Time: 2 hours. **Total Marks: 80**

General Instructions:

1. *Answers to this paper must be written on the paper provided separately.*
2. *You will **not** be allowed to write during the first **15** minutes.*
   This time is to be spent in reading the question paper.
3. *The time given at the head of the paper is the time allotted for writing the answers.*
4. ***Section A** is compulsory. Attempt **any four** questions from **Section B**.*
5. *The intended marks of questions or parts of questions are given in brackets [ ].*

SECTION A (40 Marks)

Attempt *all* Questions from this Section.

Question 1

(i) Which of the following measures small length to highest accuracy

a) metre scale
b) vernier callipers
c) screw gauge
d) none of the above

(ii) Which of the following is the third equation of motion?

a) $v^2 = u^2 + 2at$
b) $v^2 = u^2 + 2st$
c) $v^2 - u^2 = 2as$
d) $S = ut+at^2$

(iii) The property of bodies to resist a change in their state of rest or of motion is known as:

a) Force
b) Acceleration
c) Velocity
d) Inertia

(iv) State the forecast when barometric pressure rises steeply

a) The forecast is rainstorm
b) The forecast is dust storm
c) The forecast is dry weather with strong anticyclonic winds.
d) The forecast is fair weather

(v) **Assertion:** The zero error of a vernier calliper is always positive.
Reason: The zero error arises when the two jaws of the calliper are in contact but the zero mark of the vernier scale is not aligned with the main scale zero mark.

a) Both A and R are true and R is the correct explanation of A
b) Both A and R are true and R is not the correct explanation of A
c) Assertion is false but reason is true.
d) Assertion is true reason is false.

(vi) What is the unit of relative density?

a) g cm^{-3}
b) kg m^{-3}
c) m^3kg^{-1}
d) no unit

(vii) The same body is immersed in two liquids A and B in succession. The extent to which the body sinks in liquid B is less than in liquid A. What are the conclusions that could be derived from such an observation?

a) Density of liquid B is more than liquid A
b) Density of liquid A is more than liquid B
c) No such conclusion can be made
d) Density of the solid is less than the liquid in both

(viii) Aneroid barometer which directly indicates the altitude instead of atmospheric pressure is called

a) Altimeter
b) Fortinmeter
c) Lactometer
d) Micrometer

(ix) A body of weight W experiences an upthrust R in water. What will be the apparent weight of the body and apparent density of the body when W = R?

a) Apparent weight = W-R; Apparent density = $(\rho - 1)$ gcm^{-3}
b) Apparent weight=Zero; Apparent density = Zero
c) Apparent weight = R-W; Apparent density = $(1 - \rho)$ gcm^{-3}
d) Apparent weight = W-R; Apparent density = $(1000 - \rho)$ kg m^{-3}

(x) What is the basis of grouping organisms into producers, consumers and decomposers?

a) Manner in which they obtain sustenance from the environment.
b) Physiological Characters
c) Geographical distribution
d) Energy efficiency

(xi) Which trophic level has the greatest number of individuals?

a) 1st trophic level
b) 2nd trophic level
c) 3rd trophic level
d) 4th trophic level

(xii) In a lateral inversion

a) The left side of the object becomes the right side of the image and vice-versa.
b) The right side of the object remains the right side of the image.
c) The left side of the object remains the left side of the image.
d) None of the above

(xiii) Which among the following is true for a plane mirror?

a) Angle of incidence is always equal to angle of reflection.
b) Angle of incidence is not always equal to angle of reflection.
c) Angle of incidence is the angle between the reflected ray and the incident ray.
d) Angle of incidence is the angle between incident ray and the mirror surface.
incident ray.

(xiv) For which of the following ultrasound can be used?

a) Detect defective foetus
b) As a tool in the treatment of muscular pain
c) Clean spiral tubes
d) All of the above

(xv) The correct relation is:

a) 1J = 1C/1V
b) 1J = 1 V/1C
c) 1J=1C x 1V
d) 1J x 1C x 1V=1

Question 2

(i) Complete the following by choosing the correct answers from the bracket: [6]

a) The SI unit of luminous intensity is _____ *[luminous/ candela/Joules].*
b) To reflect sound waves from any surface, it should have dimensions _____ *[equal or less/ equal or greater/Always greater]* than the wavelength of the sound wave.
c) The sound which is produced due to a mixture of several frequencies is called _____ *[Noise/ Tone/Note].*
d) Between a football and stone of same size but different masses, stone being heavier the inertia of _____ *[Football is greater / Stone is greater/ Both the objects is equal.]*
e) Black or dull surfaces are _____ *[poor/good]* reflectors, but _____ *[poor/good]* absorbers of heat.

(ii) The walls of a barber shop are covered with a plane mirror and two movie films are made - one recording the movements of the barber and the other of his mirror image. From viewing the films later, can an observer differentiate between the object and the image? [2]

(iii) A ray of light is incident on a plane mirror at an angle of incidence of 50°. What is the angle (a) of reflection (b) between the incident ray and the mirror (c) between the reflected ray and the mirror (d) of deviation (angle between the directions of the incident ray and the reflected ray)? [2]

Question 3

(i) Calculate the number of seconds in a year. Take 1 year = 365 days. [2]

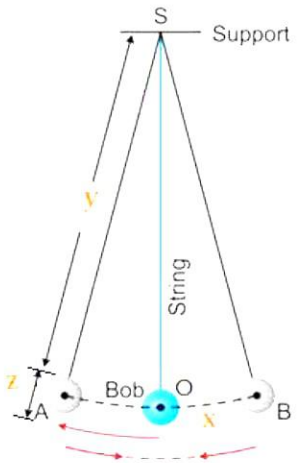
(ii) Calculate the frequency of oscillation of Second's pendulum. Does it depend upon amplitude of oscillation? [2]

(iii) Under what condition, the balance is in equilibrium? [2]

(iv) Ratio of the velocities of two bodies thrown in upward direction is 2:5. Prove that the ratio of their height attained will be $h_1:h_2 = 4:25$. [2]

(v) Name two greenhouse gases. Will these gases increase or decrease the average temperature of the earth? [2]

(vi)



Above diagram represents a simple pendulum. A simple pendulum is a heavy point mass suspended from a rigid support by a massless and inextensible string. Answer the following questions: [3]

a) What is the length of given simple pendulum?

b) What is the value of amplitude of this simple pendulum?

c) What are the factors affecting the time period of simple pendulum?

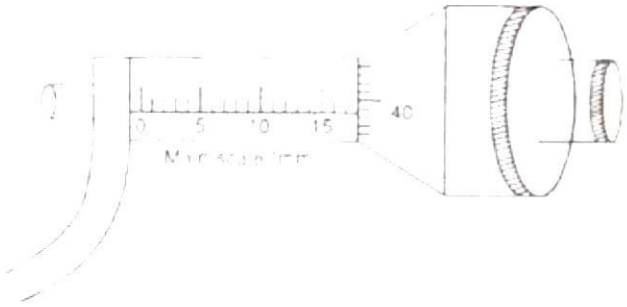
(vii) In riveting boiler plates, red hot rivets are used. Why? [2]

SECTION B (40 Marks)

Attempt *any four* Questions from this Section

Question 4

(i) Given diagram shows a screw gauge. In one measurement, the final position of the scale is as shown in the diagram. The circular scale has 50 divisions. [3]



(a) What is the least count of the screw gauge?

(b) If 40th division of the circular scale coincides with the main scale line, what is the final reading?

(c) What do you mean by back-lash error of a screw gauge?

(ii) In a physical balance, [3]

(a) State the principle on which it works.

(b) What is measured by physical balance?

(c) What is the role of a plumb line?

(d) What is the role of base screws?

(e) State two requirements for a good balance.

(iii) A weather forecasting plastic balloon of volume 15 m^3 contains hydrogen of density 0.09 kg/m^3. The volume of equipment carried by the balloon is negligible compared to its own volume. The mass of the empty balloon alone is 7.15 kg. The balloon is floating in the air of density 1.3 kg/m^3. Calculate: [4]

(a) Mass of hydrogen in the balloon.

(b) Mass of hydrogen and balloon.

(c) If mass of equipment is x kg, write down the total mass of hydrogen, the balloon and the equipment.

(d) Mass of air displaced by balloon.

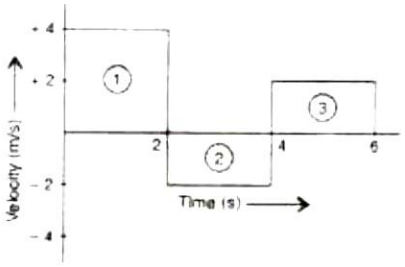
Question 5

(i) An electron moving with the speed of 5×10^4 m/s enters into an electric field and attains a uniform acceleration of 10^{15} m/s^2 in the direction of motion. In how much time, will it attain a speed twice of its initial speed? In this time, how much distance will it cover? [3]

(ii) [4]

(a) Explain with the help of an example whether the velocity or the acceleration of a body give the direction of motion.

(b) In the given figure, velocity-time graph of a body moving in a straight line is shown. Find the displacement and the distance travelled by the body in 6 s.



(iii) A body is projected vertically upwards with a velocity of 98 m/s. Find (i) the maximum height attained by the body and (ii) time taken by body to reach the highest point. (Take g = 9.8 m/s^2) [3]

Question 6

(i) [4]

(a) State Newton's third law of motion.

(b) John pushes a wall with a force of 20 N towards the east, what force will be exerted by the wall on John?

(c) In the following figure, a block of weight 10 N is hanging from a rigid support by a thread. Find:

1. The force exerted by block on the thread.
2. The force exerted by the thread on the block.

(ii) Mention three disadvantages of construction of large dams for generating hydroelectric power. [3]

(iii) A 3 kg stone is weighed first with a physical balance and then by a spring balance at the pole and at the equator. Where will the weight be maximum? [3]

Question 7

(i) Explain the effect of ozone depletion. [3]

(ii) [4]

(a) What is the use of thermos flask?

(b) Draw a labeled diagram of thermos flask.

(c) What contribution does the vacuum between the two walls give to the functioning of a thermos flask?

(d) What is the function of the two shining walls of the glass vessel in the thermos flask?

(iii) Draw a simple diagram showing the energy flow in the food chain. [3]

Question 8

(i) [4]

(a) Select the luminous objects from the following: Candle flame, stars, moon, red hot wire of heater, polished surface, and firefly.

(b) In a room, the light is not reaching directly, even then it is illuminated. Why?

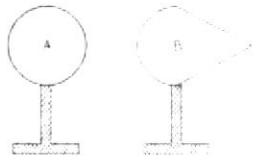
(c) What will be the colour of the sky for space travellers?

(ii) In what way, a point source should be placed in front of a concave mirror to get the parallel beam and the divergent beam. [3]

(iii) Compare the frequencies of two waves X and Y while velocity and wavelength of X are 5×10^3 m/s and 25 m respectively and for Y, 4×10^3 m/s and 20 m respectively. [3]

Question 9

(i) A and B are two negatively charged and insulated conductors as shown in the figure. State, with reason, which conductor will tend to lose charge. [3]



(ii) Draw a labelled diagram of Leclanche cell. Why is it not suitable for continuous use? [3]

(iii) [4]

(a) What is the general law of attraction and repulsion between magnetic poles?

(b) What defines the direction of the magnetic field?

(c) The middle region of a bar magnet is:

1. A north pole
2. A north seeking pole
3. Unmagnetized
4. Magnetized

(d) Name two magnetic substances.

Solution

SECTION A

Solution 1

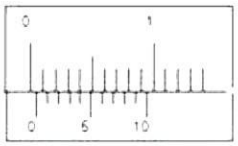
(i) Correct option - c) screw gauge
Screw gauge measures small length to high accuracy.

(ii) Correct option - c) $v^2 - u^2 = 2as$
$v^2 = u^2 + 2as$
$v^2 - u^2 = 2as$

(iii) Correct option - d) Inertia
Inertia is a property of a body due to which it resists a change in its state of rest or of motion.

(iv) Correct option - c) The forecast is dry weather with strong anticyclonic winds.
When barometric pressure rises steeply the forecast is dry weather with strong anticyclonic winds

(v) Correct option – c) Assertion is false but reason is true.
In Vernier calliper zero error occurs when the vernier scale's zero mark is not aligned with the main scale zero mark, causing a positive or negative error depending on the vernier scale's position.
For example, the below figures (a) and (b) are examples of positive and negative zero error.

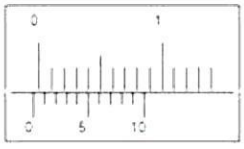


Vernier scale zero is left of main scale zero

Correct measurement with
positive error = 3.34 - 0.04 = 3.30

positive zero error = 0.04

fig (a)



Vernier scale zero is right of main scale zero

Correct measurement with
negative error = 3.34 - (-0.04) = 3.38

negative error = - 0.04

fig (b)

Hence, assertion is false, but reason is true, since zero error can be both positive and negative for a vernier caliper.

(vi) Correct option - d) no unit

Relative density being a ratio of similar quantities, has no units.

(vii) Correct option - a) Density of liquid B is more than liquid A

The density of liquid B is more than liquid A as more upthrust is exerted on the body in liquid B and hence it sinks less.

(viii) Correct option - a) Altimeter

Aneroid barometer which directly indicates the altitude instead of atmospheric pressure is called an altimeter.

(ix) Correct option - b) Apparent weight=Zero; Apparent density = Zero

When W = R, the apparent weight will be zero and apparent density is zero

(x) Correct option - a) Manner in which they obtain sustenance from the environment.

All organisms have different modes of nutrition i.e., they derive their food from different sources in different ways. They are classified into producers, consumers and decomposers.

(xi) Correct option - a) 1st trophic level

1st trophic level is composed of a large number of individuals i.e., producers that are capable of producing their own food by trapping the energy of the sun.

(xii) Correct option - a) The left side of the object becomes the right side of the image and vice-versa.

In a lateral inversion, the left side of the object becomes the right side of the image formed by the plane mirror and vice-versa

(xiii) Correct option -a) Angle of incidence is always equal to angle of reflection.

According to the law of reflection, the angle of incidence is always equal to the angle of reflection. Also, an angle of incidence is the angle between the incident ray and the normal to the reflecting surface.

(xiv) Correct option - d) All of the above

Ultrasound is used in all the given options.

(xv) Correct option - c) 1J=1C x 1V

The correct relation is 1 J = 1C x 1V

Solution 2

(i)

a) The SI unit of luminous intensity is **candela.**

b) To reflect sound waves from any surface, it should have dimensions **equal or greater** than the wavelength of sound wave so that the waves can reflect properly.

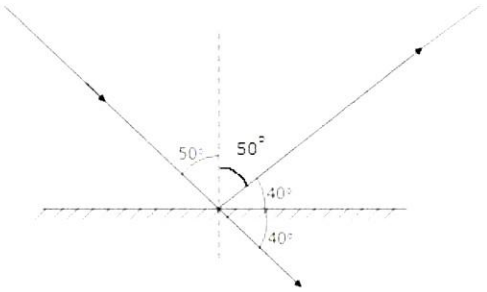
c) The sound which is produced due to a mixture of several frequencies is called **note**.

d) Between a football and stone of same size but different masses, stone being heavier the inertia of **stone is greater**.

e) Black or dull surfaces are **poor** reflectors but **good** absorbers of heat.

(ii) The observer can differentiate between the two films only if he knows that the barber is left-handed or right-handed because in a plane mirror, the image is of the same size but laterally inverted. Without this knowledge about the barber, the observer cannot differentiate between the object and the image.

(iii)



a) Angle of reflection = Angle of incidence = 50^o

b) Angle between the incident ray and the mirror = 90^o - Angle of incidence
$= 90^o - 50^o = 40^o$

c) Angle between the reflected ray and the mirror = 90^o - Angle of reflection
$= 90^o - 50^o = 40^o$

d) Angle of deviation = 2 (90^o – Angle of incidence)
$=2 \times (90^o - 50^o) = 2 \times 40^o = 80^o$

Solution 3

(i) 1 hour = 60 min = 60 ×60 s = 3600 s
1 day = 24 hours = 24 × 3600 s
1 year = 365 days = 365 × 3600 × 24 s = 31536000 s

(ii) A second's pendulum takes 2 seconds to complete one oscillation.
So, time period, T = 2 sec
Frequency, $f = \frac{1}{T}$

$= \frac{1}{2} = 0.5$ Hz

Frequency does not depend upon the amplitude of oscillation.

(iii) The balance is in equilibrium when the moment due to the weight of an object on one side of the beam is equal to the moment due to the standard weights on the other side of the beam.

(iv) $\frac{u_1}{u_2} = \frac{2}{5}$

$v^2 - u^2 = 2ah$

$v_1 = v_2 = 0$

$a_1 = a_2 = -g = -9.8\,m/s^2$

$\Rightarrow \frac{u_1^2}{u_2^2} = \frac{a_1 h_1}{a_2 h_2}$

$\frac{4}{25} = \frac{h_1}{h_2}$

$\therefore$ Ratio of heights attain is 4 : 25.

(v) Carbon dioxide and methane are two greenhouse gases. They increase the temperature of the earth by not allowing the heat to radiate back into space.

(vi)

(a) Length of pendulum is (y+z). y is length of string and z is the diameter of bob.
(b) The amplitude of simple pendulum is x.
(c) Two factors on which the time period of a simple pendulum depends are:
    (i) length of pendulum
    (ii) acceleration due to gravity

(vii) Red hot rivets are pushed into the holes in the plates and hammered tightly. When these rivets cool down, they contract and hold the plates tightly.

SECTION B

Solution 4

(i)

(a) The least count of the screw gauge $= \dfrac{\text{Pitch}}{\text{Total number of divisions on circular scale}}$

$$= \frac{1\,\text{mm}}{50} = 0.02\,\text{mm} = 0.002\ \text{cm}$$

(b) Final reading of measurement = MSR + CSR = 17 mm + 40 × 0.02 mm
= 17 mm + 0.80 = 17.8 mm.

(c) Back-lash error is the error due to the wear and tear of the threads of the screw. Owing to which, on reversing the direction of rotation of the thimble, the tip of the screw does not move in the opposite direction immediately but remains stationary for a part of the rotation.

(ii)

(a) It works on the principle of moments i.e., in equilibrium, the clockwise moment due to standard masses is equal to the anti-clockwise moment due to unknown mass.

(b) Physical balance (or beam balance) is used to measure the mass of a body by comparing it with a known standard mass.

(c) When the plumb line is set just above the pointer projection, the base board becomes horizontal.

(d) The role of base screws is to make the base board horizontal.

(e) Two requirements for a good balance are:

1. Both arms must be of equal length.
2. Both pans must be of equal weight.

(iii)

(a) Mass of hydrogen in the balloon = Volume × Density of H_2

$= 15\ m^3 \times 0.09\ kg/m^3 = 1.35\ kg$

(b) Mass of hydrogen and balloon = (1.35 + 7.15) kg

$= 8.50\ kg$

(c) Mass of equipment, hydrogen and the balloon = (x + 8.5) k

(d) Volume of air displaced = $15\ cm^3$

∴ Mass of air displaced = Volume × Density of air displaced

$= 15\ m^3 \times 1.3\ kg/m^3 = 19.5\ kg$

Solution 5

(i) Given

$u = 5 \times 10^4\ m/s$

$a = 10^{15}\ m/s^2$

$v = 2u = 2 \times 5 \times 10^4\ m/s = 10^5\ m/s$

t =? s =?

Applying v = u + at

$$t = \frac{v - u}{a} = \frac{2u - u}{a} = \frac{u}{a} = \frac{5 \times 10^4\ m/s}{10^{15}\ m/s^2} = 5 \times 10^{-11}\ s$$

Applying, $s = ut + \frac{1}{2}at^2$

$= (5 \times 10^4\ m/s) \times (5 \times 10^{-11}\ s) + ½ \times 10^{15}\ m/s^2 \times (5 \times 10^{-11}\ s)^2$

$= 25 \times 10^{-7}\ m + 12.5 \times 10^{-7}\ m$

$= 37.5 \times 10^{-7}\ m = 3.75 \times 10^{-6}\ m$

(ii)

(a) Velocity provides the direction of motion of the body, e.g., during upward motion of a body, both the direction of motion and the velocity are in the upward direction but acceleration due to gravity is in the downward direction.

(b) Displacement of the body in 6 s = Sum of areas of portions 1, 2 and 3 of figure with proper signs

$= 4 \times 2 - 2 \times 2 + 2 \times 2 = 8\ m$

Distance travelled by the body in 6 s = Sum of areas of portions 1, 2 and 3 of figure, ignoring signs

$= 4 \times 2 + 2 \times 2 + 2 \times 2 = 16\ m$

(iii)

(a) Given, $u = 98\ m/s$, $a = g = -9.8\ m/s^2$,

$v = 0$, s = ?, t = ?

Applying $v^2 = u^2 + 2as$

$0 = (98\ m/s)^2 + 2\ (-9.8\ m/s^2) \times s$

$s = \frac{98 \times 98}{2 \times 9.8} = 490\ m$

(b) Applying $V = u + at$

$t = \frac{v - u}{a} = \frac{0 - 98}{-98} = 10\ s$

Solution 6

(i)

(a) Newton's third law of motion: To every action, there is always an equal and opposite reaction.

(b) Wall exerts a force of 20 N towards West.

(c)

1. Force exerted by block on the thread will be 10 N in the downward direction.
2. 10 N of force will be exerted by a thread on the block in the upward direction.

(ii) Disadvantages of construction of large dams for generating hydroelectric power:

(a) uprooting people from their native place

(b) disruption of plant and animal life

(c) disruption of ecosystem.

(iii) A physical balance measures the mass of the body. When a physical balance is used, it measures the same mass at the pole and at the equator, because mass is a constant. Spring balance is used to measure the weight of the body. The weight of the body will be maximum at the pole because the value of acceleration due to gravity 'g' is maximum at the pole.

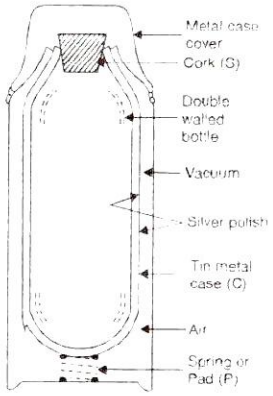
Solution 7

(i) The ozone layer serves as a protective shield of the troposphere and saves the earth's surface from most of the ultraviolet solar radiations by absorbing them. Due to ozone depletion, the increased ultraviolet solar radiations would raise the temperature of the earth which would cause global warming at the regional and global levels. Excess of incoming ultraviolet radiations will cause skin cancer and diseases of the eye.

(ii)

(a) It is used for keeping the hot liquid hot and the cold liquid cold, for a sufficiently long time.

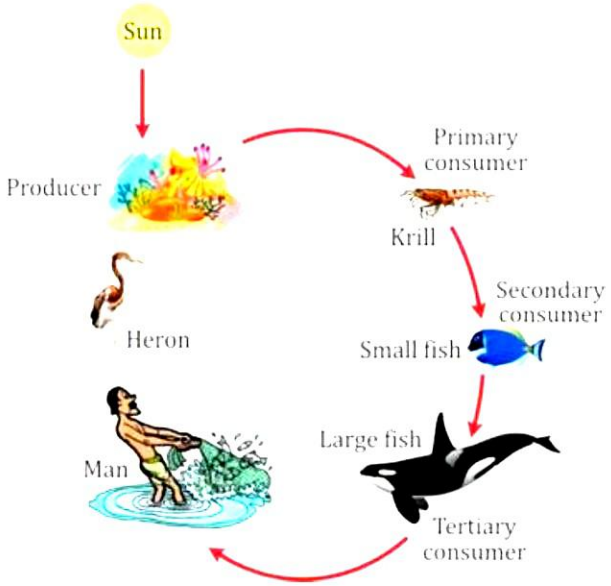
(b)



Thermos flask.

(c) The vacuum between the two walls checks the heat transfer by conduction.
The outer shining surface of the inner wall prevents transfer of inner heat by radiation and the inner shining surface of outer wall reflects the heat received from the inside.

(iii)



Solution 8

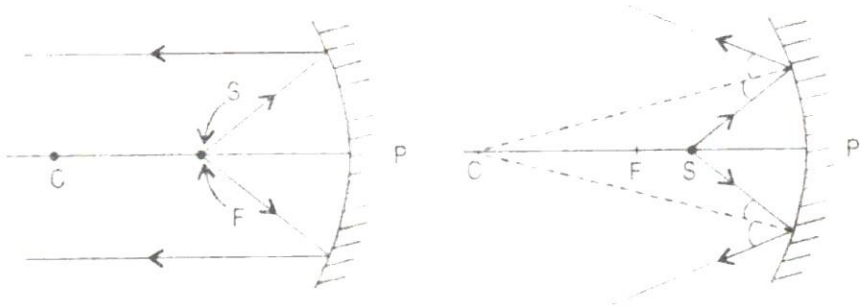
(i)

(a) Candle flame, stars, red hot wire of heater, firefly.

(b) The room is illuminated due to diffused reflection.

(c) Black

(ii)



(iii) $\lambda_X = 25\text{m},\ V_X = 5\times10^3\ \text{m/s}$

$\lambda_y = 20\text{m},\ V_y = 4\times10^3\ \text{m/s}$

$\nu_X : \nu_y = ?$

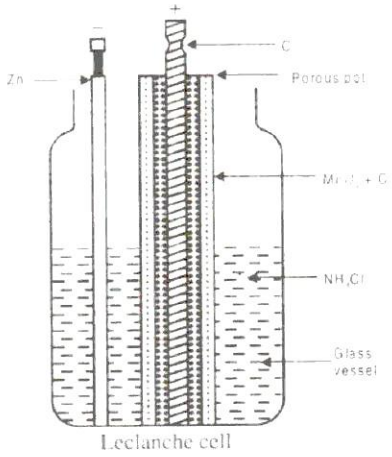
$$\frac{\nu_X}{\nu_y} = \frac{V_X\lambda_y}{V_y\lambda_X} = \frac{5\times10^3\times20}{4\times10^3\times25} = \frac{1}{1}$$

$\nu_X : \nu_y = 1$

Solution 9

(i) Conductor B will lose charge. The reason is that there is greater concentration of electrons (since B is negatively charged) at its pointed ends.

(ii)



Leclanche cell

It is not suitable for continuous use as MnO_2 being solid is a slow depolarizer. It does not oxidize hydrogen gas to water as fast as it is formed in the reaction. Therefore, if it is used for a long period, polarization starts after sometime due to deposition of excess of hydrogen on the anode which could not be converted into water. This is why, it is allowed to rest after using for some time so that MnO_2 oxidizes the excess hydrogen to water

(iii)

(a) Like poles repel and unlike poles attract each other.

(b) The direction of the magnetic field at any point is the direction of force experienced by a north pole (hypothetical) placed at that point.

(c) The middle region of a bar magnet is unmagnetized.

(d) Iron, Steel, Nickel, Cobalt.