Self Study Series

Short Answers to Questions

of the Textbook

PHYSICS XI

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GENERAL PREFACE

This book is one of the volume from a set of FIVE books. It is not a substitute for the text book. Instead it is a helping book to understand the text more clearly.

Our standard of education is deteriorating very fast. The major factors are hand-books, keys, made-easy books, notes, and finally tuition. I know there is a war in progress. This Self Study Series is an attempt to enhance the level of education. It is to be reminded that this set of FIVE Books is simply a guide to help the text book. Without prescribed text book these books are nothing.

It's a new idea in the field of F. Sc. Physics. It is a sincere effort for making prescribed text more important than any other helping books.

Comments, suggestions and criticisms are invited for the sake of education to improve this book.

F. C. College,
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Ross Nazir Ullah

August 15, 2003

INTRODUCTION

This book is prepared especially from examination point of view. Now in the question paper the trend of short answers to the question is being introduced.

The answers are written in such a brief form that intelligent as well as less intelligent student can take help from it. Answers are written short and to the point. These can be elaborated according to student's individual capacity. However, I must confess that few answers are long, as the demand of that certain question.

It is hoped that it will be helpful for F. Sc. Students and teachers. Comments for improvement are invited.

How to use this book

Dear students you should follow the following 7 steps for complete utilization of this book.

1. Read and try to understand the question.
2. Try to find answer in your mind.
3. Try to find key word and single sentence for the answer.
4. Arrange your answer in your mind.
5. Start writing (may be wrong) your answer.
6. Consult this book, 'Short Answers to Questions'.
7. Compare both answers and finally make your own answer.

August 15, 2003. Ross Nazir Ullah

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Chapter 1

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

Ans. 1) Natural periodic movements, e.g. stars at night.
2) Sun's different periodic directions making shadow at different times.
3) Human pulse rate.
4) Revolution of the moon around the earth.

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

Ans. Time period of the pendulum depends upon g. since g varies at different places, so this cannot be a good standard. Secondly, the pendulum should be free from frictional effects, and an ideal pendulum is difficult to construct.

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. Measurement in moles of different substances will give same number of molecules although their weight (in kg) will vary.

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) 0.214m which record is correct and why?***

Ans. 1 mm = 1 / 1000 m = 0.001 m
Answer (iii) 0.214 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 experimental data in a computation, is as good as it has less absolute uncertainty (precision) and less fractional uncertainty (error).

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

Ans. 1) The least count of the timing device may result a zero error as a systematic error.
2) Timing uncertainty due to human reflections in observation as a personal error.

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

Ans. No. We cannot determine numerical value of the constant of proportionality with dimensional analysis. It can be found by experiments.

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

Ans. (i) Dimensions of Pressure = $\frac{\text{dimensions of Force}}{\text{dimensions of area}}$

$$[P] = \frac{[F]}{[A]} = \frac{[m\ a]}{[L^2]} = \frac{[M\ l\ T^{-2}]}{[L^2]} = [M\ L^{-1}\ T^{-2}]$$

(ii) dimensions of density = $\frac{\text{dimensions of mass}}{\text{dimensions of volume}}$

$$[D] = \frac{[M]}{[L^3]} = [M\ L^{-3}]$$

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)

Since $[T^{-1}] \neq [L^2\ T^{-1}]$

So it is dimensionally not correct.

Now dimensions of $f = [T^{-1}]$ ….. (3)

And dimensions of $v / \lambda = [LT^{-1}] / [L] = [T^{-1}]$ ….. (4)

Since $[T^{-1}] = [T^{-1}]$

So it is dimensionally correct.

Chapter 2

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

Ans. **Unit vector:** "A unit vector in a given direction is a vector with magnitude one in that direction".

Position vector: "The position vector **r** is a vector that describes the location of a particle with respect to the origin".

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, to 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. Vector **A** lies in 3rd quadrant, its rectangular components will be negative. When the vector will lie in 2nd or 4th quadrant, its components will have opposite signs.

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, when one of the component of the vector is not zero.

e.g. if $A_x \neq 0$ & $A_y = 0$

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

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.

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

Ans. No. The magnitude of a vector has always positive values;

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

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

Ans. **A** + **B** = 0

The components must equal and opposite.

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

Ans. When $\theta = 45^o$, the components will have equal magnitude for a vector making angle 45^o with X-axis.

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. different physical quantities cannot be added according to the rules of algebra.

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

Ans. No. We cannot add zero to a null vector. Because zero, a scalar quantity cannot be added with a vector quantity—the null vector.

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 the configuration of the figure, we have
(**A** + **B)** is $\perp$ to (**A** + **B)**
i.e. sum and difference of the vectors are perpendicular to each other.

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.

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) 70N is correct.
For maximum value, both vectors in same direction,
$\mathbf{A_1} + \mathbf{A_2} = 60 + 35 = 95 \rightarrow$ cannot be (i) 100N,
For minimum value, both vectors having opposite direction,
$\mathbf{A_1} - \mathbf{A_2} = 60 + 35 = 25 \rightarrow$ cannot be (iii) 20N

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.

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

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

$F \cos\theta - mg \sin\theta$
$F \sin\theta - mg \cos\theta$
$F \cos\theta + mg \cos\theta$
$F \sin\theta + mg \sin\theta$
$mg \tan\theta$

Ans. (i) The correct answer is (B) West. As shown in the figure on the next page.

(ii) The correct answer is
(a) F cos θ - mg sin θ
the resultant force
acting Up and along
the surface of the plane
is = F cos θ - mg sin θ

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

Ans. For $\mathbf{A_1} = -\mathbf{A_1}$ & $\mathbf{A_2} = -\mathbf{A_2}$

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

There will be no effect, if all the components of the vectors $\mathbf{A_1}$ & $\mathbf{A_2}$ are reversed.

Q.18 ***Name the three different conditions that could make $A_1 \times A_2 = 0$.***

Ans. $\mathbf{A_1 \times A_2}$ could be zero, if

i) $\mathbf{A_1}$ is null vector ; $\mathbf{0 \times A_2} = 0$

ii) $\mathbf{A_2}$ is null vector ; $\mathbf{A_1 \times 0} = 0$

iii) $\mathbf{A_1 \times A_2}$ are parallel or anti-parallel, i.e.

$\mathbf{A_1 \times A_2} = \mathbf{A_1 A_2} \sin\theta = \mathbf{A_1 A_2} \sin 180^o = 0$

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.

A body moving with constant velocity can also be in equilibrium.

b) It is true.

The vector sum will be zero, for the coplanar forces forming a closed polygon, 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 T minimum, $\theta = 90^o$

$\Sigma F_y = 0$

$T_y + T_y - w = 0$

$2T_y - w = 0$

$2 T \sin\theta = w$

$T = w / 2 \sin\theta$

For minimum T, $\theta = 90^o$

i.e. $T = w / 2 \sin 90^o = w / 2$

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 center of gravity under the action of its weight. Because moment arm will be zero, so torque or turning effect will be zero.

Chapter 3

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. We define:

Uniform velocity (or constant velocity):

If a body moves over equal distances in equal intervals of time, however small, in a particular direction, it is said to move with uniform velocity.

Variable velocity:

When a body traverses 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/sec (mS^{-1})

Acceleration: m/sec^2 (mS^{-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. Since 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 bodies freely falling back in air. If a body moves upward, finally reverse direction and moves down. The acceleration due to gravity is constant for both directions of 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. Statements (b), (c) & (d) are correct.

Examples of:

(b) circular motion.

(c) total (upward & downward) velocity is zero moving under *g*.

(d) in the air, bodies freely falling back.

Q.5 ***A man standing on the top of a tower throws a ball straight up with initial velocity v_i 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. Upward thrown ball will have larger speed when it strikes the ground. Since it will take more time and move larger downward distance under *g*.

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. e.g.

$$a = \frac{v_f - v_i}{t} = \frac{0}{t} = 0 = \text{constant}$$

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. $F = m\,a = \frac{m\,(v_f - v_i)}{t} = \frac{mv_f - mv_i}{t}$ = time rate of change of momentum

so 2nd law of motion in terms of momentum:
"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 force and time for which it acts on a body".

$$\text{Impulse} = F \times t = m\,a\,t = \frac{m\,(v_f - v_i)}{t} \times t = m\,(v_f - v_i)$$

It shows the 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. 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. when calculating pressure of a gas and applying conservation of linear momentum, neglecting g, 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. We define,
Elastic collision:
"The interaction in which both momentum and kinetic energy conserve".
Inelastic collision:
"The interaction in which kinetic energy does not conserve".
Difference:
In elastic collision law of conservation of momentum and kinetic energy holds but in inelastic collisions these two laws 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 KE change into heat, sound and in their deformation due to frictions.

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 45^o with the horizontal.

Ans. Projectile motion:

"The motion of a body moving under the action of gravity and moving horizontally at the same time".

Time of flight:

We have $S = 0$; $v_i = v_i \sin\theta$; $a = -g$

Using $S = v_i t + \frac{1}{2} a t^2$

$\Rightarrow 0 = v_i \sin\theta\, t - \frac{1}{2} g t^2$

or $t = \frac{2 v_i \sin\theta}{g}$

Range of the projectile:

We have $S = R$, $v_x = v_i \cos\theta$, $t = \frac{2v_i \sin\theta}{g}$

Using $S = v t$

$\Rightarrow R = \frac{v_i \cos\theta \times 2 v_i \sin\theta}{g} = \frac{v_i^2\, 2 \sin\theta \cos\theta}{g}$

or $R = \frac{v \sin 2\theta}{g}$

for maximum range, $\sin 2\theta$ should have maximum value (i.e.) = 1

$\sin 2\theta = 1 \Rightarrow 2\theta = 90^o \Rightarrow \theta = 45^o$

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 its minimum speed at the highest point (maximum height). It has its maximum speed at the start and end of the projectile motion.

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

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. $W = F\ d \cos 0^o = F\ d = m\ a\ d = 10 \times 9.8 \times 10 = 980\ J = 0.98\ KJ$

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.

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. <u>For books:</u>

$W = F\ d \cos\theta = mgh \cos 0^o = mgh = 50 \times 9.8 \times 0.5 =$ <u>245 J (more work)</u>

<u>For crate:</u>

$W = F\ d \cos\theta = Fd\cos 0^o = Fd = 50 \times 2 =$ <u>100 J</u>

More work is done in lifting bag of books.

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

Ans. $PE_g = mgh = (1/9.8) \times 9.8 \times 1 = 1\ (N) \times 1(m) = 1\ N\text{-}m = 1\ J$

$\Rightarrow$ Force of one N is applied to a body to raise through 1 m.

$PE_e = \frac{1}{2}\ kx^2 = \frac{1}{2}\ k\ (\sqrt{2}/k)^2 = 1\ J$

$\Rightarrow$ A spring is copressed or extended through a distance $(\sqrt{2}/k)$, if k, elastic constant = 1 N, then the <u>work of 1 J is conserved</u> by compressing (or extending) of $\sqrt{2}$ m of spring.

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 are correct if they give right reference.

$PE_{wrt\ table} = mgh_1$

$PE_{wrt\ floor} = mg\ (h_1 + h_2)$

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

Ans. Due to air friction, the nose cone of the rocket becomes 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. PE $\rightarrow$ gain in KE $\rightarrow$ sound energy + heat energy

(holding the cup) (dropping the cup) (breaking into 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. $PE_{elastic}$ $\rightarrow$ gain in KE $\rightarrow$ sound + heat energy + W. done in breaking

(stone in catapult) (throwing the stone) (smashing of window)

Chapter 5

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, along the direction of the tangent at any point on that curve which is followed by the moving particle".

Angular velocity (ω):

"The rate of change of angular displacement of a particle moving along a curved path".

Difference:

Both are related as : $\boldsymbol{v} = r\,\omega$

The direction of ω is perpendicular to the plane of motion and the direction of $\boldsymbol{v}$ is along tangent of the curved path.

To find

If one quantity is given with known radius, the other can be found from $\boldsymbol{v} = r\,\omega$

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 move a body around a circular path". Mathematically,

$F = mv^2 / r = mr\,\omega^2$

Its direction is towards the center of the circle.

F_c is furnished for an object moving in a circular path (of constant radius).

For m & r constant, $F \propto \omega^2$,

Its direction needs to be changed at every point, for it, a continuous perpendicular force is required.

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

Ans. Moment of inertial (I):

"Corresponding quantity for mass in rotatory motion".

Mathematically,

$$I = \Sigma\, m\, r^2 ,$$

where m is the mass of an element distant r from the axis.

Significance:

It's a quantitative property of a solid which represent its resistance to rotation about a fixed axis. I plays the same role in angular motion as that of mass in linear motion.

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".

Mathematically,

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

Law of conservation of angular momentum:

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

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

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

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

Q.5 ***Show that orbital angular momentum L_o = mvr.***

Ans. We have

$L = I\,\omega = (\Sigma\, m_i\, r_i^2)\,\omega$

For a body of mass, m

$L = I\,\omega = m(\Sigma\, r_i^2)\,\omega$

For orbital angular momentum having a constant orbit, r

$L_o = mr^2\,(v / r) \quad [\omega = v/r]$

or $L_o = m\,v\,r$

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

Ans. $F_g = \frac{Gm_s M}{r^2} = \frac{m_e v^2}{r} = F_c$ or $v = \sqrt{GM / r}$

or $v = \sqrt{gr^2 / r} = \sqrt{g\,r}$

for minimum velocity of the satellite, $g = 9.8\ m/sec^2$

$v_{min} = \sqrt{g\,r} = \sqrt{9.8 \times 6400} = \underline{7.9\ km/sec}$

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

Ans. <u>Direction of angular momentum (**L**)</u>

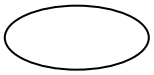
The expression for angular momentum is,

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

Its direction is perpendicular to **r** & **p**, and is determined by right hand rule of cross product.

<u>Direction of angular velocity (ω)</u>

When a particle have circular motion in anti-clockwise direction, its direction of ω will be in upward direction (by applying right hand rule).



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 <u>tangential velocity</u> for orbiting the earth. It is like <u>freely falling due to force of gravity</u>. It will follow curved path due to two forces. <u>The curvature of its path will match the curvature of the earth</u>.

Its centripetal acceleration equals its acceleration due to gravity;

i.e. a = g, so T = mg – mg = 0.

Hence <u>it appears weightless</u>.

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

Ans. The mud will fly in a direction <u>tangent to the wheel</u>. When mud separates from the tyre, centripetal force is ceased from the mud particles.

Q.10 ***A disc and a 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 disc will move faster down the bottom.

$PE = KE_{tran.} + KE_{rot.}$

For disc:

$mgh = ½ mv^2 + ½ I\omega^2 = ½ mv^2 + ½ (1/2\ mr^2)\ v^2 / r^2$

$\Rightarrow \quad v = \sqrt{4gh / 3}$

for loop:

$mgh = ½ mv^2 + ½ I\omega^2 = ½ mv^2 + ½ (mr^2)\ v^2 / r^2$

$\Rightarrow \quad v = \sqrt{gh}$

as $\sqrt{4gh / 3} > \sqrt{gh}$

or $v_{disc} > v_{hoop}$

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

Ans. To increase angular velocity, the diver changes his body positions.

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

For smaller r, ω will be greater.

The diver closed his legs and arms to make smaller r so that his angular velocity increases to make more 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. His rate of rotation will increase, due to smaller r, the distance from the axis of the distribution of mass m.

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

When he pulls the dumbbells towards his chest, his moment of inertia decreases and he spins faster.

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; ($120^o + 120^o + 120^o = 360^o$)

Chapter 6

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".

Explanation:

Different layers of a flowing fluid have frictional effect, as one layer slide over another.

Viscosity measures the force required due to these inter-layer frictional effect.

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, when an object move through a fluid".

Factors:

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

$F = 6\pi\eta\, rv$

$\Rightarrow$ F depends upon

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

v = speed of the sphere through the fluid.

This drag force increases as the speed of the object increases.

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

Ans. Due to drag force. As fog droplet falls, soon its weight becomes equal to the drag force. And net force becomes zero. So it appears to be suspended in air.

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

Ans. Laminar flow:

"Smooth sliding of layers of fluid past each other".

Turbulent flow:

"Disorderly and changing flow pattern of fluids"

Difference:

In laminar flow, every particle that passes a particular point, moves along exactly same path, as followed by particles, which passed that points earlier. But in turbulent flow, the exact path of the particle cannot be predicted due to irregular and unsteady flow.

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

Ans. Bernoulli's equation:

In the steady frictionless motion of a fluid acted on by external forces which posses a gravitational potential ρgh , then

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

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:

from Bernoulli's relation,

$$P_1 + \tfrac{1}{2}\rho v_1^2 + \rho gh_1 = P_2 + \tfrac{1}{2}\rho v_2^2 + \rho gh_2$$

for $v_1 << v_2$ & $P_1 = P_2 = P$ = atmospheric pressure

$$P + \rho gh_1 = P + \tfrac{1}{2}\rho v_2^2 + \rho gh_2$$

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

i.e. "The speed of efflux is equal to the velocity gained by the fluid in falling through the distance $(h_1 - h_2)$ under action of gravity".

b) Venturi Relation:

We have $P_1 + ½ \rho v_1^2 + \rho g h_1 = P_2 + ½ \rho v_2^2 + \rho g h_2$

taking $v_2 >> v_1$ (= 0), for horizontal pipes $h_1 = h_2 = h$

$P_1 + \rho g h = P_2 + ½ \rho v_2^2 + \rho g h$

or $P_1 - P_2 = ½ \rho v_2^2$

the above Venturi relation used to measure speed of liquid flow.

c) Relating speed & pressure:

We have $P_A + ½ \rho v_A^2 + \rho g h_A = P_B + ½ \rho v_B^2 + \rho g h_B$

For horizontal flow, $h_A = h_B = h$

so $P_A + ½ \rho v_A^2 + \rho g h = P_B + ½ \rho v_B^2 + \rho g h$

or $P_A + ½ \rho v_A^2 = P_B + ½ \rho v_B^2$

$\Rightarrow$ where the speed is high, the pressure will be low,

e.g. i) spinning of tennis ball, ii) swing of cricket ball

iii) designing of aeroplane wing.

Other application are:

a) checking human blood pressure

b) functioning 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. He will fall towards the train. As the relative speed of air is high, the pressure will be low. So the greater air pressure behind the person will push him towards low pressure.

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:

Please see, answer 6.5—relating speed and pressure.

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

Ans. Relative speed of water and air between the boats is high, the pressure will be low, so both boats pulled towards each other.

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

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. This gives swing to the ball.

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

Ans. Carburetor:

"An apparatus used to charge air with gas from petrol for producing light or power".

Air is drawn outward through small pipe with a piston. High velocity of air produces low pressure. So petrol-air mixture is drawn inside.

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.

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. Due to lack of force of gravity, (as we use to experience on the earth)
The blood pressure in major arteries in the leg will be equal than in arteries in the neck, due to weightlessness.

Chapter 7

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 independent of amplitude. It depends upon time period T. $f = 1 / T$

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

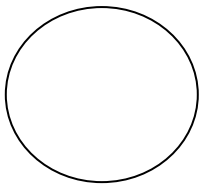
Ans. No. Due to friction and weight of the string. For an ideal simple pendulum, the string should be massless, inextensible and suspended from frictionless support.

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

Ans. T, is time for one complete vibration.

Its maximum displacement, $x_o = r = A$.

so total distance traveled will be 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. We have for simple pendulum,

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

For $l = 2l$

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

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

ii) There will be no change, when suspended mass is doubled. Since time period, T, is independent of mass, m.

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 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. i) Phase angle (or phase):

"The angle $\theta = \omega t$ which specifies the displacement as well as the direction of motion of the point executing SHM".

It indicates the state and direction of motion of a vibrating particle.

ii) 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. Under the phenomenon of parallel superposition of same waves, and beats, two harmonic motions produce a resultant simple harmonic.

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, from the above equations,

$X = 0$ then $a = 0$ & $v = \omega x_o$—maximum value,

i.e. acceleration is zero and velocity is greatest.

& at extreme positions;

$x = x_o$ 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) $y = A \sin(\omega t + \varphi)$ initial phase

Inst. displ. Amplitude angle subtended in time t

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, $x = 0$

$PE = \frac{1}{2} k x^2 = \frac{1}{2} k (0)^2 = 0 \rightarrow$ minimum

$KE = \frac{1}{2} k x_o^2 (1 - x^2/x_o^2) = \frac{1}{2} k x_o^2 \rightarrow$ maximum

At extreme position, $x = x_o$

$PE = \frac{1}{2} k x^2 = \frac{1}{2} k x_o^2 \rightarrow$ maximum

& $KE = \frac{1}{2} k x_o^2 (1 - x^2/x_o^2) = 0 \rightarrow$ minimum

At intermediate position, $x = x$

$E_{total} = PE + KE = \frac{1}{2} k x^2 + \frac{1}{2} k x_o^2 (1 - x^2/x_o^2) = \frac{1}{2} k x_o^2$

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:

1) Tuning radio/TV

We change the frequency with knob. When it becomes equal to a particular transmitted station, resonance occurs. Then we receive amplified audio/video signals.

2) Microwave oven

Microwaves (of frequency 2450 MHz) with $\lambda = 12$ cm, are absorbed due to resonance by water and fat molecules in the food, heating them up and so cooking the food.

3) Children's swing
   In order to raise the swing to a great height, we must give it a push at the right moment and in the right direction.
4) Musical instruments
   In some instruments (e.g. drums) air columns resonate in the wooden box. In string instruments (e.g. sitar) strings resonate with their frequencies and loud music is heard.

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

Ans. Due to friction and air resistance mass-spring oscillating system eventually stops.
When it oscillates, due to frictional forces energy is dissipated into heat and finally it stops.

Chapter 8

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) Transport energy and momentum but not matter.
3) When propagate in a medium they obey,

$$v = f \lambda$$

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 B represents the loudest note.
b) trace B represents the highest frequency.

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 nodal points 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".
It is a region of upward displacement in a transverse wave.

Trough:

"The lower portion of a wave below the mean level".
It is region of downward displacement in a transverse wave.

Node:

"The point of zero displacement".
It is a point of no disturbance in a stationary wave.

Antinode:

"The point of maximum displacement on a stationary wave".
It is a point which oscillate with maximum amplitude in a stationary wave.

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

Ans. In the relation

$$v = \sqrt{E / \rho}$$

E is greater for solids than in gases.
The effect of density, ρ is very less as compared to E. so sound travel faster in solids then in gases.

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

Ans. A new instrument is tuned. The new, and standard musical instruments are sounded together, beats are produced. The frequency of the new instrument is made to change until the resonance occurs.

Q.8 ***When two notes of frequencies f_1 and f_2 are sounded together, beats are formed. If $f_1 > f_2$, what will be the frequency of beats?***

i) $f_1 + f_2$ ii) ½ $(f_1 + f_2)$ iii) $f_1 - f_2$ iv) ½ $(f_1 - f_2)$

Ans. Correct answer is (iii) ($f_1 - f_2$)

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 two paths. One through earth reaches faster than traveling through atmosphere. This accounts for the time difference.

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

Ans. $v \propto \sqrt{T}$; $v = \sqrt{\gamma} P / \rho$

The speed of sound varies directly as the square root of absolute temperature. That's why sound travels faster in warm air than in cold air. As the temperature of air increases, the pressure increases and density decreases. So speed of sound increases.

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

Ans. Relative speed should be zero. From Doppler effect, there is apparent change in the frequency due to relative motion of source and observer.

When both source of sound and observer are in motion, relative speed being zero, the apparent frequency will not change.

Chapter 9

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

Ans. Two or more waves having a constant phase difference (same λ & T) are called coherent sources.
One method of producing two coherent light beams is to use monochromatic source to illuminate a two holes screen. The light emerging from the two slits is coherent because a single source produces two parts.

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 have

$$\text{Fringe spacing} = \Delta y = \lambda L / d$$

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. White light will produce coloured interference fringes.

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. No interference pattern will be observed as blue and red light not being in phase coherence.

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

Ans. Diffraction is a special type of interference. Young's experiment primarily is for studying interference. But diffraction is accompanied. Light is diffracted from two slits. So it is a combination of diffraction and interference.

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

Ans. Due to interference of light waves, colours are seen on the oil film. At a certain place of the film, its thickness and the angle of incidence of light are such that the condition of destructive interference of one colour is being satisfied. Hence that portion of the film will exhibit the remaining constituent colours of the white light.

Q.7 ***Could you obtain Newton's rings with transmitted light? If yeas, 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.

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. $d \sin\theta = n\lambda$; $d \sin\theta = 3\lambda_1$, & $d \sin\theta = 4\lambda_2$

$$\Rightarrow 3\lambda_1 = 4\lambda_2 \qquad \text{or} \qquad \lambda_1/\lambda_2 = 4/3$$

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.

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

Ans. Polaroid sunglasses reduces glare, as they produce plane polarized light.

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 a Polaroid is rotated in front of un-polarized light, a component of light will pass for each angle. But for plane-polarized light, at certain orientation, 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) tranverse
vi) polarizing material, vii) reduce.

Chapter 10

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 (linear dimensions) of the image to those of the object".

$M = I / O = q / p$

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"; $M = \beta / \alpha$

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.

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 (α_{min}):

"The ability of an instrument to reveal the minor details of the object under examination";

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

where λ = wavelength of light & D = lens diameter

Angular magnification means how large a magnification is the image formed. And resolving power reveal the minor details of the object.

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

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.

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 become half and there will be no change of shape. Less transmitted light due to half-covered objective, still he 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. [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 (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 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. By total internal reflection on continuous refraction light signals is transmitted through the optical fibre. 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. Power is lost due to scattering and absorption of light signals during travel through the optical fibre.

The information received can be faulty and distorted due to dispersion, i.e. spreading of light signals into component wavelengths. Due to impurities in the glass and multiple reflections along the fibre is occurred.

Chapter 11

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 direction. 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 gets hot due to force of friction. This heat goes inside the tyre and increases translational kinetic energy. So increase of $KE_{trans.}$ makes pressure increase.

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. Specific heat at constant pressure (C_p) is greater than C_v , because a part of heat is used in doing work as gas expands against constant pressure.

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.

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

Ans. Yes. In adiabatic expansion of a gas internal energy converts into mechanical energy or work.

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

Ans. No. It is not possible. Because according to 2nd law of thermodynamics it is not possible to construct an engine without a sink or cold body to reject a part of heat to it, the atmosphere (or cold body).

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

Ans. Yes. As KE of the molecules increases due to rapid shaking, so the temperature of the milk rises.

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. The temperature of the room will not reduce, because heat absorbs from the room is expelled in the same room. Rather the temperature will rise due to work done by the compressor will change into heat.

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

Ans. Yes. When brakes of a speeding car applied, due to frictional force, all its mechanical energy (kinetic energy) is converted into heat.

ii) In a adiabatic compression, work done on the gas, increased the internal energy, i.e. converting mechanical energy (work) into heat energy (ΔU).

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

Ans. 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. i) Melting of ice into water:

The heat Q transferred to the ice at absolute temperature from the surroundings. $\Delta S = Q / T$

Since heat is added, Q is +ve and entropy increases.

ii) Free expansion:

In a free expansion of a gas in a chamber, which is irreversible process. Here the gas molecules confined to one half of a box are permitted to fill the entire box, which is irreversible process.

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 the knowledge of 2nd law of TD, a heat engine cannot have 100 % efficiency and is independent of the working substance.