mass is a scalar quantity, moment of inertia is a scalar quantity.

Q.4 ***What is meant by angular momentum? Explain the law of conservation of angular momentum?***

Ans. Angular momentum: The cross product of position vector and linear momentum is called angular momentum.

Mathematically,

$\mathbf{L} = \mathbf{r} \times \mathbf{p}$. Also $\mathbf{L} = I\,\boldsymbol{\omega}$

Law of conservation of angular momentum:

If no external torque acts on a system, the total angular momentum of the system remains constant. Mathematically,

$L_{total} = L_1 + L_2 + \ldots = \text{constant}$

or $L = I_1\,\omega_1 = I_2\,\omega_2 = \text{constant}$

If I will increase, ω will decrease and vice versa.

Q.5 ***Show that orbital angular momentum $L_o = m\,v\,r$***

Ans. We have

$\mathbf{L_o} = \mathbf{r} \times \mathbf{p}$

$L_o = r\,p\sin\theta$

If $\theta = 90^o$ then

$L_o = r\,p$

But $p = m\,v$

$L_o = m\,v\,r$

Q.6 ***Describe what should be the minimum velocity, for a satellite, to orbit close to the Earth around it.***

Ans. We have formula for the orbital velocity of satellite

$v_{min} = \sqrt{g\,r}$

for minimum velocity of the satellite, to orbit close to the earth $g = 9.8\ m/s^2$ and $r = R = 6.4\times10^6$ m

$v_{min} = \sqrt{9.8 \times 6.4\times10^6} = 7.9$ km/s

Q.7 ***State the direction of the following vectors in simple situations; angular momentum and angular velocity.***

Ans. In a situation where a particle is moving in a circular path in anticlockwise direction, the direction of angular momentum and angular velocity, according to right hand rule, is up along the axis of rotation.

Q.8 ***Explain why an object, orbiting the Earth, is said to be freely falling. Use your explanation to point out why objects appear weightless under certain circumstances.***

Ans. An object is given certain tangential velocity for orbiting the earth. It will follow a curved path due force of gravity and act as a freely falling body. When the curvature of its path matches the curvature of the earth then it will start orbiting the earth. Its centripetal acceleration equals its acceleration due to gravity;

i.e. $a = g$, so $T = mg - mg = 0$.

Hence it appears weightless.

Q.9 ***When mud flies off the tyre of a moving bicycle, in what direction does it fly? Explain.***

Ans. The mud will fly off in a direction tangent to the wheel. When mud separates from the tyre, centripetal force on the mud particles become zero.

Q.10 ***A disc and hoop start moving down from the top of an inclined plane at the same time. Which one will be moving faster on reaching the bottom?***

Ans. The speed of disc and hoop moving from top of an inclined plane are given by

$v_d = (4/3\ gh)^{1/2}$ and $v_h = (gh)^{1/2}$

Sine 4/3 > 1 hence speed of the disc is greater than speed of hoop on reaching the ground.

Q.11 ***Why does a diver change his body positions before diving in the pool?***

Ans. To conserve the total angular momentum the diver has to change the body position. By changing the body position he changes the angular velocity.

$$I_1\ \omega_1 = I_2\ \omega_2$$

For stretched position of the diver moment of inertia is greater and ω will be smaller. When the diver closed his legs and arms to make moment of inertia becomes smaller so that his angular velocity increases to make somersaults.

Q.12 ***A student holds two dumb-bells without stretched arms while sitting on a turntable. He is given a push until he is rotating at certain angular velocity. The student then pulls the dumbbell towards his chest. What will be the effect on rate of rotation?***

Ans. The relation for angular momentum is given by

$L = I\ \omega = mr^2\ \omega$

In order to conserve the total angular momentum, the rate of rotation will increase when the student pulls the dumbbell towards his chest because moment of inertia will decrease due to smaller r.

Q.13 ***Explain how much minimum number of geo-stationary satellites are required for global coverage of T.V. transmission.***

Ans. Three correctly positioned satellites are sufficient for global coverage of TV transmission. As one such satellite covers 120 of longitude i.e. ($120^o + 120^o + 120^o = 360^o$)

Chapter 6
Fluid Dynamics
Short Answers

Q.1 ***Explain what do you understand by the term viscosity?***

Ans. Viscosity:

The property of fluids by which they resist their flow due to the internal friction.

Q.2 ***What is meant by drag force? What are the factors upon which drag force acting upon a small sphere of radius r, moving down through liquid, depend?***

Ans. **Drag force**:

The retarding force experienced by an object when it moves through a fluid is called drag force.

Factors:

According to Stoke's Law, the drag force, F is;

$F = 6\pi\eta\, r\, v$

Drag force is directly proportional to the following factors:

η = coefficient of viscosity, r = radius of the sphere

v = speed of the sphere through the fluid.

Q.3 ***Why fog droplets appear to be suspended in air?***

Ans. As the mass of fog droplet is very small so its weight is very small. Therefore, when fog droplet falls down, soon its weight becomes equal to the drag force and net force becomes zero. So it falls with very small terminal velocity due which it appears to be suspended in air.

Q.4 ***Explain the difference between laminar flow and turbulent flow.***

Ans. **Laminar flow**:

In laminar flow, every particle that passes a particular point moves along exactly same path, as followed by particles, which passed those points earlier. The paths followed by the particles are called steams.

Turbulent flow:

The unsteady or irregular flow is called turbulent flow.

Difference:

In laminar flow the streamlines do not intersect each other but in turbulent flow, the exact path of the particle cannot be predicted due to intersection of streamlines.

Q.5 ***State Bernoulli's relation to a liquid in motion and describe some of its applications.***

Ans. **Bernoulli's equation**:

The sum of pressure, K.E per unit volume and P.E. per unit volume of an ideal fluid flowing through a pipe remains same. It is based upon the law of conservation of energy.

Mathematically,

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

where P and ρ are the pressure and density of the fluid, v is the velocity of the fluid along a streamline.

Applications:

a) Torricelli's Theorem

b) Venturi Relation

c) Relating speed & pressure e.g. i) spinning of tennis ball, ii) swing of cricket ball iii) designing of aeroplane wing.

Other applications are

a) checking human blood pressure

b) functioning of a filter pump

c) working of perfume or paint sprayer

d) working of a chimney for smoke exhaust.

Q.6 ***A person is standing near a fast moving train. Is there any danger that he will fall towards it?***

Ans. Yes there is danger that he will fall towards the fast moving train. As the speed of air between person and fast moving train is high, the pressure will be low. Whereas the speed of the air on the other side of the person is low and pressure will be high. So due to this pressure difference he might fell towards the train.

Q.7 ***Identify the correct answer. What do you infer from Bernoulli's theorem?***

(i) Where the speed of the fluid is high the pressure will be low.

(ii) Where the speed of the fluid is high the pressure is also high.
(iii) This theorem is valid only for turbulent flow of the fluid.

Ans. The correct answer is (i) , where the speed of the fluid is high the pressure will be low.

Inference:

Bernoulli's theorem is just another form of law of conservation of energy for fluid flow.

Q.8 ***Two row boats moving parallel in the same direction are pulled towards each other. Explain.***

Ans. The speed of water and air between the boats is high as compared to speed of water and air on other sides of the row boats. Therefore, the pressure between the row boats will be low and pressure on other sides of the boats will be high. So due to this pressure difference both the row boats are pulled towards each other.

Q.9 ***Explain, how the swing is produced in a fast moving cricket bal?.***

Ans. The velocity of the air on one side of the ball increases due to spin and air speed in the same direction and so pressure decreases on this side. The speed of the air becomes low on the other side so pressure increases on this side which gives an extra curvature to the ball which is known as swing. This gives swing to the ball.

Q.10 ***Explain the working of a carburetor of a motor car using Bernoulli's principle.***

Ans. **Working of a Carburetor**:

The carburettor of a car engine uses a Venturi duct to feed the correct mix of air and petrol to the cylinders. Air is drawn through the duct and along a pipe to the cylinders. A tiny inlet at the side of duct is fed with petrol. The air through the duct moves very fast, creating low pressure in the duct, which draws petrol vapours into the air stream.

Q.11 ***For which position will the maximum blood pressure in the body have the smallest value. (a) Standing up right (b) Sitting (c) Lying horizontally (d) Standing on one's head?***

Ans. (c) lying horizontally position will have smallest value of maximum blood pressure in the body have the smallest value. In this position all parts of the body are nearly in level with the heart, and heart will not have to do extra work.

Q.12 ***In an orbiting space station, would the blood pressure in major arteries in the leg ever be greater than the blood pressure in major arteries in the neck?***

Ans. No, the space station is in state of weightlessness. Therefore the blood pressure in major arteries in the leg will be equal to that of in arteries in the neck due to weightlessness.

Chapter 7
Simple Harmonic Motion
Short Answers

Q.1 ***Name two characteristics of simple harmonic motion.***

Ans. $a \propto -x$

i) Acceleration is directly proportional to the displacement.

ii) Acceleration is directed towards its mean position.

Q.2 ***Does frequency depends on amplitude for harmonic oscillators?***

Ans. No. Frequency of harmonic oscillator is given by the following formula

$$f = 1/2\pi \sqrt{g / l}$$

The above formula clearly shows that frequency of harmonic oscillator is independent of amplitude. It depends upon time g and length of the harmonic oscillator.

Q.3 ***Can we realize an ideal simple pendulum?***

Ans. No we cannot realize an ideal simple pendulum. Because for an ideal simple pendulum following conditions must be met:

i. The string must be massless and inextensible.

ii. The bob should be a point mass

iii. The support must be frictionless.

iv. The length of string should not change with temperature

v. Acceleration due to gravity should not change due to change of height

vi. There should not be air friction

Clearly all these requirements cannot be met perfectly and hence we cannot make an ideal simple pendulum.

Q.4 ***What is the total distance travelled by an object moving with SHM in a time equal to its period, if its amplitude is A?***

Ans. Since the time is equal to the time period (time for one complete vibration) of the SHO. One vibration has four equal amplitudes. Therefore the total distance travelled in one vibration is equal to 4A.

Q.5 ***What happens to the period of a simple pendulum if its length is doubled? What happens if the suspended mass is doubled?***

Ans. The time period of simple pendulum is given by the formula

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

When, length $= 2l$

$$T = 2\pi\sqrt{2\, l / g} = \sqrt{2} \text{ x } 2\pi\sqrt{l / g} = \sqrt{2}\, T$$

So the time period increases by $\sqrt{2}$ (=1.414) times, as length is doubled.

ii) Since time period is independent of mass, therefore, there will be no change in the time period when suspended mass is doubled.

Q.6 ***Does the acceleration of a simple harmonic oscillator remain constant during its motion? Is the acceleration ever zero? Explain.***

Ans. No. Acceleration depends upon displacement, x

$a = -\omega^2 x$

The acceleration is zero at mean position (x = 0) and it becomes maximum at extreme position ($x = x_o$) so the acceleration of simple harmonic oscillator does not remain constant during its motion.

Q.7 ***What is meant by phase angle? Does it define angle between maximum displacement and the driving force?***

Ans. **Phase angle (or phase)**:

The angle $\theta = \omega t$ which specifies the displacement as well as the direction of motion of the point/object executing SHM". It indicates the state and direction of motion of a vibrating particle.

No, it does not define angle between maximum displacement and the driving force.

Q.8 ***Under what conditions does the addition of two simple harmonic motions produce a resultant, which is also simple harmonic?***

Ans. The conditions are as under:

i. The two SHMs must have same nature.

ii. The two SHMs must be parallel.

iii. The two SHMs must have same phase difference.

Q.9 ***Show that in SHM the acceleration is zero when the velocity is greatest and the velocity is zero when the acceleration is greatest.***

Ans. We have for SHM

$v = \omega \sqrt{x_o^2 - x^2}$ & $a = -\omega^2 x$

At mean position

$x = 0$ then $a = 0$ & $v = \omega x_o$ — maximum value,
i.e. acceleration is zero and velocity is greatest.

At extreme potions

$x = x_o$ then $v = 0$ & $a = -\omega x_o$ — maximum value.
i. e. velocity is zero when acceleration is greatest.

Q.10 ***In relation to SHM, explain the equations;***

(i) $y = A \sin(\omega t + \varphi)$
(ii) $a = -\omega^2 x$

Ans. i) $y = A \sin(\omega t + \varphi)$

y = Instantaneous displacement, A= Amplitude, ωt = angle subtended in time t, φ= initial phase
This equation shows that displacement of SHM as a function of amplitude and phase angle depending upon time.

ii) $a = -\omega^2 x$

where a = acceleration of a particle executing SHM, ω = constant angular frequency, x = instantaneous displacement from the mean position.
This equation shows that acceleration is directly proportional to displacement and is directed towards mean position.

Q.11 ***Explain the relation between total energy, potential energy and kinetic energy for a body oscillating with SHM.***

Ans. For a body executing SHM;

At mean position, x = 0

$P.E = \frac{1}{2} k x^2 = \frac{1}{2} k (0)^2 = 0 \rightarrow$ minimum
$K.E = \frac{1}{2} k x_o^2 (1 - x^2 / x_o^2) = \frac{1}{2} k x_o^2 \rightarrow$ maximum

At extreme position, x = xo

$P.E = \frac{1}{2} k x^2 = \frac{1}{2} k x_o^2 \rightarrow$ maximum
$K.E = \frac{1}{2} k x_o^2 (1 - x^2 / x^{o2}) = 0 \rightarrow$ minimum

At intermediate position, x = x

Total Energy = $P.E + K.E = \frac{1}{2} k x^2 + \frac{1}{2} k x_o^2 (1 - x^2 / x_o^2) = \frac{1}{2} k x_o^2$
We conclude that energy oscillate between maximum and minimum values and remain constant throughout equal to $\frac{1}{2} k x_o^2$.

Q.12 ***Describe some common phenomena in which resonance plays an important role.***

Ans. Important role of resonance:

- Tuning radio/TV
- Microwave oven
- Children's swing
- Musical instruments

Q.13 ***If a mass spring system is hung vertically and set into oscillations, why does the motion eventually stop?***

Ans. Due to air resistance, damping force acts on mass-spring oscillating system. The energy of mass spring system is dissipated into heat due to these frictional forces and eventually it stops.

Chapter 8
Wave Motion
Short Answers

Q.1 ***What features do longitudinal waves have in common with transverse waves?***

Ans. Common features of longitudinal and transverse waves:

1) In both waves, particles of the medium vibrate about their mean position.
2) Both transport energy and momentum but not matter.
3) When propagate in a medium they obey, $v = f\lambda$
4) Both are mechanical waves.

Q.2 ***The five possible waveforms obtained when the output from a microphone is fed into the Y-input of cathode ray oscilloscope, with the time base on, are shown in the fig. These waveforms are obtained under the same adjustment of the cathode ray oscilloscope controls. Indicate the waveform***

a) which trace represents the loudest note?

b) which trace represents the highest frequency?

Ans. a) trace D represents the loudest note because the amplitude is maximum.

b) trace B represents the highest frequency because it have more number of waves.

Q.3 ***Is it possible for two identical waves travelling in the same direction along a string to give rise to a stationary wave?***

Ans. No, it is not possible. For stationary waves two identical waves should travel in opposite direction along a string.

Q.4 ***A wave is produced along a stretched string but some of its particles permanently show zero displacement. What type of wave is it?***

Ans. Stationary wave. Here nodes show permanently zero displacement.

Q.5 ***Explain the terms crest, trough, node and antinode.***

Ans. Crest:

The portion of a wave above the mean level in transverse waves is called crest.

Trough:

The portion of a wave below the mean level in transverse waves is called trough.

Node:

The point in stationary waves which have zero displacement is called node.

Antinode:

The point in stationary waves which have maximum displacement from the mean position is called antinode.

Q.6 ***Why does sound travel faster in solids than in gases?***

Ans. In the relation $v = \sqrt{E / \rho}$

ρ of solids is greater than density of gasses but E of solids is far greater than E of gasses. Therefore speed of sound is greater in solids than in gasses.

Q.7 ***How are beats useful in tuning musical instruments?***

Ans. The musical instruments which are to be tuned are sounded together with standard musical instrument. If the beats are produced then frequency of the musical instruments is changed by either changing the length or tension in the strings until the beats are not produced.

Q.8 ***When two notes of frequencies f1 and f2 are sounded together, beats are formed. If f1 > f2 , what will be the frequency of beats?***

i) f1 + f2 ii) ½ (f1 + f2) iii) f1 - f2 iv) ½ (f1 - f2)

Ans. Correct answer is (iii) (f1 - f2)
Number of beats per second is equal to the difference between the frequencies of the tuning forks.

Q.9 ***As a result of distant explosion, an observer senses a ground tremor and then hears the explosion. Explain the time difference.***

Ans. Sound waves travel faster in solids than in air. The sound waves produced by the explosion travel along two paths. One through earth (solid) reaches faster than travelling through atmosphere (air). This is the reason for the time difference.

Q.10 ***Explain why sound travels faster in warm air than in cold air.***

Ans. $v \propto \sqrt{T}$

The speed of sound varies directly as the square root of absolute temperature. The temperature of warm air is greater than cold air that's why sound travels faster in warm air than in cold air.

Q.11 ***How should a sound source move with respect to an observer so that the frequency of its sound does not change?***

Ans. From Doppler effect, there is apparent change in the frequency due to relative motion of source and observer which changes the distance between them. When source moves in a circle around a stationary observer then distance does not change and there will be no apparent change in frequency.

Chapter 9
Physical Optics
Short Answers

Q.1 ***Under what conditions two or more sources of light behave as coherent sources?***

Ans. Two or more sources of light having a constant phase difference and same amplitude and frequency are called coherent sources.

Q.2 ***How is the distance between interference fringes affected by the separation between the slits of Young's experiment? Can fringes disappear?***

Ans. We know that
Fringe spacing = $\Delta y = \lambda L / d$
The relation shows that fringe spacing is inversely proportional to the separation 'd' between the slits. If separation is increased the distance between fringes will decrease. Ultimately fringes disappear for larger distance between the slits.

Q.3 ***Can visible light produce interference fringes? Explain.***

Ans. Yes, visible light can produce interference fringes, if it has phase coherence. Since white light has different colours hence coloured interference fringes will be produced with it.

Q.4 ***In the Young's experiment, one of the slits is covered with blue filter and other with red filter. What would be the pattern of light intensity on the screen?***

Ans. For interference two waves must have phase coherence and same frequency. Since blue and red colours don't have this property so there will be no interference pattern.

Q.5 ***Explain whether the Young's experiment is an experiment for studying interference or diffraction effects of light.***

Ans. Basically Young's experiment is an experiment for studying interference. But diffraction of light also takes place in this experiment.

Q.6 ***An oil film spreading over a wet footpath shows colours. Explain how does it happen?***

Ans. It is due to interference phenomena of light waves. It takes place due the interference of portion of wave reflected from the upper surface of the oil film and a portion of wave reflected from the bottom of oil film.

Q.7 ***Could you obtain Newton's rings with transmitted light? If yes, would the pattern be different from that obtained with reflected light?***

Ans. Yes. We can obtain Newton's rings with transmitted light. The difference will be that, the central spot will be bright in this case whereas it is dark for reflected light.

Q.8 ***In the white light spectrum obtained with a diffraction grating, the third order image of a wavelength coincides with the fourth order image of a second wavelength. Calculate the ratio of the two wavelengths.***

Ans. We know that

$d \sin\theta = n\lambda$

for n=3

$d \sin\theta = 3\lambda 1$ ----------(1)

and for n=4

$d \sin\theta = 4\lambda 2$ -----------(2)

Comparing equation (1) and (2) we get

$3\lambda 1 = 4\lambda 2$

or $\lambda 1 / \lambda 2 = 4/3$

Q.9 ***How would you manage to get more orders of spectra using a diffraction grating?***
Ans. We have, $d \sin\theta = n\lambda$
To increase more orders of spectra (n), we should increase the grating element (d)

i.e. a grating with lesser number of ruled lines. Also we should use light of short wavelength.

Q.10 ***Why the Polaroid sunglasses are better than ordinary sunglasses?***

Ans. Polaroid sunglasses reduces glare due partially polarization of light. Due this our eyes are saved from unnecessary strain.

Q.11 ***How would you distinguish between un-polarized and plan-polarized lights?***

Ans. A Polaroid will distinguish between un-polarized and plane-polarized light. If the light is un-polarized and a Polaroid is rotated in front it then a component of light will pass through it for each angle. But it the light is polarized the at certain angle no light will pass.

Q.12 ***Fill the blanks.***

i) ***According to _________ principle, each point on a wave front acts as a source of secondary _______.***

ii) ***In Young's experiment, the distance between two adjacent bright fringes for violet light is _______ than that fore green light.***

iii) ***The distance between bright fringes in the interference pattern______ as the wavelength of light used increases.***

iv) ***A diffraction grating is used to make a diffraction pattern for yellow light and then for red light. The distances between the red spots will be_____ than that for yellow light.***

v) ***The phenomenon of polarization of light reveals that light waves are______ waves.***

vi) ***A Polaroid glass_______ glare of light produced at a road surface.***

Ans. i) Huygen's, wavelets
ii) smaller
iii) increases
iv) larger
v) transverse
vi) polarizing material
vii) reduce.

Chapter 10
Geometrical Optics
Short Answers

Q.1 ***What o you understand by linear magnification and angular magnification? Explain how a convex lens is used as a magnifier?***

Ans. **Linear (or Transverse) magnification**:

The ratio of the size of the image to that of the object is called linear magnification.

$$M = I / O = q / p$$

Angular magnification (Magnifying power):

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.

$$M = \beta / \alpha$$

In linear magnification, we take ratio of linear dimensions, but in angular magnification we take ratio of the angles.

Magnifier:

An ordinary convex lens held close to the eye is served as magnifying glass or simple microscope. The image formed is erect, virtual and magnified because in this case the object is placed inside the focus point.

Q.2 ***Explain the difference between angular magnification and resolving power of an optical instrument. What limits the magnification of an optical instrument?***

Ans. Angular magnification (or Magnifying power):

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.

$$M = \beta / \alpha$$

Resolving power:

The ability of an instrument to reveal the minor details of the object under examination is called resolving power.

$\alpha_{min} = 1.22\ \lambda / D$,

where λ = wavelength of light & D = lens diameter

Limits: Due to chromatic and spherical aberrations, the magnification of the optical instruments is limited.

Q.3 ***Why would it be advantageous to use blue light with a compound microscope?***

Ans. The formula for resolving power is given by, $R = D/1.22\ \lambda$

As blue light produce less diffraction due to short wavelength (λ) hence it increases the resolving power and more details of an object can be seen.

Q.4 ***One can buy a cheap microscope for use by the children. The image seen in such a microscope have coloured edges. Why is this so?***

Ans. Due to chromatic aberration, we see coloured edges in cheap microscope. It is due to non-focusing of light of different colours. These colours arise due to dispersion.

Q.5 ***Describe with the help of diagrams, how (a) a single biconvex lens can be used as a magnifying glass. (b) biconvex lenses can be arranged to form a microscope.***

Ans. This is a long question. Pl see the text book.

Q.6 ***If a person were looking through a telescope at the full moon, how would the appearance of the moon be changed by covering half of the objective lens.***

Ans. The intensity of the image becomes half and due this the brightness of the moon will become half. The reason is that the less transmitted light due to half-covered objective. There will be no change of shape and he still will see full image of the moon

Q.7 ***A magnifying glass gives a five times enlarged image at a distance of 25 cm from the lens. Find, by ray diagram, the focal length of the lens.***

Ans. We know that the formula for the magnification is

$M = 1 + d/f$

or $f = d / M – 1 = 25/5-1 = 6.2$ cm

Q.8 ***Identify the correct answer.***

i) The resolving power of a compound microscope depends on;

a) The refractive index of the medium in which the object is placed.
b) The diameter of the objective lens.
c) The angle subtended by the objective lens at the object.
d) The position of an observer's eye with regard to the eye lens.

ii) The resolving power of an astronomical telescope depends on:

a) The focal length of the objective lens.
b) The least distance of distinct vision of the observer.
c) The focal length of the eye lens.

d) The diameter of the objective lens.

Ans. **i**) Correct answer is (b) The diameter of the objective lens.

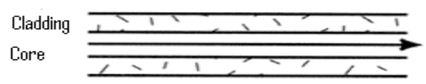
$\alpha_{min} = 1.22\ \lambda / D$,

ii) Correct answer is (d) The diameter of the objective lens.

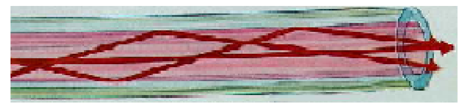
$\alpha_{min} = 1.22\ \lambda / D$,

Q.9 ***Draw sketches showing the different light paths through a single-mode and multi- mode fibre. Why is the single-mode fibre preferred in telecommunications?***

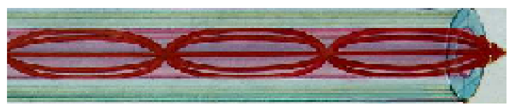
Ans.



Single mode step index fibre



Multimode step index fibre



multimode graded index fibre

Single-mode fibre is preferred in modern telecommunications because they are digital and use monochromatic laser light. Here the transmission is free from dispersion, and can carry 14 TV channels & 1400 phone calls at the same time.

Q.10 ***How the light signal is transmitted through the optical fibre?***

Ans. There are two methods by which the light signal is transmitted through the optical fibre.

i. By total internal reflection of light signals

ii. Continuous refraction of light

A transmitter converts electrical signal into light signal and at the receiving end these are converted back to electrical signals. The most common method of transmission is digital modulation, in which the laser is flashed on and off at extremely fast rate. The communication is represented by code of 1s and 0s. The receiver is programmed to decode 1s and 0s.

Q.11 ***How the power is lost in optical fibre through dispersion? Explain.***

Ans. There are two major sources for the lost of power:

i. **Scattering/Dispersion**: Scattering/dispersion of light signal by groups of atoms which are formed at places such as joints when fibres are joined together.

ii. **Absorption**: When a light signal travels along fibres by multiple reflections, some light is absorbed due to impurities in the glass.

Careful manufacturing can reduce the power loss by scattering/dispersion and absorption.

Chapter 11
Heat and Thermodynamics
Short Answers

Q.1 ***Why is the average velocity of the molecules in a gas zero but the average of the square of velocities is not zero?***

Ans. The molecules of the gas moves in random directions. We assume that the same number of molecules move in both directions, so the average of each component velocity is zero. But the average of the squares of the velocities of the molecules include square of negative velocity and so cannot be zero.

Q.2 ***Why does the pressure of a gas in a car tyre increase when it is driven through some distance?***

Ans. In driving, the car tyre beomes hot due to force of friction between road and tyre. This heat goes inside the tyre and increases translational kinetic energy of the molecules of the gas. Since pressure is directly proportional to the average translational kinetic energy of molecules of the gas, therefore pressure of the gas in a tyre increases.

Q.3 ***A system undergoes from state P_1 V_1 to state P_2 V_2 as shown in the fig. What will be the change in internal energy?***

Ans. The change in internal energy (ΔU) will be zero. In the figure the graph is isotherm. It means temperature remain constant. So $\Delta U = 0$

Q.4 ***Variation of volume by pressure is given in the fig. A gas is taken along the paths ABCDA, ABCA and A to A. What will be the change in internal energy?***

Ans. In the figure, all three paths returns to the initial state, so there is no change in internal energy.

Q.5 ***Specific heat of a gas at constant pressure is greater than specific heat at constant volume. Why?***

Ans. In case of specific heat at constant pressure, a part of heat is used in doing work as gas expands against constant pressure a part of heat is used in raising the temperature of the gas. But in case of specific heat at constant volume all the heat is used in raising the temperature. Since the rise of temperature of the gas in both the cases is same hence C_p is grater than C_v.

Q.6 ***Give an example of a process in which no heat is transferred to or from the system but the temperature of the system changes.***

Ans. In adiabatic expansion of a gas, the work is done by the system and so the temperature decreases but in this process no heat is given or taken from the system.

Q.7 ***Is it possible to convert internal energy into mechanical energy? Explain with example.***

Ans. Yes it is possible. In adiabatic expansion of a gas internal energy is converted into mechanical energy or work according to following equation:

$$W = -\Delta U$$

Q.8 ***Is it possible to construct a heat engine that will not expel heat into the atmosphere?***

Ans. No it is not possible. According to 2^{nd} law of thermodynamics it is not possible to construct a heat engine without a heat sink or cold body to reject a part of heat to it.

Q.9 ***A thermos flask containing milk as a system is shaken rapidly. Does the temperature of milk rise?***

Ans. Yes the temperature of the thermos flask will rise. During the shaking the milk work is being done on the molecules of the milk which increase the K.E of the molecules. Since the Temperature of the molecules of the milk is directly proportional to the average translational K.E. hence temperature of the milk will rise.

Q.10 ***What happens to the temperature of the room, when a air conditioner is left running on a table in the middle of the room?***

Ans. If we ignore the heat produced due the friction between different parts of the air conditioner, the temperature of the room will not change. The reason is that heat absorbs from the room is expelled in the same room. Therefore net temperature of the room will be constant.

Q.11 ***Can the mechanical energy be converted completely into heat energy? If so give an example.***

Ans. Yes mechanical energy can be converted into heat energy. In an adiabatic compression, work done on the gas, increases the internal energy, i.e. converting mechanical energy (work) into heat energy (ΔU). i.e. $\Delta U = - W$

Q.12 ***Does entropy of a system increases or decreases due to friction?***

Ans. The change in the entropy is given by the formula

$$\Delta S = \Delta Q/T$$

Due friction heat is produced which rises the temperature of the system. The entropy of the system increases, due to friction. As work done against friction changes into heat and this irreversible process increases its entropy.

Q.13 ***Give an example of a natural process that involves an increase in entropy.***

Ans. **Melting of ice into water:**

During melting of ice into water the heat Q is transferred to the ice from the surroundings at absolute zero. Since $\Delta S = \Delta Q / T$

Therefore, heat is added to the ice hence Q is +ve and entropy increases.

Q.14 ***An adiabatic change is the one in which***

a. No heat is added to or taken out of a system

b. No change of temperature takes place

c. Boyle's law is applicable

d. Pressure and volume remains constant

Ans. Correct answer is (a) No heat is added to or taken out of a system in the adiabatic change.

Q. **15** ***Which one of the following process is irreversible?***

a. Slow compressions of an elastic spring

b. Slow evaporation of a substance in an isolated vessel

c. Slow compression of a gas d. A chemical explosion

Ans. Correct answer is (d) a chemical explosion is irreversible process.

Q.16 ***An ideal reversible heat engine has***

a. 100 % efficiency

b. Highest efficiency

c. An efficiency, which depends on the nature of working substance

d. None of these.

Ans. Correct answer is (b), an ideal reversible heat engine has highest efficiency. From second law of thermodynamics, a heat engine cannot have 100 % efficiency and is independent of the working substance