Scholars Den Mock Test: Sure Success Recipe
ICSE Class 10 Physics
Solutions

Question 1

(a) According to the principle of moments, if the algebraic sum of moments about the axis of rotation of all the forces acting on the body is zero, then the body is said to be in equilibrium. A beam balance is the device which works on the principle of moments.

(b) A long arm of a jack screw which is used to lift a heavy load like a vehicle will help to apply less effort which is required to rotate it to raise or lower the jack. Hence the jack screw has a long arm.

(c) The power spent by a source depends on two factors

(i) The amount of work done by a source and

(ii) The time taken by the source to do the said work.

For example:

If a coolie A takes 1 minute to lift a load to the roof of a bus and a coolie B takes 2 minutes to lift a load to the roof of a same bus. The work done by both the coolies remain same, but the power spent by the coolie A is twice the power spent by the coolie B because coolie A does the work faster than B.

(d)

Energy	Power
Energy of a body is its capacity to do work.	Power of a source is the rate at which energy is supplied by it
Energy spent does not depend on time	Power depends on the time in which energy is spent
S.I unit of energy is joule (J)	S.I unit of power is watt (W)

(e) Two forces not acting along the same line, which are equal and opposite parallel forces,form a couple. A couple is always required to produce the rotation.

Examples: turning a key in the hole of a lock and turning the steering wheel of a car.

Question 2

(a) **(i)** A machine is a device by which we can either overcome a large resistive force (or load) at some point by applying a small force (or effort) at a convenient point and in a desired direction or by which we can obtain a gain in speed.

(ii) A machine whose parts are weightless and frictionless so that which there is no dissipation of energy in any manner is an ideal machine. The work output is equal to work input i.e its efficiency is 100%.

(b) The term efficiency of a machine is defined as the ratio of the work done on load by the machine to the work done on machine by the effort or efficiency is the ratio of the work output to the work input.

There is always some loss of energy due to friction and weight of moving parts in practical machines. So, the output energy is less than the input energy.

(c) The speed of sound depends on the elasticity and density of the medium through which it is travelling. Sound travels faster in liquids when compared to gases and faster in solids when compared to liquids. Thus greater the elasticity and lower the density, sound travels faster in a medium.

(d) The return of a sound wave on striking a surface such as wall, metal sheet, plywood etc. back in the same medium is called reflection of sound wave. The only condition for reflection of sound wave is that the size of the reflecting surface must be bigger than the wavelength of the sound wave. Megaphone (or speaking tube) is the device in which reflection of sound wave is used.

(e) The applications of echo are:

(i) Dolphins use the technique of echolocation to locate their ways as they cannot see from their eyes. From the reflected sound they can understanding if there is any object before it. Thus by using this technique it hunt its prey.

(ii) In medical field, doctors use this technique in cardiography, sonogram and many other medical diagnosis.

Question 3

(a)

Heat capacity	Specific heat capacity
Heat capacity is the amount of heat energy required to raise the temperature of entire body by 1^oC	Specific heat capacity is the amount of heat energy required to raise the temperature of unit mass of the body by 1^oC
It depends both on the substance and mass of the body. More the mass of the body, more is its heat capacity	Power depends on the time in which energy is spent
S.I. unit is $J\ K^{-1}$	S.I. unit is $J\ kg^{-1}\ K^{-1}$

(b) The three factors on which the heat energy absorbed by a body depends are

(i) The mass of the body: The amount of heat energy required is directly proportional to the mass of the object.

(ii) The increase in temperature of the body: The amount of heat energy required is directly proportional to the rise in temperature.

(iii) The material of the body: The amount of heat energy required depends on the substance of the object which is expressed in terms of its specific heat capacity c.

(c) By allowing water to flow in pipes around the heated parts of a machine, heat energy from such parts is removed. Water in pipes can extract more heat from the surroundings without much rise in its temperature because of its high specific heat capacity. For this reason water is used as an effective coolant.

(d) Radioactivity is a nuclear phenomenon. It is the process of spontaneous emission of α or β and γ radiations from the nucleus of atoms during their decay. Uranium and radium are the two radioactive substances.

(e) The speed of α radiations is of the order of 10^7 m s^{-1}, speed of β radiations is of the order of 10^8 m s^{-1} and the speed of γ radiations is same as the speed of light i.e., 3×10^8 m s^{-1} in vacuum or air.

Question 4

(a) Change in direction of path of light in other medium or the refraction of light occurs because light travels with different speeds in different media. When a ray of light passes from one medium to another medium, its direction or path (except $\angle i = 0^o$ changes because of the change in speed of light

(b) The Snell's laws of refraction of light are:

(i) The incident ray, the refracted ray and the normal at the point of incidence, all lie in the same plane.

(ii) The ratio of the sine of the angle of incidence i to the sine of the angle of refraction r is constant for the pair of given media.

$$\text{Sin } i / \sin r = \text{constant } {}_1\mu_2$$

where constant ${}_1\mu_2$ is called the refractive index of the second medium with respect to the first medium.

(c) The factors on which the refractive index of a medium depends are as follows

(i) Nature of the medium (e.g. $\mu_g = 1.5$, $\mu_w = 1.33$) : Less the speed of light in the medium as compared to that in air, more is the refractive index of the medium

(ii) Physical condition such as temperature: With increase in temperature, the speed of light in medium increases, so the refractive index of medium decreases.

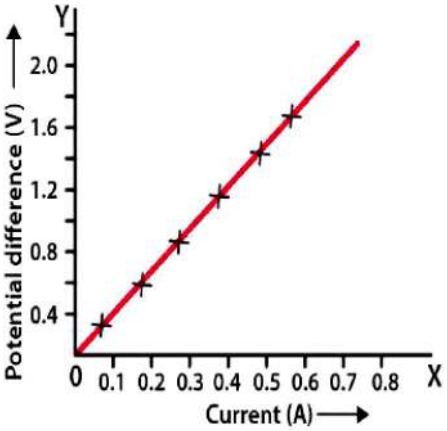
(d) Speed, intensity and wavelength are the quantities in which refracted ray will differ from that of incident ray.

(e) Dispersion of light is the phenomenon of splitting of a beam of white light into its seven constituent colours when passed through a transparent medium.

Question 5

(a) The conductors which obey the Ohm's law are known as the ohmic resistors or linear resistances.

Examples: All metallic conductors such as silver, aluminium, copper, iron etc.



Resistance is determined in the form of slope from the above graph

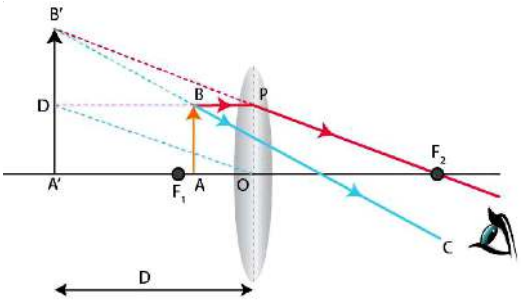
(b) Alloy of lead and tin is used for making a fuse wire because it has high resistivity and low melting point.

(c) With the increase in temperature of a conductor, the random motion of electrons increases. This makes the number of collisions of electrons with the positive ions to increase. Hence, the resistance of a conductor increases with an increase in its temperature.

The resistance of filament of a bulb is more when it is glowing that is when it is at a high temperature as compared to when it is not glowing that is when it is cold.

Question 6

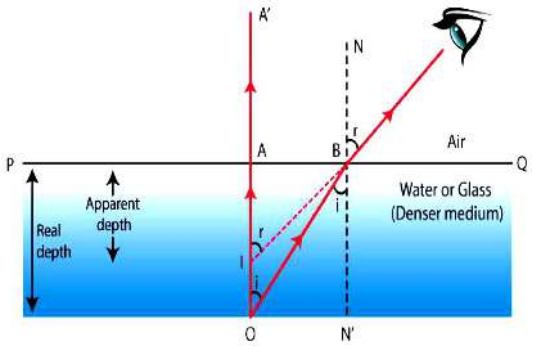
(a) The image (A'B') of the object (AB) will form on the same side of lens when the object (AB) is situated between focal length and optical centre of a convex lens.



The image formed will be virtual, magnified and erect.

(b) Given, Object distance, u = –30 cm
Focal length, f = –30 cm
Image distance, v = ?
Len's formula is
1 / f = 1 / v – 1 / u
1 / –30 = 1 / v – 1 / –30
1 / v = –1 / 30 – 1 / 30
1 / v = –2 / 30
1 / v = – 1 / 15
v = –15
The relation between u and v is
m = v / u
m = –15 / –30
m = 0.5
∴ The image formed is virtual and erect.

(c)



Consider a ray of light OA is incident on the surface PQ normally. It passes straight along AA'. Consider another ray from O, incident at angle i along OB. This ray gets refracted and passes along BC. The ray BC appears to be coming from point I which is the virtual image of O, obtained on producing A'A and BC backwards. Hence, AI represents the apparent depth, which is less than the real depth.

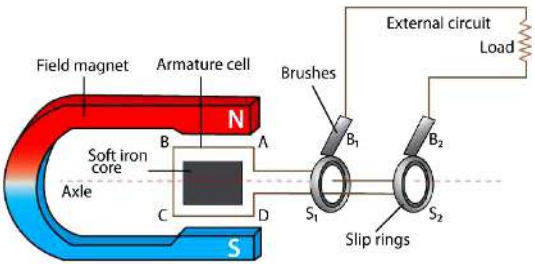
Since, AO and BN' are parallel and OB is transversal line, so
$\angle AOB = \angle OBN^1 = i$
Similarly, IA' and BN are parallel and IC is the transversal line, so
$\angle BIA' = \angle CBN = r$
In right angle triangle BAO,
sin i = BA / OB and
In right angle triangle IAB,
sin r = BA / IB
For refraction from medium to air, by Snell's law
${}_m\mu_a$ = sin i/sin r = (BA/OB)/(BA/IB) = IB/OB
Hence, refractive index of medium with respect to air is,
${}_a\mu_m = 1 / {}_m\mu_a$ = OB / IB
The object is viewed from a point vertically above the object O, since point B is very close to the point A.
∴ IB = OA
Hence ${}_a\mu_m$ = OA / IA = Real depth / Apparent depth

Question 7

(a) The factors on which the magnitude of force on a current carrying conductor placed in a magnetic field depends directly are as follows:
(i) On strength of magnetic field B
(ii) On current I in the conductor
(iii) On length l of conductor

(b) Faraday formulated the following two laws of electromagnetic induction:
(i) Whenever there is a change in magnetic flux linked with a coil, an e.m.f. is induced. The e.m.f. induced lasts so long there is a change in the magnetic flux linked with the coil.
(ii) The magnitude of e.m.f. induced is directly proportional to the rate of change of magnetic flux linked with the coil. If magnetic flux changes at a constant rate, a steady e.m.f. is produced.

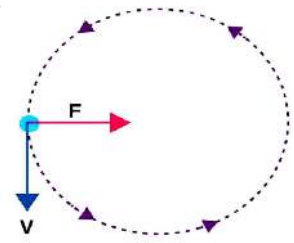
(c)



An A.C. generator works on the principle of Faraday's law of electromagnetic induction.
Principle: In a generator, if a coil is rotated in a magnetic field, then due to rotation, the magnetic flux linked with the coil changes and therefore an e.m.f. is induced between the ends of the coil. Thus a generator acts as a source of current in an external circuit containing load when connected between the ends of its coil.
Use: A.C. generator is used to supply power or electricity to a device that requires alternating current.

Question 8

(a) When the object with uniform speed moves in a circular path, it means that its magnitude of velocity does not change, it only changes its direction continuously. Therefore it is considered as uniformly accelerated motion.



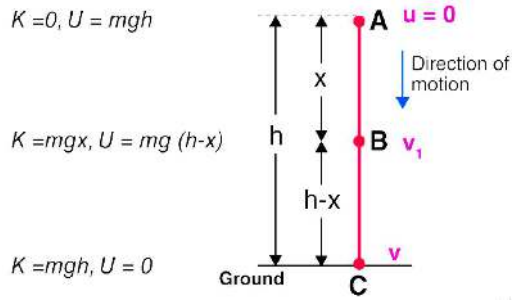
(b) Given
OA = 2m and OB = 4m
(i) Moment of force F_1 = 5N about the point O at A

$= F_1 \times OA$
$= 5 \times 2$
$= 10Nm$ (anticlockwise)

(ii) Moment of force $F_2 = 3N$ about the point O at B
$= F_2 \times OB$
$= 3 \times 4$
$= 12$ Nm (clockwise)

(iii) Total moment of forces about the midpoint O
$= 12 - 10$
$= 2Nm$ (clockwise)

(c) Let a body of mass m be falling freely under gravity from a height h above the ground (i.e from position A). Now calculate sum of kinetic energy K and potential energy U at various positions, say at A (at height h above the ground), at B (when it has fallen through a distance x) and at C (on the ground).



(i) At the position A (at height h above the ground):
Initial velocity of body = 0 (since body is at rest at A)
Therefore Kinetic energy K = 0
Potential energy U = mgh
Hence total energy = K + U
= 0 + mgh
= mgh (1)

(ii) At the position B (when it has fallen a distance x):
Let v_1 be the velocity acquired by the body at B after falling through a distance x.
Then u = 0, s = x, a = g
From equation $v^2 = u^2 + 2aS$
$V_1^2 = 0 + 2gx$
$= 2gx$
$\therefore$ Kinetic energy $K = 1 / 2\ mv_1^2$
$= 1 / 2\ m\ (2gx)$
$= mgx$
Now at B, height of body above the ground = h – x
$\therefore$ Potential energy U = mg (h – x)
Hence, total energy = K + U
= mgx + mg (h – x)
= mgh (2)

(iii) At position C (on the ground):
Let the velocity acquired by the body on reaching the ground be v. Then u = 0, s = h, a = g
From equation: $v^2 = u^2 + 2aS$
$v^2 = 0^2 + 2gh$
$v^2 = 2gh$
or Kinetic energy $K = 1 / 2\ mv^2$
$= 1 / 2\ m\ (2gh)$
$= mgh$
And potential energy U = 0 (at the ground when h= 0)
So, total energy = K + U
= mgh + 0
= mgh (3)

Thus from equation (1), (2) and (3) we note that the total mechanical energy i.e the sum of kinetic energy and potential energy always remain constant at each point of motion and it is equal to the initial potential energy at height h.

Question 9

(a) Given
Mass of water m = 5.0 g
Specific heat capacity of water c =4.2 J $g^{-1}K^{-1}$
Specific latent heat of fusion of ice L=336 J g^{-1}
Amount of heat energy released when 5.0 g of water at 20°C changes into water at 0°C =
$5 \times 4.2 \times 20$
= 420 J
Amount of heat energy released when 5.0 g of water at 0°C changes into ice at 0°C = 5×336 J
= 1680 J
Total amount of heat released = 1680 J + 420 J
= 2100 J

(b) When two nuclei approach each other, due to their positive charge, the electrostatic force of repulsion becomes too strong between them that they donot fuse. Hence, at ordinary temperature and pressure nuclear fusion is not possible.
To make the fusion possible, a high temperature of approximately 10^7 K and high pressure is required. Due to thermal agitations both nuclei acquire sufficient kinetic energy at such a high temperature so as to overcome the force of repulsion between them when they approach each other and so they get fused.

(c) The following are the changes which occur when an atom emits
(i) When alpha particle emits, the atomic number decreases by 2 units and mass number decreases by 4 units
Example:

$$^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He$$

(ii) When beta particle emits, the atomic number increases by 1 and the mass number remains unchanged
Example:

$$^{1}_{0}n \longrightarrow {}^{1}_{1}P + {}^{0}_{-1}e$$

(iii) When gamma particle emits, the atomic number and mass number does not change.
Hence, the energy of the nucleus decreases
Example:

$$^{A}_{Z}X^{*} \longrightarrow {}^{A}_{Z}X + \gamma$$