Physics

CURRENT ELECTRICITY

★ **Electric Charge** → It is the physical property of matter that cause it to experience a force when placed in an electric field. Electric charge is represented by q.
S.I unit of charge is coulomb.

1 micro Coulomb (μC) = 10^{-6} C
1 mili Coulomb (mC) = 10^{-3} C

Electric charge $\boxed{q = ne}$

q = charge on electron
n = No. of electron
$e = -1.6 \times 10^{-19}$ Coulomb (negative)

(Ex) $q = 6.25 \times 10^{18} e^-$

★ **Electric Current** → The rate of flow of charge is known as electric current. It is represented by i.

$$\boxed{i = \frac{q}{t}}$$

$q = it$

SI unit of Current is Ampere.

Point
(i) Current is measured by Ammeter connected in series.
(ii) Always flow opposite to electron (scalar quantity).

★ **Electric Potential (Voltage)** → ~~The ratio of work done to carry a charge from infinity to a point to that charge is known as Electric potential.~~ or ⊛
It is represented by V.

$$\boxed{V = \frac{W}{q}}$$

SI unit of electric potential is Volt

⊛ The amount of work done in bringing a unit positive charge from Infinity to that point is known as Electric potential.

Note
Electric potential is measured by Voltmeter connected in Parallel.
" " is a scalar quantity.

★ **Oh'm law** → If there is no change in temprature and pressure of any body, then voltage applied is directly proportional to current flow.

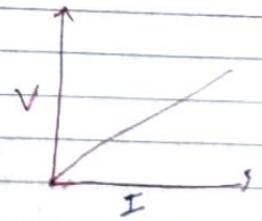
$V \propto i$
or
$$\boxed{V = iR}$$
↓
Ohm's law Expression

R = Resistance of Conductor

Limitations of Ohm's law →

1. It is applicable only for conductor.
2. There should be no change in Temprature and pressure.

★ **Graphical Representation of Ohm's law**



Resistance → It is the property of any substance which oppose the current flow. SI unit of Resistance is Ohm (Ω).

Conductors
- Silver ⇒ $1.6 \times 10^{-8}\ \Omega m$
- Copper ⇒ $1.62 \times 10^{-8}\ \Omega m$
- Aluminium ⇒ $2.6 \times 10^{-8}\ \Omega m$

Insulator ⇒ $10^{12} - 10^{14}\ \Omega m$

Factors at which Resistance depend →

Resistance depend on the following factors-

(i) It is directly proportinal to the length Conductor

$$R \propto l$$

(ii) It is inversely proportinal to the area of cross section

$$R \propto \frac{1}{A}$$

(iii) It is directly proportinal to the temprature of material.

(iv) It depends on the nature of material.

on combine (i) and (ii)

$$R \propto \frac{l}{A} \quad \text{so,} \quad \boxed{R = \rho\left(\frac{l}{A}\right)}$$

Where ρ is a constant known as specific Resistance or conductivity of substance. Its SI unit is Ohm-meter.

$$\rho_{conductor} < \rho_{alloy} < \rho_{semiconductor} < \rho_{Insulator}$$

Combination of Resistances → Combination of Resistance can be classified in two ways.

Series Combination Parallel Combination

Series Combination → In this Combination

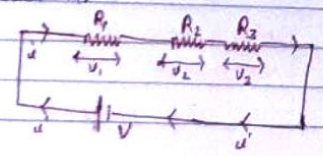
(a) One end of a Resistance is connected to one end of another

(A) If different resistance are joined connected with each other in such a way that there is only one path for flow of current then this combination of such resistances is called Series Combination.

Resistance and its other end is connected to next Resistance

(b) In this combination current will same on each R.

(c) Voltage will differ on each R.



for I^{st} Resistance $V_1 = iR_1$

" IInd " $V_2 = iR_2$

" IIIrd " $V_3 = iR_3$

Total Voltage $V = V_1 + V_2 + V_3$

$iR = iR_1 + iR_2 + iR_3$

so, $iR = i(R_1 + R_2 + R_3)$

$$\boxed{R = R_1 + R_2 + R_3}$$

Where R is Equivalent Resistance

Note

(i) In Series Combination Equivalent Resistance is maximum.

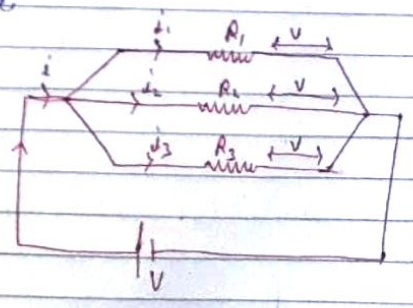
(ii) Decorating Light bulb connected in series.

Parallel Combination → In this Combination the components used in the circuit are present in parallel combination.

(a) Both ends of Resistances are connected.

(b) Current is differ on each R.

(c) Voltage become same on each R.



for Ist Resistance $i_1 = V/R_1$

" IInd " $i_2 = V/R_2$

" IIIrd " $i_3 = V/R_3$

Total Current $i = i_1 + i_2 + i_3$

$V/R = V/R_1 + V/R_2 + V/R_3$

$V/R = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$

$$\boxed{\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

Note - (i) In Parallel Combination Equivalent Resistance is minimum.
(ii) Domestic Circuit is always connected in parallel.

★ **Electric power** → The rate of Electric Energy of any appliance is known as its Electric power.

It is represented by P.

Power $\boxed{P = \frac{W}{t}}$

$\because \quad V = \frac{W}{q}$ or $W = Vq \quad (\because q = it)$

$W = Vit$

So,

$P = \frac{Vit}{t}$

$\boxed{P = Vi}$

$\because \quad V = iR$

So,

$P = iR \times i$

$\boxed{P = i^2R}$

$\because \quad i = \frac{V}{R}$

So,

$\boxed{P = \frac{V^2}{R}}$

$P = \frac{W}{t}$

$W = Pt$

★ **Electric Energy (E) or Heat (H)** → E or $H = P \times t$ (work)

So,

$E = Vit$
$E = i^2Rt$
$E = \frac{V^2}{R}t$

In Joule

$1\,KWh = 1\,KW \times 1\,hour$

$1\,KWh = 1000\,W \times 3600\,sec$

$1\,KWh = 3600000\,W\,sec$

$1\,KWh = 3.6 \times 10^6$ Joule

★ **Commercial unit of Electric Energy** →

Commercial unit is kilowatt hour (KWh) generally known as units.

$$\text{no. of units} = \frac{\text{Watt} \times \text{hours} \times \text{days}}{1000}$$

and

$$1\,KWh = 3.6 \times 10^6 \text{ Joule}$$

★ **Kirchhoff's law** → It gives two law

Ist → According to this law the algebric sum of all the current meeting at a point in a junction is always zero.

OR

The algebric sum of all the current meeting at a point means the sum of all the current meeting (coming) is equal to the sum of outgoing current.

$$\boxed{i_1 + i_2 = i_3 + i_4 + i_5}$$

IInd → According to this law In any close phase the sum of the product of all the Resistance to corresponding current is Equal to total EMF (Electromotive force) or Voltage of Phase

$$\boxed{\Sigma iR = \Sigma E}$$

Q→1 Calculate the number of electrons constituting one Coulomb of charge?

Ans→ Given,

Electric charge $(q) = 1C$

$e = 1.6 \times 10^{-19} C$

We know that,

$q = ne$

$n = \frac{q}{e}$

$n = \frac{1}{1.6 \times 10^{-19}} = \frac{10^{19}}{1.6} = \frac{10^{19} \times 10}{16} = \frac{100 \times 10^{18}}{16}$

$= 6.25 \times 10^{18}$ electrons

Q→2 How much work is done to carry 2 Coulomb charge to voltage 6 volt?

Ans→ Given,

Electric charge $(q) = 2C$

voltage $(v) = 6$ volt

work done $(w) = ?$

We know that

$$v = \frac{w}{q}$$

$w = vq$

$= 6 \times 2 = 12J$

Q→3 When a 12 volt battery is connected to resistance R, there is a current of 2.5 mA in the circuit. Find R

Ans→ Given,

Voltage $= 12 V$

Current $(i) = 2.5 mA = 2.5 \times 10^{-3} A$

Resistance $(R) = ?$

We know that, According to ohm's law,

$V = iR$

$$R = \frac{V}{i}$$

$R = \frac{12}{2.5 \times 10^{-3}} = \frac{12 \times 10^{2} \times 10^{3}}{25} = \frac{24 \times 200}{5} = 4800 \Omega$

Resistance $(R) = 4800 \Omega$ Ans

Q→4 Calculate the current, if 96000 Coulomb charge flow in 20 min through a conductor?

Given,

Electric charge $(q) = 96000 C$

Time $(t) = 20$ min $= 20 \times 60 = 1200$ sec

Current $(i) = ?$

We know that,

$i = \frac{q}{t}$

$= \frac{96000}{20 \times 60} = \frac{4800}{60} = 80 A$

Current $(i) = 80 A$

Q→5 Calculate the number of electrons in a conductor in which 0.5 A current passed for 2 second.

Given,

Current (i) = 0.5 A

Time (t) = 2s = $\frac{2}{3600}$ hr.

we know that,

$q = it$

$= 0.5 \times 2$

$= 1\ C$

$n = \frac{q}{e}$

$= \frac{1}{1.6\times10^{-19}} = \frac{10^{19}}{1.6} = \frac{100\times10^{18}}{16} = 6.25\times10^{18}$ electron

Q→6 Calculate the Potential through 50 Ω Resistor having current 2 Ampere.

Given,

Resistance (R) = 50 Ω

Current (i) = 2 A

Potential (v) = ?

we know that,

$V = i\times R$

$= 2\times50 = 100V$

Q→7 If the voltage across a wire is 100 volt it given current 5A. If voltage become 200 volt. Find amount of current?

Ans In first condition, $(V = iR)$, $R = \frac{V}{i}$

$R = \frac{100}{5} = 20\ \Omega$

If voltage become 200 volt, Resistance will be same

$R = \frac{V}{i}$

$20 = \frac{200}{i}$

$i = 10$ $i = 10\ A$

Q→8 Calculate the Energy transferred through 96000 Coulomb charge in 1 hour having voltage 50 volt.

Given,

Electric charge (q) = 96000C

Potential difference (V) = 50 V

Time (T) = 1 h = 3600 s

we know that,

$q = it$

$i = \frac{q}{t}$

$= \frac{96000}{3600} = \frac{80}{3}\ A$

Energy (E) = Vit

$= 50\times\frac{80}{3}\times3600$

$= 4800000$ Joule

$= 4.8\times10^6\ J$

Sheet-2

Q→1 The length of a conductor is 2m, Area of cross section is 4 cm² if its Resistivity is $2\times10^3\ \Omega m$. Find its new resistance.

Solⁿ $l = 2m$, $A = 4\ cm^2 = \frac{4}{(100)^2} = \frac{4}{10^4} m^2 = 4\times10^{-4}\ m^2$

$\rho = 2\times10^3\ \Omega m$.

we know that,

$R = \rho\left(\frac{l}{A}\right)$

$= 2\times10^3\left(\frac{2}{4\times10^{-4}}\right) = \frac{10^3}{10^{-4}} = 10^7\ \Omega$

=

Q→2 The Resistance of a wire is 10 Ω. Calculate its new Resistance if (i) length become double
(ii) length become double by stretching
(iii) length become half by folding.

Sol.

$$R = \rho\left(\frac{l}{A}\right)$$

$$10 = \rho\left(\frac{l}{A}\right) \quad -(i)$$

(i) $R_1 = \rho\left(\frac{2l}{A}\right)$

$= 2 \times \rho\left(\frac{l}{A}\right) = 2 \times 10 = 20\ \Omega$

(ii) $R_2 = \rho\left(\frac{2l}{A/2}\right)$

$= \rho\left(\frac{2 \times 2l}{A}\right)$

$= 4 \times \rho\left(\frac{l}{A}\right)$

$= 4 \times 10 = 40\ \Omega$

(iii) $R_3 = \rho\left(\frac{l/2}{2A}\right)$

$= \rho\left(\frac{l}{2 \times 2A}\right)$

$= \frac{1}{4}\rho\left(\frac{l}{A}\right)$

$= \frac{1}{4} \times 10 = 2.5\ \Omega$

Q→3 The Resistance of a wire is 10 Ω. Calculate its new Resistance if (i) Diameter become double.
(ii) Diameter gets half.

Sol.

$$R = \rho\left(\frac{l}{A}\right)$$

$$10 = \rho\left(\frac{l}{A}\right) \quad \text{— (1)}$$

(i) $A_1 \Rightarrow d_1 = 2d$

$A_1 = (2)^2 A = 4A$ (Area become square of double as the diameter) as diameter

$R_1 = \rho\left(\frac{l}{A_1}\right)$

$= \rho\left(\frac{l}{4A}\right)$

$= \frac{1}{4} \times 10 = 2.5\ \Omega$

(ii) $d_2 = \frac{d}{2}$

$A_2 = \left(\frac{1}{2}\right)^2 A = \frac{1}{4}A$

$R_2 = \rho\left(\frac{l}{A_2}\right)$

$= \rho\left(\frac{l}{A/4}\right)$

$= \rho\left(4\frac{l}{A}\right)$

$= 4 \times 10 = 40\ \Omega$

Q→4 The Resistance of a wire is 20 Ω. Calculate its new Resistance.
(i) if its length become 3 times (60 Ω)
(ii) if its length become 2 times by stretching. (100 Ω)
(iii) its ~~length~~ become double up by folding. (5 Ω)
(iv) its diameter become half. (80 Ω)
(v) its diameter become double. (5 Ω)
(vi) its length become half and area of cross section become 4 times. (2.5 Ω)

Sol$_n$ 4:

$$R = \rho\left(\frac{l}{A}\right)$$
$$20 = \rho\left(\frac{l}{A}\right)$$

(i) $l_1 = 3l$

$$R_1 = \rho\left(\frac{3l}{A}\right)$$
$$= 3 \times 20 = 60\ \Omega$$

(ii) $l_2 = 2l$, $A_2 = \frac{A}{3}$

$$R_2 = \rho\left(\frac{2l}{\frac{A}{3}}\right)$$
$$= 9 \times \rho\left(\frac{l}{A}\right) = 9 \times 20 = 180\ \Omega$$

(iii) $l_3 = \frac{l}{3}$, $A_3 = 2A$

$$R_3 = \rho\left(\frac{\frac{l}{3}}{2A}\right)$$
$$= \frac{1}{6} \times 20 = 5\ \Omega$$

(iv) $l_4 = \frac{l}{2}$, $A_4 = \left(\frac{1}{2}\right)^2 A = \frac{A}{4}$

$$R_4 = \rho\left(\frac{l}{\frac{A}{4}}\right)$$
$$= 4 \times 20 = 80\ \Omega$$

(v) $l_5 = 2l$, $A_5 = (2)^2 A = 4A$

$$R_5 = \rho\left(\frac{l}{4A}\right)$$
$$= \frac{1}{4} \times 20 = 5\ \Omega$$

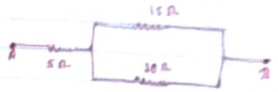
(vi) $l_6 = \frac{l}{5}$, $A_6 = 4A$

$$R_6 = \rho\left(\frac{\frac{l}{5}}{4A}\right)$$
$$= \frac{1}{5} \times 20 = 2.5\ \Omega$$

Sol$_n$ - 3

★ In Given Combination of Resistances, find Equivalent Resistance b/w A and B.

(i)



Given,
$R_1 = 5\ \Omega$ $R_2 = 20\ \Omega$
$R_3 = 15\ \Omega$

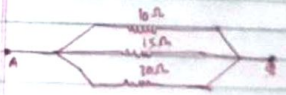
We know that R_2 and R_3 are in parallel to each other so, Resistance R_4 which is Equivalent Resistance of R_2 and R_3 i.e.

$$\frac{1}{R_4} = \frac{1}{R_2} + \frac{1}{R_3}$$
$$\frac{1}{R_4} = \frac{1}{15} + \frac{1}{20}$$
$$\frac{1}{R_4} = \frac{2+1}{20} = \frac{3}{20}$$
$$\frac{1}{R_4} = \frac{1}{10}$$
$$\boxed{R_4 = 10}$$

Now, R_1 and R_4 are in series to each other then Equivalent Resistance R i.e.

$$R = R_1 + R_4$$
$$= 5 + 10 = 15\ \Omega$$
$$\boxed{R = 15\ \Omega}$$

(ii)

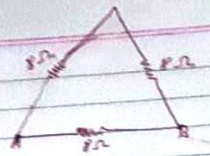


Given,
$R_1 = 10\ \Omega$
$R_2 = 15\ \Omega$
$R_3 = 20\ \Omega$

Equivalent Resistance R is

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$
$$\frac{1}{R} = \frac{1}{10} + \frac{1}{15} + \frac{1}{20}$$
$$\frac{1}{R} = \frac{3+2+1}{30}$$
$$\frac{1}{R} = \frac{6}{30}$$
$$\boxed{R = 5}$$

(iii)



let from point A $R_1 = 8\Omega$
$R_2 = 8\Omega$, $R_3 = 8\Omega$
So, R_1 and R_2 are in series, then

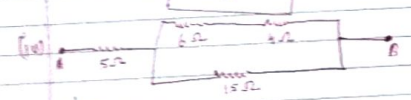
Eq. Resistance $R_4 = R_1 + R_2$
$= 8+8 = 16\Omega$

Now, R_3 and R_4 are in parallel to each other then, Equivalent Resistance R is,

$$\frac{1}{R} = \frac{1}{R_3} + \frac{1}{R_4}$$
$$= \frac{1}{8} + \frac{1}{16} = \frac{2+1}{16} = \frac{3}{16}$$

$$\boxed{R = \frac{16}{3}\Omega}$$

(iv)



Given,
$R_1 = 5\Omega$
$R_2 = 6\Omega$
$R_3 = 4\Omega$
$R_4 = 15\Omega$

Now, R_2 and R_3 are in series,
$R_5 = R_2 + R_3$
$R_5 = 6+4 = 10\Omega$
Now, R_5 and R_4 are in parallel

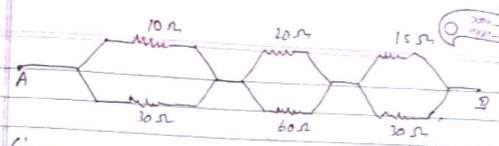
$$\frac{1}{R_6} = \frac{1}{R_4} + \frac{1}{R_5}$$
$$= \frac{1}{15} + \frac{1}{10}$$
$$= \frac{3+2}{30} = \frac{5}{30} = \frac{1}{6}$$

$R_6 = 3$

Now, R_1 and R_6 are in series combination, then Equivalent Resistance R is

$$R = R_1 + R_6$$
$$= 5+6 = 11\Omega$$

(v)



Given,
$R_1 = 10\Omega$ $R_3 = 20\Omega$ $R_5 = 15\Omega$
$R_2 = 30\Omega$ $R_4 = 60\Omega$ $R_6 = 30\Omega$

R_1 is parallel to R_2 then $\frac{1}{R_7} = \frac{1}{R_1} + \frac{1}{R_2}$
R_3 is parallel to R_4 then $\frac{1}{R_8} = \frac{1}{R_3} + \frac{1}{R_4}$
R_5 is parallel to R_6 then $\frac{1}{R_9} = \frac{1}{R_5} + \frac{1}{R_6}$

$$\frac{1}{R_7} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$\frac{1}{R_7} = \frac{1}{10} + \frac{1}{30}$$
$$\frac{1}{R_7} = \frac{3+1}{30} = \frac{4}{30}$$
$$\boxed{R_7 = \frac{30}{4}}$$

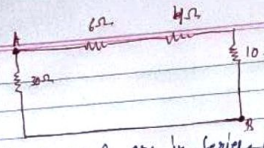
$$\frac{1}{R_8} = \frac{1}{R_3} + \frac{1}{R_4}$$
$$= \frac{1}{20} + \frac{1}{60}$$
$$= \frac{3+1}{60}$$
$$= \frac{4}{60} = \frac{1}{15}$$
$$\boxed{R_8 = 15}$$

$$\frac{1}{R_9} = \frac{1}{R_5} + \frac{1}{R_6}$$
$$= \frac{1}{15} + \frac{1}{30}$$
$$= \frac{2+1}{30} = \frac{1}{30}$$
$$= \frac{1}{10}$$
$$\boxed{R_9 = 10}$$

Now, R_7, R_8 and R_9 are in series combination then Equivalent R is

$$R = R_7 + R_8 + R_9$$
$$= \frac{30}{4} + 15 + 10$$
$$= \frac{30}{4} + 25 = \frac{30+100}{4} = \frac{130}{4}$$
$$\boxed{R = 32.5\Omega}$$

(vii)



$R_1 = 6\Omega$, $R_2 = 4\Omega$
$R_3 = 10\Omega$
$R_4 = 30\Omega$

R_1, R_2 and R_3 are in series then,

$R_s = R_1 + R_2 + R_3$
$= 6 + 4 + 10 = 20$

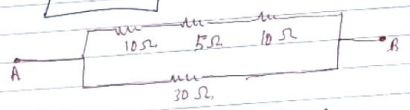
$R_s = 20$

Now = R_4 and R_s are in parallel to each other,

$$\frac{1}{R} = \frac{1}{R_4} + \frac{1}{R_s}$$
$$= \frac{1}{30} + \frac{1}{20}$$
$$= \frac{20+30}{600} = \frac{50}{600} = \frac{1}{12}$$

$\boxed{R = 12\Omega}$

(vii)



$R_1 = 10\Omega$
$R_2 = 5\Omega$
$R_3 = 10\Omega$
$R_4 = 30\Omega$

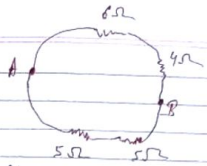
$R_s = R_1 + R_2 + R_3$
$= 10 + 5 + 10 = 25$

Equi Resistance $= R$,

$$\frac{1}{R} = \frac{1}{R_4} + \frac{1}{R_s}$$
$$= \frac{1}{30} + \frac{1}{25}$$
$$= \frac{25+30}{750} = \frac{55}{750} = \frac{11}{150}$$

$\boxed{R = \frac{150}{11}}$

(viii)



Given,

$R_1 = 6\Omega$ $R_3 = 5\Omega$
$R_2 = 4\Omega$ $R_4 = 5\Omega$

$R_5 = R_1 + R_2 = 6 + 4 = 10\Omega$
$R_6 = R_3 + R_4 = 5 + 5 = 10\Omega$

Equivalent Resistance R =

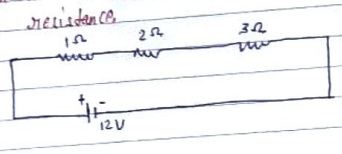
$$\frac{1}{R} = \frac{1}{R_5} + \frac{1}{R_6}$$
$$= \frac{1}{10} + \frac{1}{10}$$
$$= \frac{1+1}{10} = \frac{2}{10} = \frac{1}{5}$$

$\boxed{R = 5\Omega}$

Sheet-4 Current Voltage based Numericals

Q-> 1 Three resistance 1Ω, 2Ω and 3Ω are combined in series with a battery of 12 volt. Obtain potential drop across each resistance.

Ans



Given, $R_1 = 1\Omega$
$R_2 = 2\Omega$
$R_3 = 3\Omega$
Potential difference (V) = 12 V

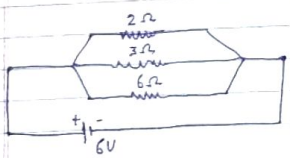
∵ R_1, R_2 and R_3 are in series combination. we know that,
Equivelent Resistance (R) = $R_1 + R_2 + R_3$
$= 1+2+3 = 6\Omega$

Acc. to ohm's law,
$V = iR$
$i = V/R$
$= 12/6 = 2A$

Now,
Potential difference on 1Ω (V_1) = $iR_1 = 2\times1 = 2V$
" " " 2Ω (V_2) = $iR_2 = 2\times2 = 4V$
" " " 3Ω (V_3) = $iR_3 = 2\times3 = 6V$ Ans

Q-> 2 Three Resistance 2Ω, 3Ω and 6Ω are connected in Parallel by a battery of 6 volt. Calculate (i) Equivalent Resistance
(ii) Current on each resistance
(iii) Voltage on each resistance.

Ans



Given, $R_1 = 2\Omega$
$R_2 = 3\Omega$
$R_3 = 6\Omega$
$V = 6V$

(i) Equivalent Resistance (R),

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$
$$= \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = \frac{6}{6} = 1\Omega$$
$R = 1\Omega$

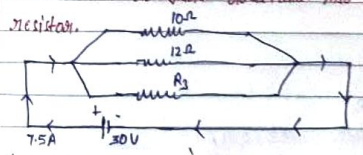
(ii) Voltage on each resistance will be 6V. because resistance R_1, R_2, R_3 are connected in parallel to each other.

(iii) Total Current (i), Acc. to ohm's law,
$V = iR$
$6 = i\times1$
$i = 6A$

Current on 2Ω (i_1) = $\frac{V}{R_1} = \frac{6}{2} = 3A$
" " 3Ω (i_2) = $\frac{V}{R_2} = \frac{6}{3} = 2A$
" " 6Ω (i_3) = $\frac{V}{R_3} = \frac{6}{6} = 1A$ Ans

Q-> 3 Three resistors are joined in parallel. A current of 7.5A flow due to 30 volt battery. If two resistors have resistance of 10Ω and 12Ω. Find out third resistance. Also find current passing through each resistor.

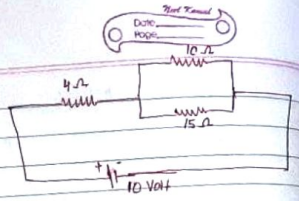
Ans



Given, $R_1 = 10\Omega$ $i = 7.5A$
$R_2 = 12\Omega$
$R_3 = ?$
$V = 30V$

Current on 10Ω (i_1) = $\frac{V}{R_1} = \frac{30}{10} = 3A$
" " 12Ω (i_2) = $\frac{V}{R_2} = \frac{30}{12} = 2.5A$
$i = i_1 + i_2 + i_3$
$7.5 = 3 + 2.5 + i_3$
$i_3 = 7.5 - 5.5 = 2A$
Acc to ohm's law,
$V_3 = i_3 R_3$
$R_3 = \frac{V_3}{i_3} = \frac{30}{2} = 15\Omega$ Ans

Q->4 In the given Circuit find
(i) Equivalent Resistance
(ii) Current on each Resistance
(iii) Voltage on each Resistance



Given,

(i) $R_1 = 4\Omega$ $V = 10V$
$R_2 = 10\Omega$
$R_3 = 15\Omega$

we know that, R_2 and R_3 is Connected parallel to each other,

$\frac{1}{R_4} = \frac{1}{R_2} + \frac{1}{R_3}$

$= \frac{1}{10} + \frac{1}{15} = \frac{3+2}{30} = \frac{5}{30} = \frac{1}{6}$

$R_4 = 6\Omega$

Here,
R_1 and R_4 are Connected in Series to each other. Then, Equivalent Resistance R is,

$R = R_1 + R_4 = 4 + 6 = 10\Omega$

(ii) According to ohm law,
~~voltage on $4\Omega (V_1) = i_1 R_1$~~ $V = iR$
$i = \frac{V}{R} = \frac{10}{10} = 1A$

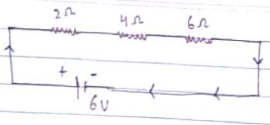
~~Current on $4\Omega (i_1) = V/R$~~
~~" " $10\Omega (i_2) = \frac{V_2}{R_2}$~~

voltage on $4\Omega (V_1) = i_1 R_1$
$= 1 \times 4 = 4V$

Voltage on $10\Omega (V_2)$ and $15\Omega (V_3) = V - V_1$
$= 10 - 4 = 6V$

(iii) Current on $4\Omega (i_1) = 1A$
" " $10\Omega (i_2) = \frac{V_2}{R_2} = \frac{6}{10} = 0.6A$
" " $15\Omega (i_3) = V_3/R_3 = \frac{6}{15} = 0.4A$

Q->5 In the given Circuit find
(i) Equivalent Resistance
(ii) Current in each Resistance
(iii) Voltage on Each Resistance



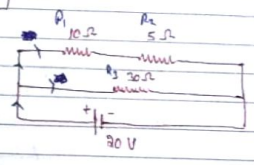
(i) $R = R_1 + R_2 + R_3$
$= 2 + 4 + 6 = 12\Omega$

(ii) According to ohms law,
$V = iR$
$i = V/R = 6/12 = \frac{1}{2}A$

Current $(\frac{1}{2}A)$ will be passed in each Resistance.

(iii) Voltage on 2Ω
$(V_1) = iR_1 = \frac{1}{2} \times 2 = 1V$
" " $4\Omega (V_2) = iR_2 = \frac{1}{2} \times 4 = 2V$
" " $6\Omega (V_3) = iR_3 = \frac{1}{2} \times 6 = 3V$
Ans

Q->6 In the given circuit find
(i) Equivalent Resistance
(ii) Current in each Resistance
(iii) Voltage on each resistance



(i) $R_4 = R_1 + R_2 = 10 + 5 = 15\Omega$
$\frac{1}{R} = \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{30} + \frac{1}{15} = \frac{1+2}{30} = \frac{3}{30} = \frac{1}{10}$

$\boxed{R = 10}$

(ii) Acc. to ohm's law, $V = iR$, $i = V/R = \frac{20}{10} = 2A$ $\boxed{i = 2A}$
Current on 10Ω and 5Ω $(i_4) = \frac{V_4}{R_4} = \frac{20}{15} = \frac{4}{3}A$
" " $30\Omega (i_3) = \frac{V_3}{R_3} = \frac{20}{30} = \frac{2}{3}A$

Same current will be passed on 10Ω and 5Ω. i.e, $4/3$ A

(iii) Voltage on 10Ω $(V_1) = i_1 R_1$

$= \frac{4}{3} \times 10 = \frac{40}{3}$ V

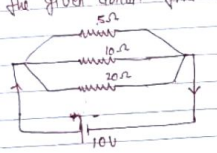
Voltage on 5Ω $(V_2) = i_2 R_2$

$= \frac{4}{3} \times 5 = \frac{20}{3}$ V

Voltage on 30Ω $(V_3) = i_3 R_3$

$= \frac{2}{3} \times 30 = 20$ V

Q7. In the given Circuit find Current drawn from battery.



Eq. Resistance, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$= \frac{1}{5} + \frac{1}{10} + \frac{1}{20} = \frac{4+2+1}{20} = \frac{7}{20}$

$R = 20/7\ \Omega$

$V = 10$ V

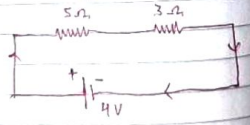
According to Ohm's law,

$V = iR$

$i = V/R$

$= 10/\frac{20}{7} = 10 \times \frac{7}{20} = \frac{7}{2} = 3.5$ A

Q→8. In the Given Circuit. Find
(i) Equivalent Resistance
(ii) Current on Each Resistance
(iii) Voltage on Each Resistance



(i) $R = R_1 + R_2 = 5 + 3 = 8\Omega$

(ii) According to ohm's law,

$V = iR$

$i = V/R$

$= \frac{4}{8} = \frac{1}{2}$ A

Current on 5Ω $(i_1) = 1/2$ A

" " 3Ω $(i_2) = 1/2$ A

(iii) Voltage on 5Ω $(V_1) = i_1 R_1$

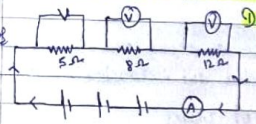
$= \frac{1}{2} \times 5 = \frac{5}{2} = 2.5$ V

Voltage on 3Ω $(V_2) = i_2 R_2$

$= \frac{1}{2} \times 3 = \frac{3}{2} = 1.5$ V

★ Resistance of $5\Omega, 8\Omega, 12\Omega$ are connected in series to 3 cells of 2 volt each. Draw circuit Diagram. Also calculate reading of Ammeter & Voltmeter.

Ans

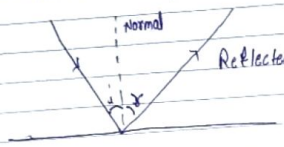


m = − = R.I
m = + = V.E

LIGHT OPTICS

Note:- Speed of light in vaccum or air is 3×10^8 m/s.

2019 **Reflection of light** → The bouncing back of light in same medium on striking a surface is known as reflection of light.



i = Angle of incidence
r = Angle of Reflection

2019 **Laws of Reflection :-**

① Incident Ray, Reflected Ray and Normal all lie in same plane.
② Angle of incidence is always equal to angle of Reflection.

$\boxed{\angle i = \angle r}$

Image -

The ray coming from an object meet or appear to meet at a point after reflection and refraction is known as image.

Types of Images

① Real Image
(a) Rays actually meet
(b) Inverted
(c) Obtain on Screen

② Virtual Image
(a) Rays appear to meet
(b) Erect
(c) Can not obtain on Screen

Note:- Reflection of light take place through Mirror.

$N = \frac{360}{\theta} - 1$
$= \frac{360}{60} - 1 = 6 - 1 = 5$ Ans

if $N = \frac{360}{50} - 1$
$= 7.2 - 1 = 6.2$
means ⑦ image at

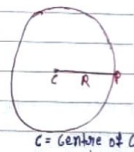
Mirror
- plane mirror
- spherical Mirror (Imp)
  - Convex
  - Concave

Plane Mirror -

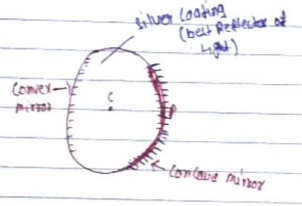
1. Image formed by plane mirror is of equal size and same distance.
2. Image formed is always Virtual and Erect
3. Focal length is Infinity.
4. If two plane are inclined at an angle θ. then the number of images of an object placed b/w them $N = \frac{360}{\theta} - 1$
5. Image is Laterally Inverted.

Spherical Mirror -

Hollow Glass sphere



C = Centre of Curvature
R = Radius of Curvature
P = Pole

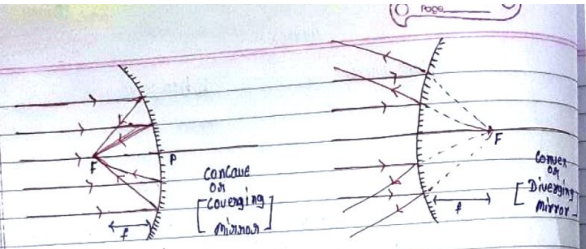


Convex Mirror — Generally formed small size Image

Concave mirror — Generally formed large size image

Focus - The parallel rays after reflection through Mirror meet at a point known as Focus (F).

Lateral Inverted → Right side appears to be left and vice versa.



Relation

$$f = R/2$$

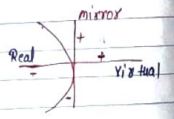
Mirror formula → $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

u = distance of object
v = distance of image
f = focal length

Magnification → $m = \frac{h_2}{h_1} = \frac{-v}{u}$

h_2 = ht of image
h_1 = ht of object

Sign →



Convex Mirror	Concave Mirror
(i) u = -ive	(i) u = -ive
(ii) f = +ive	(ii) f = -ive
(iii) v = +ive	(iii) v = -ive (for Real Image)
formed virtual image always	= +ive (for Virtual Image)

Condn (Nature) h_2 or h_1 = -ive Real
= +ive Virtual

★ ~~जब~~ जब m (1) से ज्यादा हो तो Image का size बड़ा होगा।
अगर m (1) से छोटा हो तो Image का size छोटा होगा।
अगर m = 1 हो तो Image object के बराबर होगी।

Image formed by Concave Mirror :-

I

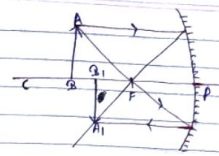


Image
Real Inverted

II

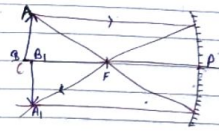


Image
Real Inverted

III

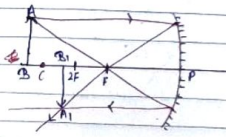


Image
Real Inverted

★ अगर कोई ray centre of curvature से आती है तो वे वहीं से वापस आएगी।
★ अगर कोई ray, object से parallel mirror पे आती तो वे focus से ही वापस आएगी।
★ अगर कोई ray focus से आकर पे तो mirror से वापस parallel से आएगी।

IV

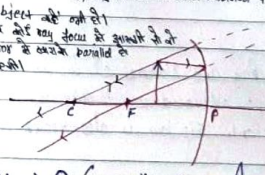
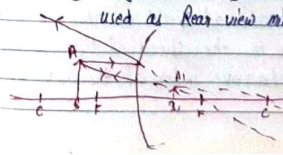


Image
Virtual
Erect

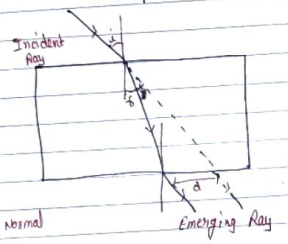
Note → ① Generally Image formed by Concave Mirror is large in size used by ENT specialist, Solar Cooker.
② Image formed by Convex Mirror is always shorter than object. used as Rear view mirror in car.

Convex always

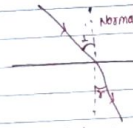


Virtual
Erect

★ **Refraction of Light** -> when the light ray goes from one medium to another, then it bend something. This phenomena is known as refraction of light.



i = Angle of incidence
r = Angle of refraction
d = Lateral shift



★ **Law of Refraction** ->

① Incident Ray, Refracted Ray and Normal all lie in same plane.
② The Ratio of sine of angle of incidence to the sine of angle of refraction is always constant. This law is also known as Snell's law.

$$\boxed{\frac{\sin i}{\sin r} = \text{Constant}(n)}$$

This Constant is known as refractive index of Material. (n)

absolute Refractive index -> The ratio of speed of light in air or vaccum to the speed of light in any medium is known as refractive index of the medium. It is represented by n.

-> The ability of a medium to bend light from air.
-> Refractive index of light in Air is always = 1.

n ∝ D (Density of light)
n ∝ $\frac{1}{v}$ (velocity of light)

$${}_2n_1 = \frac{n_1}{n_2} = \frac{v_2}{v_1}$$

$$\boxed{n = \frac{c}{v}}$$

$c = 3 \times 10^8$ m/s (speed of light in air)
v = speed of light in any medium

Relative Refractive index -

$${}_1n_2 = \text{refractive index of Medium 2nd with respect to 1st Medium} = \frac{n_2}{n_1}$$

refractive index of glass in water

Eg: $${}_wn_g = \frac{n_g}{n_w}$$

g -> glass
w -> water

$$\boxed{{}_1n_2 = \frac{1}{{}_2n_1}}$$ or ${}_gn_w = \frac{n_w}{n_g}$ or $\frac{1}{{}_wn_g}$

Note

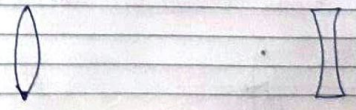
① if $n_1 > n_2$
then $v_1 < v_2$

② $v_R > v_D$
and $n_R < n_D$

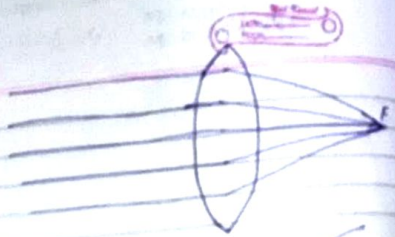
★ Refraction of light take place through lens.

⇒ **Lens** - Lens are of two types.

① Conver Lens — Concave Lens



Convex Lens
or
(Converging Lens)



Concave Lens
or
(Diverging Lens)

Lens formula $\boxed{\frac{1}{f} = \frac{1}{v} - \frac{1}{u}}$

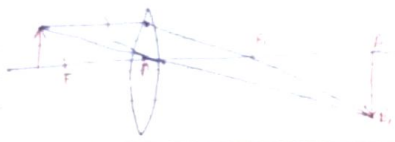
magnification $\boxed{m = \frac{h_2}{h_1} = \frac{v}{u}}$

Sign

Convex Lens
u = -ive
f = +ive
v = +ive (Real)
-ive (Virtual)

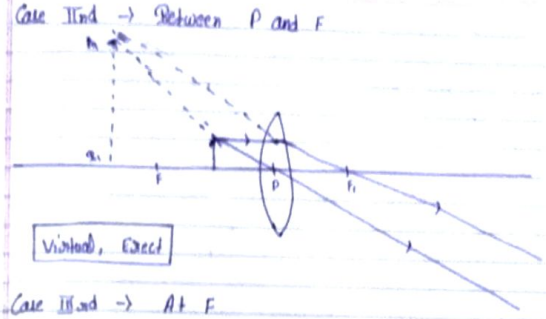
Concave Lens
u = -ive
f = -ive
v = -ive (always virtual)

★ Image formation by Convex lens: Case I st → Beyond F (At any point)



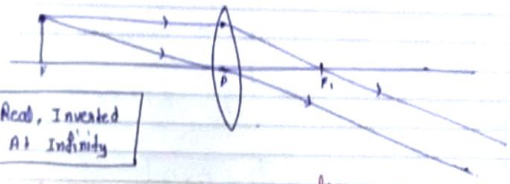
Real, Inverted

Case IInd → Between P and F



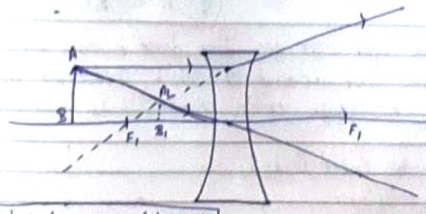
Virtual, Erect

Case IIIrd → At F



Real, Inverted
At Infinity

★ Image Formation by Concave ~~mirror~~ lens →



Virtual, Erect (always)

★ **Power of Lens** → It is reciprocal to focal length of a lens. It is represented by P.

$$P = \frac{1}{f\ (\text{in metre})}$$

S.I unit of power is Dioptre (D).

For Convex Lens . P = +ive
For Concave Lens P = -ive

Combination of Lens → If two lenses are placed in contact and this combination of lens is replaced by single lens which give same image as this combination. So it is known as Equivalent lens and its focal length is known as Equivalence focal length.

Combined focal length $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

Combined power $P = P_1 + P_2$

$P = P_1 + P_2 - d P_1 P_2$

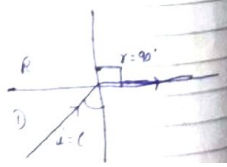
$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$

★ **Critical Angle** →

When the light rays goes from dense to rare medium then the angle of incidence at which refracted angle become 90° is known as critical Angle, it is represented by C.

Relation b/w Critical Angle (C) and refractive index (n) -

$$n = \frac{1}{\sin C}$$



2012

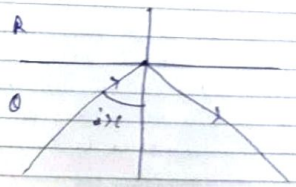
Numerical - If the critical angle of a medium is 45°. Find the refractive index of medium.

Sol. $C = 45°$

$n = \frac{1}{\sin C} = \frac{1}{\sin 45°} = \frac{1}{1/\sqrt{2}} = \sqrt{2}$

$n = \sqrt{2}$

★ **Total Internal Reflection** - when the light ray goes from dense to rare medium and the angle of incidence is slightly more than the critical angle. then the ray back to same medium. this phenomena is known as total internal reflection.



Condition for Total Internal Reflection-

1. Ray should go from dense to rare Medium.
2. Angle of incidence should be slightly more than the critical angle (i > c)

optical illusion

Phenomen based on Total internal Reflection

2019 ① Mirage → In desert area passenger and animal have optical illusion due to which it feel water instead of sand. This illusion is known as mirage. It is based on Total internal reflection in which ray enter from dense to rare medium angle comes more than critical angle.

② Shining of Cracking of glass

③ optical fibre

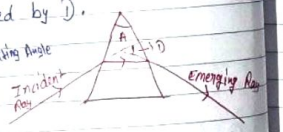
★ Refraction through Prism

When the light ray falls on the surface of a prism then it become parallel inside the prism and finally come out in the form of Emerging ray. The angle b/w the incident ray and finally Emerging ray is known as angle of deviation, which is represented by D.

A = Prism Angle / refracting Angle

D = Angle of Deviation

r = Angle of refraction



For Minimum Deviation

(a) $i = \frac{A+D}{2}$

(b) $r = A/2$

We can find refractive index of Prism by Snell's law

$$\boxed{n = \frac{\sin i}{\sin r}}$$

2018 Numerical

① A ray of light falling at an angle of 45° is refracted through a prism and suffer minimum deviation. The angle of prism is 60°. Find refractive index for prism.

Sol: $i = 45°$, $A = 60°$, $n = ?$

We know that, $r = \frac{A}{2}$, $r = \frac{60}{2} = 30$

$$n = \frac{\sin i}{\sin r} = \frac{\sin 45°}{\sin 30°} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{2}} = \frac{2}{\sqrt{2}} = \frac{\sqrt{2}\times\sqrt{2}}{\sqrt{2}} = \sqrt{2}$$

$$\boxed{n = \sqrt{2}}$$

② A ray falls on a prism of angle 60° and suffer minimum deviation of 30°. Find refractive index of material of Prism.

Sol: $A = 60°$, $D = 30°$

$i = \frac{A+D}{2} = \frac{60+30}{2} = 45°$

$r = A/2 = \frac{60}{2} = 30°$

$$n = \frac{\sin i}{\sin r} = \frac{\sin 45°}{\sin 30°} = \frac{1/\sqrt{2}}{1/2} = \frac{2}{\sqrt{2}} = \frac{\sqrt{2}\times\sqrt{2}}{\sqrt{2}} = \sqrt{2}$$ Ans

★ Refraction through thin prism

If the prism is thin of prism Angle A and minimum deviation through prism is D_m.

then

$$\boxed{D_m = (n-1)A}$$

where, n is refrective index for Prism.

2019 Numerical

A thin prism of 5° angle gives a minimum deviation of 3.2°. What is n of prism.

Soln

$A = 5°$; $D = 3.2°$

$D = (n-1)A$

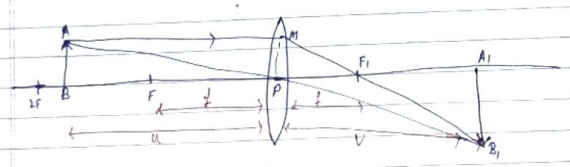
$3.2 = (n-1)5$

$n-1 = \frac{3.2}{5}$

$n = 0.64+1$

$\boxed{n = 1.64}$

★ Derivation of Lens formula → Suppose an object AB is placed b/w F and 2F of a convex lens of focal length f and its distance is u from pole P. Its real inverted image A_1B_1 is formed at distance V.



$\Delta ABP \sim \Delta A_1B_1P$

So by BPT

$\frac{AB}{A_1B_1} = \frac{BP}{A_1P}$ —(i)

$\Delta MPF_1 \sim \Delta B_1A_1F_1$

So, by BPT

$\frac{MP}{A_1B_1} = \frac{PF_1}{A_1F_1}$ ($\because MP = AB$) OR

$\frac{AB}{A_1B_1} = \frac{PF_1}{A_1F_1}$ —(ii)

by Eqn (i) and (ii)

$\frac{BP}{A_1P} = \frac{PF_1}{A_1F_1}$ and

$BP = -u$

$A_1P = V$

$PF_1 = f$

$A_1F_1 = -f+V$

$\frac{-u}{V} = \frac{f}{-f+V}$

$-u(-f+V) = Vf$

$uf - uV = Vf$

$uf - Vf = uV$ divide both sides by uVf

$\frac{\cancel{uf}}{\cancel{uVf}} - \frac{\cancel{Vf}}{\cancel{uVf}} = \frac{\cancel{uV}}{\cancel{uVf}}$

$\boxed{\frac{1}{V} - \frac{1}{u} = \frac{1}{f}}$ Lens formula.

Part-II Numerical based on Mirror formula

Q-11 Find focal length of a convex mirror whose Radius of curvature is 32 cm

Soln $R = 32$ cm

so $f = R/2 = 32/2 = 16$ cm.

Q-12 An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the Position and Nature of image?

Soln $u = -10$ cm

$f = 15$ cm

mirror formula, $\frac{1}{f} = \frac{1}{V} + \frac{1}{u}$

$\frac{1}{15} = \frac{1}{V} - \frac{1}{10}$

$\frac{1}{15} + \frac{1}{10} = \frac{1}{V}$

$\frac{2+3}{30} = \frac{1}{V}$

$\frac{5}{30} = \frac{1}{V}$

$\boxed{V = 6}$

$m = \frac{-V}{u}$

$m = +\frac{6}{+10} = 0.6$

Position of image is 6 cm.

Nature of image is virtual, Erect.

Q-3 An object 5 cm in length is placed at a distance of 20cm in front of convex mirror of radius of curvature 30cm. Find position, nature and size of image.

Sol: $h_1 = 5cm$

$u = -20cm$

$R = 30 cm$

$f = R/2 = 30/2 = 15 cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{15} = \frac{1}{v} - \frac{1}{20}$

$\frac{1}{v} = \frac{1}{15} + \frac{1}{20} = \frac{4+3}{60}$

$\frac{1}{v} = \frac{7}{60}$

$v = 60/7 = 8.6 cm.$

Position of image 8.6 cm

Size of image: $\frac{h_2}{h_1} = \frac{-v}{u}$

$\frac{h_2}{5} = \frac{+8.6}{+20}$

$20 \times h_2 = 8.6 \times 5$

$h_2 = \frac{8.6 \times 5}{20} = \frac{8.6}{4} = 2.15$

Nature of image = Virtual, Erect

Q-4 An object 7cm size is placed at 27 cm in front of concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed so that obtain a sharp image. Find the size and nature of image.

Given, $h_1 = 7 cm$

$u = -27 cm$

$f = -18 cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$-\frac{1}{18} = \frac{1}{v} - \frac{1}{27}$

$\frac{1}{v} = \frac{1}{27} - \frac{1}{18}$

$\frac{1}{v} = \frac{2-3}{54} = -\frac{1}{54}$

$v = -54 cm.$

Size $\frac{h_2}{h_1} = \frac{-v}{u}$

$\frac{h_2}{7} = -\frac{(+54)}{+27}$

$\boxed{h_2 = -14}$

Nature Real Inverted

Q-5 A convex mirror has focal length 20 cm produced image 1/3rd to the size of object. Calculate the distance of object and also nature of image.

Given, $f = 20 cm$

$m = \frac{1}{3}$

$\because m = -\frac{v}{u}$

$\frac{1}{3} = -\frac{v}{u}$

$-v = \frac{u}{3}$

so, $v = -\frac{u}{3}$

$\because \frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{20} = \frac{1}{-u/3} + \frac{1}{u}$

$\frac{1}{20} = -\frac{3}{u} + \frac{1}{u}$

$\frac{1}{20} = \frac{-2+1}{u} = -\frac{2}{u}$

$u = -2 \times 20 = -40$

Distance of object (u) = -40 cm

Nature will be Virtual, Erect.

Q-6 A 4.5 cm needle is placed 12 cm away from a concave mirror of focal length 15 cm. Find the location (position) of image.

Given, $h_1 = 4.5 cm$

$u = -12 cm$

$f = -15 cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$-\frac{1}{15} = \frac{1}{v} - \frac{1}{12}$

$\frac{1}{v} = \frac{1}{12} - \frac{1}{15}$

$\frac{1}{v} = \frac{5-4}{60} = \frac{1}{60}$

$\boxed{v = 60}$

Q27 A needle 3cm in size is placed 25 cm away from a concave mirror of focal length 10 cm. Find the location of image.

Given, $h_1 = 3cm$

$u = -25 cm$

$f = -10 cm$

$\because \frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$-\frac{1}{10} = \frac{1}{v} - \frac{1}{25}$

$\frac{1}{v} = \frac{1}{25} - \frac{1}{10} = \frac{2-5}{50} = \frac{-3}{50}$

$\boxed{v = -\frac{50}{3}}$

location of image -16.67 cm.

Q28 A convex mirror used for rear view on an automobile has radius of curvature 3m. If a bus is located at 5m from mirror. Find position, nature and size of image.

Given, $R = 3m$

$u = -5m$

$f = R/2 = \frac{3}{2} = 1.5m$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{1.5} = \frac{1}{v} - \frac{1}{5}$

$\frac{1}{v} = \frac{1}{5} + \frac{1}{1.5}$

$\frac{1}{v} = \frac{6+20}{30} = \frac{26}{30}$

Position $v = \frac{30}{26} = 1.15m$

Size

$m = \frac{-v}{u}$

$= \frac{+1.15}{+5} = 0.23$ times

Nature

Virtual, Erect

Q29 An object 4cm in size is placed 25 cm in front of concave mirror of focal length 15 cm. At what distance from the mirror should a screen be placed to obtain sharp image. Find nature and size of image.

Given,

$h_1 = 4 cm$

$u = -25 cm$

$f = -15 cm$

$\because \frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$-\frac{1}{15} = \frac{1}{v} - \frac{1}{25}$

$\frac{1}{v} = \frac{1}{25} - \frac{1}{15}$

$\frac{1}{v} = \frac{3-5}{75} = \frac{-2}{75}$

$v = -\frac{75}{2} = -37.5$

$\boxed{v = -37.5 cm}$

size, $\frac{h_2}{h_1} = \frac{-v}{u}$

$\frac{h_2}{4} = \frac{-(-75/2)}{-25}$

$h_2 = -\frac{75}{2} \times \frac{1}{25} \times 4$

$h_2 = -6$

Nature,

Real Inverted

Q30 A concave mirror produce three times magnified real image an object placed at 10 cm in front of it. Find the location of image and focal length of mirror.

Given,

$m = -3$

$u = -10 cm$

$\because m = \frac{-v}{u}$

$-3 = \frac{-v}{-10}$

location $v = -30 cm$

$\because \frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{f} = -\frac{1}{30} - \frac{1}{10}$

$\frac{1}{f} = \frac{-1-3}{30} = \frac{-4}{30}$

$f = -\frac{30}{4} = -7.5 cm$

Focal length $f = -7.5 cm$

Q-11 An object is placed at a distance of 25 cm from a mirror. The mirror produce image that is 20 cm. (i) behind the mirror (ii) In front of mirror for each case. [Find focal length and nature of mirror.]

Given,

$u = -25$ cm

(i) $v = 20$ cm (behind the mirror)

(ii) $v = -20$ cm (In front of mirror)

(i) $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{f} = \frac{1}{20} - \frac{1}{25}$

$\frac{1}{f} = \frac{-5-4}{100} = \frac{-9}{100}$

$f = -\frac{100}{9}$

focal length = $-\frac{100}{9}$ cm

nature: real Inverted

concave mirror

(ii) $\frac{1}{f} = \frac{1}{20} - \frac{1}{25}$

$= \frac{5-4}{100} = \frac{1}{100}$

$f = 100$

focal length = 100 cm

nature: Virtual Erect

Convex mirror

Q-12 A concave mirror has focal length of 4 cm and an object 2 cm tall is placed 9 cm away from it find the position, size and nature of image.

$f = -4$ cm

$h_1 = 2$ cm

$u = -9$ cm

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$-\frac{1}{4} = \frac{1}{v} - \frac{1}{9}$

$\frac{1}{v} = \frac{1}{9} - \frac{1}{4}$

$\frac{1}{v} = \frac{4-9}{36} = \frac{-5}{36}$

$v = -\frac{36}{5}$

Size, $\frac{h_2}{h_1} = \frac{-v}{u}$

$\frac{h_2}{2} = \frac{-(+36/5)}{-9}$

$h_2 = -\frac{36}{5} \times \frac{1}{9} \times 2$

$h_2 = -\frac{8}{5}$

$h_2 = -1.6$ cm

Real Inverted. Nature

Q-13 When an object is placed 20 cm away from a concave mirror a real image magnified three times is formed. find

(i) the focal length of mirror

(ii) Distance of image.

Given, $u = -20$ cm

$m = -3$

(ii) $\because m = \frac{-v}{u}$

$-3 = \frac{-v}{-20}$

$v = -60$ cm

(i) $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{f} = \frac{1}{-60} - \frac{1}{20}$

$\frac{1}{f} = \frac{-1-3}{60} = -\frac{4}{60}$

$f = -15$

Distance of image = -60 cm

focal length = -15 cm

Q-14 An object is placed at a distance of 6 cm from a convex mirror of focal length 12 cm. Find position, size and nature of image.

Given, $u = -6$ cm

$f = 12$ cm

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{12} = \frac{1}{v} - \frac{1}{6}$

$\frac{1}{v} = \frac{1}{12} + \frac{1}{6}$

$\frac{1}{v} = \frac{1+2}{12} = \frac{3}{12}$

$v = 4$

Position = 4 cm

Size, $\frac{h_2}{h_1} = \frac{-v}{u}$

$m = \frac{-v}{u}$

$= \frac{+12}{+6} = \frac{2}{3}$ (Virtual Erect.)

Q.15 A Convex Mirror used as rear view mirror in a car has radius of curvature of 3m. If bus is located at a distance of 5m from his mirror. Find position and nature of image.

Given,

$R = 3m$

$u = -5m$

$f = R/2 = 3/2 = 1.5m$

we know that,

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{1.5} = \frac{1}{v} + \frac{1}{-5}$

$\frac{1}{v} = \frac{1}{5} + \frac{10}{15}$

$\frac{1}{v} = \frac{3+10}{15} = \frac{13}{15}$

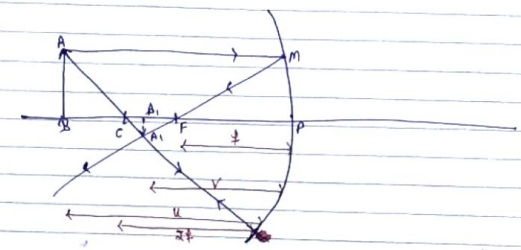
$v = \frac{15}{13} = 1.15$

Position $v = 1.15$

nature of image = Virtual and Erect.

★ Derivation of mirror formula →

Mirror formula can be derived from both Convex and Concave mirror. we are taking concave mirror for finding the same :-



$\Delta ABC \sim \Delta A_1B_1C$

$\frac{AB}{A_1B_1} = \frac{BC}{B_1C}$ —— (i)

$\Delta MPF \sim \Delta A_1B_1F$

$\frac{MP}{A_1B_1} = \frac{PF}{B_1F}$

$(\because MP = AB)$

So, $\frac{AB}{A_1B_1} = \frac{PF}{B_1F}$ —— (ii)

by eqn (i) & (ii),

$\frac{BC}{B_1C} = \frac{PF}{B_1F}$

$\because BC = -(u-2f)$

$B_1C = -(2f-v)$

$PF = -f$

$B_1F = -(v-f)$

$\frac{-(u-2f)}{-(2f-v)} = \frac{-f}{-(v-f)}$

$(u-2f)(v-f) = f(2f-v)$

$uv - uf - 2fv + 2f^2 = 2f^2 - vf$

$uv - uf - 2vf + 2f^2 - 2f^2 + vf = 0$

$uv - uf - vf = 0$

$uv = uf + vf$

Deviding by uvf,

$\frac{uv}{uvf} = \frac{uf}{uvf} + \frac{vf}{uvf}$

$\boxed{\frac{1}{f} = \frac{1}{v} + \frac{1}{u}}$ mirror formula.

Numericals based on refractive index

Q→1 The speed of light in glass is 2×10^8 m/s. Find refractive index of glass?

Sol: $n = \frac{c}{v} = \frac{3\times10^8}{2\times10^8} = \frac{3}{2} = 1.5$

Q→2 If the refractive index of glass with respect to water is $\frac{9}{8}$. Find refractive index of water with respect to glass.

Sol: ${}_wn_g = \frac{9}{8}$ now ${}_gn_w = \frac{1}{{}_wn_g} = \frac{1}{9/8} = \frac{8}{9}$ Ans

Q→3 If the refractive index of glass is 3/2 and for water is 4/3. Find the refractive index of glass with respect to water.

Sol: $n_g = \frac{3}{2}$, $\therefore n_w = \frac{4}{3}$

${}_wn_g = \frac{n_g}{n_w} = \frac{3/2}{4/3} = \frac{3}{2}\times\frac{3}{4} = \frac{9}{8}$ Ans

Q→4 The refractive index of glass is 3/2. Find the speed of light in glass?

Sol: $n = \frac{c}{v}$, $v = \frac{c}{n}$

$v = \frac{3\times10^8}{\frac{3}{2}} = 3\times10^8\times\frac{2}{3} = 2\times10^8$ m/s.

Q→5 If the refractive index of glass with respect to water is $\frac{9}{8}$ and the refractive index of glass is 3/2. Find the refractive index of water.

Sol: ${}_wn_g = \frac{9}{8}$ ${}_wn_g = \frac{n_g}{n_w}$

$n_g = \frac{3}{2}$

$n_w = ?$

$n_w = \frac{n_g}{{}_wn_g} = \frac{\frac{3}{2}}{\frac{9}{8}} = \frac{3}{2}\times\frac{8}{9} = \frac{4}{3}$ Ans

Q→6 If the refractive index of diamond is 2.42 what does it mean?

Numerical Based on Lens formula

Q→7 A Diverging (Convex) Lens of focal length 15 cm forms an image 10 cm from lens. Calculate the distance of object from lens.

Sol: $f = -15$ cm

$v = -10$ cm

Lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{-15} = \frac{1}{-10} - \frac{1}{u}$$

$$-\frac{1}{u} = \frac{1}{10} - \frac{1}{15}$$

$$-\frac{1}{u} = \frac{3-2}{30} = \frac{1}{30}$$

$$\frac{1}{u} = -\frac{1}{30}$$

$$\boxed{u = -30}$$ Ans

Q→8 A Concave lens of focal length 15 cm form an image 10 cm from the lens. How far is object placed from the lens. Draw ray diagram.

Ans $f = -15\,cm$

$v = -10\,cm$

by $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

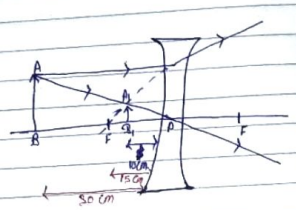
$\frac{1}{-15} = \frac{1}{-10} - \frac{1}{u}$

$-\frac{1}{u} = \frac{1}{10} - \frac{1}{15}$

$\frac{1}{u} = \frac{1}{15} - \frac{1}{10}$

$\frac{1}{u} = \frac{2-3}{30} = -\frac{1}{30}$

$\boxed{u = -30}$



Q→9 If an object of 7cm height is placed at distance of 12 cm from a convex lens of focal length 8cm. find position, nature and size of image.

Ans Given,

$h_1 = 7cm$

$u = -12cm$

$f = 8cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{8} = \frac{1}{v} - \frac{1}{-12}$

$\frac{1}{v} = \frac{1}{12} - \frac{1}{8}$

$\frac{1}{v} = \frac{2-3}{24} = -\frac{1}{24}$

$\boxed{v = -24}$

$\frac{h_2}{h_1} = \frac{v}{u}$

$\frac{h_2}{7} = \frac{-24}{-12}$ 2

$h_2 = 14$

$\frac{1}{v} = \frac{1}{8} - \frac{1}{12}$

$\frac{1}{v} = \frac{3-2}{24} = \frac{1}{24}$

$\boxed{v = 24}$

$\frac{h_2}{h_1} = \frac{v}{u}$

$\frac{h_2}{7} = \frac{24}{-12}$ 2

$\boxed{h_2 = -14}$

Real, Inverted

Q→10 An object 4cm high is placed at distance 10 cm from a Convex lens of focal length 20 cm. Find position, nature and size of image.

$h_1 = 4cm$

$u = -10\,cm$

$f = 20\,cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{20} = \frac{1}{v} - \frac{1}{-10}$

$\frac{1}{20} = \frac{1}{v} + \frac{1}{10}$

$\frac{1}{v} = \frac{1}{20} - \frac{1}{10}$

$\frac{1}{v} = \frac{1-2}{20} = -\frac{1}{20}$

$\boxed{v = -20}$

$\frac{h_2}{h_1} = \frac{v}{u}$

$\frac{h_2}{4} = \frac{-20}{-10}$

$h_2 = 8\,cm$

virtual, Exect

Q→11 Calculate the focal length of a Convex lens which produce a virtual image at 50 cm of an object placed 20 cm in front of it.

Ans $v = -50\,cm$

$u = -20\,cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$= -\frac{1}{50} - \frac{1}{-20}$

$= -\frac{1}{50} + \frac{1}{20}$

$= \frac{-2+5}{100} = \frac{3}{100}$

$= \frac{100}{3}$

$f = 33.33\,cm$

Q312 An object 2cm tall is placed on the axis of convex lens of focal length 5cm at distance of 10m from the lens. find position, size, nature of image.

$h_1 = 2\,cm$

$f = 5\,cm$

$u = -10m = -1000\,cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{5} = \frac{1}{v} - \frac{1}{-1000}$

$\frac{1}{5} = \frac{1}{v} + \frac{1}{1000}$

$\frac{1}{v} = \frac{1}{5} - \frac{1}{1000}$

$\frac{1}{v} = \frac{200-1}{1000} = \frac{199}{1000}$

$v = \frac{1000}{199} = 5.02$

$\boxed{v = 5}$ (approx)

$\frac{h_2}{h_1} = \frac{v}{u}$

$\frac{h_2}{2} = \frac{5}{-1000}$

$h_2 = \frac{10}{-1000}$

$\boxed{h_2 = -0.01}$ Real, Inverted.

Q313 A Convex lens of focal length 0.10m is used to form 5 times magnified image of an object of height 5mm placed at 0.08m from the lens. Calculate the position of image.

$f = 0.10m$

$m = -5$

$h_1 = 5mm$

$u = -0.08m$

$m = \frac{v}{u}$

$-5 = \frac{v}{-0.08}$

$v = -5 \times -0.08$

$v = -0.40m$

Q314 Determine how far an object be placed in front of Convex lens of focal length 10 cm in order to produce an erect image of magnification 4.

Soln. $f = 10\,cm$

$m = 4$

$\because m = \frac{v}{u}$

$4 = \frac{v}{u}$ so, $v = 4u$

$\because \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{10} = \frac{1}{4u} - \frac{1}{u}$

$\frac{1}{10} = \frac{1-4}{4u} = -\frac{3}{4u}$

$4u = -30$

$u = \frac{-30}{4} = -7.5\,cm$

$\boxed{u = -7.5\,cm}$

Q315 An object is placed at distance of 50 cm from a concave lens of focal length 20 cm. Find position, nature of image.

$u = -50\,cm$

$f = -20\,cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{-20} = \frac{1}{v} - \frac{1}{-50}$

$\frac{1}{v} = \frac{1}{-20} - \frac{1}{50}$

$\frac{1}{v} = \frac{-5-2}{100} = -\frac{7}{100}$

$v = -\frac{100}{7} = -14.3\,cm.$

$m = \frac{v}{u} = \frac{-\frac{100}{7}}{-50} = -\frac{100}{7} \times -\frac{1}{50} = \frac{2}{7}$

Virtual, Erect.

Q→16 A Convex lens form real inverted image of a needle at a distance of 50 cm from it. where is needle placed in front of convex lens if the image is equal to the size of object. Also find focal length of lens.

$v = 50$ cm

So, According to Question,

$u = -50$ cm

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{f} = \frac{1}{50} - \frac{1}{-50}$

$\frac{1}{f} = \frac{1+1}{50} = \frac{2}{50} = \frac{1}{25}$

$f = 25$ cm

Q→17 An object 5cm high is held 25cm away from a converging lens of focal length 10cm. Find position size and nature of image. Also draw ray diagram.

Sol: $h_1 = 5$cm, $u = -25$cm, $f = 10$ cm

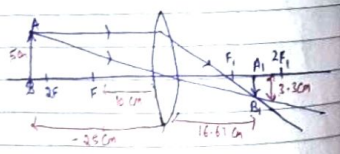
$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{10} = \frac{1}{v} - \frac{1}{-25}$

$\frac{1}{v} = \frac{1}{10} - \frac{1}{25}$

$\frac{1}{v} = \frac{5-2}{50} = \frac{3}{50}$

$\boxed{v = \frac{50}{3} \text{ cm}}$



$\frac{h_2}{h_1} = \frac{v}{u}$

$\frac{h_2}{5} = \frac{\frac{50}{3}}{-25}$

$\frac{h_2}{5} = \frac{50}{3} \times \frac{1}{-25} = -\frac{2}{3}$

$h_2 = -\frac{10}{3} = -3.3$ cm Real Inverted

Q→18 A convex lens of focal length 15 cm forms an image 10 cm from lens. How far is object from lens? Draw ray Diagram also.

$f = 15$ cm

$v = 10$ cm

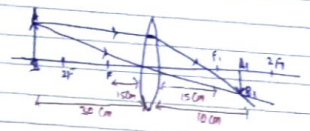
$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{15} = \frac{1}{10} - \frac{1}{u}$

$\frac{1}{u} = \frac{1}{10} - \frac{1}{15}$

$\frac{1}{u} = \frac{3-2}{30} = \frac{1}{30}$

$\boxed{u = 30}$



Q→19 A Concave lens has focal length of 20 cm. At what distance from lens a 5 cm tall object be placed so that it form an image at 15 cm from lens. Also calculate size of image formed.

$f = -20$ cm

$h_1 = 5$ cm

$v = -15$ cm

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{-20} = \frac{1}{-15} - \frac{1}{u}$

$\frac{1}{u} = \frac{1}{20} - \frac{1}{15}$

$\frac{1}{u} = \frac{3-4}{60} = -\frac{1}{60}$

$\boxed{u = -60}$

$\frac{h_2}{h_1} = \frac{v}{u}$

$\frac{h_2}{5} = \frac{-15}{-60}$

$h_2 = \frac{5}{4} = 1.25$ cm

Power and Combination of lens

Eg:- If the focal length of a lens is 20 cm. find its power.

Sol:- $f = 20\ cm = \frac{20}{100} m = \frac{1}{5} m$

$P = \frac{1}{f} = \frac{1}{1/5} = 5$

$\boxed{P = 5D}$ D = Diopture

Eg:- Two lenses of focal length 20 cm and 30 cm are placed in contact. Find the focal length and power of combination.

$f_1 = 20\ cm$

$f_2 = 30\ cm$

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$= \frac{1}{20} + \frac{1}{30} = \frac{3+2}{60} = \frac{5}{60} = \frac{1}{12}$

$\boxed{f = 12\ cm}$

Focal length = 12 cm = $\frac{12}{100} = 0.12 m$

$P = \frac{1}{f}$

$P = \frac{1}{\frac{12}{100}} = \frac{100}{12} = 8.33 D$

Eg:- If the focal length of combination of two lens is 20 cm and focal length of first lens is 30 cm. Find focal length and power of other lens

Sol:- $F = 20\ cm$

$f_1 = 30\ cm$

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{20} = \frac{1}{30} + \frac{1}{f_2}$

$\frac{1}{f_2} = \frac{1}{20} - \frac{1}{30}$

$\frac{1}{f_2} = \frac{3-2}{60} = \frac{1}{60}$

$\boxed{f_2 = 60\ cm} = \frac{60}{100} m$

Power $= \frac{1}{f_2} = \frac{1}{\frac{60}{100}} = \frac{100}{60} = 1.67 D$

Eg:- If the power of two lenses are 6D and -4D. Find the power and focal length of combination.

Sol:- $P_1 = 6D$

$P_2 = -4D$

$P = P_1 + P_2$

$P = 6 - 4$

$\boxed{P = 2D}$

$P = \frac{1}{f}$

$f = \frac{1}{P} = \frac{1}{2} m$

$f = \frac{1}{2} \times 100 = 50\ cm.$

Q-1 Define 1 Diopture power of lens?

Ans ~~1 Diopture of~~ Power of lens is the ability of a lens to converge the rays falling on it. One diopture is the power of the lens whose focal length is 1m.

$P = \frac{1}{f} = 1D$

Q-2 A diverging lens has a focal length of 3 cm. Calculate the power and give the units of power.

Ans $f = 3\ cm = \frac{3}{100} m$

$P = \frac{1}{f} = \frac{1}{3/100} = \frac{100}{3} = 33.3D$

As it is a Concave (Diverging) lens so power is negative.

$P = -33.3D$

Q.3 The focal length of a convex lens is 25 cm. what is its power?

Ans $f = 25\ cm = \frac{25}{100} = \frac{1}{4}\ m$

$P = \frac{1}{f} = \frac{1}{1/4} = 4D$

Q.4 The Power of a lens is -2D, what is its focal length?

Ans $P = -2D$

$f = \frac{1}{P} = \frac{1}{-2}\ m$

$f = -\frac{1}{2} \times 100\ cm = -50\ cm.$

Q.5 what do you understand by the power of a lens? Define also its unit?

Ans The power of a lens is a measure of the degree of converging or diverging of light rays falling on it. It is defined as the reciprocal of the focal length of a lens in metres.

Power = $\frac{1}{\text{focal length of lens (in metre)}}$

Therefore, the power of lens depends on the focal length.

S.I unit of power is Dioptre (D)

Q.6 An object of height 4cm is placed at a distance of 15 cm in front of a concave lens and its power, -10 Dioptres. Find the size of image.

Given,

$h_1 = 4\ cm$

$u = -15\ cm$

$P = -10D$

$P = \frac{1}{f} = \frac{1}{-10} \times 100 = -10\ cm$

$\boxed{f = -10\ cm}$

we know that,

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$-\frac{1}{10} = \frac{1}{v} - \frac{1}{-15}$

$\frac{1}{v} = -\frac{1}{10} - \frac{1}{15}$

$= -\frac{3-2}{30} = -\frac{5}{30}$

$\boxed{v = -6}$

$\frac{h_2}{h_1} = \frac{v}{u}$

$\frac{h_2}{4} = \frac{-6}{-15}$

~~$h_2 = 8\ cm$~~

$h_2 = \frac{24}{15}$

$\boxed{h_2 = 1.6\ cm}$

Q.7. which type of lens has a positive power? (Convex lens)

Q.8. How is the power of a lens related to its focal length?

Ans Power of a lens is inverse of its focal length. (in metre).

$P = \frac{1}{\text{focal length of lens (in metre)}}$

Q.10. which of the two has a greater power: a lens of shorter focal length or a lens of large focal length?

Ans Because the Power is inverse of focal length of a lens. So, a lens of short focal length has a greater power.

Q.11. Name the physical Quantity whose unit is Dioptre?

Ans The power of lens is a physical Quantity whose unit is Dioptre.

Q.12. A lens has a focal length of -10 cm. what is the power of lens and what is its nature.

Ans $f = -10\ cm = -\frac{10}{100}\ m = -\frac{1}{10}\ m$

$P = \frac{1}{f}$

$= \frac{1}{-\frac{1}{10}} = -10D$

Nature of lens = Concave lens

Because lens has negative power.

Q.13 The Power of lens is +4D. what kind of lens it is and what is its focal length

Ans $P = +4D$

$f = \frac{1}{P} = \frac{1}{4}\ m$

$f = \frac{1}{4} \times 100 = 25\ cm$

This is the Convex lens. Because lens has positive power.

Q.16. The power of a combination of two lenses X and Y is 5D. If the focal length of lens X is 15 cm. Calculate the focal length of lens Y?

Given,

$P = 5D$

$f_1 = 15 cm$

$f_2 = ?$

we know that,

$P = \frac{1}{f}$

$5 = \frac{1}{f}$

$f = \frac{1}{5} m$

$f = \frac{1}{5} \times 100 = 20 cm$

$\boxed{f = 20 cm}$

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{20} = \frac{1}{15} + \frac{1}{f_2}$

$\frac{1}{f_2} = \frac{1}{20} - \frac{1}{15}$

$\frac{1}{f_2} = \frac{3-4}{60} = \frac{-1}{60}$

$\boxed{f_2 = -60 cm}$

Ans

Q.17. A Convex lens of power 5D and a concave lens of power 7.5D are placed in contact to each other. What is the power of combination of lenses?

Given,

Power of Convex lens $(P_1) = 5D$

" " Concave lens $(P_2) = -7.5D$

we know that,

Combination of power of lenses $(P) = P_1 + P_2$

$= 5 - 7.5 = -2.5D$

Q.18. A ~~Concave~~ Convex lens of focal length 10 cm and a concave lens of focal length 20 cm are placed in close contact with each other.

(a) What is the power of this combination?

(b) What is the focal length of this combination?

Given,

focal length of Convex lens $(f_1) = 10 cm$

" " " Concave " $(f_2) = -20 cm$

we know that,

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$= \frac{1}{10} - \frac{1}{20} = \frac{2-1}{20} = \frac{1}{20}$

$f = 20 cm$ or $\frac{20}{100} = \frac{1}{5} m$

$P = \frac{1}{f} = \frac{1}{\frac{1}{5}} = 5D$

(a) Power of Combination = 5D

(b) focal length of " = 20 cm

Q.19. What is the power of a convex lens of focal length 0.5m?

Ans $f = 0.5 m$

$P = \frac{1}{f} = \frac{1}{0.5} = \frac{10}{5} = 2D$

Q.20. A doctor has prescribed a corrective lens of power +1.5D. Find the focal length of the lens. Is the prescribed lens diverging or converging?

Ans $P = 1.5D$

$f = \frac{1}{P} = \frac{1}{1.5} = \frac{10}{15} m = \frac{10}{15} \times 100 = \frac{200}{3} = 66.6 cm.$

$f = 66.6 cm.$

This is the converging lens.

Q.21. A convex lens of focal length 25 cm and a concave lens of focal length 10 cm are placed close to contact with one another.

(a) What is the power of combination.

(b) What is the focal length of this combination.

Ans focal length of Convex lens $(f_1) = 25 cm$

" " " Concave " $(f_2) = -10 cm$

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$= \frac{1}{25} - \frac{1}{10} = \frac{2-5}{50} = -\frac{3}{50}$

$\boxed{f = -\frac{50}{3} = -16.67 cm}$ or $-\frac{50}{3} \times \frac{1}{100} = -\frac{1}{6} m$

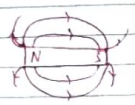
$P = \frac{1}{f} = \frac{1}{-1/6} = -6$

$\boxed{P = -6 D}$

Magnetic field → The field around at a magnet at which a magnetic needle placed and it experience a force is known as magnetic field. It is represented by B.
Its SI unit is Newton/Ampere-metre or Tesla. Its other unit is Gauss.

$1 \text{ Gauss} = 10^{-4} \text{ Tesla}$

Magnetic field lines → The lines around the magnet which represent the direction of magnetic field known as magnetic field lines.



Properties →

(i) They start from North and end at South pole.
(ii) Always close curve.
(iii) They represent the direction of magnetic field.
(iv) Two magnetic field lines never intersect each other because if they intersect then at the intersection point there will be two direction of magnetic field which is not possible.

Magnetic Effect of current → When current is passed in a wire then Magnetic field produced around it which is known as magnetic Effect of current.

Magnetic force

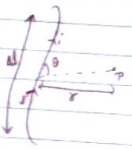
(a) $F = iBl \sin\theta$ (b) $F = qVB \sin\theta$

i = Current, l = length of Conductor, θ = Angle
B = Magnetic field, q = Charge of Conductor

Note → (i) Force Maximum → at 90° angle (θ = 90°), Perpendicular ⊥
(ii) Force Minimum → at 0° angle (θ = 0°), Parallel ∥

Bio Savart law → According to this law magnetic field produced due to current element depend on following factor :-

(i) it is directly proportional to current flow. (B ∝ i)
(ii) It is directly proportional to small length. (B ∝ Δl)
(iii) It is Inversely proportional to the square of distance (B ∝ 1/r²)
(iv) It is directly proportional to Sine of angle θ. (B ∝ sinθ)

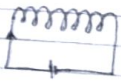


So, $B \propto \frac{i \times \Delta l \times \sin\theta}{r^2}$

$$B = \frac{\mu_0}{4\pi} \times \frac{i\Delta l \sin\theta}{r^2}$$ where, $\frac{\mu_0}{4\pi} = 10^{-7}$

★ **Magnetic field due to different shape of Conductor** →

(i) Circular Coil	(ii) Straight Wire	(iii) Solenoid
Shape - Circular	Shape - ~~Circular~~ Straight	Shape → Outside (Curved), Inside (Uniform - Straight line)
Formula - $B = 2\pi \times 10^{-7}\left(\frac{i}{r}\right)$	Formula - $B = 2 \times 10^{-7}\left(\frac{i}{r}\right)$	
Depend - $B \propto i$, $B \propto \frac{1}{r}$, $B \propto$ no. of turn	Depend - $B \propto i$, $B \propto \frac{1}{r}$	Depend - $B \propto i$, $B \propto$ no. of turn, $B \propto \frac{1}{r}$



(Solenoid Shape) **ElectroMagnet** → It is formed by wrapping insulated Cu (copper) wire on Soft iron rod.
Its strength depend on following factors.
(i) $B \propto i$ (ii) $B \propto$ no. of turns (iii) $B \propto$ Soft iron Core (Nature of material)

Note → In electromagnet we use soft iron rod as a core not of Ni or Co because they do not loose magnetism easily.

★ Difference b/w Electromagnet and Bar Magnet →

Electro Magnet	Bar Magnet
① It is temporary magnet.	It is permanent magnet.
② It produces strong force of attraction.	It produce weak force of attraction.
③ Its strength can be changed.	Its strength can not be changed.
④ Its polarity can be changed. (polarity N S)	Its polarity can not be changed. (N S)

★ Fleming Left Hand Rule →

According to this rule, if we raised the forefinger, middle finger and thumb in such a way so that they are perpendicular to each other, then if our forefinger represent the direction of magnetic field and middle finger represent the direction of current, then our thumb will represent the direction of magnetic force.

Note: Fleming left hand rule is generally used to find the direction of magnetic force.

Electro Magnetic Induction :-

When there is a relative motion b/w a coil and a magnet then current is induced in the coil, this process is known as Electromagnetic Induction.

Faraday's law of Electromagnetic Induction → There are two law of Electromagnetic Induction :-

Ist law :- When there is a change in flux in a coil then electro motive force (emf) produced in the coil.

(★) According to Lenz's law the polarity of the induced e.m.f is such that it opposes the change in the magnetic flux responsible for its production.

IInd law :- The emf produced in the coil is equal to the rate of change in flux.

$$e = N\left(\frac{\Delta\phi}{\Delta t}\right)$$

e = emf produced
N = No of turn in coil
$\Delta\phi$ = change in flux

★ Magnetic flux →

The number of magnetic field lines passes ~~through~~ perpendicular to area of any surface is known as magnetic flux. It is represented by ϕ.

$$\phi = BA$$

A = area of surface.

SI unit of magnetic flux ϕ is ~~weber~~ weber (Wb)

★ Lenz Law → (current or emf ★ direction) physics with Rajana

According to this law the direction of the current induced in a conductor by a changing magnetic field is such that the magnetic field created by induced current oppose the initial changing magnetic field. or (★)

★ Electric Motor :- It is a device which convert Electric Energy to Mechanical Energy.

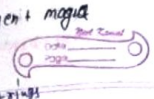
Principal - when a coil placed perpendicular to magnetic field then it experience a force act on it.

Construction - It has following parts :-

(i) Poles of Magnet - There are two poles N and S.
(ii) Rectangular Coil - In this, there is a rectangular coil ABCD. which is placed in magnetic field in such a way so that it can rotate freely.

To increase the power of motor :-

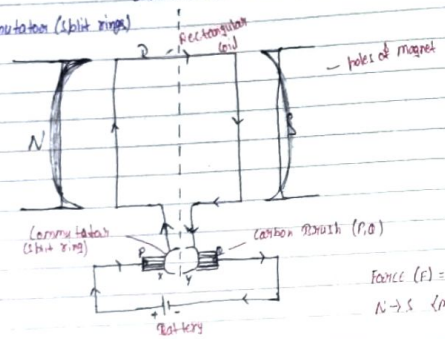
① electromagnet is placed in place of permanent magnet
② No. of turns of coil are increased
③ Coil is wounded over soft iron core.



(iii) Commutator (split Rings) - There are two split rings (X and Y) connected to coil. The work of commutator (split rings) is to reverse the direction of current.

(iv) Carbon brush - Two carbon brushes P and Q connected to commutator. which provide current from battery to

Commutator (split rings)



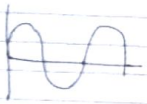
Force (F) = i.R.l. Sinθ
N → S (magnetic field)

Working - when current is passed in the coil which is placed in magnetic field then a magnetic force act on it due to which coil start to rotate whose direction can be found by Fleming left hand Rule.

★ Fleming Right Hand Rule :- According to this law if we raise our right hand in such a way that our thumb, fore finger and middle finger are perpendicular to each other. if our thumb represent the direction of motion, fore finger represent the direction of magnetic field then our middle finger represent the direction of induced current.

Note - Fleming Right Hand Rule is used generally to find the direction of induced current.

★ AC Generator → This device is used to convert mechanical energy to electrical energy.



Principle - It is based on electromagnetic Induction.

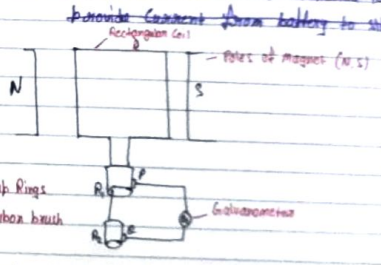
Construction -

(i) Poles of Magnet - There are two poles N and S.

(ii) Rectangular Coil - In this, there is a rectangular coil ABCD. which is placed in magnetic field in such a way so that it can rotate freely.

(iii) ~~Commutator~~ (Slip Rings) - There are two circular Rings R_1 and R_2 made up of metal, connected with two ends of coil.

(iv) Carbon brush - Two carbon brush P and Q connected to ~~Commutator~~ slip rings as well as Galvanometer. ~~provide current from battery to slip rings~~



Working - when the shaft of rectangular coil is rotated by an external device then by the process of electromagnetic induction, current induced in the coil whose direction can be found by Flemings Right Hand Rule.

* When does ~~Short~~ an electric short circuit occur?

Ans ① Short circuit occurs when more than allowable current is drawn from circuit.

② A $H \propto I^2$ (Joule's law), there is a heating of circuit and the insulation cover of wires get damaged leading to positive and negative ends of wires coming in contact.

③ This cause resistance of a circuit to become zero and large amount of current flows in a circuit causing ELECTRIC FIRE.

Q→ Why Nichrome used in Heating appliances?

Ans ① Nichrome is an alloy made of Nickel and chromium.

② It has high restivity so when current passes through it, heat is ~~gee~~ generated.

③ It has high melting point so it does not melt or oxidise.

$H \propto I^2$
Joule's law

Domestic Wiring -

Domestic Wiring
- Neutral Wire (Black Colour)
- Live Wire (Red Colour)
- Earth Wire (Green Colour)

Short Circuit - The touching of live wire and neutral wire directly is known as short circuit.

Overloading - If too many appliances of high power rating operated together then this situation is known as overloading. It can also occur if too many appliances are connected in a single socket.

Earthing of Wire - To avoid Electric shock, we need to Earthing of wire. It means (for any appliance) to connect the metal case of electric appliance to the earth.

Electric fuse - It is a safety device which is used to protect the circuit or any Electric appliance.

In domestic circuit are use Electric fuse which is made up of porcelain of high melting point. In which there is a thin copper wire is used which has low melting point. It is applied on live wire. when there is short circuit or overloading then excess amount of current produced due to which ~~Curve~~ wire of fuse get so much heated and melt due to which current supply stopped. It based on Heating effect of Current.

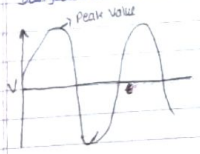
thin wire of alloy of Tin & Lead

Difference b/w D.C and A.C

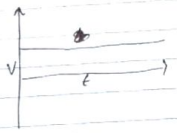
D.C	A.C
1. The value of D.C may be change but its direction never be change.	The direction and value of A.C changes periodically.
2. It can be changed by half of rectifier.	A.C can be changed by chok coil
3. D.C voltage cannot be changed by a transformer.	A.C voltage can be changed by the help of transformer.
4. The cost of production of D.C is very high.	The cost of production of A.C is very less.
5. It cannot to a large distance	It can transmit to a long distance without energy loss.
6. It is less dangerous.	It is more dangerous.

(Q.) Justify 220 volt A.C is more dangerous than 220 volt D.C?

Ans Since the Magnitude of D.C is always remains same as 220 volt but we know that A.C magnitude is variable and its peak voltage (max. voltage) is $220\sqrt{2}$ volt $\simeq$ 311 volt but the peak value of D.C will 220 volt which is less to A.C. So, 220 volt D.C is less Dangerous than A.C



A.C



D.C

Numerical (Magnetism)

(1) A wire of length 2m is placed in uniform magnetic field of 2×10^{-5} Tesla at the angle of 30°. If Current flows in wire is 3A. Find magnetic force act on it. (Ans - 3×10^{-5} N)

(2) An electron is moving in magnetic field of 5×10^{-5} Tesla at the angle of 30° by speed of 2 m/s. Calculate magnetic force act on it. (Ans 2.5×10^{-15} N)

(3) In a straight wire there is a current of 4 ampere. Find magnetic field intensity at a point 2 cm away from it. (Ans - 4×10^{-5})

(4) There is a circular coil of radius 2 cm. Find magnetic field at its centre. If the current flow in coil is 2A. (Ans - $2\pi\times10^{-5}$ Tesla)

(5) In a circular coil of radius 2 cm having Current 2A, if the number of turn in coil is 100. Find intensity of magnetic field at its centre. (Ans - $6\pi\times10^{-2}$ Tesla)

(6) There is a wire of length 20 cm having Current 2A placed in uniform magnetic field of 5×10^{5} Tesla. Find Maximum magnetic force act. (Ans - 2×10^{-5} N)

(7) A Coil of Area 4 cm² is placed in uniform magnetic field of 2×10^{5} Tesla. Find magnetic flux produced. (Ans - 80 wb)

(8) The flux of a coil changes from 2×10^{-3} weber to 8×10^{-3} wb in time 0.001 sec. If the coil has 50 turns. Find emf (voltage) produced. (Ans - 300 volt)

(9) A house wiring supplied with 220 volt protected by 6A fuse. Calculate the maximum number of 60 watt bulbs in parallel that can be turned on. (Ans - 22)

(10) A house wiring supplied by 220 volt supply line is protected by 15 Ampere fuse. Calculate the maximum no. of 100 watt bulb in parallel that can be turn on. (Ans - 33)

(18) A house wiring supplied by 220 volt which is protected by fuse of 5A. Calculate maximum no. of no watt bulb that can be turned on. (ANS - 10)

(19) In a house there are four electric appliance 90 W, 500 W, 300 W, 200 W are operated by supply at 220 volt supply. Find the correct current fuse rating for safely working of device. (ANS - 5A)

ANS-1 Given,

$l = 2m$, $\theta = 30°$

$B = 2\times10^5 T$, $i = 2A$

we know that

$F = iBl \sin\theta$

$= 2\times2\times10^5\times2\times\sin30°$

$= 8\times10^5\times\frac{1}{2} = 4\times10^5 N$

ANS-2 Given, $B = 5\times10^4 T$ $v = 2m/s$

$\theta = 60°$ electron have charge $(q) = 1.6\times10^{-19}$

we know that,

$F = qvB\sin\theta$

$= 1.6\times10^{-19}\times2\times5\times10^4\times\sin60°$

$= 16\times10^{-15}\times\frac{\sqrt{3}}{2} = 8\sqrt{3}\times10^{-15} N$

ANS-3 Given, $i = 4A$, $r = 2cm = \frac{2}{100} = 2\times10^{-2} m$

we know that, In straight wire

$B = 2\times10^{-7}\times\frac{i}{r}$

$= 2\times10^{-7}\times\frac{4}{2\times10^{-2}} = 4\times10^{-5} T$

ANS-4 Given, $r = 3cm = 3\times10^{-2} m$, $i = 2A$

we know that, In circular wire

$B = 2\pi\times10^{-7}\times\frac{i}{r} = 2\pi\times10^{-7}\times\frac{2}{3\times10^{-2}} = \frac{4\pi\times10^{-5}}{3} = 1.33\pi\times10^{-5} T$

ANS-5 Given, $r = 2cm = 2\times10^{-2} m$, $i = 6A$, $N = 1000$

we know that, In circular wire

$B = N\left(2\pi\times10^{-7}\times\frac{i}{r}\right)$

$= 1000\times2\pi\times10^{-7}\times\frac{6}{2\times10^{-2}} = 6\pi\times10^{-2}$ Tesla

ANS-6 Given, $l = 20cm = 2\times10^{-1} m$, $i = 2A$, $B = 5\times10^5$ Tesla

maximum magnetic force will be applied at angle (θ) 90°. So, $\theta = 90°$

we know that,

$F = iBl\sin\theta$

$= 2\times5\times10^5\times2\times10^{-1}\times\sin90°$

$= 2\times10^5\times1 = 2\times10^5 N$

ANS-7 Given, $A = 4cm^2 = \frac{4}{(100)^2} = 4\times10^{-4} m$

$B = 2\times10^5$ Tesla

we know that,

$\phi = BA$

$= 2\times10^5\times4\times10^{-4} = 80$ weber

ANS-8 Given, $\phi_1 = 2\times10^{-3}$ wb $\Delta t = 0.001$ sec $= 1\times10^{-3}$ sec

$\phi_2 = 8\times10^{-3}$ wb $N = 50$

(change in flux) $\Delta\phi = \phi_2 - \phi_1$

$= 8\times10^{-3} - 2\times10^{-3} = 6\times10^{-3}$

we know that,

$e = N\left(\frac{\Delta\phi}{\Delta t}\right)$

$= 50\left(\frac{6\times10^{-3}}{1\times10^{-3}}\right) = 300$ Volt

Ans = 9 $V = 220$ volt , $i = 6A$, ~~watt~~ voltage of 1 bulb = 60 watt

maximum power support by fuse $(P) = Vi$

$= 220 \times 6 = 1320$ watt

$$\text{No. of bulb} = \frac{\text{maximum power supported by fuse}}{\text{voltage of 1 bulb}}$$

$$= \frac{1320}{60} = 22$$

Ans = 10 $V = 220$ volt , fuse $(i) = 15A$, Voltage of 1 bulb = 100 Watt

maximum power supported by fuse $(P) = Vi$

$= 220 \times 15 = 3300$ watt

$$\text{No. of bulb} = \frac{\text{maximum power supported by fuse}}{\text{voltage of 1 bulb}}$$

$$= \frac{3300}{100} = 33$$

Ans = 11 $V = 220$ volt , fuse $(i) = 5A$, Voltage of 1 bulb = 110 watt

maximum power supported by fuse $(P) = Vi$

$= 220 \times 5 = 1100$ watt

$$\text{No. of bulb} = \frac{1100}{110} = 10$$

Ans = 12 $V = 220$ Volt, $P_1 = 90w$, $P_2 = 500w$, $P_3 = 300w$, $P_4 = 200w$.

Total power $(P) = P_1 + P_2 + P_3 + P_4$

$= 90 + 500 + 300 + 200 = 1090$ w

$P = Vi$

$1090 = 220 \times i$

$i = \frac{1090}{220} = 4.9A$

We will have to use 5A fuse for safely working devices.

DIMENSION ANALYSIS

Quantities

Fundamental Quantities — which does not depend on other and has self unit.

Derived Quantities — Which depend on other and its unit obtain from other quantity.

Fundamental Quantity		units
Distance	-	metre
mass	-	kilogram
Time	-	Second
Current	-	Ampere
Temprature	-	kelvin
Angle	-	Radian

Imp

Derived Quantity	unit
Speed $= \frac{\text{Distance}}{\text{Time}} = \frac{m}{s}$	
Acceleration $= \frac{\text{Change in speed}}{\text{Time}} = \frac{m/s}{s}$	
$= m/s^2$	
etc.	

Dimension - It is the Expression for fundamental Quantities.

		Dimension
Distance	-	L
Mass	-	M
Time	-	T
Current	-	A
Temprature	-	θ

Imp

Dimension Formula - It is the expression for the unit of a physical Quantity in terms of the fundamental quantities. It is expressed as $= [M^a L^b T^c]$

Ex - ① Speed $= \frac{\text{Distance}}{\text{Time}} = \frac{[L]}{[T]} = [LT^{-1}]$

② Acceleration $= \frac{\text{change in velocity}}{\text{Time}} = \frac{[LT^{-1}]}{[T]} = [LT^{-2}]$

③ Force = Mass × Acceleration $= [M] \times [LT^{-2}] = [MLT^{-2}]$

(4) Work = Force x Displacement
$= [MLT^{-2}] \times [L] = [ML^2T^{-2}]$

Energy = Same as work ↑

(5) Pressure = $\frac{\text{Force}}{\text{Area}} = \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$

(6) Density = $\frac{\text{Mass}}{\text{Volume}} = \frac{[M]}{[L^3]} = [ML^{-3}]$

(7) Momentum = Mass x Velocity = $[M] \times [\overset{LT^{-1}}{\cancel{\text{velocity}}}] = [MLT^{-1}]$

(8) Impulse = Force x Time = $[MLT^{-2}] \times [T] = [MLT^{-1}]$

(9) Gravitational Force Constant (G) = (universal)

$F = G\frac{m_1 m_2}{r^2}$

$G = \frac{F \times r^2}{m_1 m_2} = \frac{[MLT^{-2}][L^2]}{[M][M]} = [M^{-1}L^3T^{-2}]$

UNIT SYSTEM

	CGS	MKS	SI	FPS
	C - Centimetre	m - metre (for length)	System of International	F = Feet
(for length)	G - Gram	K - Kg (mass)	Same as MKS	P = Pound
(mass)	S - Second	S - Second (Time)		S = Second
(Time)				

Numerical (Dimension Analysis)

I st Type Checking the formula

Q-1 Check the relation $s = ut + \frac{1}{2}at^2$ is dimensionally correct or not.

u = speed/velocity
a = acceleration
t = time

Soln L.H.D → Dimension of $s = [L]$
R.H.D → Dimension of $ut = [LT^{-1}][T] = [L]$
" $\frac{1}{2}at^2 = [LT^{-2}][T^2] = [L]$
Yes, it's Dimension is Correct.

Q-2 Check the relation $T = 2\pi\left(\frac{l}{g}\right)$ is dimensionally correct or not.

l = Acceleration
g = length

Soln L.H.D → Dimension of $T = [T]$
R.H.D → Dimension of $2\pi\left(\frac{l}{g}\right) = \frac{[L]}{[LT^{-2}]} = [T^2]$.

No, Not Correct.

★ IInd Type Conversion

Q-1 Speed of Car is 36 km/h Convert it into m/s by Dimension.
(n_1, L_1, T_1 → n_2, L_2, T_2)

Soln Dimension of speed = $[LT^{-1}]$

$n_2 = n_1\left[\frac{L_1}{L_2}\right]^1\left[\frac{T_1}{T_2}\right]^{-1}$

$= 36\left[\frac{km}{m}\right]\left[\frac{hr}{sec}\right]^{-1}$

$= 36\left[\frac{1000\,m}{m}\right]\left[\frac{3600\,s}{s}\right]^{-1}$

$= \frac{36 \times 1000}{3600} = 10$ m/s

Q→2 Convert 1 Newton into dyne by dimension?

Soln: dimension of force = $[MLT^{-2}]$ ∵ Unit of force is Newton.

$$n_2 = n_1 \left[\frac{M_1}{M_2}\right]\left[\frac{L_1}{L_2}\right]\left[\frac{T_1}{T_2}\right]^{-2}$$

Hint: (MKS to CGS)

$$= 1\left[\frac{kg}{g}\right]\left[\frac{m}{cm}\right]\left[\frac{s}{s}\right]^{-2}$$

$$= 1\left[\frac{1000\ gm}{gm}\right]\left[\frac{100\ cm}{cm}\right] = 10^3 \times 10^2 = 10^5 \text{ dyne.}$$

Q→3 Conversion 1 Joule to Erg by dimension?

Soln: ∵ Joule is the unit of work.

Dimension of work = $[ML^2T^{-2}]$

$$n_2 = n_1\left[\frac{M_1}{M_2}\right]^1\left[\frac{L_1}{L_2}\right]^2\left[\frac{T_1}{T_2}\right]^{-2}$$

$$= 1\left[\frac{kg}{gm}\right]\left[\frac{m}{cm}\right]^2\left[\frac{s}{s}\right]^{-2}$$

$$= 1\left[\frac{1000\ gm}{gm}\right]\left[\frac{100\ cm}{cm}\right]^2$$

$$= 10^3 \times (10^2)^2 = 10^3 \times 10^4 = 10^7 \text{ Erg.}$$

III rd type – making formula.

Q→1 Time period of simple pendulum depends on its length (l) and acceleration (g) due to gravity. Derive a relation b/w them by dimension.

Soln:

$$T \propto l^a g^b$$

$$T = K l^a g^b \quad \text{— (i)}$$

Take dimension both sides.

$$[T] = [L]^a [LT^{-2}]^b$$

$$[T] = [L^{a+b} T^{-2b}]$$

Compare the power of L and T.

$a+b = 0$ [∵ L has a power in L.H.S]

$-2b = 1$

$\boxed{b = -\frac{1}{2}}$

So, $a+b = 0$

$a - \frac{1}{2} = 0$

$\boxed{a = \frac{1}{2}}$

Put the value of a & b in eq-(i).

$$\boxed{T = K l^{1/2} g^{-\frac{1}{2}}}$$

or

$$\boxed{T = K \frac{l^{1/2}}{g^{1/2}}}$$

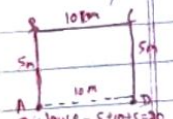
or

$$\boxed{T = K\sqrt{\frac{l}{g}}}$$

KINEMATICS (MOTION)

★ **Distance** – The total length of a moving body is known as distance.
(i) It is a scalar quantity.
(ii) Its SI unit is metre.

★ **Displacement** – The shortest distance between the initial and final position is known as displacement.
(i) It is a vector quantity. [direction + metre]
(ii) Its SI unit is metre.



Distance = 5+10+5 = 20
Displacement = 10m

★ **Speed** – The ratio of distance to the time of a moving body is known as speed.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

(i) It is a scalar quantity.
(ii) Its SI unit is m/sec.
(iii) Can't zero.

$$\boxed{1\ \text{Km/hr} = \frac{5}{18}\ \text{m/s}}$$

★ **Velocity** – The ratio of distance (displacement) to the time is known as velocity.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

(i) It is a vector quantity.
(ii) Its SI unit is m/sec.
(iii) Can be zero if displacement is zero.

★ **Uniform And Non uniform Motion** –

If a body travel Equal distance in equal interval of time is known as uniform motion and if a body travel unequal distance in equal interval of time is known as non uniform motion.

★ **Acceleration** – The rate of change of velocity in a body is known as acceleration.

$$\text{Acceleration} = \frac{\text{Final velocity} - \text{Initial velocity}}{\text{Time}}$$

$$a = \frac{v-u}{t}$$

(i) It is a vector quantity.
(ii) Its SI unit is m/s^2.

Note :- If Acceleration is negative then it is known as Retardation.

u = Initial velocity
v = final velocity
s = Distance
a = acceleration
t = time

Equation of Motion

I $(v = u + at)$ II $(s = ut + \frac{1}{2}at^2)$ III $(v^2 = u^2 + 2as)$

Derive Equation of motion –

I st Eqn → Suppose a body has initial velocity u moving under uniform accelerated motion (a) and in time (t). its final velocity become v.

So, $a = \frac{v-u}{t}$

$at = v - u$

$$\boxed{v = u + at}$$

II nd Eqn → Suppose the distance travel by body is s.

s = Average velocity × time

$s = \left(\frac{u+v}{2}\right) \times t$

$= \left(\frac{u+u+at}{2}\right)t = \left(\frac{2u+at}{2}\right)t$

$= \frac{2ut}{2} + \frac{at^2}{2}$

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

IIIrd Eqn → Again the distance travelled

$$s = \left(\frac{u+v}{2}\right) \times t$$

by I^{st} Eqn.

$$v = u + at$$

$$v - u = at$$

$$t = \frac{v-u}{a}$$

$$s = \left(\frac{u+v}{2}\right) \times \left(\frac{v-u}{a}\right)$$

$$s = \frac{v^2 - u^2}{2a}$$

$$2as = v^2 - u^2$$

$$\boxed{v^2 = u^2 + 2as}$$

★ Uniform Circular motion →

If a body moves on a circular track by uniform velocity then its motion is known as uniform circular-motion.

Ex- motion of minute and second hand of clock.

If a body moves on a circular track of radius r and complete 1 revolution in t sec then uniform velocity.

$$\boxed{v = \frac{2\pi r}{t}}$$

Scalar and Vector Quantity

Scalar Quantity - The quantity for which only magnitude is needed no direction is known as scalar quantity.

Ex- Distance, speed, Time etc.

Vector Quantity - The quantity for which both magnitude and direction is needed to represent is known as vector quantity.

Ex- Velocity, Displacement, Force etc.

Average Speed - Average speed = $\frac{\text{Total Distance}}{\text{Total Time}}$

Short cut Concept → If a person moves from A to B by speed v_1 and return by speed v_2. then average speed

Average speed $\boxed{V_{av} = \frac{2v_1v_2}{v_1+v_2}}$

Average velocity will be zero. because Displacement is zero.

Eg- Ram goes to his School from home ~~to school~~ by 36 km/hr and return by 18 km/hr. Find his average speed and average velocity.

Soln. $v_1 = 36$ km/hr, $v_2 = 18$ km/hr

average speed $(V_{av}) = \frac{2v_1v_2}{v_1+v_2}$

$= \frac{2 \times 36 \times 18}{36+18}$

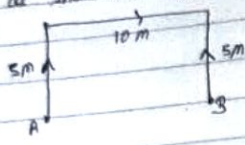
$= \frac{2 \times 36 \times 18}{54} = 24$ km/hr

Average Velocity = 0

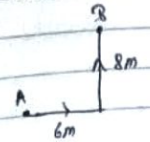
Topic - Distance, Displacement Numerical

Q-1 A person moves on a track start from A and reaches at B as shown in diagram. Find his distance and displacement.

(i)

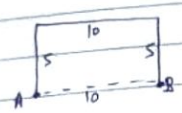


(ii)



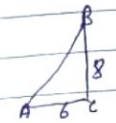
Ans (i) Distance = 5 + 10 + 5 = 20 m

Displacement = 10 m



(ii) Distance = 8 + 6 = 14 m

Displacement = 10 m



Acc. to Pythagoras theorem,

$AB^2 = AC^2 + BC^2$

$= 6^2 + 8^2 = 36 + 64 = 100$

$AB = \sqrt{100} = 10m$

Q-2 Ram goes to his office from home at distance of 2 km and due to closing return back to home. Find its distance and displacement.

Ans

Distance = 2 + 2 = 4 km

Displacement = Initial position to final position

means 0 km. (Because he came back to initial point)

Q-3 A person moves on a circular track of radius 14 m. Find his distance and displacement in

(a) 1 round

(b) 2 round

(c) $1\frac{1}{2}$ round.

Ans (i) Distance in 1 round = $2\pi r$

$= 2 \times \frac{22}{7} \times 14 = 88 m$

Displacement in 1 round = 0 m.

(ii) Distance in 2 round = 88 + 88 = 176 m

Displacement in 2 round = 0 m

(iii) Distance in $1\frac{1}{2}$ round = $88 + \frac{88}{2}$ = 88 + 44 = 132 m

Displacement in $1\frac{1}{2}$ round = 14 + 14 = 28 m

Q-4 A person goes 12 km East and 5 km towards North. Find his distance, displacement

Ans Distance = 5 + 12 = 17 km.

Acc. to pythagoras theorem,

$d^2 = 5^2 + 12^2$

$= 25 + 144 = 169$

$d = \sqrt{169} = 13$ km

Displacement = 13 km.

Q- Can its possible for a moving body its displacement become zero. Explain.

Ans- Yes, Displacement can be zero. Displacement is the shortest distance between initial position and final position. if both are same then least distance would be zero.

For example → If you travel from your home to school and back to home, distance would be twice but the displacement would be zero, because you came back to initial point.

⇒ Equation of Motion Numericals

Q→1 A Scooter acquires a velocity of 36 km per hour in 10 seconds just after the start. Calculate the acceleration of the Scooter.

Soln Given,

$v = 36\ km/h = 36 \times \frac{1000}{3600} = 10\ m/s$

$u = 0\ m/s$

$t = 10\ s$

we know that,

$v = u + at$

$10 = 0 + a \times 10$

$a = \frac{10}{10} = 1\ m/s^2$

Thus, the acceleration is $1\ m/s^2$.

Q→2 A moving train is brought to rest within 20 seconds by applying brakes. Find the initial velocity, if the retardation due to brakes is $2\ ms^{-2}$.

Soln Given, $t = 20$ second

$a = -2\ ms^{-2}$

$v = 0\ m/s$

we know that,

$v = u + at$

$0 = u + (-2 \times 20)$

$0 = u - 40$

$u = 40\ m/s$

Thus, the initial velocity of the train is 40 m/s.

Q→3 A body starts to slide over a horizontal surface with an initial velocity of 0.5 m/s. Due to friction, its velocity decreases at the rate of $0.05\ m/s^2$ (acceleration, $-0.05\ m/s^2$). How much time will it take for the body to stop?

Given,

$u = 0.5\ m/s$

$a = -0.05\ m/s^2$

$v = 0\ m/s$

we know that, $v = u + at$

$0 = \frac{5}{10} + \left(\frac{-5}{100}\right) t$

$+\frac{5}{10} = +\frac{5}{100} t$

$t = \frac{5}{10} \times \frac{100}{5} = 10\ s$

Thus, the body will take 10 second to stop.

Q→4 A racing car has a uniform acceleration of $4\ m/s^2$. What distance will it cover in 10 second after the start?

Soln Given,

$a = 4\ m/s^2$

$t = 10\ s$

$u = 0\ m/s$

we know that,

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

$= 0 \times 10 + \frac{1}{2} \times 4 \times (10)^2$

$= 2 \times 100 = 200\ m$

Thus the distance covered by the car in 10 second is 200 metres.

Q→5 A Scooter moving at a speed of 10 m/s is stopped by applying breaks which produce a uniform acceleration of $-0.5\ m/s^2$. How much distance will be covered by the scooter before it stops?

Given,

$u = 10\ m/s$

$v = 0\ m/s$

$a = -0.5\ m/s^2$

we know that, $v^2 = u^2 + 2as$

$(0)^2 = (10)^2 + 2 \times -0.5 \times s$

$0 = 100 - 1 \times s$

$+100 = +1s$

$s = 100\ m$

Thus, the distance will be covered by the scooter is 100 metres.

Q→6 A Car travelling at 20 km/h speed up to 60 km/h in 6 seconds. what is its acceleration?

Soln Given,

$u = 20 \text{ km/h} = 20 \times \frac{1000}{3600} = \frac{50}{9} \text{ m/s}$

$v = 60 \text{ km/h} = 60 \times \frac{1000}{3600} = \frac{50}{3} \text{ m/s}$

$t = 6 \text{ s}$

we know that,

$v = u + at$

$\frac{50}{3} = \frac{50}{9} + a \times 6$

$\frac{50}{3} - \frac{50}{9} = a \times 6$

$\frac{150 - 50}{9} = a \times 6$

$\frac{100}{9} \times \frac{1}{6} = a$

$a = \frac{50}{27} = 1.85 \text{ m/s}^2$

Q→7 A bus increases its speed from 20 km/h to 50 km/h in 10 seconds. Its acceleration is:

(a) 30 m/s² (b) 3 m/s² (c) 18 m/s² (d) 0.83 m/s² ✓

Soln Given,

$u = 20 \text{ km/h} = 20 \times \frac{1000}{3600} = \frac{50}{9} \text{ m/s}$

$v = 50 \text{ km/h} = 50 \times \frac{1000}{3600} = \frac{125}{9} \text{ m/s}$

$t = 10 \text{ s}$

$v = u + at$

$\frac{125}{9} = \frac{50}{9} + a \times 10$

$a \times 10 = \frac{125}{9} - \frac{50}{9}$

$a \times 10 = \frac{125 - 50}{9}$

$a = \frac{75}{9} \times \frac{1}{10} = \frac{15}{18} = 0.83$

$a = 0.83 \text{ m/s}^2$

Q→8 A bus starting from rest moves with a uniform acceleration of 0.1 m/s² for 2 minutes. Find (a) the speed acquired, (b) the distance travelled.

Soln Given,

$u = 0 \text{ m/s}$

$a = 0.1 \text{ m/s}^2$

$t = 2 \text{ m} = 2 \times 60 = 120 \text{ s}$

we know that,

(i)

$v = u + at$

$= 0 + 0.1 \times 120$

$= \frac{1}{10} \times 120 = 12 \text{ m/s}$

Thus, the speed acquired is 12 m/s.

(ii)

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

$= 0 \times 120 + \frac{1}{2} \times \frac{1}{10} \times (120)^2 = \frac{1}{20} \times 14400 = 720 \text{ m}$

Thus, the distance travelled by bus is 720 m.

Q→9 A train is travelling at a speed of 90 km/h. Brakes are applied so as to produce a uniform acceleration of −0.5 m/s². Find how far the train will go before it is brought to rest.

Soln Given,

$u = 90 \text{ km/h} = 90 \times \frac{1000}{3600} = 25 \text{ m/s}$

$a = -0.5 \text{ m/s}^2$

$v = 0 \text{ m/s}$

we know that,

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

$(0)^2 = (25)^2 + 2 \times -0.5 \times s$

$0 = 625 - s$

$+625 = +s$

$s = 625 \text{ m}$

Thus, the train will go 625 meters before it is brought to rest.

Q→10 A trolley, while going down an inclined plane, has an acceleration of 2 cm/s². What will be its velocity 3 s after the rest?

Ans Given, $a = 2\ \frac{cm}{s^2}$

$t = 3\ s$

$u = 0$

$v = u + at$

$v = 0 + 2 \times 3 = 6\ cm/s$

Thus, the velocity of trolley after 3 s will be 6 centimetres per second.

Q-11 A racing car has a uniform acceleration of $4\ m/s^2$. What distance will it cover in 10 s after start?

Ans Given, $a = 4\ m/s^2$

$t = 10\ s$

$u = 0$

~~$v = u + at$~~

~~$v = 0 + 4 \times 10 = 40$~~

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

$= 0 \times 10 + \frac{1}{2} \times 4 \times (10)^2$

$= 2 \times 100 = 200\ m$

Thus, the distance of 200 m it will cover in 10 s after start.

Q-12 A stone is thrown in vertically upward direction with a velocity of $5\ m\ s^{-1}$. If the acceleration of the stone during its motion is $10\ m/s^2$ in the downward direction, what will be the height attained by the stone and how much time will it take to reach there?

Ans Given, $u = 5\ m/s$

$a = -10\ m/s^2$

$v = 0$

$s = ?$

$t = ?$

We know that,

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

$(0)^2 = (5)^2 + 2 \times -10 \times s$

$0 = 25 + -20 \times s$

$+25 = +10 \times s$

$s = \frac{25}{20} = \frac{5}{4} = 1.25\ m$

We know that,

$v = u + at$

$0 = 5 + (-10 \times t)$

$+5 = +10 \times t$

$t = \frac{5}{10} = 0.5\ s$

Thus, the time taken by the stone to reach at the top will be 0.5 second.

Q-13 A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of $3.0\ m/s^2$ for 8.0 s. How far does the boat travel during this time?

Soln Given, $u = 0$

$a = 3\ m/s^2$

$t = 8\ s$

$s = ?$

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

$= 0 \times 8 + \frac{1}{2} \times 3 \times (8)^2$

$= \frac{1}{2} \times 3 \times 64$

$= 96\ m$

Thus, the boat travels a distance of 96 metres.

Q-14 A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of $10\ m/s^2$, with what velocity will it strike the ground? After what time will it strike the ground?

Soln Given, $s = 20\ m$

$a = 10\ m/s^2$

$u = 0$

We know that,

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

$v^2 = (0)^2 + 2 \times 10 \times 20$

$v = \sqrt{400} = 20\ m/s$

$v = u + at$

$20 = 0 + 10t$

$t = 20/10$

$t = 2\ s$

Thus, the ball strike the ground by 20 m/s and it will take 2 second for the same.

FORCE AND LAW OF MOTION

Force → A Push or pull on a body is called force. when we applied a force on a body it can change the position of body.

~~Effect of motion → A force cannot be seen, it can be judge only by effect which it can produce.~~

Motion → motion is the phenomenon in which an object changes its position over time.

Effect of Motion → A force cannot be seen, only we can judge our feel the force. ~~by effect~~ by effect. when it will produce on various bodies around us.

★ It produces the following effect:-

1. A force can move a stationary body.
   Eg:- when we hit a football in the ground it started moving.

2. A force can stop a moving body.
   eg:- when a player catches a fast moving ball, it ~~can~~ will be stop.

3. A force can change the speed of a moving body.
   Eg:- when we accelerate our speed on bike by applying forces, it change the speed of a moving body.

4. A force can change the direction of a moving body.
   eg:- when we hit a ball with a bat, then ~~it~~ we can change the direction according to our choice.

5. A force can change the shape (and size) of a body.
   eg:- when we stretch a rubber band by applying force, then it can change the shape.

★ Balanced and Unbalanced forces → forces are of two types -
① Balanced ② Unbalanced

⇒ Balanced forces -

If the resultant of all the force acting on a body is zero. The forces are called balanced forces.

Note:- ① If the number of balanced forces act on stationary body, The bodies continue to remain in its stationary position.

② If a number of balanced forces act on a body in a uniform motion, the body continue to be in its state of uniform motion.

③ Balanced forces cannot produce motion in a stationary body or stop a moving body but they can change the shape of a body.
Eg:- when a ballon is pressed b/w the hands then balanced forces act on ballon due to which the shape of ballon will change.

⇒ Unbalanced forces -

If the resultant of all the forces acting on a body is not zero, the force are called unbalanced force.

Note ① The unbalanced forces can move the stationary body or they can stop a moving body.

② If they were no unbalanced forces of friction and no air resistance then a moving object would go moving forever.

★ Newton's laws of motion → ~~According to this law~~

Newton was given three laws to describe the motion of body, these laws are known as Newton's laws of motion.

⇒ Newton's first law of motion →

According to this law a body which is in rest will remain in rest or a body which is in uniform motion remain in same uniform motion until no external force is applied on it. It is also known as law of Intertia.

Intertia → It is that property of a body which oppose the change in its position or motion. It depend on mass or weight compare to lighter object

Types of Intertia :- This is of two types — Inertia of rest, Inertia of motion

~~Inter~~ Inertia of rest → If an object is in rest it will oppose the change in it stationary position. It is also known as Inertia of rest.

Inertia of motion → If an object is in motion it will oppose the change in it stationary position. It is also known as Inertia of motion.

★ Example :- based on Newton's first law of motion

① If a moving bus stop suddenly than the passenger setting in it move forward. It is based on Newton's first law of motion. In a moving bus a person sitting in it is in motion when it stop suddenly then the body of person oppose the change due to which it come to rest so he move forward.

② If a bus start suddenly then the passenger sitting in it move backward.
When a bus is in rest position a passenger sitting in it is also in rest position, when a bus start suddenly then the body of passenger oppose the change in its position due to which it move backward.

⇒ Momentum → It is equals the product of mass and velocity of the object.

Momentum (P) = mass x velocity

$$\boxed{P = mv}$$

Its SI unit is kg m/s.

Q→ A car of mass 500 kg moving with a velocity of 36 km/hr. Find its momentum.

Ans Given,

mass = 500 kg

velocity = 36 km/h = $\frac{\cancel{36}^{2} \times \cancel{1000}\ 5}{\cancel{3600}\ \cancel{18}}$ = 10 m/s

We know that,

Mementum (P) = mV

= 500x10 = 5000 kg m/s

⇒ Newton Second law of motion

According to this law the force applied on a body is equals to rate of change in momentum.

Suppose a body of mass (m) has initial velocity (u) it accelerated by acceleration (a) in time (t) its final velocity become (v) then the initial and final momentum of a body will be given by

$$\overset{u}{\boxed{m}} \xrightarrow[\text{time } (t)]{\text{acceleration } (a)} \overset{v}{\boxed{m}}$$

Initial momentum $P_1 = mu$
final momentum $P_2 = mv$

According to newton's second law,

$$F = \frac{\text{Change in Momentum}}{\text{Time}}$$

$$F = \frac{P_2 - P_1}{t}$$

$$F = \frac{mv - mu}{t} = \frac{m(v-u)}{t}$$

$$\boxed{F = ma} \qquad \left(\because \frac{v-u}{t} = a\right)$$

SI unit of force is Newton. $\boxed{1N = 10^5 \text{ dyne}}$
CGS unit of force is dyne.

Q→1 A Constant force act on an object of mass 5 kg for a duration of 2s. It increases the objects velocity from 3 m/s to 7 m/s. Find the magnitude of the applied force. Now, if the force was applied for a duration of 5s. what would be the final velocity of the object.

Given,

mass = 5 kg
Time (t) = 2s
Initial velocity (u) = 3 m/s
Final velocity (v) = 7 m/s.

we know that,

$$\text{acceleration } (a) = \frac{v-u}{t}$$

$$= \frac{7-3}{2} = \frac{4}{2} = 2 \text{ m/s}^2$$

$$\text{Force } (F) = ma$$

$$= 5 \times 2 = 10 \text{ N}$$

Now, According to the Question,
t = 5s
then,

$$v = u + at$$

$$= 3 + 2 \times 5 = 3 + 10 = 13 \text{ m/s}$$

Q→2 Which would require a greater force - accelerating a 2kg mass at 5 m/s² or a 4 kg mass at 2 ms⁻²

Ans

$m_1 = 2$ kg $a_1 = 5$ m/s² $F_1 = m_1 a_1$ $= 2 \times 5 = 10$N	$m_2 = 4$ kg $a_2 = 2$ m/s² $F_2 = m_2 a_2$ $= 4 \times 2 = 8$N	2 kg mass ~~at 5 m/s²~~ require greater force to accelerate ~~it~~ at 5 m/s².

Q→3 A Motorcar is moving with a velocity of 108 km/h and it takes 4s to stop after the breaks are applied. calculate the force exerted by the breakes on the motorcar if its mass alongwith the passengers is 1000 kg.

Given, Initial velocity (u) = 108 km/h = $\frac{108 \times 1000}{3600} = 30$ m/s
Time (t) = 4s
Mass (m) = 1000 kg
Final velocity (v) = 0 m/s

we know that,

$$a = \frac{v-u}{t} = \frac{0-30}{4} = -\frac{30}{4} = -\frac{15}{2} \text{ m/s}^2$$

The negative sign tells us that the force exerted of motion of the motorcar.

$$F = ma = -\frac{15}{2} \times 1000 = -7500 \text{ N}$$

by the breaks is opposite to the direction

Q-74 A Force of 5N gives a mass m_1 an acceleration of $10\ ms^{-2}$ and a mass m_2 an acceleration of $20\ ms^{-2}$. What acceleration would it give if both the masses were tied together.

Given,

$F = 5N$

$m_1 = ?$ $\quad m_2 = ?$

$a_1 = 10\ m/s^2$ $\quad a_2 = 20\ m/s^2$

We know that, (According to Newton's Second law of motion)

$F = m_1 a_1$ $\quad F = m_2 a_2$

$m_1 = \frac{F}{a_1}$ $\quad m_2 = \frac{F}{a_2}$

$m_1 = \frac{5}{10} = 0.50\ kg$ $\quad m_2 = \frac{5}{20} = 0.25\ kg$

If both the masses were tied together ~~the~~ ~~are~~ then,

$m = m_1 + m_2$

$= 0.50 + 0.25 = 0.75\ kg$

$F = ma$

$a = \frac{F}{m} = \frac{5}{0.75} = \frac{5 \times \cancel{100}^{4}}{\cancel{75}\,3} = \frac{20}{3} = 6.67\ m/s^2$ Ans

⇒ Newton's third law of Motion →

According to this law, whenever one body ~~exerts~~ applied a force on another body. The second body ~~exert~~ will also applied an equal and opposite force on first body. The force ~~exerted~~ applied by the first body on the second body is known as action force and the force ~~exerted~~ applied by second body on first body is know as reaction force. So, we can say that every action has equal and opposite direction.

✱ Example based on Third law of motion :-

(i) We walk on the ground.
(ii) When we fire a bullet from the gun, it recoil
(iii) The flying of aeroplanes.
(iv) When a man jump out of a boat to bank of river, the boat move backward.
(v) The case of horse pulling a cart.

Eg-(i) When we tried to walk forward, we applied action force to the backward. Due to which the ground applies the same amount of force on us known as reaction force which enables us to walk.

(ii) When fire a bullet, the gun applied the force on bullet which enables it to move forward and bullet also apply same amount of force on gun which make it to move a little back.

(iii) At a jet aeroplane, there is a supply of hot air gases which burns and then applied as strong force on the ground to backward direction and in return the reaction force is applied which enables a jet plane to move forward.

(iv) When a man jumps out of boat, the boat applied a backward forces on man which enables man to jump forward and due to this, the moves boat is backward.

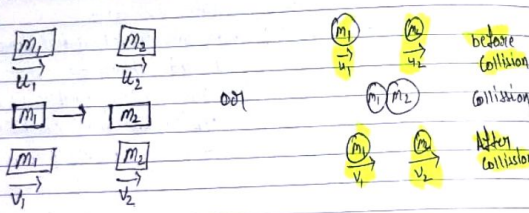
(v) The horse applied a backward force on the cart and the cart in return applied a reaction force which enables cart to move.

⇒ Conservation law of Momentum →

According to this law, when two bodies act upon one another then their total momentum remains constant provided no

external forces are acting. This laws can also be ~~stated~~ states as momentum's never created or destroyed.

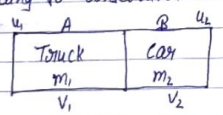
Suppose two bodies - A truck and a car of masses m_1 and m_2 as initial velocity u_1 and u_2. they collide each other and after the collision, their final speed become v_1 & v_2.



★ Initial momentum (before the collision)
$= m_1u_1 + m_2u_2$

★ Final momentum (after the collision) $= m_1v_1 + m_2v_2$

According to Conservation law of Momentum.



Force applied by truck on car : $F_{BA} = m_1\left(\frac{v_1-u_1}{t}\right)$

" " " car on truck : $F_{AB} = m_2\left(\frac{v_2-u_2}{t}\right)$

by newton's third law of motion,

$$F_{AB} = -F_{BA}$$

$$m_2\left(\frac{v_2-u_2}{t}\right) = -m_1\left(\frac{v_1-u_1}{t}\right)$$

$$m_2v_2 - m_2u_2 = -m_1v_1 + m_1u_1$$

so, $\boxed{m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2}$

Numericals are based on Newton's Second law of motion.

Q→1 The speed of a car increases from 36 km/hr to 72 km/hr in 5 sec. if the mass of car is 500 kg. Find the force applied on it.

Q→2 A mass of a car is 500kg. Calculate the force applied. if the acceleration produced 1.7 m/s2

Q→3 An object mass 100 kg it accelerate uniformly from 5 m/s to 8 m/s in 6 sec. Calculate: (i) initial momentum (ii) Final momentum (iii) Force applied.

Q→4 A body of mass 5 kg start and roll down 32m of an inclined plane in 4 sec. Find the acting force on the body.

Q→5 A car is moving by 54 km/hr. brake is applied on the car and it is stopped in 10 sec. If the mass of a car is 400 kg then find the retarding force on the car.

Q→6 A truck has initial velocity of 20 m/s on applied force its velocity become 40 m/s on moving distance of 10m. if the mass of truck 500 kg. Find the force applied.

Ans-1

Initial velocity (u) = 36 km/hr = $\frac{\cancel{36}^{2} \times \frac{\cancel{1000}^{5}}{\cancel{3600}}}{} = 10$ m/s

Final velocity (v) = 72 km/hr = $\frac{\cancel{72}^{4} \times \frac{\cancel{1000}^{5}}{\cancel{3600}}}{} = 20$ m/s

Time (t) = 5 sec

mass (m) = 500 kg

We know that $a = \frac{v-u}{t} = \frac{20-10}{5} = \frac{10}{5} = 2$ m/s2

and $F = ma$

$= 500 \times 2 = 1000$ N

Ans-2

mass (m) = 500 kg

acceleration (a) = 1.7 m/s²

$F = ma = 500 \times 1.7 = \frac{500 \times 17}{10} = 850\ N$

Ans-3

mass (m) = 100 kg

Initial velocity (u) = 5 m/s

final velocity (v) = 8 m/s

Time (t) = 6 second

we know that,

(i) Initial momentum (P_1) = mu = 100 × 5 = 500 kg-m/s

(ii) Final momentum (P_2) = mv = 100 × 8 = 800 kg-m/s

~~Force applied (F) = ma = 100~~

acceleration (a) = $\frac{v-u}{t} = \frac{8-5}{6} = \frac{3}{6} = \frac{1}{2}$ m/s²

(iii) Force (F) = ma = $100 \times \frac{1}{2} = 50N$

Ans-4

mass (m) = 5 kg

Distance (s) = 32 m

Time (t) = 4 sec

Initial velocity (u) = 0 m/s

we know that,

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

$32 = 0 \times 4 + \frac{1}{2} \times a \times 4 \times 4^2$

$32 = 8 \times a$

$a = \frac{32}{8} = 4\ m/s^2$

Force (F) = ma = 5 × 4 = 20 N

Ans-5

Initial velocity (u) = 54 km/h = $54 \times \frac{1000}{3600} = 15$ m/s

final velocity (v) = 0 m/s

Time (t) = 10 sec

mass (m) = 400 kg

acceleration (a) = $\frac{v-u}{t} = \frac{0-15}{10} = \frac{-15}{10} = -1.5\ m/s^2$

Force (F) = ma = 400 × −1.5 = −400 × 1.5 = −600 N

Ans-6

Initial velocity (u) = 20 m/s

final velocity (v) = 40 m/s

Distance (s) = 10 m

mass (m) = 500 kg

~~$s = ut + \frac{1}{2}at^2$~~ $v^2 = u^2 + 2as$

~~10 = 20~~ $(40)^2 = (20)^2 + 2 \times a \times 10$

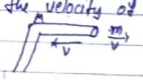
1600 = 400 + 20a

20a = 1200

$\boxed{a = 60}$ then Force (F) = ma = 500 × 60 = 30000 N

=> Applications of Conservation of motion → (i) Recoil of Gun

when a bullet is fired from a gun, then bullet impart an equal and opposite momentum to the gun due to which the gun jerk backward or recoil. Suppose. A mass of gun is 'M' and mass of bullet 'm' is fired from a gun with a velocity 'v' and the gun jerk backward by the velocity of 'V'. then according to Conservation law of momentum,



momentum of gun = momentum of bullet

$\boxed{MV = mv}$

Q→ A bullet of mass 10g is fired from a gun of mass 6 kg with a velocity of 300 m/s. Calculate the recoil velocity of gun.

Ans

m = 10g = $\frac{10}{1000}$ = 0.010 kg

M = 6 kg

v = 300 m/s

recoil velocity (u) = ?

momentum of gun = momentum of bullet

MU = mv

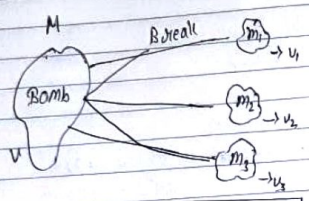
$6u = 0.010 \times 300$

$6u = \frac{1}{100} \times 300$

$u = \frac{3}{6} = \frac{1}{2} = 0.5$

u = 0.5 m/s

Explosion of Bomb →



Then $\boxed{mv = m_1v_1 + m_2v_2 + m_3v_3}$

$I = F \times t$

$F = ma$

$a = \frac{v-u}{t}$

$F = m \times \left(\frac{v-u}{t}\right)$

$I = m \times \frac{(v-u)}{t} \times t$

$\boxed{I = mv - mu}$ or

$mu = P_1$

$mv = P_2$

$\boxed{I = P_2 - P_1}$

⇒ **Impulse** → It is force applied for short duration of time. It is represented by I.

$\boxed{I = F \times t}$ SI unit is Newton Second.

or $\boxed{I = P_2 - P_1}$ or $\boxed{I = mv - mu}$

Q→ ~~A ball~~

Q→ A ball of mass 200 gm strike on a wall by speed of 20 m/s and bounce back by 10 m/s. Calculate Impulse.

Ans $m = 200 gm = \frac{200}{1000} = \frac{1}{5}$ kg

$u = 20$ m/s

$v = -10$ m/s

we know that, $I = F \times t$

$a = \frac{v-u}{t}$

$F = ma$

$= \left(\frac{v-u}{t}\right)m$

so, $I = m\left(\frac{v-u}{t}\right) \times t$

$= m(v-u)$

$= \frac{1}{5}(-10-20)$

$= \frac{1}{5}(-30) = -6$ NS.

Numericals based on Newton's IInd law of Motion

Q→1 What force would be needed to produce an acceleration of 4 m/s² in a ball of mass 6 kg?

Ans Given, $a = 4$ m/s²

$m = 6$ kg

$F = ma = 6 \times 4 = 24$ N

Q→2 What is the acceleration produced by a force of 12 N exerted on an object of mass 3 kg?

Ans $F = 12$ N

$m = 3$ kg

$F = ma$

$a = \frac{F}{m} = \frac{12}{3} = 4$ m/s²

Q→3 Calculate the force required to impart to a car a velocity of 30 m/s in 10 seconds starting from rest. The mass of the car is 1500 kg.

Ans Final velocity (v) = 30 m/s

Initial " (u) = 0 m/s

Time (t) = 10 s

Mass (m) = 1500 kg

$a = \frac{v-u}{t}$

$= \frac{30-0}{10}$

$= 3$ m/s²

$F = ma$

$= 1500 \times 3$

$= 4500$ N

Q→4 A truck starts from rest and rolls down a hill with constant acceleration. It travels a distance of 400 m in 20 s. Find the acceleration. Find the force acting on it if its mass is 7 metric tonnes.

Given, Initial velocity (u) = 0 m/s

Distance (s) = 400 m

Time (t) = 20 s

Mass (m) = 7 metric tonne

$= 7 \times 1000$ kg

$= 7000$ kg

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

$400 = 0 \times 20 + \frac{1}{2} \times a \times 20 \times 20$

$a = \frac{400}{200} = 2$ m/s²

$F = ma$

$= 7000 \times 2$

$= 14000$ N

Q→5 A force of 5 Newtons gives a mass m_1 an acceleration of 8 m/s², and a mass m_2 an acceleration of 24 m/s². What acceleration would it give if both the masses are tied together?

Ans Given,

Force (F) = 5 N

$a_1 = 8\ m/s^2$

$a_2 = 24\ m/s^2$

$F = m_1 a_1$

$m_1 = F/a_1$

$= \frac{5}{8} = 0.625$ kg

$F = m_2 a_2$

$m_2 = \frac{F}{a_2}$

$= \frac{5}{24} = 0.208$ kg

$m = m_1 + m_2$

$= 0.625 + 0.208 = 0.833$ kg

Or $= \frac{5}{8} + \frac{5}{24} = \frac{15+5}{24} = \frac{20}{24} = \frac{5}{6}$ kg

then, $a = \frac{F}{m} = \frac{5}{0.833} = \frac{5 \times 1000}{8333} = 6\ m/s^2$

$a = \frac{F}{m} = \frac{5}{5/6} = \frac{5 \times 6}{5} = 6\ m/s^2$

Q→6 Which would require a greater force - accelerating a 10 g mass at 5 m/s² or a 20 g mass at 2 m/s²?

Ans Given,

$m_1 = 10g = \frac{10}{1000} = kg$

$a_1 = 5\ m/s^2$

$F_1 = m_1 a_1$

$= \frac{1}{100} \times 5 = 0.05 N$

$m_2 = 20g = \frac{20g}{1000} = \frac{1}{50} kg$

$a_2 = 2\ m/s^2$

$F_2 = m_2 a_2$

$= \frac{1}{50} \times 2 = 0.04 N$

Thus, a greater force of 0.05 N is required for accelerating a 10 g mass.

Q→7 A stone of 1 kg is thrown with a velocity of 20 m s⁻¹ across the frozen surface of a lake and comes to rest after travelling a distance of 50 m. What is the force of friction between the stone and the ice?

Ans mass (m) = 1 kg

$u = 20\ m/s$

$v = 0\ m/s$

$s = 50\ m$

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

$0^2 = 20^2 + 2 \times a \times 50$

$0 = 400 + 100a$

$100a = -400$

$F = ma$

$= 1 \times -4$

$= -4 N$

Q→8 A 8000 kg engine pulls a train of 5 wagons, each of 2000 kg, along a horizontal track. If the engine exerts a force of 40000 N and the track offers a friction force of 5000 N, then calculate:
(a) the net accelerating force, (b) the acceleration of the train
(c) the force of wagon 1 on wagon 2.

(a) Force exerts by engine = 40000 N

Force opposing by track = 5000 N

Net accelerating force = 40000 − 5000 = 35000 N

(b) The train have 5 wagons and each of 2000 kg then total mass of the wagons = 5 × 2000 = 10000 kg

Net accelerating force = 35000 N

then, acceleration of the train (a) = $\frac{F}{m} = \frac{35000}{10000} = 3.5\ m/s^2$

(c) The train have 4 wagons behind wagon 1. Thus, mass of balance four wagons = 4 × 2000 = 8000 kg

~~Net accelerating force~~ and, the acceleration of the train (a) = 3.5 m/s²

Force of wagon 1 on wagon 2 = Mass of four wagons × acceleration of train

$= 8000 \times 3.5 = 8000 \times \frac{35}{10} = 28000$ Newtons.

Q→9 A bullet of mass 10 g travelling horizontally with a velocity of 150 m/s strikes a stationary wooden block and comes to rest in 0.03 s. Calculate the distance of penetration of the bullet into the block. Also calculate the magnitude of the force exerted by the wooden block on the bullet.

Ans $m = 10\ g = \frac{10}{1000} = \frac{1}{100} kg$

$u = 150\ m/s$

$v = 0$

$t = 0.03\ s = \frac{3}{100} s$

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

$0^2 = 150^2 + 2 \times a \times$

$a = \frac{v-u}{t} = \frac{0 - 150}{\frac{3}{100}} = \frac{-150 \times 100}{3}$

$a = -5000$

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

$= 150 \times \frac{3}{100} + \frac{1}{2} \times -5000 \times \frac{3}{100} \times \frac{3}{100}$

$= \frac{45}{10} - \frac{9}{4} = \frac{90-45}{20} = \frac{45}{20}$

$s = 2.25\ m$

$F = ma$

$= \frac{1}{100} \times (-5000)$

$= 50\ N$

Q→10 An object of mass 100 kg is accelerated uniformly from a velocity of 5 ms^{-1} to 8 ms^{-1} in 6 s. Calculate the initial and final momentum of the object. Also find the magnitude of the force exerted on the object.

Ans
$m = 100$ kg
$u = 5$ m/s
$v = 8$ m/s
$t = 6$ s

Initial $P = mu$
$= 100 \times 8$
$= 800$ kg m/s

Initial $P = mu$
$= 100 \times 5 = 500$ kgm/s

$a = \frac{v-u}{t}$
$= \frac{8-5}{6}$
$= \frac{3}{6} = 0.5$ m/s²

$F = ma$
$= 100 \times 0.5$
$= 100 \times \frac{5}{10}$
$= 50$ N

Q→11 How much momentum will a dumb-bell of mass 10 kg transfer to the floor if it falls from a height of 80 cm? Take its downward acceleration to be 10 m/s²?

Ans
$m = 10$ kg
$u = 0$
$a = 10$ m/s²
$s = 80$ cm $= \frac{8}{10}$ m

$v^2 = u^2 + 2as$
$= 0^2 + 2 \times 10 \times \frac{8}{10}$
$v = \sqrt{16} = 4$ m/s

$P = mv$
$= 10 \times 4$
$= 40$ kg m/s

★ NUMERICALS BASED ON ~~LAW OF~~ LAW CONSERVATION OF Momentum

Q→1 A bullet of mass 10 g is fired from gun of mass 6 kg with a velocity of 300 m/s. Calculate the recoil velocity of the gun.

Given, $m_1 = 6$ kg
$m_2 = 10g = \frac{10}{1000} = \frac{1}{100}$ kg
$V = 300$ m/s

$mU = mV$
$6u = \frac{1}{100} \times 300$

$u = \frac{1}{2} = 0.5$ m/s

Q→2 The Car A of mass 1500 kg, travelling at 25 m/s collides with another car of mass 1000 kg travelling at 15 m/s in the same direction. After collision the velocity of Car A becomes 20 m/s. Calculate the velocity of Car B after the collision.

Given,
mass of Car A $m_1 = 1500$ kg
Mass of Car B $m_2 = 1000$ kg
Velocity of Car A $u_1 = 25$ m/s
" " Car B $u_2 = 15$ m/s
" " Car A $v_1 = 20$ m/s

Acc. to Conservation law of momentum
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
$1500 \times 25 + 1000 \times 15 = 1500 \times 20 + 1000 v_2$
$37500 + 15000 = 30000 + 1000 v_2$
$52500 - 30000 = 1000 v_2$
$\frac{22500}{1000} = v_2$
$v_2 = 22.5$ m/s

Q→3 A bullet of mass 10 g moving with a velocity of 400 m/s gets embedded in a freely suspended wooden block of mass 900 g. What is the velocity acquired by block.

Ans Given,
mass of bullet $(m_1) = 10g = \frac{1}{100}$ kg
velocity " " $(u_1) = 400$ m/s
mass of Wooden block $(m_2) = 900g = \frac{9}{10}$ kg

$m_1u_1 = m_2v_2$
$\frac{1}{100} \times 400 = \frac{9}{10} v_2$
$v_2 = 4 \times \frac{10}{9} = 4.4$ m/s

Q→4 A boy of mass 50 kg running at 5 m/s jumps on to a 20 kg trolley travelling in the same direction at 1.5 m/s. What is their common velocity?

Ans Given,
mass of boy $(m_1) = 50$ kg
velocity " " $(u_1) = 5$ m/s
mass of trolley $(m_2) = 20$ kg
velocity " " $(u_2) = 1.5$ m/s
Find velocity will be same

$m_1u_1 + m_2u_2 = m_1v + m_2v$
$50 \times 5 + 20 \times 1.5 = 50v + 20v$
$250 + 30 = 70v$
$\frac{280}{70} = v$
$v = 4$ m/s

Q→5 A girl of mass 50 kg jumps out of a rowing boat of mass 300 kg on to the bank with a horizontal velocity of 3 m/s. At what velocity does the boat begin to move backwards?

Given, $m_1 = 50$ kg, $m_2 = 300$ kg
$v_1 = 3$ m/s, $v_2 = ?$

$m_1v_1 = m_2v_2$
$50 \times 3 = 300 v_2$
$\frac{150}{300} = v_2$
$v_2 = \frac{1}{2}$

$v_2 = 0.5$ m/s

after collision u_2 should be (−), on opposite direction
after collision, if both are stick together the final velocity will be same,

Q→6 A truck of mass 500 kg moving at 4 m/s collides with another truck of mass 1500 kg moving in the same direction at 2 m/s. What is their common velocity just after the collision if they move off together?

Ans Given, $m_1 = 500$ kg
$m_2 = 1500$ kg
$u_1 = 4$ m/s
$u_2 = 2$ m/s

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
$500 \times 4 + 1500 \times 2 = 500v + 1500v$
$2000 + 3000 = 2000v$
$v = \frac{5000}{2000} = 2.5$ m/s

Q→7 A ball X of mass 1 kg travelling at 2 m/s had a head-on-collision with an identical ball Y at rest. X stops and Y moves off. Calculate the velocity of Y after the collision.

Ans Before Collision, $m_1 = 1$ kg
$u_1 = 2$ m/s
$m_2 = 1$ kg
$u_2 = 0$ m/s
After Collision, $v_2 = 0$ m/s

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
$1 \times 2 + 1 \times 0 = 1 \times 0 + 1 \times v_2$
$2 + 0 = v_2$
$v = 2$

Q→8 A heavy car A of mass 2000 kg travelling at 10 m/s has a head-on-collision with a sports car B of mass 500 kg, if both car stops dead on colliding, what was the velocity of car B?

Ans Given, $m_1 = 2000$ kg
$u_1 = 10$ m/s
$m_2 = 500$ kg
$u_2 = ?$
$v_1 = 0$, $v_2 = 0$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
$2000 \times 10 + 500 \times u_2 = 2000 \times 0 + 500 \times 0$
$20000 + 500u_2 = 0$
$500u_2 = -20000$
$u_2 = -40$

Q→9 From a rifle of mass 4 kg, a bullet of mass 50 g is fired with an initial velocity of 35 m/s. Calculate the initial recoil velocity of the rifle?

Given,
$m_1 = 4$ kg
$m_2 = 50\,g = \frac{50}{1000} = \frac{1}{20}$ kg
$v_1 = ?$
$v_2 = 35$ m/s

$m_1v_1 = m_2v_2$
$4 \times v_1 = \frac{1}{20} \times 35$
$v_2 = \frac{7}{4} \times \frac{1}{4} = \frac{7}{16} = 0.4375$ m/s

Q→10 Two objects of masses 100 g and 200 g are moving along the same line and direction with velocities of 2 m/s and 1 m/s, respectively. They collide and after the collision, the first object moves at a velocity of 1.67 m/s. Determine the velocity of the second object.

Ans Given,
$m_1 = 100\,g = \frac{100}{1000} = \frac{1}{10}$ kg
$m_2 = 200\,g = \frac{200}{1000} = \frac{1}{5}$ kg
$u_1 = 2$ m/s
$u_2 = 1$ m/s
$v_1 = 1.67$ m/s

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
$\frac{1}{10} \times 2 + \frac{1}{5} \times 1 = \frac{1}{10} \times \frac{16}{10} + \frac{1}{5}v_2$
$\frac{1}{5} + \frac{1}{5} = \frac{16}{100} + \frac{1}{5}v_2$
$\frac{2}{5} - \frac{16}{100} = \frac{1}{5}v_2$
$\frac{40-16}{100} = \frac{1}{5}v_2$
$v_2 = \frac{6}{5} = 1.2$ m/s

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
$\frac{1}{10} \times 2 + \frac{1}{5} \times 1 = \frac{1}{10} \times 1.67 + \frac{1}{5}v_2$
$\frac{1}{5} + \frac{1}{5} = \frac{167}{1000} + \frac{1}{5}v_2$
$\frac{2}{5} - \frac{167}{1000} = \frac{1}{5}v_2$
$\frac{400-167}{1000} = \frac{1}{5}v_2$
$\frac{233}{1000} \times 5 = v_2$
$\frac{233}{200} = v_2$
$v_2 = 1.165$ m/s

WORK, POWER AND ENERGY

★ Work –

When we applied a force on the body and it produces motion, then we say that work is done on the body.

- Work done in moving a body is equal to the product of force exerted on the body and the distance moved by the body in the direction of force.

⇒ Suppose, a force of 'F' Newton act on a body and the body is displaced by 's' in the direction of force, then the work done by the

Work done = Force × displacement

$W = F \times s$

⇒ Work done by a force acting at an angle :- Suppose, a force F is acting on a body at an angle θ due to this force, body is displaced by 's' then work done.

So,

$W = F \times s \times \cos\theta$

$\cos 180° = -1$

⇒ Workdone by a force ~~acting~~ to upward :- Suppose, a force F is acting on a body having mass m to ~~height~~ distance h height then work done.

$W = mgh$

$W = F \times s$

$W = mg \times h$

$W = mgh$

g = gravity

$F = ma$

⇒ Workdone by a force ~~acts~~ to upward with an angle θ :- Suppose, a force is applied on a body to upward by with an angle then Workdone.

$W = mgh \sin\theta$

- The S.I unit of work is newton meter, which commonly known as Joule. In C.G.S System, the unit of work is 'erg'. 1 Joule = 10^7 Erg

Q→ A Force of 40N acting on a body at an angle of 60° and it displace by 4m. Calculate the work done.

Soln. $W = F \times s \times \cos\theta$

$= 40 \times 4 \times \cos 60°$

$= 160 \times \frac{1}{2} = 80\,J$

★ Work done when the force acts at right angles to the direction of motion

When the displacement of the body is perpendicular (at 90°) to the direction of force, no work is done. The workdone on a body in a circular path is also zero.

Eg:- Earth moving around the sun. the work done in this case is zero.

Eg:- A satellite moving round the earth thumb, work done here is also zero.

Eg- If a man carry suitcase strictly horizontally, he done no work with gravity.

★ Positive, Negative and zero Work →

(i) Work done is positive when a force acts in the direction of motion of the body.

(ii) Work done is negative when force acts opposite to the direction of motion of the body.

(iii) Work done is zero when a force acts at right angles to the direction of motion of the body.

★ On the basis of angle :-

$\theta < 90°$, workdone = +	$\theta = 90°$, workdone = 0
$\theta > 90°$, workdone = −	

★ Power – Power is defined as the rate of doing work.

$$\text{Power} = \frac{\text{Work done}}{\text{Time taken}} \quad \boxed{P = \frac{W}{T}}$$

Power is the work done per unit time :- when work is done, an equal amount of energy is consumed.

$$\text{Power} = \frac{\text{Energy consumed}}{\text{Time taken}} \quad \boxed{P = \frac{E}{T}}$$

Unit of power is watt. (Define watt) →
1 watt is the power of an appliance which does work at the rate of 1 Joule per second.

$$1 \text{ watt} = \frac{1 \text{ Joule}}{1 \text{ sec}}$$

⇒ 1 kilowatt = 1000 watts
1 Mega watt = 1000000 watts or 10^6 W
1 Horse power (hp) = 746 watts

★ Energy –

Energy is the ability to do work. The amount of energy possessed by a body is equal to the amount of work it can do when its energy is released. Energy is a scalar quantity.
The S.I unit of energy is Joule.
An energy required to do 1 Joule of work is called 1 Joule energy.

1 Kg = 1000 J

⇒ Different form of energy →

1. Mechanical energy — Kinetic Energy, Potential Energy
2. Chemical energy
3. Heat energy
4. Light energy
5. Sound energy
6. Electrical energy
7. Nuclear energy
8. Wave energy
9. Solar energy

Kinetic energy is the energy possessed by an object due to its motion. The K.E of an object increases with its speed. Eg:- A running car, A falling coconut, A rolling stone, A flying aircraft, flowing water, blowing wind, A running athlete etc.

Kinetic Energy → The energy of a body, value to its motion is called kinetic energy. Eg:- A Running Car.

Formula for kinetic Energy :- The kinetic energy of a moving body is measured by the amount of work it can do before comming to rest.
Suppose a body, such as a bull of mass m with zero initial velocity moves final velocity by abblying force 'f' with displaced by (s) distance.

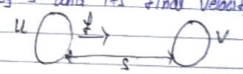
$v^2 = u^2 + 2as$
$v^2 = 0 + 2as$
$v^2 = 2as$
$s = \frac{v^2}{2a}$

$W = F \times s$
$W = ma \times \frac{v^2}{2a} = \frac{1}{2}mv^2$

Thus, the work will save in the form of KE.
So, KE $\boxed{K = \frac{1}{2}mv^2}$

⇒ Work energy theoram :-

According to this theoram, the change in kinetic energy of a body is allways equal to the work done by a body.
Suppose a body of mass 'm' has initial velocity 'u' of applying a force 'f'. this body displace by 's' and its final velocity become 'v'.



$v^2 = u^2 + 2as$
$v^2 - u^2 = 2as$
$s = \frac{v^2 - u^2}{2a}$ — (1)

work done by body,

$W = F \times s$
$W = ma \times \frac{(v^2 - u^2)}{2a}$
$W = \frac{mv^2 - mu^2}{2}$

$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$
$\boxed{W = K_f - K_i}$

∵ Initial K.E $= \frac{1}{2}mu^2$
Final K.E $= \frac{1}{2}mv^2$

⇒ Relation between kinetic energy and momentum :-

Suppose a body of mass 'm' moving with velocity 'v' then its momentum

$$P = mv$$

$$v = \frac{P}{m}$$

Kinetic energy $= \frac{1}{2}mv^2$

$$KE = \frac{1}{2}m\left(\frac{P}{m}\right)^2$$

$$= \frac{1}{2}m\frac{P^2}{m^2} = \frac{1}{2}\frac{P^2}{m} = \frac{P^2}{2m}$$

$$K = \frac{P^2}{2m}$$

★ POTENTIAL ENERGY -

The energy of a body value to its position or change in shape is known as potential energy. P.E is of 2 types.

- **Gravitational potential energy** → The energy of a body value to its position above the ground is called gravitational potential energy.
- **Elastic potential energy** → The energy of a body value to a change in its shape and size is called elastic potential energy.

⇒ Formula of Potential Energy :-

The potential energy of a body is due to the higher position above the earth and it is equal to the work done on the body against gravity in moving the body to that position.

W = Force × displacement

$W = (mg) \times h$

$\because W = mgh$

$\therefore P.E = mgh$

⇒ Using Energy Converters

→ In our everyday life, we make use of many appliances which converts one form of energy into another form.

1. Electric motors - Electric energy → mechanical energy.
2. Electric Iron : Electric energy → Heat energy
3. Electric bulb : Electric energy → Heat → Light energy
4. Radio : Electric energy → kinetic energy → Sound energy
5. Steam engine : Heat → kinetic energy
6. Car engine : Chemical energy → Heat → kinetic energy
7. Cell (or battery) : Chemical energy → Electrical energy
8. Gas stove : Chemical energy → Heat energy
9. Solar water heater : Sunlight → ~~electrical energy~~ Heat energy
10. Solar cell : Sun light → electrical energy
11. Microphone : Electrical Energy → Sound energy

⇒ Conservation law of Energy

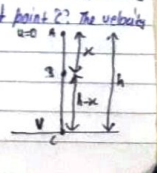
→ According to this law, the total energy of a body always remains constant. It means energy never be created and never be destroyed. It can only transform from one form to another.

⇒ Conservation law of mechanical energy

→ According to this law, for a freely falling body the sum of K.E and P.E is always constant. $\boxed{K + V = \text{Constant}}$

⇒ Proof

→ Suppose a body of mass 'm' is falling freely from point A at a height of 'h'. after droping a distance 'x' it reaches at point 'B'. Suppose the velocity of body at this point is 'v' and finally it reaches on the ground at point 'C'. The velocity of body at that point is 'V'.



At point A, K.E (K) = 0 P.E (U) = mgh T.E = P.E. K + U = 0 + mgh = mgh	At point B, by equation of motion $v^2 = u^2 + 2gx$

Numericals :- Work, power and Energy

Q.1 How much work is done by a force of 10N in moving an object through a distance of 1 m in the direction of the force ? [Ans :- 10 J]

Q.2:- Calculate the work done in lifting 200kg of water through a vertical height of 6 meters [Assume $g = 10 m/s^2$] Ans :- 12000 J

Q.3:- A car weighing 100 kg and travelling at 30 m/s stops at a distance of 50 m decelerating uniformly. what is the force exerted on it by the brakes? what is the work done by the brakes? [Ans :- 4.5×10^4 J]

Q.4:- Calculate the kinetic energy of a body of mass 2 kg moving with a velocity of 0.1 metre per second. [Ans - 0.01 J]

Q.5:- Two bodies of equal masses move with uniform velocities v and 3v respectively find the ratio of their kinetic energies [1:9]

Q.6:- How much work should be done on a bicycle of mass 20 kg to increase its speed from $2ms^{-1}$ to $5ms^{-1}$? [Ans - 210 J]

Q.7:- A bag of wheat weight 200 kg. To what height should it be raised so that its potential energy may be 98000 J [Ans :- h = 5m]

Q.8:- A body of mass 100 kg is lifted up by 10m. Find a: the amount of work done. (ii) potential energy of body at that height (value of $g \rightarrow 10 m/s^2$] Ans :- (i) 10,000 J (ii) 10,000 J

Q.9:- On a levels roads, a scooterist applies to slow down from a speed of 10 m/s to 5 m/s if the mass the scooterist and the scooter be 150 kg Calculate the work done by brakes [Ans - 5625]

Q.10:- A body of mass 2kg is thrown vertically upwards with an initial velocity of 20 m/s. what will be its potential energy at the end of 2 s ? [Assume g :- 10 m/s^2] Ans :- 400 J

Q.11:- A ball of mass 200 g falls from a height of 5 metres. what is its kinetic energy when it just reaches the ground [Ans :- 9.8 J] [g = 9.8 m/s^2]

Q.12:- A boy weighing 40 kg makes a high jump of 1.5 m. (i) what is his kinetic energy at the highest point ? (ii) what is his potential energy at the highest point ($g \rightarrow 10 m/s^2$) Ans/ (i) 600 J (ii) Ans → 600 J

Q.13:- The kinetic energy of an object of mass in moving with a velocity of $5ms^{-1}$ is 25 J. what will be its kinetic energy when its velocity is doubled ? what will be its kinetic energy when its velocity is increased three times ? [Ans - 225 J]

Q.14:- Certain force acting on a 20 kg mass changes its velocity from $5ms^{-1}$ to $2ms^{-1}$, Calculate the work done by the force [Ans - 21 kJ]

Q.15:- An object of mass 40 kg is raised to a height of 5 m above the ground. what is its potential energy? if the object is allowed to fall. find its kinetic energy when it is half way down ($g \rightarrow 10 m/s^2$) (Ans → 1000 J]

Q.16:- An electric heater is rated 1500 W. How much energy does it use in 10 hours ? (Ans → 15 units]

Q.17:- Calculate the work required to be done to stop a car of 1500 kg moving at a velocity of 60 km/h [Ans - 208333 J]

Q.18:- Find the energy in KWH consumed in 10 hours by four devices of power 500 W each. (Ans - 20 units)

Solutions

Ans-1 Given, F = 10 N, s = 1 m | $W = F \times s = 10 \times 1 = 10$ J

Ans-2 m = 200 kg, h = 6 m, g = 10 m/s^2 | $W = mgh = 200 \times 10 \times 6 = 12000$ J

Ans-3 m = 100 kg, u = 30 m/s, s = 50 m, v = 0 m/s | $v^2 = u^2 + 2as$; $0^2 = 30^2 + 2 \times a \times 50$; $0 = 900 + 100a$; $100a = -900$; $a = -9$ | F = ma = 100 × 9 = 900 N | $W = F \times s = 900 \times 50 = 45000 = 4.5 \times 10^4$ J

Ans-4 m = 2 kg, v = 0.1 m/s | $K = \frac{1}{2} m v^2 = \frac{1}{2} \times 2 \times \frac{1}{10} \times \frac{1}{10} = \frac{1}{100} = 0.01$ J

Ans-5 Velocity of first body $(v_1) = v$

" " Second " $(v_2) = 2v$

K.E of first body = K.E of second body

$\frac{1}{2}mv_1^2 = \frac{1}{2}mv_2^2$

$\frac{1}{2}mv^2 = \frac{1}{2}m(2v)^2$

$\frac{1}{2}mv^2 \times \frac{2}{m} = 4v^2$

$v^2 = 4v^2$ $\boxed{1:4}$

Ans-6
$m = 20\ kg$
$u = 2\ m/s$
$v = 5\ m/s$

By Work Energy theorem,
$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$
$= \frac{1}{2}m(v^2 - u^2)$
$= \frac{1}{2} \times 20\ (5^2 - 2^2)$
$= 10\ (25 - 4)$
$W = 210\ J$

Ans-7
$m = 200\ kg$
$PE = 9800\ J$

$P.E = mgh$
$9800 = 200 \times 9.8 \times h$
$h = \frac{9800 \times 10}{200 \times 98}$
$\boxed{h = 5\ m}$

Ans-8
$m = 100\ kg$
$h = 10\ m$
$g = 10\ m/s$

$W = P.E = mgh$
$= 100 \times 10 \times 10$
$= 10000\ J$

Because, $W = P.E$
So, $W = 10000\ J$

Ans-9
$u = 10\ m/s$
$v = 5\ m/s$
$m = 150\ kg$

By work Energy theorem,
$W = \frac{1}{2}m(v^2 - u^2)$
$= \frac{1}{2} \times 150\ (5^2 - 10^2)$
$= 75\ (25 - 100)$
$= 75 \times -75$
$W = -5625\ J$

Ans-10
$m = 2\ kg$
$u = 20\ m/s$
$t = 2\ s$

$s = ut + \frac{1}{2}at^2$
$h = ut + \frac{1}{2}gt^2$
$h = 20 \times 2 + \frac{1}{2} \times 10 \times 2^2$
$= 40 + 20$
$h = 60\ m$

$P.E = mgh$
$= 2 \times 10 \times 20$
$= 400\ J$

Ans-11
$m = 200\ kg$
$h = 5\ m$
$u = 0$

$v^2 = u^2 + 2as$
$v^2 = u^2 + 2gh$
$= 0^2 + 2 \times 9.8 \times 5$
$= 10 \times \frac{98}{10}$
$v^2 = 98$

$K.E = \frac{1}{2}mv^2 = \frac{1}{2} \times 200 \times 98$
$= 9800\ J$

Ans-12
$m = 40\ kg$
$h = 1.5\ m$
$g = 10\ m/s^2$

v should be zero on highest point
$K.E = \frac{1}{2}mv^2$
$= \frac{1}{2} \times 40 \times 0^2$
$= 0$

$P.E = mgh$
$= 40 \times 10 \times \frac{15}{10} = 600\ J$

Ans-13
$v = 5\ m/s$
$K.E = 25\ J$

$K.E = \frac{1}{2}mv^2$
$25 = \frac{1}{2}m \times 5^2$
$50/25 = m$
$\boxed{m = 2\ kg}$

If velocity double,
$v = 5 \times 2 = 10\ m/s$
$K.E = \frac{1}{2} \times 2 \times 10 \times 10 = 100\ J$

If velocity three times,
$v = 5 \times 3 = 15\ m/s$
$K.E = \frac{1}{2} \times 2 \times 15 \times 15$
$= 225\ J$

Ans-14
$m = 20\ kg$
$u = 5\ m/s$
$v = 2\ m/s$

Work energy theorem,
$W = \frac{1}{2}m(v^2 - u^2)$
$= \frac{1}{2}20(2^2 - 5^2)$
$= 10\ (4 - 25)$
$= 10 \times -21$
$= -210\ J$

Ans-15
$m = 40\ kg$
$h = 5\ m$
$g = 10\ m/s^2$

$P.E = mgh$
$= 40 \times 10 \times 5$
$= 2000\ J$

If object on half way,
$h = \frac{5}{2} = 2.5\ m$
and both potential and kinetic energy should be same.

mean,
$P.E = \frac{2000}{2} = 1000\ J$
$K.E = 1000\ J$

Ans-16
Power $= 1500\ W$
Time $= 10\ hrs$
$P = \frac{E}{T}$

$E = P \times T$
$E = 1500 \times 10$
$E = 15000\ Wh.$

$E = \frac{15000}{1000}\ KWh$
$= 15\ KWh.$

Ans-17
$m = 1500\ kg$
$v = 60\ km/h$
$u = \frac{50}{3}\ m/s$
$v = 0$

$W = \frac{1}{2}m(v^2 - u^2)$
$= \frac{1}{2} \times 1500\ (0^2 - (\frac{50}{3})^2)$
$= 750 \times -\frac{2500}{9} = \frac{-1875000}{9} = -208333.33\ J$

Ans-18 Power of each device $= 500\ W$

4 " fan 4 $= 4 \times 500 = 2000\ W$

Time $= 10\ hrs$

$P = \frac{E}{T}$

$E = P \times T$

$= 2000 \times 10 = 20000\ Wh.$

$E = \frac{20000}{1000} = 20\ KWh.$

Physics (Important Numericals)

Q→1 A diverging lens of focal length 15 cm form an image 10 cm from lens. Calculate the distance of object from lens. (Ans -30cm)

Q→2 A thin prism of angle 5° gives minimum deviation of 3.2°. Calculate the refractive index of prism. (1.64)

Q→3 A house wiring supplied with 220 volt supply protected by 6A fuse. Calculate the maximum number of 60 watt bulb in parallel that can be (22)

Q→4 4.5 cm needle is placed 12 cm away from a convex mirror of focal length 15 cm. Find the position, size and nature of image. (6.67, 2.5, virtual)

Q→5 A needle of 3 cm size placed 25 cm away from a concave mirror of focal length 10 cm. Find position, size and nature of image. (16.67, 2, Real)

Q→6 A resistance of wire is 20Ω. Calculate its new resistance if
(a) length of wire become 2 times (b) length 2 times by stretching.
(c) wire become double up by folding (d) diameter become half
(e) diameter become 2 times. (a) 40Ω, 80Ω, 5Ω, 80, 5Ω)

Q→7 An electric heating element consume 500 watt when voltage is 100 volt. If voltage become 150 volt. Calculate the power consumed. (1125W)

Q→8 Two lens first is convex of focal length 20 cm and second is concave of focal length 60 cm. Find the focal length, power and nature of combination. (30cm, 3.3D, convex)

Q→9 Two thin lenses are placed in contact and focal length of the combination is 80 cm. If focal length of one lens is 20 cm. Find the focal length and power of other lens. (-26.67, -3.75D)

Q→10 Three resistance 1Ω, 2Ω and 3Ω are connected in series by supply of 12 volt. Find potential difference at each resistance. (2V, 4V, 6V)

Q→11 Three resistance 10Ω, 20Ω and 30Ω are connected in parallel by a battery of 10 volt. Calculate (i) Total Resistance (ii) Voltage on each resistance (iii) Current on each (6Ω, 10V, 1.5, 0.5, 0.3A)

Q→12 A ray of light falling at angle of 45° is reflected through a prism and suffer minimum deviation prism angle is 60°. Find the refractive index for prism. (1.414)

Q→13 A ray falls on equilateral prism and suffer minimum deviation of 60°. Find the refractive index for prism. (Ans √3)

Q→14 Calculate the heat produced by 200W heater in 5 minute. (60000 J)

400, 0.5A

Q→15 If a bulb of 100 watt is connected by 200 volt supply. Find Resistant and current.

Q→16 A concave lens of focal length 15 cm form an image 10 cm from the lens. How far object placed also find magnification. Draw ray diagram. (-30 cm, 0.33, virtual, erect)

Q→17 Three Resistance are connected in parallel. Draw current 7.5A by 20 volt battery. Two resistance have 10Ω and 12Ω. Find out third resistance and current through each resistance. (Ans - 15Ω, 3A, 2.5A, 2A)

Q→18 A current 5mA passes through Resistance of 2200Ω and voltage. (Ans - 11 volt)

Q→19 Find speed of light in glass if its refractive index is 3/2. (2×10^8 m/s)

Q→20 An object height 6 cm is placed at a distance of 10 cm from a convex mirror with radius of curvature 30 cm. Find position (6cm), size (3.6cm) and nature of image. (Erect, virtual, diminish)

Q→21 Two lenses of 100W and 60W are connected in parallel by supply of 220 volt. Calculate current drawn. (Ans - 0.73A)

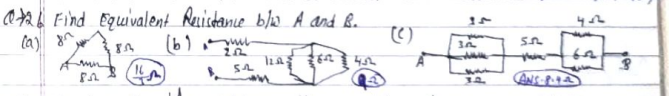
Q→22 Two lenses of focal length 20 cm and 30 cm are placed in contact. Find the focal length and power of combination. (Ans - 12 cm, 8.33 D)

Q→23 Two lenses of power 3.5D and -1.5D are placed in contact. Find focal length and power of combination. (Ans ⇒ 2D, 50 cm)

Q→24 Find the critide angle of a medium whose refractive index is 2/√3. (Ans - 60°)

Q→25 Three Resistance of 2Ω, 4Ω and 6Ω are connected in series by supply of 12 volt. Calculate (i) Total Resistance (ii) current and voltage on each resistance. (Ans - 1A, 2V, 4V, 6V)

Q→26 Find Equivalent Resistance b/w A and B.



Q→27 A wire of uniform thickness with a resistance of 27Ω is cut into three equal pieces and they are joined in parallel. Find the resistance in parallel combination. (3Ω)

Q→28 What current will be required by a lamp marked 225 volt and 40W. Find resistance of this lamp and heat produced in 5 minute. (0.18A, 1265.6Ω, 180000 J)

Q→29 There are three Resistance 10Ω, 15Ω and 30Ω. Find the ratio in the minimum and maximum Resistance in this combination. (1:3)

Q→30 A ray falls on a prism and suffer minimum deviation of 40°. If prism angle is 60°. Find refractive index for prism. (sin 50° = 0.7660) (Ans - 1.512)

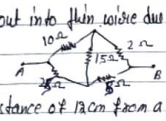
1.83

Q→31 For a thin prism, if angle of minimum is 5° and prism angle 6°. Find refractive index.

Q→32 An object 5 cm size is placed at the focus of convex lens of focal length 10cm. Find position, size and nature of image. Draw ray Diagram also. (=5cm, 2.5 cm, virtual)

Q→33 If two bulbs of 25 W and 100 W, each rated 220 volt connected in series with supply of 440 volt. Calculate potential across both the bulb. Connect whether any bulb will fuse. (52 volt, 88 volt, 2.5 W fuse)

Q→34 A wire of resistance 10 Ω is drawn out into thin wire due to flux its length become 3 times. Find new Resistance.



(ANS-90Ω)

8.55Ω Q→35 Find Equivalent Resistance b/w A and B.

Q→36 A needle of size 4.5 cm is placed at distance of 12cm from a convex mirror of focal length 15cm. Find position, size and nature of image. (ANS- 6cm, 2.5 cm, virtual erect)

(-80 cm) Q→37 Two lens of power +3.5 D and -4.75 D are placed in contact. Find the focal length of combination.

Q→38 Two lenses of focal length 20 cm and 50 cm are placed on same axes at 20 cm. Find Equivalent focal length and power. (ANS - 30 cm, 5 D)

Q→39 There is a prism of angle 60° has refractive index $\sqrt{2}$. In case of minimum deviation find (i) Angle of deviation (ii) Incidence Angle.

Q→40 In a coil the value of magnetic flux decreases from 12×10^{-3} weber to 6×10^{-3} weber in 0.01 sec. Calculate e.m.f produced in coil. (ANS - 0.6 volt)

Q→41 An electron enter in magnetic field by speed 5×10^{7} m/s at angle 30°. If magnetic field is 1 Tesla. Find magnetic force on it. (ANS - 4×10^{-12} N)

Q→42 There is a straight wire of length 10 cm having 10 A in it. placed perpendicular in magnetic field of 5 Tesla. Find magnetic force on it. (ANS - 5 N)

(2×10^{-5} T) Q→43 The current of 10 A flow in a straight wire. Find Mantic field at a point 10cm away from

Q→44 The current of 10A flow in a circular wire of radius 10cm. Find magnetic field at its centre. It has 1000 turn. (ANS - $2\pi\times10^{-3}$ T)

Q→45 The far point of a myopic person is 80cm. What is the nature and power of lens required to correct defect. (ANS → -1.25, Concave lens)

Q→46 The near point of hypermetropia Eye is 1m. Find the nature and power of lens required to correct defect. (ANS - 3D, Convex lens)

Q→47 An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5A. what result do you expect? (fuse, blown)

Date
Page

Q→48 A circuit has a fuse of 5A. What is the maximum number of 100 W (220V) bulbs of that can be safely used in the circuit? (x=11)

Q→49 What is the maximum number of 60 W bulbs that can be run from the main supply of 220 V if you do not want to overload a 5A fuse? (18 bulbs)

Q→50 A 1.25 kW heater works on a 220V mains supply. what current rating would a suitable fuse have? 5.68A

Q→51 An electric lamp of 100 Ω, a toaster of resistance 50 Ω and a water filter of resistance 500 Ω are connected in parallel to a 220V source. what is the resistance of an electric iron connected to the same source that takes as much current as all three appliances and what is the current through it? (7.04A)

Q→52 How can three resistors of resistance 2Ω, 3Ω and 6Ω be connected to give a total resistance of (a) 4Ω, (b) 1Ω?

Q→53 what is (a) the highest and (b) the lowest, total resistance that can be secured by the combination of four coils of resistance 4Ω, 8Ω, 12Ω, 24Ω? (48Ω, 2Ω)

Q→54 Compute the heat generated while transferring 9600 coulomb of charge in one hour through a potential ~~differential~~ difference of 50V. (4.8×10^{5} J)

Q→55 An electric iron of resistance 20Ω takes a current of 5A. Calculate the total heat developed in 30 s. (15000 J)

Q→56 An electric motor takes 5A from a 220V line. Determine the power of the motor and the energy consumed in 2 h. (7.92×10^{6} J)

Q→57 An electric bulb is rated 220 V and 100 W when it is operated on 110V, the power consumed calculate. (25 W)

Q→58 When a 12V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor. (4800 Ω)

Q→59 A battery of 9V is connected in series with resistors of 0.2Ω, 0.3Ω, 0.4Ω, 0.5Ω and 12Ω resistor? (I = 0.67A)

Q→60 How many 176Ω resistors in parallel are need to carry 5A on a 220V line. (x=4)

Q→61 Several electric bulbs designed to be used on a 220V electric supply line are rated 10 W each. How many bulbs can be connected in parallel with each other across the two wires of 220V line if the maximum allowable current is 5A? (110 bulbs)

Q→62 Two lamps, one rated 100W at 220V and the other 60W at 220V are connected in parallel to electric mains supply. What current is drawn from the line if the supply voltage is 220V? ($I = 0.727A$ or $0.73A$)

Q→63 Which uses more energy, a 250W TV set in 1 hr or a 1800W toaster in 10 min?

Q→64 An electric heater of resistance 8Ω draws 15A from the service mains for 2 hours. Calculate the rate at which heat is developed in the heater. ($P = 1800W$)

($f = -160cm$)

Q→65 Find the focal length of a convex mirror whose radius of curvature is 32 cm.

Q→66 Find the power of a concave lens of focal length 2m. (−0.5)

Q→67 An object 5cm in length is held 25cm away from a converging lens of focal length 10cm. Draw the ray diagram and find the position, size and nature of the image formed. (16.67, −3.3 cm)

Q→68 A concave lens of focal length 15 cm forms an image 10 cm from the lens. How far is the object from the lens? Draw the ray diagram. ($u = -30cm$)

Q→69 An object 5.0 cm in length is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position of the image, its nature and size. (8.1 cm) (8.57 cm)

Q→70 An object of size 7.0 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed so that a sharp focussed image can be obtained? Find the size and nature of the image. (14.0 cm) (−54 cm)

($f = -50cm$)

Q→71 Find the focal length of a lens of power, −20D. What type of lens is this?

Q→72 A doctor has prescribed a corrective lens of power +1.5D. Find the focal length of the lens. Is the prescribed lens diverging or converging? ($f = 66.7cm$)

Q→73 The filament of a lamp is 80 cm from a screen and a converging lens forms an image of it on a screen, magnified three times. Find the distance of lens from the filament and the focal length of the lens.

ANS-1 $f = -15cm$, $v = -10cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$-\frac{1}{15} = \frac{1}{-10} - \frac{1}{u}$

$-\frac{1}{u} = \frac{1}{10} - \frac{1}{15}$

$\frac{1}{u} = \frac{1}{15} - \frac{1}{10}$

$\frac{1}{u} = -\frac{1}{30}$

$u = -30$

ANS-2 $A = 5°$, $D = 3.2$

$D = (n-1)A$

$3.2 = (n-1)5$

$n - 1 = \frac{3.2}{5}$

$n - 1 = 0.64$

$n = 1 + 0.64$

$n = 1.64$

Ans-3 $V = 220V$, $I = 6A$, $W = 60W$

Total Power supported by fuse (P) = VI

$P = 220 \times 6 = 1320$ watt

maximum No. of bulb = $\frac{\text{Total Power}}{\text{1 bulb power}} = \frac{1320}{60} = 22$ bulb.

Ans-4 $h_1 = 4.5cm$, $u = -12cm$, $f = 15cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{15} = \frac{1}{v} + \frac{1}{-12}$

$\frac{1}{v} = \frac{1}{15} + \frac{1}{12}$

$\frac{1}{v} = \frac{4+5}{60} = \frac{9}{60}$

$v = \frac{20}{3} = 6.67$

$v = 6.67$

$m = \frac{h_2}{h_1} = -\frac{v}{u}$

$\frac{h_2}{4.5} = +\frac{20/3}{+12}$

$h_2 = \frac{20}{3} \times \frac{1}{12} \times \frac{45}{10} = 2.5$

$h = 2.5$

virtual.

Erect

Ans-5 $h_1 = 3cm$, $u = -25cm$, $f = -10cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{-10} = \frac{1}{v} - \frac{1}{25}$

$\frac{1}{v} = \frac{1}{25} - \frac{1}{10}$

$\frac{1}{v} = \frac{2-5}{50} = -\frac{3}{50}$

$v = -\frac{50}{3} = -16.67$

$v = 16.67$

$\frac{h_2}{h_1} = -\frac{v}{u}$

$\frac{h_2}{3} = -\frac{-50/3}{-25}$

$h_2 = -\frac{50}{3} \times \frac{1}{25} \times 3$

$h_2 = -2$

Real, Inverted.

ANS-6 $R = 20\Omega$, $R = \rho\left(\frac{l}{A}\right)$, $20 = \rho\left(\frac{l}{A}\right) \rightarrow (1)$

(i) $R_1 = \rho\left(\frac{2l}{A}\right) = 2 \times \rho(l/A) = 2 \times 20 = 40\Omega$

(ii) $R_2 = \rho\left(\frac{2l}{A/2}\right) = 2 \times 2 \times \rho(l/A) = 4 \times 20 = 80\Omega$

(iii) $d_1 = \frac{d}{2}$, $A_2 = A/4$

$R_3 = \rho\left(\frac{l}{A/4}\right) = \frac{1}{2} \times \frac{1}{2} \times \rho(l/A) = \frac{1}{4} \times 20 = 5\Omega$

$R_4 = \rho\left(\frac{l}{A/4}\right) = 4 \times \rho(l/A) = 4 \times 20 = 80\Omega$

(v) $d_1 = 2d$, so $A = A/4$ $R_5 = \rho\left(\frac{d}{A/4}\right) = \frac{1}{4} \times \rho(l/A) = \frac{1}{4} \times 20 = 5\Omega$.

ANS-7 $P = 500W$, $V = 100V$, $V_1 = 150V$

$P = \frac{V^2}{R}$

$500 = \frac{(100)^2}{R}$

$R = \frac{10000}{500}$

$R = 20\Omega$

now, $P = \frac{V_1^2}{R}$

$P = \frac{(150)^2}{20}$

$P = \frac{150 \times 150}{20} = 1125W$

ANS-8 $f_1 = 20cm$, $f_2 = -60cm$

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{f} = \frac{1}{20} - \frac{1}{60} = \frac{3-1}{60} = \frac{2}{60} = \frac{1}{30}$

$f = 30cm$

$f = \frac{30}{100} = 0.3m$

$P = \frac{1}{f}$

$= \frac{1}{0.3}$

$= 1 \times \frac{10}{3}$

$= 3.33D$

Nature - Convex lens

bcz power is positive (+).

ANS-9

$f = 80\ cm$, $f_1 = 20\ cm$

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{80} = \frac{1}{20} + \frac{1}{f_2}$

$\frac{1}{f_2} = \frac{1}{80} - \frac{1}{20} = \frac{1-4}{80} = -\frac{3}{80}$

$f_2 = -\frac{80}{3} = -26.67\ cm$

$P_2 = \frac{1}{f} = \frac{1}{-\frac{80}{3} \times \frac{1}{100}} = -\frac{300}{80} = -3.75$

$P_2 = -3.75\ D$

ANS-10 Current Same in series.

$V = 12V$, $R_1 = 1\Omega$, $R_2 = 2\Omega$, $R_3 = 3\Omega$

$R = R_1 + R_2 + R_3 = 1 + 2 + 3$, $R = 6$

$V = IR$, $I = \frac{V}{R} = \frac{12}{6} = 2A$

$V_1 = IR_1 = 2 \times 1 = 2V$

$V_2 = IR_2 = 2 \times 2 = 4V$

$V_3 = IR_3 = 2 \times 3 = 6V$

ANS-11 Voltage same in parallel

$V = 10V$, $R_1 = 10\Omega$, $R_2 = 20\Omega$, $R_3 = 30\Omega$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{10} + \frac{1}{20} + \frac{1}{30} = \frac{6+3+2}{60} = \frac{11}{60}$

$R = \frac{60}{11}\Omega$, $R = 5.45\Omega$

$V = IR$, $10 = I \times \frac{60}{11}$, $I = \frac{110}{60} = \frac{11}{6}A$

$I_1 = \frac{V}{R_1} = \frac{10}{10} = 1A$

$I_2 = \frac{10}{20} = 0.5A$

$I_3 = \frac{10}{30} = 0.3A$

$V_1 = V_2 = V_3 = 10V$

ANS-12

$i = 45°$, $A = 60°$, $r = R/2 = 30°$

$n = \frac{\sin i}{\sin r}$, $n = \frac{\sin 45°}{\sin 30°}$, $n = \frac{1/\sqrt{2}}{1/2} = \frac{1}{\sqrt{2}} \times \frac{2}{1} = \frac{\sqrt{2} \times \sqrt{2}}{\sqrt{2}} = \sqrt{2}$

ANS-13

$D = 60°$, $A = 60°$

$i = \frac{A+D}{2} = \frac{60+60}{2} = \frac{120}{2} = 60°$

$i = 60°$, $r = A/2 = 60/2 = 30°$

$n = \frac{\sin i}{\sin r} = \frac{\sin 60°}{\sin 30°} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \frac{\sqrt{3}}{2} \times \frac{2}{1} = \sqrt{3}$

ANS-14

$P = 200\ W$, $t = 5min = 300 sec.$

$P = \frac{W}{t}$, $W = P \times t$

$W = 200 \times 300 = 60000\ J$

ANS-15

$P = 100\ W$, $V = 200\ V$

$P = \frac{V^2}{R}$, $R = \frac{V^2}{P}$

$R = \frac{200 \times 200}{100}$, $R = 400\Omega$

$V = IR$, $I = V/R$

$I = \frac{200}{400}$, $I = 0.5A$

ANS-16

$f = -15\ cm$, $V = -10\ cm$

$\frac{1}{f} = \frac{1}{V} - \frac{1}{u}$

$\frac{1}{-15} = \frac{1}{-10} - \frac{1}{u}$

$-\frac{1}{u} = \frac{1}{10} - \frac{1}{15}$

$-\frac{1}{u} = \frac{3-2}{30} = \frac{1}{30}$

$u = -30$

$m = -\frac{V}{u} = \frac{+10}{+30} = \frac{1}{3} = 0.33$

virtual, Erect.

ANS-17

$I = 7.5A$, $V = 30V$, $R_1 = 10\Omega$, $R_2 = 12\Omega$, $R_3 = ?$

$V = IR$, $R = V/I = \frac{30}{7.5} = 4\Omega$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$\frac{1}{4} = \frac{1}{10} + \frac{1}{12} + \frac{1}{R_3}$

$\frac{1}{4} = \frac{6+1}{60} + \frac{1}{R_3}$

$\frac{1}{R_3} = \frac{1}{4} - \frac{11}{60}$

$\frac{1}{R_3} = \frac{15-11}{60} = \frac{4}{60} = \frac{1}{15}$

$R_3 = 15\Omega$

$I_1 = \frac{V}{R_1} = \frac{30}{10} = 3A$

$I_2 = \frac{V}{R_2} = \frac{30}{12} = 2.5A$

$I_3 = \frac{V}{R_3} = \frac{30}{15} = 2A$

ANS-18

$I = 5mA = 5 \times 10^{-3} A$, $R = 2200\Omega$

$V = IR = 5 \times 10^{-3} \times 2200$

$= \frac{5 \times 2200}{1000} = 11$ Volt

ANS-19

refractive index $(n) = 3/2$, speed of light in air $(c) = 3 \times 10^8\ m/s$

$n = \frac{c}{v}$, $v = \frac{c}{n}$

$v = \frac{3 \times 10^8}{3/2} = \frac{3 \times 10^8 \times 2}{3} = 2 \times 10^8\ m/s$

ANS-20

$h_1 = 6cm$, $u = -10cm$, $R = 30cm$

$f = R/2$, $f = 15cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{15} = \frac{1}{v} - \frac{1}{10}$

$\frac{1}{v} = \frac{1}{15} + \frac{1}{10}$

$\frac{1}{v} = \frac{2+3}{30} = \frac{5}{30}$

$v = 6cm$

$\frac{h_2}{h_1} = \frac{-v}{u}$

$\frac{h_2}{6} = \frac{+6}{+10}$

$h_2 = \frac{36}{10} = 3.6cm$

virtual Erect.

$h_2 = 3.6cm$, $v = 6cm$

ANS-21

$P_1 = 100\ W$, $P_2 = 60\ W$

$V = 220V$, $P = P_1 + P_2 = 160W$

$P = VI$, $I = P/V = \frac{160}{220}$

$I = \frac{8}{11} = 0.72\ A$

ANS-22

$f_1 = 20\ cm$, $f_2 = 30\ cm$

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{20} + \frac{1}{30}$

$f = \frac{60}{5} = 12\ cm$

$P = \frac{1}{f} = \frac{1}{12/100}$

$P = \frac{100}{12} = 8.33\ D$

ANS-23

$P_1 = 3.5D$, $P_2 = -1.5D$

$P = P_1 + P_2 = 3.5 - 1.5 = 2D$

$P = +2D$, $P = \frac{1}{f}$

$2 = \frac{1}{f}$, $f = \frac{1}{2}m$

$f = \frac{1}{2} \times 100 = 50\ cm$

$f = 50cm$, $P = +2D$

ANS-24

$n = 2/\sqrt{3}$

$n = \frac{1}{\sin c}$, $\sin c = \frac{1}{n}$, $\sin c = \frac{1}{2/\sqrt{3}}$, $\sin c = \frac{\sqrt{3}}{2}$

$\sin c = \sin 60°$, $c = 60°$

ANS-25

$V = 12V$, $R_1 = 2\Omega$, $R_2 = 4\Omega$, $R_3 = 6\Omega$

$R_e = R_1 + R_2 + R_3 = 2 + 4 + 6$, $R = 12\Omega$

$V = IR$, $I = \frac{V}{R} = \frac{12}{12} = 1A$

$V_1 = IR_1 = 1 \times 2 = 2V$

$V_2 = IR_2 = 1 \times 4 = 4V$

$V_3 = IR_3 = 1 \times 6 = 6V$

ANS-26 (a)

$R_4 = 8 + 8 = 16\Omega$

$\frac{1}{R} = \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{8} + \frac{1}{16} = \frac{2+1}{16} = \frac{3}{16}$

$R = \frac{16}{3}\Omega$

(b)

$\frac{1}{R_6} = \frac{1}{12} + \frac{1}{6} + \frac{1}{4} = \frac{1+2+3}{12} = \frac{6}{12} = \frac{1}{2}$

$R_6 = 2\Omega$

$R = R_4 + R_5 + R_6 = 2 + 5 + 2 = 9\Omega$

(1) $\frac{1}{R_7} = \frac{1}{3} + \frac{1}{2} + \frac{1}{3}$; $\frac{1}{R_7} = \frac{1+1+1}{3} = \frac{3}{3} = 1$ | $R_7 = 1\Omega$; $\frac{1}{R_8} = \frac{1}{6} + \frac{1}{4}$ | $\frac{1}{R_8} = \frac{2+3}{12} = \frac{5}{12}$; $R_8 = \frac{12}{5}\Omega$ | $R = R_7 + R_4 + R_8 = 1 + 5 + \frac{12}{5} = \frac{5+25+12}{5} = \frac{42}{5}$; $R = 8.4\Omega$

ANS-27 $R = 27\Omega$; $\because R \propto l$ | $R_1 = \frac{R}{3} = \frac{27}{3} = 9\Omega$ | $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{9} + \frac{1}{9} + \frac{1}{9}$ | $\frac{1}{R} = \frac{1+1+1}{9} = \frac{3}{9} = \frac{1}{3}$; $R = 3\Omega$

ANS-28 $t = 5$ min, $P = 40W$, $V = 225V$ | $P = \frac{V^2}{R}$; $R = \frac{V^2}{P}$ | $R = \frac{225 \times 225}{40} = \frac{10125}{8} = 1265.625\Omega$ | $V = IR$; $I = \frac{V}{R}$ | $I = \frac{225}{1265.625} = \frac{45}{8} = 0.18A$ | $H = Vit = \frac{45}{8} \times 300 = 12000 J$

ANS-29 $R_1 = 10\Omega$, $R_2 = 15\Omega$, $R_3 = 30\Omega$ | min $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{10} + \frac{1}{15} + \frac{1}{30} = \frac{3+2+1}{30} = \frac{6}{30} = \frac{1}{5}$ | max $R = 5\Omega$; $R = R_1 + R_2 + R_3 = 10 + 15 + 30$ | $R = 55\Omega$; Ratio $\frac{R_1}{R_2} = \frac{5}{55} = \frac{1}{11}$ | 1 : 11

ANS-30 $A = 60°$, $D = 40°$ | $r = \frac{A}{2} = 30°$; $i = \frac{A+D}{2} = \frac{60+40}{2} = 50°$ | $n = \frac{\sin i}{\sin r} = \frac{\sin 50°}{\sin 30°} = \frac{0.7660}{\frac{1}{2}} = 0.7660 \times 2 = 1.532$

Prism Division

ANS-31 $A = 6°$, $D = 5°$ | $D = (n-1)A$, $5 = (n-1)6$ | $n - 1 = \frac{5}{6}$; $n = \frac{5}{6} + 1$ | $n = \frac{5+6}{6} = \frac{11}{6}$; $n = 1.83$

ANS-32 $h_1 = 5cm$, $f = 10cm$, $u = -10cm$ | $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$; $\frac{1}{10} = \frac{1}{v} - \frac{1}{-10}$; $\frac{1}{v} = \frac{1}{10} - \frac{1}{10}$ | $\frac{1}{v} = 0$; $v = \infty$ Infinite | $\frac{h_2}{h_1} = \frac{v}{u}$; $\frac{h_2}{5} = \frac{0}{-10}$; $h_2 = 0$

Infinite and Highly Enlarged.

ANS-33 $V_1 = V_2 = 220V$, $P_1 = 25W$, $P_2 = 100W$, $V = 440V$ | $P_2 = \frac{V^2}{R_2}$; $R_2 = \frac{V^2}{P_2}$; $R_2 = \frac{220 \times 220}{100}$; $R_2 = 484\Omega$ | Voltage across bulb 1, $V_1 = IR_1$; $V_1 = 0.1818 \times 1936$; $V_1 = 352V$

Resistance of bulb $R_1 = \frac{V^2}{P_1} = \frac{V^2}{R_1} \Rightarrow$; $R_1 = \frac{220 \times 220}{25}$; $R_1 = 1936$

Current flowing in circuit $I = \frac{V}{R_1 + R_2} = \frac{440}{1936 + 484}$; $I = 0.1818$

$V_2 = IR_2 = 0.1818 \times 484$; $V_2 = 88V$

$\because$ max. Power supply of bulb = 220V, if V_1 take 352V, V_2 take 88V

So, bulb 1 Power 25W will fuse first.

Drawn out → Stream

ANS-34 $R = 10\Omega$ | $R = 9(\rho/A) = 10$; $9\left(\frac{2\rho}{A/3}\right)$ | $R = 9 \times 9(\rho/A) = 9 \times 10 = 90\Omega$

Ans-35 $= \frac{10}{25} = \frac{2}{5}$ (because there is a wheat stone bridge. So, no current will be passed in R=15Ω.

$R_6 = R_1 + R_2 = 10 + 2 = 12\Omega$, $R_7 = R_3 + R_4 = 25 + 5 = 30\Omega$ | $\frac{1}{R} = \frac{1}{R_6} + \frac{1}{R_7} = \frac{1}{12} + \frac{1}{30}$ | $\frac{5+2}{60} = \frac{7}{60}$; $R = \frac{60}{7}\Omega = 8.57\Omega$

ANS-36 $h_1 = 4.5cm$, $h = -12cm$, $f = 15cm$ | $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$; $\frac{1}{15} = \frac{1}{v} + \frac{1}{-12}$; $\frac{1}{v} = \frac{1}{15} + \frac{1}{12}$ | $\frac{1}{v} = \frac{4+5}{60}$; $\frac{1}{v} = \frac{9}{60} = \frac{3}{20}$; $v = \frac{20}{3} = 6.67cm$ | $\frac{h_2}{4.5} = \frac{-20/3}{-12}$; $h_2 = \frac{5}{3} \times \frac{1}{12} \times \frac{45}{2} = \frac{5}{2}$; $h_2 = 2.5cm$ | Virtual, Erect.

Ans-37 $P_1 = +3.5D$, $P_2 = -4.75D$ | $P = P_1 + P_2 = 3.5 - 4.75$ | $P = -1.25D$; $f = \frac{1}{P}$ | $f = \frac{1}{-1.25}$; $f = -\frac{100}{125} \times 4$ | $f = -\frac{4}{5} \times 20$; $f = -80cm$

Ans-38 $f_1 = 20cm$, $f_2 = 50cm$, $d = 20cm$ | $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$; $= \frac{1}{20} + \frac{1}{50} - \frac{20}{1000}$; $\frac{1}{f} = \frac{1}{20} + \frac{1}{50} - \frac{1}{50}$ | $\frac{1}{f} = \frac{1}{20}$; $f = 20cm$; $f = \frac{20}{100} = \frac{1}{5}m$ | $P = \frac{1}{f} = \frac{1}{1/5} = 5D$

Ans-39 $A = 60°$, $n = \sqrt{2}$ | $r = A/2 = 30°$; $n = \frac{\sin i}{\sin r}$; $\sqrt{2} = \frac{\sin i}{\sin 30°}$; $\sin i = \frac{1}{2} \times \sqrt{2} = \frac{1}{\sqrt{2}}$ | $\sin i = \sin 45°$; $i = 45°$ | $i = \frac{A+D}{2}$; $45 = \frac{60+D}{2}$ | $90° = 60 + D$; $D = 30°$

Ans-40 $\phi_1 = 12 \times 10^{-3}$, $\phi_2 = 6 \times 10^{-2}$ | $\phi = \phi_2 - \phi_1 = 12 \times 10^{-2} - 6 \times 10^{-2} = 6 \times 10^{-3}$ | $t = 0.01$ sec ; $e = N\left(\frac{\Delta\phi}{\Delta t}\right)$ | $= 1\left(\frac{6 \times 10^{-2}}{\frac{1}{100}}\right)$; $= \frac{6 \times 100}{100}$; $= \frac{6}{10}$ | $e = 0.6$ volt

Ans-41 $V = 5 \times 10^7 m/s$, $\theta = 30°$, $B = 1$ Tesla | $F = qvB \sin\theta = 1.6 \times 10^{-19} \times 5 \times 10^7 \times 1 \times \sin 30°$ | $= 40 \times 10^{-12}$; $= 4 \times 10^{-12} N$

Ans-42 $d = 10cm = \frac{10}{100}m$, $I = 10A$, $B = 5T$, $\theta = 90°$ | $F = IBd \sin\theta = 10 \times 5 \times \frac{10}{100} \times \sin 90°$ | $= \frac{50 \times 1}{10}$; $F = 5N$

Ans-43 $I = 10A$, $r = 10cm = 0.1m$ | $B = 2 \times 10^{-7}\left(\frac{I}{r}\right)$; $= 2 \times 10^{-7}\left(\frac{10}{1/10}\right)$ | $= 2 \times 10^{-7} \times 100$; $= 2 \times 10^{-5} T$

ANS-44

$I = 10A$, $r = 10\ cm = 0.1m$

$B = \frac{\mu_0}{2\pi}\left(\frac{I}{r}\right) = 10^{-7} \times 2\pi \times 10^{-7}$

$= 10^{-7} \times 2\pi \times 10^{-7} \times \frac{10}{1/10}$

$= 2\pi \times 10^{-2}\ T$

ANS-45

$V = -80\ cm$, $u = -\infty$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-80} - \frac{1}{-\infty}$

$\frac{1}{f} = -\frac{1}{80}$, $f = -80\ cm$

$P = \frac{1}{f} = \frac{100}{-80} = -1.25\ D$

Concave lens

ANS-46

$V = -1m = -100\ cm$, $u = -25\ cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-100} + \frac{1}{25} = \frac{-1+4}{100}$

$\frac{1}{f} = \frac{3}{100}$, $f = \frac{100}{3}\ cm$

$f = \frac{100}{3} \times \frac{1}{100} = \frac{1}{3} m$

$P = \frac{1}{f} = \frac{1}{1/3} = 3D$

Convex lens

ANS-47

$I = 5A$, $V = 220V$

$P = VI$, $2000 = 220 \times I$

$I = \frac{2000}{220}$, $I \simeq 9A$

fuse blown off

ANS-48

$I = 5A$, $V = 220V$

$P = VI$, $P = 220 \times 5$, $P = 1100\ W$

No. of bulbs $(x) = \frac{1100}{100} = 11$ bulbs

ANS-49

$V = 220V$, $I = 5A$

$P = 220 \times 5 = 1100\ W$

$x = \frac{1100}{60} = 18.33$

$x = 18$ bulbs

ANS-50

$P = 1.25\ KW = \frac{125}{100} \times 1000 = 1250\ W$

$V = 220V$, $P = VI$, $I = P/V$

$I = \frac{1250}{220} = 5.68A$

ANS-51

$R_1 = 100\Omega$, $R_2 = 50\Omega$, $R_3 = 500\Omega$

$V = 220V$

$\frac{1}{R} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500} = \frac{5+10+1}{500}$

$R = \frac{500}{16} = \frac{125}{4}\Omega$

$V = IR$, $I = V/R$

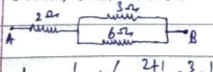
$I = \frac{44}{220} \times \frac{4}{125/25}$

$I = \frac{176}{25}$

$I = 7.04\ A$

ANS-52

Suppose, first condition



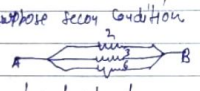
$\frac{1}{R} = \frac{1}{3} + \frac{1}{6} = \frac{2+1}{6} = \frac{3}{6} = \frac{1}{2}$

$R_1 = 2\Omega$

$R = R_1 + R_2$

$= 2 + 2 = 4\Omega$

Suppose second condition



$\frac{1}{R} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6}$

$= \frac{3+2+1}{6} = \frac{6}{6} = 1\Omega$

Highest Resistance when in series & lowest Resistance when in parallel.

ANS-53

$R_0 = 4 + 8 + 12 + 24 = 48\Omega$

$\frac{1}{R} = \frac{1}{4} + \frac{1}{8} + \frac{1}{12} + \frac{1}{24} = \frac{6+3+2+1}{24} = \frac{12}{24} = \frac{1}{2} = 0.5\Omega$

ANS-54

$q = 9600$ coulombs, $t = 1h = 3600\ sec$, $V = 50V$

$I = \frac{q}{t} = \frac{9600}{3600} = \frac{240}{9} A$

$E = Vit = 50 \times \frac{240}{9} \times 3600 = 4800000\ J = 4.8 \times 10^6\ J$

ANS-55

$R = 20\Omega$, $I = 5A$, $t = 30s$

$V = IR = 5 \times 20 = 100V$

$E = Vit = 100 \times 5 \times 30 = 15000\ J$

OR $E = I^2Rt = 5^2 \times 20 \times 30 = 15000\ J$

ANS-56

$I = 5A$, $V = 220V$, $t = 2h = 7200s$

$V = IR$, $R = V/I = \frac{220}{5} = 44\Omega$

$P = \frac{V^2}{R} = \frac{220 \times 220}{44} = 1100\ W$

$E = Pxt = 1100 \times 7200 = 7920000\ J = 7.92 \times 10^6\ J$

ANS-57

$V = 220V$, $P = 100W$

$P = \frac{V^2}{R}$, $R = \frac{V^2}{P} = \frac{220 \times 220}{100} = 484\Omega$

$P = \frac{V^2}{R} = \frac{100}{484} = \frac{100}{4} = 25W$

ANS-58

$V = 12V$, $I = 2.5mA = 2.5 \times 10^{-3} A$

$R = V/I = \frac{12 \times 10^3}{2.5} = \frac{12 \times 2000}{25} = 4800\Omega$

ANS-59

$V = 9V$, $R = 0.2 + 0.3 + 0.4 + 10 + 12 = 13.4$

$I = V/R = \frac{9 \times 10}{134} = \frac{45}{67} = 0.67A$

ANS-60

$I = 5A$, $V = 220$, $R = \frac{V}{I} = \frac{220}{5} = 44\Omega$

No. of Resistor in parallel $(x) = \frac{176}{44} = 4$

ANS-61

$V = 220V$, $I = 5A$

$P = VI = 220 \times 5 = 1100W$

no. of bulb $= \frac{1100}{10} = 110$ bulb

ANS-62

$P_1 = 100W$, $P_2 = 60W$, $V = 220V$

$P = P_1 + P_2 = 100 + 60 = 160W$

$P = VI$, $I = \frac{P}{V} = \frac{160}{220} = 8/11 = 0.727A$ OR $0.73A$

ANS-63

$P_1 = 250W$, $t_1 = 1hr = 3600s$, $P_2 = 1200W$, $t_2 = 10min = 600s$

$E_1 = P_1t_1 = 250 \times 3600 = 900000\ J$

$E_2 = P_2 \times t_2 = 1200 \times 600 = 720000\ J$

250W IV

Ans-64 $I = 15A$, $R = 8\Omega$, $t = 8h = 28800 sec$

$V = IR = 15 \times 8 = 120V$

$P = VI = 120 \times 15 = 1800W$

Ans-65 $R = 32cm$, $f = \frac{R}{2} = \frac{32}{2} = 16cm$

Ans-66 $f = -2m$, $P = \frac{1}{f} = \frac{1}{-2} = -0.5D$

Ans-67 $h_1 = 5cm$, $u = -25cm$, $f = -10cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

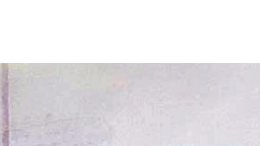
$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-10} - \frac{1}{-25} = \frac{-5+2}{50} = \frac{3}{50}$

$v = \frac{50}{3} = 16.67cm$

$\frac{h_2}{h_1} = \frac{v}{u}$, $h_2 = \frac{50}{3} \times \frac{1}{-25} \times 5 = -\frac{10}{3}$

$h_2 = -3.33cm$

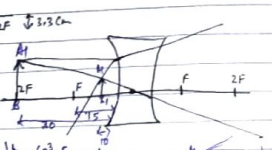
Real Inverted.



Ans-68 $f = 15cm$, $v = -10cm$, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{u} = \frac{1}{v} - \frac{1}{f} = \frac{1}{-10} - \frac{1}{15} = \frac{-3-2}{30} = -\frac{1}{6}$

$u = -30cm$



Ans-69 $h_1 = 5cm$, $u = -30cm$, $R = 30cm$, $f = 15cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{15} + \frac{1}{-30}$

$\frac{1}{v} = \frac{1}{15} + \frac{1}{30}$

$\frac{1}{v} = \frac{4+3}{60} = \frac{7}{60}$

$v = \frac{60}{7} = 8.57cm$

$\frac{h_2}{5} = \frac{+60/7}{+30}$

$h_2 = \frac{60}{7} \times \frac{5}{30} = \frac{10}{7}$

$h_2 = 2.14cm$

Virtual Erect.

Ans-70 $h_1 = 7cm$, $u = -27cm$, $f = -18cm$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-18} - \frac{1}{-27} = \frac{-2+3}{54}$

$v = -54$

$\frac{h_2}{7} = \frac{-54}{+27}$

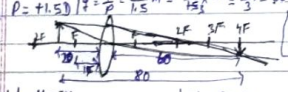
$h_2 = -14$

Real, Inverted

Ans-71 $P = -2.0D$, $f = \frac{1}{P} = \frac{1}{-2}$, $f = -\frac{1}{2} \times 100 = -50cm$ Concave lens

Ans-72 $P = +1.5D$, $f = \frac{1}{P} = \frac{1}{1.5}m = \frac{10}{15} \times 100 = \frac{200}{3} = 66.67cm$ Converging lens.

Ans-73



Filament mean the distance b/w the object and image

Let, $u = -x$

So, $v = 80 - x$ ($\because u + v = 80$)

$m = \frac{v}{u}$

$-3 = \frac{80-x}{-x}$

$3x = 80 - x$

$4x = 80$

$x = 20$

$u = -20$

$v = 80 - x$

$v = 80 - 20$

$v = 60$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{60} - \frac{1}{-20} = \frac{1+3}{60} = \frac{4}{60} = \frac{1}{15}$

$f = 15$

ERROR

⇒ The difference in the values which is true and experimental is known as Error.

Types of Error

1) **Absolute Error** → The difference between Experimental value and True value is known as absolute error.

Absolute Error (Δa) = True value − Experimental or Measured value.

2) **Relative Error** → It is the ratio of absolute error to its true value.

Relative Error = $\frac{\Delta a}{a}$

3) **Percentage Error** → It is a relative error is represented in the form of percentage than it is known as % age Error.

Percentage error = $\frac{\Delta a}{a} \times 100$

Q→ The value of gravity is $9.8 m/s^2$. If it is measured $10 m/s^2$ find (a) Absolute error (b) Relative error (c) Percentage error.

Solu (i) Absolute Error = True value − Measured value

$\Delta a = 10 - 9.8 = 0.2 m/s^2$

(ii) Relative Error = $\frac{\Delta a}{a} = \frac{0.2}{9.8} = \frac{1}{49} = 0.02$ (abbrev)

(iii) Percentage error = $\frac{\Delta a}{a} \times 100 = 0.02 \times 100 = 2\%$

Rule

Ist $y = a + b$

$\Delta y = \Delta a + \Delta b$

IInd $y = ab$

$\left|\frac{\Delta y}{y}\right| \times 100 = \left|\frac{\Delta a}{a}\right| \times 100 + \left|\frac{\Delta b}{b}\right| \times 100$

IIIrd $y = \frac{a}{b}$

$\left|\frac{\Delta y}{y}\right| \times 100 = \left|\frac{\Delta a}{a}\right| \times 100 - \left|\frac{\Delta b}{b}\right| \times 100$

Note $\left|\frac{\Delta y}{y}\right|_{max} \times 100 = \left|\frac{\Delta a}{a}\right| \times 100 + \left|\frac{\Delta b}{b}\right| \times 100$

IVth $y = a^b$

$\left|\frac{\Delta y}{y}\right| \times 100 = b \times \left|\frac{\Delta a}{a}\right| \times 100$

Q→ A Quantity $Y = \frac{a^3b^2}{c\sqrt{d}}$. if the percentage error in a, b, c and d are 6%, 4%, 3% and 2%. find error in Y.

Sol: $Y = \frac{a^3b^2}{c\sqrt{d}}$ $a = 6\%$ $c = 3\%$ $b = 4\%$ $d = 2\%$.

$Y = \frac{a^3b^2}{c\,d^{1/2}}$

$$\left|\frac{\Delta Y}{Y}\right|_{max} \times 100 = 3\left|\frac{\Delta a}{a}\right| \times 100 + 2\left|\frac{\Delta b}{b}\right| \times 100 + \left|\frac{\Delta c}{c}\right| \times 100 + \frac{1}{2}\left|\frac{\Delta d}{d}\right| \times 100$$

$$= 3 \times 6 + 2 \times 4 + 1 \times 3 + \frac{1}{2} \times 2$$

$$= 18 + 8 + 3 + 1 = 30\%$$

Q→ The radius of a sphere is (4 ± 0.3). Find its %age in volume.

Ans: Given, $r = 4$, $\Delta r = 0.3$

we know that, volume of sphere $(V) = \frac{4}{3}\pi r^3$

$$\left|\frac{\Delta V}{V}\right| \times 100 = 3\left|\frac{\Delta r}{r}\right| \times 100$$

$$= 3 \times \frac{0.3}{4} \times \cancel{100}^{25} = \frac{15}{\cancel{5}} \times \frac{3}{\cancel{10}_2} = \frac{45}{2} = 22.5\%$$

Q→ The length and breath of a rectangle is 4m and 3m. If their least count is 0.1 then find its %age error in Area.

Sol: Given, $l = 4m$ $\Delta l = 0.1$
$b = 3m$ $\Delta b = 0.1$

we know that,

$A = l \times b$

$$\left|\frac{\Delta A}{A}\right| \times 100 = \left|\frac{\Delta l}{l}\right| \times 100 + \left|\frac{\Delta b}{b}\right| \times 100$$

$$= \frac{0.1}{4} \times 100 + \frac{0.1}{3} \times 100$$

$$= \frac{10}{4} + \frac{10}{3} = \frac{30+40}{12} = \frac{70}{12} = \frac{35}{6} = 5.8\%$$

SOURCE OF ENERGY

★ Good Source of Energy → ① Safe and convinent to use.
② Easy to transport and store.

Characteristics of Good fuel → ① It has high calorific value.
② Give less smoke.
③ less residue after burning.
④ proper ignition temprature.
⑤ Easy to store and transport. (eg:- LPG cylinder)

Calorific value → It is amount of Energy produce on burning 1 gram of fuel. Hydrogen has highest calorific value.

Ignition temprature → It is the temprature at which a fuel catche fire.

★ Renewable Source of Energy → Those source of energy which ~~are again and again~~ are inexhaustible, which can be used again and again and can be replaced. Ex:- Solar Energy, Wind Energy.

Renew

★ Non Renewable Source of Energy → Those Source which are exhaustible and can not be replaced if once they have been used. ex:- Coal, oil, Natural gas.

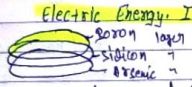
⇒ Fossil Fuel → Fossil fuel are the remains of plants and animals which was got buried deep inside early millions of years ago.
Ex:- Petrol, Diesel, kerosene oil etc.

⇒ Conventional Source of Energy → Those Sources which are used extensively and meet a marked portion of our Energy requirement.
Ex:- Fossil fuel, Hydro Energy etc.

⇒ **Non Conventional Source of energy** → Those Source of Energy which are not used as extensively and meet our energy requirement on a limited scale. Ex- Solar Energy.

Solar Energy → The Energy which is obtained from sun is known as Solar Energy. This Energy is used in various purposes.

Solar Cell → It is a device which convert solar Energy directly into Electric Energy. It is made up of Silicon - Boron and Silicon - Arsenic layer.



★ **Calorific values of Some fuels** →

Fuels		Calorific value (KJ/g)
Cow dung	-	6 to 8
Wood	-	17 to 22
Coal	-	25 to 33
~~Petrol~~ Biogas	-	35 to 40
~~Kerosene~~ Petrol	-	45.8
~~Diesel~~ Kerosene	-	45

Fuels		Calorific value (KJ/g)
Diesel	-	45.5
Methane	-	50
CNG	-	50.1
LPG	-	55
Hydrogen	-	150

Wind Energy → Unequal heating of landmass and water bodies by Solar radiation generate air movement and cause wind to blow.

⇒ **Wind Mill** → In wind mill Electric Energy is produced by the help of Wind Energy. In wind mill the rotatory motion of mill is used to run and turn the rotar of turbine which then generate Electricity through dynamo.

In this to produce a large amount of Electricity many wind mills are connected together on a land. which is called wind Energy farm. ~~The mind speed~~ The minimum wind speed for wind mill is 30 km/hr.

Advantage - ① Eco friendly
② Efficient source of renewable Energy.

Limitations - ① Wind energy farm needed large area of land.
② High Cost
③ High wind speed (15-20 km/hr)

★ **Ocean Thermal Energy** - The power plant used to harness the ocean thermal Energy is known as Ocean Thermal Energy Conversion plant. **(OTEC)**

★ **Geothermal Energy** - Energy stored as heat inside the Earth is known is known as geothermal Energy.

★ **Nuclear Energy** → It is the energy which is stored in the nucleus of atom. It comes up from two process:-
(i) Nuclear Fission (ii) Nuclear Fusion

⇒ **Nuclear Fission** → It is the process in which a heavy nucleus split up two or more than two comparatively lighter nucleus and produce large amount of heat is known as nuclear fission. The Energy produce in this process is known as nuclear Energy.

$$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3\,{}_{0}n^{1} + \text{Energy}$$

(Uranium, neutron → Barium, Krypton, neutron)

★ Atom Bomb is based on nuclear fission.

⇒ **Nuclear fusion** – It is the process in which two lighter Element (nucleus) combine together to form a comparatively heavy nucleus is known as nuclear fusion. Energy also produces in this process but comparatively less than the process of Nuclear fission.

$$_1H^2 + _1H^2 \longrightarrow _2He^4 + \text{Energy}$$

Deuterium Deuterium Helium

(*) Hydrogen Bomb is based on nuclear fusion.

⇒ **Advantages of Nuclear Energy** → ① large amount of Energy is released
② has long period of time.

⇒ **Disadvantages** → ① High cost of installation.
② Harmful nuclear radiation produced.

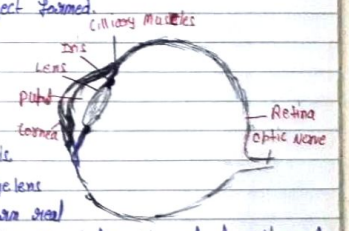
HUMAN EYE

Human Eye → It acts like a camera which enable us to see the objects.

Parts of Human Eye → The various parts of human eye are as :-

1. Cornea :- It is a thin membrane through which light enters.
2. Eyeball (Lens) :- It is a convex lens, which has variable focal length.
3. Iris :- It is a dark muscular diaphragm that control the size of pupil. It is behind the cornea.
4. Pupil :- It regulate and control the amount of light entering in the Eye.
5. Ciliary Muscles :- It help to change the focal length of Lens.
6. Retina :- It is the last part of the Eye, it is a screen at which real inverted image of object formed.

Working of Human Eye –



First of all light enter through Cornea and it is control by iris. The light rays converge by Eye lens (converging lens) and this lens form real inverted image of object on Retina. The information of formation of image sent to brain by optical nerve through electric signal. Brain read that message and on the basis of previous experience we can see that object exact.

Far point – It is the farthest point upto which Eye can see an object clearly. for normal eye far point is at infinity.

Near point → It is the nearest point upto which eye can see an object clearly without any strain. For normal eye near point is about 25 cm.

Last Distance of Vision → It is the minimum distance at which a person can see object clearly without any strain. For a normal eye this distance is 25 cm.

★ **Accomodation of Eye** → The tendency of Eye to change the focal length of Eye Lens is known as accomodation of Eye.

Defect of Vision

- Cataract
- Hypermetropia (Far sightedness)
- Myopia (Near sightedness)
- Presbyopia

⇒ **Cataract** → In this defect eye lens become milky and cloudy. It can cause complete or partial loss of vision. This can be corrected by surgical remove of extra growth.

⇒ **Hypermetropia** → In this defect a person can not see nearby object clearly but can see distant object distently. (clearly)

Reason :- ① Increase in focal length of Eye lens.
② Eye ball has become too small.

Correction :- Corrected by convex lens.

Numerical Condition :- use formula $\left(\frac{1}{f} = \frac{1}{v} - \frac{1}{u}\right)$ where $u = -25$ cm, $v = -x$ (x, distance of far point)

⇒ ★ **Myopia**

In this defect a person can see nearby object clearly but can not see distant object dist.

Reason :- ① Decrease in focal length of Eye lens
② Eye ball has become too large.

Correction :- Corrected by concave lens.

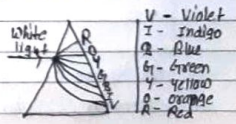
Numerical Condn :- Use formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ where $u = -\infty$, $v = -x$ (distance of near point)

⇒ **Presbyopia** → In old age the power of accomodation of the eye usually decreases, the near point gradually recedes away. This defect is known as presbyopia. It is a special kind of hypermetropia.

Reason :- Gradually weaking of cillary muscles.

Correction :- Use bifocal lens. This lens consist of both concave and convex lens, upper position consist of concave lens and lower portion consist of convex lens.

★ **Dispersion of Light** → The splitting of white light into seven colours through a prism is known as dispersion of white light.



Condition - (i) $n_V > n_R$ (Refractive Index)
(ii) $D_V > D_R$ (Deviation)
(iii) $I_V > I_R$ (Scattering)
(iv) $f_V < f_R$ (focal length)
(v) $\lambda_V < \lambda_R$ (wave length)

★ **Rainbow** -> It is based on dispersion of light, in this rain time when Sun light enter in rainy season on rain drop then these drop act like a prism and disperse into seven Colours and form rainbow.

★ **Atmospheric Refraction** -> when the light rays pass through the atmosphere having layers of different densities and refractive index then refraction of light take place. This refraction of light is known as atmospheric refraction.

=> ★ **Phenomena Based on Refraction of Light** ->

~~① stars~~ ① stars appear higher than they actually are.
② Twinkling of stars.

★ **Scattering of Light** -> It is the phenomena by which a beam of light is redirected in different direction on interacting with the particles present in medium.

★ **Phenomena based on scattering of Light** ->

① Sky Appears blue
② Sun appear red at the time of sunrise or sunset.

Condition

$$I_V > I_R$$

Scattering of light is maximum for voilet or Blue Colour and minimum of Red Colour.

Q-1 The far point of myopic person is 80cm in front of eye. What is the nature and power of lens required to correct the problem.

Ans For myopia $u = -\infty$, $v = -80\,cm$

by $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\frac{1}{f} = \frac{1}{-80} - \frac{1}{-\infty}$$

$$\frac{1}{f} = \frac{1}{-80}$$

$$\boxed{f = -80\,cm} \quad \text{or} \quad \frac{-80}{100} = -\frac{4}{5}\,m$$

Power $P = \frac{1}{f} = \frac{1}{-4/5} = -\frac{5}{4} = -1.25D$

Nature - Concave Lens.

Q-2 The near point of a hypermetropic Eye is 1m. What is the power and nature of lens required to correct this defect.

Ans For hypermetropia $u = -25\,cm$

$v = -1m = -100\,cm$

by $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\frac{1}{f} = \frac{1}{-100} - \frac{1}{-25} = \frac{-1+4}{100} = \frac{3}{100}$$

$$\boxed{f = 100/3\,cm} \quad \text{or} \quad \frac{100}{3} \times \frac{1}{100} = \frac{1}{3}\,m$$

Power $= \frac{1}{f} = \frac{1}{1/3} = 3D$

$$\boxed{P = 3D}$$

Nature - Convex Lens

LIGHT OPTICS (Level-2)

Refraction at Spherical Surface - (Lens Maker formula)

Suppose Radius of curvature of Two surface for a spherical lens are R_1, R_2 & the refractive index of its material is n then its focal length

$$\boxed{\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)}$$

Condition.

(I) Bi = Convex Lens	II Bi = Concave lens	III Plane Surface
R_1 = +ive	R_1 = -ive	$R = \infty$
R_2 = -ive	R_2 = +ive	

Q→1 The Radius of curvature of a bi-Convex lens are 20 cm, 30 cm. If its refractive index is 1.5. Find its focal length.

Ans $R_1 = 20$ Cm, $R_2 = -30$ Cm, $n = 1.5$

$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$= (1.5-1)\left(\frac{1}{20} - \frac{1}{-30}\right)$

$= 0.5 \times \frac{3+2}{60}$

$\frac{5}{10_2} \times \frac{5}{60_{12}} = \frac{1}{24}$

$\boxed{f = 24}$

Q→2 The Radius of curvature of a bi Concave Lens is 15 Cm, 60 Cm and its refractive index is 1.5. Find its focal length.

Ans $R_1 = -15$, $R_2 = 60$, $n = 1.5$

$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$= (1.5-1)\left(\frac{1}{-15} - \frac{1}{60}\right)$

$= 0.5 \times \frac{-4-1}{60}$

$= \frac{5}{10_2} \times \frac{-5}{60_{12}}$

$\frac{1}{f} = -\frac{1}{24}$

$\boxed{f = 24}$

Q→3 Find the focal length of a thin lens for which radius of one surface is 20 Cm and other Surface is ~~20 cm and~~ plane. (refractive index of its material is 3/2.)

Ans $R_1 = 20$ Cm, $R_2 = \infty$, $n = 1.5$ or $\frac{3}{2}$

$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$= (1.5-1)\left(\frac{1}{20} - \frac{1}{\infty}\right) = 0.5 \times \frac{1}{20} = \frac{5}{10} \times \frac{1}{20_4}$

$\frac{1}{f} = \frac{1}{40}$ $\boxed{f = 40 \text{ Cm}}$

Q→4 If the focal length of bi-convex lens is 30cm and radius of its spherical surface are same. Find radius. (n=1.6)

Ans $f = 30$ Cm, $R_1 = R$, $R_2 = -R$, $n = 1.6$

$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{30} = (1.6-1)\left(\frac{1}{R} - \frac{1}{-R}\right)$

$\frac{1}{30} = 0.6 \times \frac{1+1}{R}$

$\frac{1}{30} \times \frac{10}{6} = \frac{2}{R}$

$\frac{1}{12} = \frac{2}{R}$

$\boxed{R = 24}$

$R_1 = 24$ Cm

$R_2 = -24$ Cm

Q→5 The focal length of lens (convex) is 30 cm and the radius of curvature of its surface are 15 Cm, 60 Cm. Find its refractive index

Ans $f = 30$ Cm, $R_1 = 15$ Cm, $R_2 = -60$ Cm

$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{30} = (n-1)\left(\frac{1}{15} - \frac{1}{-60}\right)$

$\frac{1}{n-1} = \frac{5}{2}$

$2 = 5n-5$

$5n = 7$

$n = 7/5 = 1.4$ Ans

Q→6 The focal length of a lens is 20cm. If this lens is immersed in water. Find its new focal length. (Given - $n_g = \frac{3}{2}$, $n_w = \frac{4}{3}$)

Ans

$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{20} = \left(\frac{3}{2} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{20} = \frac{3-2}{2}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{20_{10}} \times \frac{2}{1}$

$\frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{10}$ —①

Now in water,

$\frac{1}{f_1} = \left(\frac{\frac{3}{2}}{\frac{4}{3}} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ $\boxed{\because n = \frac{n_g}{n_w}}$

$\frac{1}{f_1} = \left(\frac{3}{2} \times \frac{3}{4} - 1\right) \times \frac{1}{10}$

$\frac{1}{f_1} = \left(\frac{9}{8} - 1\right) \times \frac{1}{10}$

$\frac{1}{f_1} = \frac{9-8}{8} \times \frac{1}{10}$

$\frac{1}{f_1} = \frac{1}{8} \times \frac{1}{10} = \frac{1}{80}$

$\boxed{f = 80 \text{ cm}}$

GRAVITATION

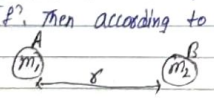
A force is necessary to produce motion in a body. The earth attracts all the objects towards its centre. The force with which the earth pulls the objects towards it is called the gravitational force of earth or gravity. The gravitational force of earth is responsible for holding the atmosphere above the earth; for the rain falling to the earth; and for the flow of water in the rivers. It is also the gravitational force of earth which helps us firmly on ground.

★ Newton's law of Motion :-

According to the newton, every object in this universe attracts every other object with a certain force. The force with which two objects attracts each other is called gravitational force. If the masses of the objects are small, then the gravitational force between them is very small. If it is big, then the G.F becomes very large. The G.F or gravity is always a force of attraction between two objects.

★ Universal law of Gravitation :-

This law was given by newton. According to this law, every body in the universe attracts every other body, with a force which is directly proportional to the product of the masses and inversly proportional to the square of distance between them. suppose two bodies 'A' and 'B' of masses 'm_1' and 'm_2' are lying at the distance 'r' from each other and the force of attraction between two bodies is 'F'. Then according to newton's law of gravitation,



$F \propto m_1 m_2$

$F \propto \frac{1}{r^2}$

On combining,

$F \propto \frac{m_1 m_2}{r^2}$

$$\boxed{F = G\frac{m_1 m_2}{r^2}}$$

Where, G is a constant. which is known as Universal Gravitational constant. and its value is $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

Q. The gravitation force between two bodies is 10N. Calculate its new force if
① Both the masses get doubled.
② Distance between the objects become half.
③ Distance between the objects is doubled.

$$F = G\left(\frac{m_1 m_2}{r^2}\right) = 10$$

① $f_1 = \frac{G \times 2m_1 \times 2m_2}{r^2} = 4\frac{G m_1 m_2}{r^2} = 4 \times 10 = 40\,N$

② $f_2 = \frac{G m_1 m_2}{\left(\frac{r}{2}\right)^2} = \frac{G m_1 m_2}{\frac{r^2}{4}} = 4 \times \frac{G m_1 m_2}{r^2} = 4 \times 10 = 40\,N$

③ $f_3 = \frac{G m_1 m_2}{(2r)^2} = \frac{G m_1 m_2}{4r^2} = \frac{1}{4} \times \frac{G m_1 m_2}{r^2} = \frac{1}{4} \times 10 = 2.5\,N$

★ Gravitational force in Solar System :-

In the Solar System, Planets move in almost circular object around the Sun and the satellite moves around the planet. It is the gravitational force ~~between~~ b/w the sun and the earth which keep the earth in uniform circular motion around the sun. The tide in the sea formed by the rising and falling of water level in the sea due to gravitation force of attraction which the moon and the sun ~~exert~~ applied on the water surface on the sea.

Imp ★ **Kepler's laws of Planetary motion :-**

Johannes Kepler was a 16th century astronomer. Who established three laws which govern the motion of planets. These are known as Keplers laws of planetary motion.

(i) **First law** → The planets move in elliptical orbits around the sun, at the one of the two foci of the elliptical orbit.

(ii) **Second law** → Each planet revolves around the sun in such a way that the line joining the planet to the sun sweeps over equal areas in equal intervals of time.

(iii) **Third law** → The cube of the mean distance of a planet from the sun is directly proportional to the square of time it takes to move around the sun. ($T^2 \propto r^3$)

Imp ★ **Free Fall :-**

The falling of a body from a height towards the earth under the gravitational force of earth is called free fall. and such a body is called freely falling body. Our earth attracts all the bodies which are near ~~near~~ its surface so that when a body is dropped from the roof of the house. it falls down the earth. The acceleration of an object falling freely towards the earth does not depend on the mass of the object.

★ **Acceleration due to Gravity :-**

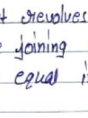
When an object is dropped from some height, a uniform acceleration is produced in it by the gravitation pull of the earth. Acceleration due to gravity, $g = 9.8\ m/s^2$. when a body is dropped freely, it falls with an acceleration of $9.8\ m/s^2$ and when a body is thrown vertically upwards, it undergoes a retardation of $9.8\ m/s^2$

★ **Equations of motion for freely falling bodies :-**

	from up to down			down to up	
(i)	$v = u + at$	changes to	$v = u + gt$	$v = u - gt$	
(ii)	$s = ut + \frac{1}{2}at^2$	changes to	$s = ut + \frac{1}{2}gt^2$	$s = ut - \frac{1}{2}gt^2$	
(iii)	$v^2 = u^2 + 2as$	changes to	$v^2 = u^2 + 2gh$	$v^2 = u^2 - 2gh$	

fall or drop	
$u = 0$	
~~[illegible]~~	
through object	
$v = 0$	
time taken equally when go up and come downward	

★ **Relation between 'g' and 'G'** → Suppose a body of mass 'm' is dropped from a distance 'R' from the centre of earth of mass 'M'. Then the force exerted by the earth on the body.



$F = \frac{GMm}{R^2}$ (If the acceleration due to gravity is g.) then $F = mg$.

So, $mg = \frac{GMm}{R^2}$; $\boxed{g = \frac{GM}{R^2}}$

★ **Difference b/w g and G**

	g	G
①	It is known as acceleration due to Gravity	It is Universal gravitational Constant.
②	It's value is never changed in universe.	It's value is change in universe
③	It's value is $9.8\ m/s^2$	It's value is $6.67 \times 10^{-11}\ N\,m^2/kg^2$

★ **Variation of acceleration due to gravity :-** The value of acceleration due to gravity of earth (g) depends on the values of gravitational constant (G), mass of the earth (M), and radius of the earth (R). The value of acceleration due to gravity (g) is not constant at all the places on the surface of the earth. Since, the radius of the earth at the poles is minimum, the value of g is maximum at the

poles. Again, the radius of earth, is maximum at the equator, so the value of g is a minimum at the equator. $\boxed{g = G \times \frac{M}{R^2}}$

As we go up from the surface of earth, the distance from the centre of the earth increases and hence the value of (g) decreases. This is due to the fact that the earth is not a perfect sphere. The value of (g) also decreases as we go down inside the earth.

Q-> If the mass of the earth is approximately 100 times to the mass of moon and the radius of ~~moon~~ earth is 4 times to the radius of moon. Then prove that gravity of moon is $\frac{1}{6}$th to the gravity of earth.

Ans Let gravity of earth = g_e | gravity of moon = g_m
mass of earth = M_e | mass of moon = M_m
radius " " = R_e | radius of moon = R_m

Then According to the Question,

$M_e = 100\, M_m$ So, $M_m = M_e/100$

$R_e = 4\, R_m$ So, $R_m = R_e/4$

We know that gravity on moon is,

$g_m = G \times \frac{M_m}{R_m^2}$ | $g_m = G \times \frac{M_e}{100} \times \frac{R_e^2}{R_e^2}$ | $g_m \simeq \frac{1}{6}\left(G \times \frac{M_e}{R_e^2}\right)$

$g_m = G \times \frac{\frac{M_e}{100}}{\left(\frac{R_e}{4}\right)^2}$ | $g_m = \frac{4}{25}\left(G \times \frac{M_e}{R_e^2}\right)$ | $\boxed{g_m \simeq \frac{1}{6} \times g_e}$ (approx).

=> Mass :- The mass of a body is the quantity of matter contained in it. Scalar quantity. The S.I unit of a body mass is kg. The mass of a body is constant and does not change from place to place. The mass of a body cannot be zero.

=> Weight :- The weight of a body is the force with which it is attracted towards the centre of the earth.

=> The acceleration produced by the force of attraction of the earth is known as acceleration due to gravity and written as 'g'.
Thus, the downward force (W) acting on a body of mass (m) is given by:-
$W = m \times g$
The SI unit of weight is Newton. Weight is a vector quantity. We feel force weightlessness. Thus, the ~~m~~ weight of a body can be zero.

	MASS	WEIGHT
1	The mass of an object is the quantity of matter contained in it	The weight of an object is the force with which it is attract towards the centre of earth.
2	The S.I unit of mass is kg.	The S.I unit of weight is Newton.
3	The mass of an object is constant	The weight of an object is non-constant.
4	The mass of an object can never be zero.	The weight of an object can be zero.
5	It is a scalar quantity.	It is a vector quantity.

★ Thrust and Pressure ->

=> The ratio of the perpendicular force which act on the surface of object to the area of surface is known as pressure. OR

=> Pressure is the force acting perpendicularly on the unit area of the object. Suppose, a force of (F) newton act on the surface of area (A). Then the pressure on the body.

$P = \frac{Force}{Area}$, $\boxed{P = F/A}$ (the S.I unit of pressure is N/m² or Pascal).

$P \propto \frac{F}{A}$

★ Some observation related to pressure →

1. Why School bag have wide straps?
Ans Pressure is inversely proportional to ~~area~~ area. As the wide straps have more area. Since, it applies small force on shoulders comparing to narrow strips.

2. Why a sharp knife cuts better than a blunt knife?
Ans Pressure is inversely proportional to area. As the sharp knife have small area, since, it applies large force on objects comparing to blunt knife.

3. Why the tip of a needle is sharp?
Ans Pressure is inversely proportional to area. As the sharp needle has small area and applies large force on cloth and sweeing it more effectively.

4. Why the pressure on ground is more when a man is walking than when he is standing?
Ans Pressure is inversely proportional to area. As during walking, one leg applies force on ground. That is why, applies large pressure and during standing the both leg applies force (large area). That's why, force is small.

5. Why the depression is more when a man stands on the cusion than when he lies down on it?
Ans As during standing, the area of contact is small. That is why applies more pressure and during lies down, the area is large and applies large pressure. Pressure is directly proportional to area.

6. The tractors have broad tyres. Why?
Ans The tractors have heavy weight and broad tyres has large area and that's why applies small force on ground and prevents sinking. As pressure is directly proportional to area.

7. It is easier to walk on soft sand if we have flat shoes rather than shoes with sharp hills?
Ans As flat shoes have large area and applies small force on soft sand rather than sharp heels. (which have small area and applies large force). As pressure is directly proportional to area.

Buoyant force = $\frac{mass}{volume}$

★ Archimede's Principle →

(Law) According to this principle, when an object is completely or partially immersed in a liquid. It experience a buoyant force which is equal to the weight of liquid displace by the object.

Buoyant force acting on an object = Weight of liquid displace by that object.

Even, gases exert an upward force on the objects placed in them. Even it is the buoyant force due to displaced air which makes a balloon rise in air.

⇒ Applications of Archimede's Principle :-

1. Archimede's principle is used in determining the relative density of a substance.
2. The hydrometres used for determining the density of liquids based on this principle.
3. The lactometres used for determining the purity of milk based on this principle.
4. This principle is used in designing ships & submarine.

★ Floating principle :- How does a body float or sink in a liquid?
It can be described on the following two basis :-
① On the basis of buoyant Force.
② on the basis of density.

★ **Density** → The ratio of the mass of the substance to the volume of substance is known as density of the substance.

$$\text{Density of a substance} = \frac{\text{mass of Substance}}{\text{Volume of Substance}}$$

$$\boxed{d = \frac{M}{V}}$$

Unit is kg/m^3 or gm/cm^3.

$1\ gm/cm^3 = 1000\ kg/m^3$

→ Density of water = $1\ gm/cm^3$ or $1000\ kg/m^3$

→ Density of Mercury = $13.6\ gm/cm^3$ or 13.6×1000 ~~kg/cm³~~ kg/m^3

★ **On the basis of density :-**

The density of floating objects.

① An object will float in a liquid if its density is less than that of the liquid.

② An object will also float in a liquid if its density is equal to that of the liquid.

③ An object will sink in a liquid if its density is more ~~that~~ than that of the liquid.

$$\boxed{\text{Density} = \frac{\text{mass}}{\text{volume}}}$$

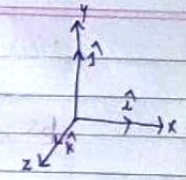
VECTOR

★ Any Vector has direction as well as magnitude.

★ magnitude of any vector $\vec{a} = |\vec{a}|$

★ Unit vector $|\vec{a}| = 1$

★ Unit prependicular vector → $|\hat{i}| = |\hat{j}| = |\hat{k}| = 1$



★ Representing of any vector →

$\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$

Magnitude $|\vec{a}| = \sqrt{a_1^2 + a_2^2 + a_3^2}$

for Example $\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}$

$|\vec{a}| = \sqrt{(2)^2 + (-3)^2 + (4)^2} = \sqrt{4+9+16} = \sqrt{29}$

★ Add and Subtraction of vector –

$\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$

$\vec{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$

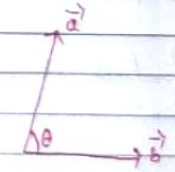
$\vec{a} + \vec{b} = \hat{i}(a_1+b_1) + \hat{j}(a_2+b_2) + \hat{k}(a_3+b_3)$

$\vec{a} - \vec{b} = \hat{i}(a_1-b_1) + \hat{j}(a_2-b_2) + \hat{k}(a_3-b_3)$

★ Product of vectors
- scalar product or dot product
- vector or cross product

Scalar Product –

$\vec{a} \cdot \vec{b} = |\vec{a}|\,|\vec{b}| \cos\theta$



property –

(i) $\hat{i}\cdot\hat{i} = \hat{j}\cdot\hat{j} = \hat{k}\cdot\hat{k} = 1$

(ii) $\hat{i}\cdot\hat{j} = \hat{j}\cdot\hat{k} = \hat{k}\cdot\hat{i} = 0$

(iii) $(a_1\hat{i} + a_2\hat{j} + a_3\hat{k})\cdot(b_1\hat{i} + b_2\hat{j} + b_3\hat{k}) = a_1b_1 + a_2b_2 + a_3b_3$

(iv) If $\vec{a} \perp \vec{b}$ perpendicular then $\vec{a}\cdot\vec{b} = 0$

(v) Work done $W = \vec{F}\cdot\vec{S}$
force displacement

(vi) $\vec{a}\cdot\vec{b} = \vec{b}\cdot\vec{a}$ (commutative law)

Vector or Cross Product - $|\vec{a}\times\vec{b}| = |\vec{a}|\,|\vec{b}|\sin\theta$

Properties - ① $\hat{i}\times\hat{i} = \hat{j}\times\hat{j} = \hat{k}\times\hat{k} = 0$

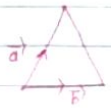
② $\hat{i}\times\hat{j} = \hat{k}$
$\hat{j}\times\hat{k} = \hat{i}$
$\hat{k}\times\hat{i} = \hat{j}$

③ $(a_1\hat{i}+a_2\hat{j}+a_3\hat{k})\times(b_1\hat{i}+b_2\hat{j}+b_3\hat{k}) =$

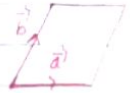
$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix} = \hat{i}(a_2b_3-b_2a_3)-\hat{j}(a_1b_3-b_1a_3)+\hat{k}(a_1b_2-b_1a_2)$$

④ if $\vec{a}\parallel\vec{b}$ (parallel)
then $\vec{a}\times\vec{b} = 0$

⑤ Area of Triangle → $A = \frac{1}{2}|\vec{a}\times\vec{b}|$



⑥ Area of parallelogram → $A = |\vec{a}\times\vec{b}|$



Vectors Practice Sheet

① Find the magnitude of following :-
(a) $2\hat{i}-3\hat{j}+4\hat{k}$ (b) $\hat{i}+2\hat{j}-\hat{k}$ (c) $2\hat{i}-\hat{k}$

② If vectors $2\hat{i}-\hat{j}+4\hat{k}$ and $\hat{i}+3\hat{j}-3\hat{k}$ are perpendicular to each other. Find value of P.

③ Find $\vec{a}\cdot\vec{b}$ and $\vec{a}\times\vec{b}$ for vectors
(a) $\vec{a} = 2\hat{i}+\hat{j}+4\hat{k}$, $\vec{b} = \hat{i}-3\hat{j}-2\hat{k}$ (b) $\vec{a} = 2\hat{i}-3\hat{j}+5\hat{k}$, $\vec{b} = \hat{i}+2\hat{j}-3\hat{k}$

④ Find angle ~~b/w~~ show the vectors $\hat{i}-2\hat{j}+3\hat{k}$ and $2\hat{i}-3\hat{j}+\hat{k}$

⑤ Show that the vectors $(2\hat{i}+3\hat{j}+6\hat{k})$ and $(3\hat{i}-6\hat{j}+2\hat{k})$ are perpendicular to each

⑥ Find the magnitude of two vectors $\vec{a}$ and $\vec{b}$ having same magnitude such that the angle b/w them is 60° and their scalar product is $\frac{1}{2}$.

⑦ Find $|\vec{x}|$ for $(\vec{x}-\vec{a})\cdot(\vec{x}+\vec{a}) = 12$, where $\vec{a}$ is unit vector.

⑧ Show that the vectors $2\hat{i}-\hat{j}+\hat{k}$, $\hat{i}-3\hat{j}-5\hat{k}$ and $3\hat{i}-4\hat{j}-4\hat{k}$ form the vertices of right angle triangle.

⑨ Find angle b/w vectors $\vec{a}$ and $\vec{b}$ with magnitude $\sqrt{3}$ and 2 respectively having $\vec{a}\cdot\vec{b} = \sqrt{6}$

⑩ Find $|\vec{a}\times\vec{b}|$ if $\vec{a} = \hat{i}-7\hat{j}+7\hat{k}$ and $\vec{b} = 3\hat{i}-2\hat{j}+2\hat{k}$

⑪ Show that $(\vec{a}-\vec{b})\times(\vec{a}+\vec{b}) = 2(\vec{a}\times\vec{b})$

⑫ Find λ and μ if
$(2\hat{i}+6\hat{j}+27\hat{k})\times(\hat{i}+\lambda\hat{j}+\mu\hat{k}) = 0$

① (a) $\vec{a} = 2\hat{i}-3\hat{j}+4\hat{k}$
$|\vec{a}| = \sqrt{(2)^2+(-3)^2+(4)^2} = \sqrt{4+9+16} = \sqrt{29}$

(b) $\vec{a} = \hat{i}+2\hat{j}-\hat{k}$
$|\vec{a}| = \sqrt{(1)^2+(2)^2+(-1)^2} = \sqrt{1+4+1} = \sqrt{6}$

(c) $\vec{a} = 2\hat{i}-\hat{k}$
$|\vec{a}| = \sqrt{(2)^2+(-1)^2} = \sqrt{4+1} = \sqrt{5}$

(2) $\vec{a} = 2\hat{i} - \hat{j} + 4\hat{k}$

$\vec{b} = p\hat{i} + 4\hat{j} - 3\hat{k}$

We know that, $\vec{a}$ and $\vec{b}$ are perpendicular to each other then $\vec{a}\cdot\vec{b} = 0$

$\vec{a}\cdot\vec{b} = (2\hat{i} - \hat{j} + 4\hat{k}) \cdot (p\hat{i} + 4\hat{j} - 3\hat{k})$

$0 = 2p - 4 - 12$

$0 = 2p - 16$

$2p = 16$

$\boxed{p = 8}$

(3) (a) $\vec{a} = 2\hat{i} + \hat{j} + 4\hat{k}$

$\vec{b} = \hat{i} - 3\hat{j} - 2\hat{k}$

$\vec{a}\cdot\vec{b} = (2\hat{i} + \hat{j} + 4\hat{k}) \cdot (\hat{i} - 3\hat{j} - 2\hat{k})$

$= 2 - 3 - 8 = 2 - 11 = -9$

$\vec{a}\times\vec{b} = (2\hat{i} + \hat{j} + 4\hat{k}) \times (\hat{i} - 3\hat{j} - 2\hat{k})$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & 4 \\ 1 & -3 & -2 \end{vmatrix} = \hat{i}(-2+12) - \hat{j}(-4-4) + \hat{k}(-6-1)$

$= 10\hat{i} + 8\hat{j} - 7\hat{k}$

(b) $\vec{a} = 2\hat{i} - 3\hat{j} + 6\hat{k}$

$\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$

$\vec{a}\cdot\vec{b} = (2\hat{i} - 3\hat{j} + 6\hat{k}) \cdot (\hat{i} + 2\hat{j} - 3\hat{k}) = 2 - 6 - 18 = -22$

$\vec{a}\times\vec{b} = (2\hat{i} - 3\hat{j} + 6\hat{k}) \times (\hat{i} + 2\hat{j} - 3\hat{k})$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -3 & 6 \\ 1 & 2 & -3 \end{vmatrix} = \hat{i}(9-12) - \hat{j}(-6-6) + \hat{k}(4+3)$

$= -3\hat{i} + 12\hat{j} + 7\hat{k}$

(4) $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$

$\vec{b} = 3\hat{i} - 2\hat{j} + \hat{k}$

$|\vec{a}| = \sqrt{1^2 + (-2)^2 + (3)^2} = \sqrt{1+4+9} = \sqrt{14}$

$|\vec{b}| = \sqrt{(3)^2 + (-2)^2 + (1)^2} = \sqrt{9+4+1} = \sqrt{14}$

$\vec{a}\cdot\vec{b} = 3+4+3 = 10$

$\vec{a}\cdot\vec{b} = |\vec{a}|\,|\vec{b}| \cos\theta$

$10 = \sqrt{14} \times \sqrt{14} \times \cos\theta$

$\frac{\cancel{10}^{5}}{\cancel{14}_{7}} = \cos\theta$

$\theta = \cos^{-1}\left(\frac{5}{7}\right)$ Ans

(5) $\vec{a} = 2\hat{i} + 3\hat{j} + 6\hat{k}$

$\vec{b} = 3\hat{i} - 6\hat{j} + 2\hat{k}$

$\vec{a}\cdot\vec{b} = 6 - 18 + 12 = 0$

(If dot product of two vector is equal to zero. It means they are perpendicular to each other.

(6) $\vec{a}\cdot\vec{b} = \frac{1}{2}$, $\theta = 60^\circ$, $|\vec{a}| = |\vec{b}|$

$\vec{a}\cdot\vec{b} = |\vec{a}|\,|\vec{b}| \cos\theta$

$\frac{1}{2} = |\vec{a}|\,|\vec{b}| \cos 60^\circ$

$\frac{1}{2} = |\vec{a}|\,|\vec{b}| \frac{1}{2}$

$|\vec{a}|\,|\vec{b}| = 1$

$|\vec{a}|\,|\vec{a}| = 1$ ($\because |\vec{a}| = |\vec{b}|$ Given)

$|\vec{a}|^2 = 1$

$|\vec{a}| = \sqrt{1} = 1$

So, $|\vec{b}| = 1$

(7) $(\vec{x} - \vec{a}) \cdot (\vec{x} + \vec{a}) = 12$, $|\vec{a}| = 1$

$|\vec{x}|^2 + \cancel{\vec{x}\cdot\vec{a}} - \cancel{\vec{a}\cdot\vec{x}} - |\vec{a}|^2 = 12$

$|\vec{x}|^2 - |\vec{a}|^2 = 12$

$|\vec{x}|^2 - 1^2 = 12$

$|\vec{x}|^2 = 12 + 1$

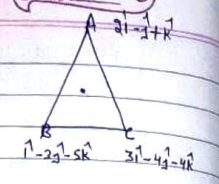
$|\vec{x}| = \sqrt{13}$ Ans

(8) $\vec{AB} = \vec{OB} - \vec{OA}$

$= \hat{i} - 2\hat{j} - 5\hat{k} - 2\hat{i} + \hat{j} - \hat{k}$

$= -\hat{i} - 2\hat{j} - 6\hat{k}$

$|\vec{AB}| = \sqrt{(-1)^2 + (-2)^2 + (-6)^2} = \sqrt{1+4+36} = \sqrt{41}$



$\vec{BC} = \vec{OC} - \vec{OB}$

$= 3\hat{i} - 4\hat{j} - 4\hat{k} - \hat{i} + 3\hat{j} + 5\hat{k}$

$= 2\hat{i} - \hat{j} + \hat{k}$

$|\vec{BC}| = \sqrt{(2)^2 + (-1)^2 + (1)^2} = \sqrt{4+1+1} = \sqrt{6}$

$\vec{CA} = \vec{OA} - \vec{OC}$

$= 2\hat{i} - \hat{j} + \hat{k} - 3\hat{i} + 4\hat{j} + 4\hat{k}$

$= -\hat{i} + 3\hat{j} + 5\hat{k}$

$|\vec{CA}| = \sqrt{(-1)^2 + (3)^2 + (5)^2} = \sqrt{1+9+25} = \sqrt{35}$

By Pythagoras theorem,

$|\vec{AB}|^2 = |\vec{BC}|^2 + |CA|^2$

$(\sqrt{41})^2 = (\sqrt{6})^2 + (\sqrt{35})^2$

$41 = 6 + 35$

$41 = 41$

Hence, It is proved that vectors $\vec{A}, \vec{B}, \vec{C}$ are the vectors of a right angle triangle.

(9) $|\vec{a}| = \sqrt{3}$, $|\vec{b}| = 2$, $\vec{a} \cdot \vec{b} = \sqrt{6}$

$\vec{a} \cdot \vec{b} = |\vec{a}|\,|\vec{b}| \cos\theta$

$\sqrt{6} = \sqrt{3} \times 2 \cos\theta$

$\cos\theta = \frac{\sqrt{6}}{\sqrt{3} \times 2} = \frac{\sqrt{2}}{2} = \frac{\sqrt{2}}{\sqrt{2} \times \sqrt{2}} = \frac{1}{\sqrt{2}}$

$\cos\theta = \cos 45^\circ$

$\boxed{\theta = 45^\circ}$

(10) $\vec{a} = \hat{i} - 7\hat{j} + 7\hat{k}$

$\vec{b} = 3\hat{i} - 2\hat{j} + 2\hat{k}$

$(\vec{a} \times \vec{b}) = (\hat{i} - 7\hat{j} + 7\hat{k}) \times (3\hat{i} - 2\hat{j} + 2\hat{k})$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -7 & 7 \\ 3 & -2 & 2 \end{vmatrix} = \hat{i}(-14+14) - \hat{j}(2-21) + \hat{k}(-2+21)$

$= 19\hat{j} + 19\hat{k}$

$|\vec{a} \times \vec{b}| = \sqrt{(19)^2 + (19)^2} = \sqrt{361+361} = \sqrt{722} = 19\sqrt{2}$ Ans

(12) $\vec{a} = 2\hat{i} + 6\hat{j} + 27\hat{k}$

$\vec{b} = \hat{i} + \lambda\hat{j} + \mu\hat{k}$

$\vec{a} \times \vec{b} = (2\hat{i} + 6\hat{j} + 27\hat{k}) \times (\hat{i} + \lambda\hat{j} + \mu\hat{k})$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 6 & 27 \\ 1 & \lambda & \mu \end{vmatrix} = \hat{i}(6\mu - 27\lambda) - \hat{j}(2\mu - 27) + \hat{k}(2\lambda - 6)$

Given that, $\vec{a} \times \vec{b} = 0$

$\hat{i}$	$\hat{j}$	$\hat{k}$
$6\mu - 27\lambda = 0$	$-(2\mu - 27) = 0$	$2\lambda - 6 = 0$
$6\mu = 27\lambda$	$-2\mu + 27 = 0$	$2\lambda = 6$
$\mu = \frac{27}{6}\lambda$	$+2\mu = +27$	$\lambda = 3$
	$\mu = 27/2$	

Therefore, $\lambda = 3$ and $\mu = \frac{27}{2}$

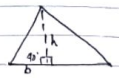
Heron's formula

★ Perimeter (P) of triangle = $a+b+c$

★ Semiperimeter (s) " " = $\frac{a+b+c}{2}$

Heron's formula → ★ Area of triangle (A) = $\sqrt{s(s-a)(s-b)(s-c)}$

★ Area of ~~right angle~~ triangle = $\frac{1}{2} \times b \times h$

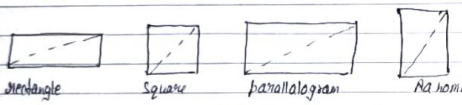


★ Area of Equilateral triangle (समबाहु त्रिभुज) = $\frac{\sqrt{3}}{4}a^2$

★ Area of triangle (if angle θ and two sides are given)

$A = \frac{1}{2} ab \sin\theta$

★



Rectangle Square parallalogram Na hombus

ऊपर दी गई सभी आकृतियों में अगर इनको उनके आधे क्षेत्रफल (त्रिभुज) का Area पता है तो उस आकृति का Area उसके Diagonal से बराबर वाले त्रिभुज का दोगुना होगा।

① Find the Area of triangle whose sides are 3cm, 4cm, 5cm.

② Find the Area of triangle whose two sides are 18 cm, 10 cm and perimeter is 42 cm.

③ Sides of Triangle are in the ratio 12:17:25 and its perimeter is 540 cm. Find its Area.

④ An isosceles triangle has perimeter 30cm and each of equal side is 12 cm. Find the Area of triangle.

⑤ Find the area of Quadrilateral ABCD in which AB = 3cm, BC = 4cm, CD = 4cm, DA = 5cm, AC = 5cm.

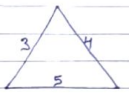
⑥ A Rhombus shape field has green grass for 18 cow to graze. If each side of Rhombus is 30m and its longer diagonal is 48cm. How much area of grass field will each cow be getting.

⑦ Find the area of equilateral triangle whose side is 30 cm.

⑧ Find the area of triangle whose two sides are 6 cm and 12 cm and angle b/w sides is 30. Find its area.

⑨ A Triangle in which two sides are 8cm, 11 cm and perimeter of Δ is 32 cm. Find its Area.

Ans-1



Semiperimeter of the triangle (s) = $\frac{a+b+c}{2} = \frac{3+4+5}{2} = \frac{12}{2} = 6$ cm

Area of triangle = $\sqrt{s(s-a)(s-b)(s-c)} = \sqrt{6(6-3)(6-4)(6-5)}$

$= \sqrt{6 \times 3 \times 2 \times 1} = \sqrt{36} = 6$ cm.

Ans-2

Let
a = 18 cm
b = 10 cm
perimeter (P) = 42 cm.
We know that,
$P = a+b+c$
$42 = 18+10+c$
$c = 42-28 = 14$ cm
Semiperimeter (s) = $\frac{P}{2} = \frac{42}{2} = 21$ cm.

Area of triangle = $\sqrt{s(s-a)(s-b)(s-c)}$
$= \sqrt{21(21-18)(21-10)(21-14)} = \sqrt{21 \times 3 \times 11 \times 7}$
$= \sqrt{21 \times 21 \times 11} = 21\sqrt{11}$ cm Ans

Ans-3 Let the Sides of the triangle is 12x, 17x, 25x.

Perimeter = 540
$P = a+b+c$
$540 = 12x+17x+25x$
$540 = 54x$
$\boxed{x = 10}$

$a = 12 \times 10 = 120$
$b = 17 \times 10 = 170$
$c = 25 \times 10 = 250$
Semiperimeter (s) = $P/2$
$= \frac{540}{2} = 270$

Area of Δ = $\sqrt{s(s-a)(s-b)(s-c)}$
$= \sqrt{270(270-120)(270-170)(270-250)}$
$= \sqrt{270 \times 150 \times 100 \times 20} = \sqrt{81000000}$
$= 9000$ cm²

Ans-4 ∵ two sides are equal in isosceles triangle,

So, $a = 12$, $b = 12$, $c = ?$

perimeter $(P) = 30$ Cm

$P = a+b+c$

$30 = 12+12+c$

$c = 30-24 = 6$ Cm

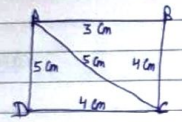
$s = P/2 = 15$ Cm

Area of the triangle $= \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{15(15-12)(15-12)(15-6)} = \sqrt{15\times3\times3\times9}$

$= \sqrt{3\times5\times3\times3\times3\times3} = 9\sqrt{15} = 9\sqrt{15}$ Cm²

Ans-5



In Δ ABC,

Semiperimeter of Δ ABC $(s) = \frac{3+4+5}{2} = \frac{12}{2} = 6$ Cm

Area of Δ ABC $(A_1) = \sqrt{6(6-3)(6-4)(6-5)} = \sqrt{6\times3\times2\times1} = \sqrt{36} = 6$ Cm²

In Δ ADC,

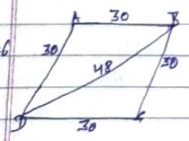
Semiperimeter of Δ ADC $(s) = \frac{5+4+5}{2} = \frac{14}{2} = 7$ Cm

Area of Δ ADC $= \sqrt{7(7-5)(7-4)(7-5)} = \sqrt{7\times2\times3\times2} = 2\sqrt{21}$ Cm²

Area of quadrilateral ABCD = Area of Δ ABC + Area of Δ ADC

$6 + 2\sqrt{21}$ Cm²

Ans-6



In Δ ABD, Semiperimeter of Δ ABD $(s) = \frac{30+30+48}{2} = \frac{108}{2} = 54$

Area of Δ ABD $(A) = \sqrt{54(54-30)(54-30)(54-48)} = \sqrt{54\times24\times24\times6}$

$= \sqrt{9\times6\times6\times24\times24} = 432$ m²

Area of rhombus $= 2\times432 = 864$ m²

Each cow getting Area $= \frac{864}{18} = 48$ m²

equilateral

Ans-7 $a = 30$ Cm

Area of equilateral triangle $= \frac{\sqrt{3}}{4}a^2 = \frac{\sqrt{3}}{4}\times30\times30 = 225\sqrt{3}$ Cm²

Ans-8 $a = 6$ Cm

$b = 12$ Cm

$\theta = 30°$

Area of triangle $= \frac{1}{2}ab\sin\theta = \frac{1}{2}\times6\times12\sin30° = 36\times\frac{1}{2} = 18$ Cm²

Ans-9 $a = 8$ Cm

$b = 11$ Cm

$P = 32$ Cm

$P = a+b+c$

$32 = 8+11+c$

$c = 32-19 = 13$ Cm

$s = P/2 = 32/2 = 16$ Cm

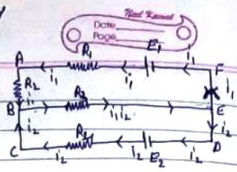
$A = \sqrt{s(s-a)(s-b)(s-c)}$

$= \sqrt{16(16-8)(16-11)(16-13)} = \sqrt{16\times8\times5\times3} = 8\sqrt{30}$ Cm²

CURRENT ELECTRICITY

Part - II

★ **Kirchhoff's second law Example →**



In closed phase ABEFA, ($\Sigma iR = \Sigma E$)

$$i_1R_1 + i_1R_2 + (i_1+i_2)R_3 = E_1 \quad \text{—①}$$

In closed phase CBEDC,

$$i_2R_4 + (i_1+i_2)R_3 = E_2 \quad \text{—②}$$

★ **Wheat stone Bridge →**

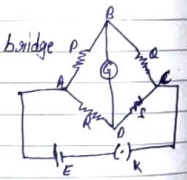
It is accurate arrangement for measuring the unknown Resistance.

It is combined with four resistances with the help of cells and key in the form of quadrilateral Resistance are arranged in such a manner that there is no current in galvanometer. Then it is called balance wheat stone.

In balance wheat stone the ratio of resistance of any two sides is equal to the ratio of resistance of other side.

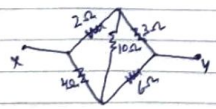
If ABCD represent a balance wheatstone bridge

then, $\frac{P}{Q} = \frac{R}{S}$



NUMERICALS

① what is the effective resistance between x and y, if



$\frac{2}{4} = \frac{3}{6}$

Hence, this is the balanced wheatstone, and no current has in 10Ω.

Let, $R_1 = 2\Omega$, $R_2 = 3\Omega$, $R_3 = 4\Omega$, $R_4 = 6\Omega$

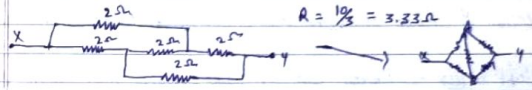
∵ R_1 and R_2 is series, $R_5 = R_1 + R_2 = 2+3 = 5\Omega$

∵ R_3 and R_4 is series, $R_6 = R_3 + R_4 = 4+6 = 10\Omega$

Now, R_5 and R_6 is in parallel, $\frac{1}{R} = \frac{1}{R_5} + \frac{1}{R_6} = \frac{1}{5} + \frac{1}{10} = \frac{2+1}{10} = \frac{3}{10}$

$R = 10/3 = 3.33\Omega$

②



$\frac{2}{2} = \frac{2}{2}$

hence it is balance wheatstone.

$R_1 = 2+2 = 4\Omega$

$R_2 = 2+2 = 4\Omega$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4}$ | $R = 2\Omega$

③

WATER

1. It is tasteless and odorless.
2. It freeze into ice at 0°c.
3. It's boiling point is 100°c.
4. The density of water is 1gm/cm³ or 1000kg/m³.
5. In water molecule Bond is 104.5°

★ Lather formation of water may be classified as soft water and hard water.

Soft Water → water that produce lather with soap readily is called soft water.

eg:- Rain water, Distilled water.

Hard Water → water does not produce lather with soap readily is called Hard water.

eg:- Sea water, River, spring, lake, well water.

★ Reason of Hardness of water → Hardness of water is due to the presence of bicarbonate, chloride and sulphate of calcium and magnesium.

~~Type~~ There are two types of hardness of water.

1) Temporary 2) permanant

i) Temporary Hardness :- This type of hardness due to the presence of bicarbonate of calcium and magnisium.

$Ca(HCO_3)_2$, $Mg(HCO_3)_2$.

2) Permanant Hardness :- This type of hardness is due to the presence of chloride and sulphate of calcium and magnisium. $CaCl_2$, $MgCl_2$, $CaSO_4$, $MgSO_4$.

Method of Removing Hardness of water :- temporary Hardness

i) By Boiling :- by boiling, bicarbonate decompose to carbonate and which is removed by filterization.

$$Mg(HCO_3)_2 \xrightarrow{\text{boiling}} MgCO_3 + CO_2\uparrow + H_2O$$

ii) Clark process :- In this process slaked lime is added to bicarbonate and it converted into carbonate which can be filtered and water become soft.

$$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3 + 2H_2O$$

(2) For Permanent Hardness → washing Soda process

By treated with washing soda, chloride and sulphate converted into carbonate which can be filtered and water become soft.

$$CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$$
$$MgSO_4 + Na_2CO_3 \longrightarrow MgCO_3 + Na_2SO_4$$

Q→ The following salts were found in 10 lakh parts of water sample :-
$Ca(HCO_3)_2 = 16.2g$, $Mg(HCO_3)_2 = 29.2g$, $CaSO_4 = 27.2g$
Calculate the hardness of water sample in ppm.

Formula of Salts	Dissolved Amount	molecular weight	$\frac{\text{Dissolved Amount}}{\text{Molecular wt}} \times 100$ Equivalent to $CaCO_3$
$Ca(HCO_3)_2$	16.2	162	$\frac{16.2}{162} \times 100 = 10$
$Mg(HCO_3)_2$	29.2	146	$\frac{29.2}{146} \times 100 = 20$
$CaSO_4$	27.2	136	$\frac{27.2}{136} \times 100 = 20$

Total weight of Hardness = 10 + 20 + 20 = 50 ppm
temp Hardness = 10 + 20 = 30 ppm
Permanent Hardness = 20 ppm

HYBRIDIZATION

It is defined as the mixing two atomic orbitals with same energy level to give new hybrid orbitals. This process is called hybridization. The new orbital thus formed is known as hybrid orbital.

Types of Hybridization

Based on the types of orbitals involving in mixing the hybridization can be classified as sp, sp^2, sp^3, sp^3d, sp^3d^2, sp^3d^3.

① **Sp hybridization** → It is observed when one s and one p orbital in same shell mix to form new sp hybridized orbital.
It form linear molecules with an angle 180°. (Eg:- $BeCl_2$, C_2H_2 etc)

② **Sp^2 hybridization** → It is observed when one s and two p orbitals of same Energy level mix together to form new sp^2 hybrid orbital.
The shape of sp^2 hybrid orbital is Trigonal at angle 120°. (Eg:- BF_3, C_2H_4)

③ **sp^3 hybridization** → It is observed when one s and three p orbitals belonging to same shell, mixed together and form sp^3 hybrid orbital.
The shape of sp^3 hybrid orbital is Tetrahedron at angle 109°28' (Eg:- C_2H_6, CH_4)

④ **Sp^3d hybridization** → It involves the mixing of 1s, 3p and 1d orbital.
The shape of sp^3d - Trigonal Bipyramidal at angle of 120° (Eg:- PCl_5)

SHORTCUT TO FIND HYBRIDIZATION

Hybridization of any atom = no. of atom attached + Lone pair of atom.

Type	Sum
sp →	2
sp^2 →	3
sp^3 →	4
sp^3d →	5
sp^3d^2 →	6

So on.

EX-① CH_4 → 4+0 = 4 = sp^3 (shape - Tetrahedron)
② NH_3 → 3+1 = 4 = sp^3 (shape - Tetrahedron)
③ H_2O → 2+2 = 4 = sp^3 (shape - Tetrahedron)
④ XeF_4 → 4+2 = 6 = sp^3d^2 (shape -
⑤ $BeCl_2$ → 2+0 = 2 = sp (shape - Linear)

ATOMIC STRUCTURE PART - 2

Quantum Numbers → To describe each electron in atom in different orbital we need quantum number to provide complete information of electron in atom.

There are four type of quantum no:-

n ① **Principle Quantum Number** → This quantum No. determine the main energy shell in which the electron is present.
It is represented by n.

Shell	K	L	M	N
n	1	2	3	4

l ② **Azimuthal Quantum Number** → This quantum No. determine the angular momentum of electron. It describe the shape of orbital. It is represented by l. value of l = 0 to (n-1)

Ex:- n = 1, l = 0 (n-1)
n = 2, l = 0, 1
n = 3, l = 0, 1, 2

Sub shell	s	p	d	f	g	h
l	0	1	2	3	4	5

n	l	Sub shell
1	0	1s
2	0, 1	2s, 2p
3	0, 1, 2	3s, 3p, 3d
4	0, 1, 2, 3	4s, 4p, 4d, 4f

E_1 - 13.6 eV
E_2 - 3.4 eV
E_3 - 1.51
E_4 - 0.85

m (3) **Magnetic Quantum Number** :- This quantum no. describe the behaviour of electron in magnetic field. It gives the no. of orbital in a given subshell. It is represented by m. The value of m is -l to +l.

Ex:- for l = 1. m = -1 to 1 means -1, 0, 1
So, p sub shell has 3 orbitals.

for l = 2 m = -2 to 2 = -2, -1, 0, 1, 2
So, d sub shell has 5 orbitals

Note:- Total value of $\boxed{m = 2l+1}$. Ex:- l = 1, m = 2×1+1 = 3
and one orbital has max. 2 electrons.

Sub shell	s	p	d	f
no. of orbitals	1	3	5	7
Max. electrons	1×2=2	3×2=6	5×2=10	7×2=14

s (4) **Spin Quantum Number** :- This quantum no. describe the spin orientation of electron. It is represented by s or m_s. It has two values = $+\frac{1}{2}$, $-\frac{1}{2}$.
for up ↑ for down ↓

[↑] [↑|↑|↑]

★ **Electronic Configuration of atom (on the basis of sub shell)**

Imp **Aufbau Principle** → According to this principle in the ground state of an atom an electron enter the orbital of lowest Energy first and subsequent electron are filled in the order of increasing Energy.

No more than two electrons can occupy the same orbital and two electrons in the same orbit must have opposite spins. [↑↓] [↑↓]

2 6 10 14

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f 5g
6s 6p 6d 6f
7s 7p 7d

Energy increasing order

1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p < 7s < 5f < 6d < 7p < 5g < 6f < 7d ... and so on

★ **Pauli principle** → According to this principle no. of two electon in an atom can have same values for all four quantum numbers.

Imp ★ **Hund Rule** → According to this rule electron pairing will not take place in the orbital of same energy with each is singly filled.
OR
One electron goes into each orbital untill all of them are half fill before pairing up.

Eg:- p^4 = [↑|↑|] ✗ OR [↑|↑|↑] ✓

Electronic Configuration of some elements →

$_6C = 1s^2\ 2s^2\ 2p^2$ [↑|↑] [↑|↑] [↑|↑|]
$_{11}Na = 1s^2\ 2s^2\ 2p^6\ 3s^1$ [↑|↑] [↑|↑] [↑|↑|↑] [↑]
$_8O = 1s^2\ 2s^2\ 2p^4$ [↑|↑] [↑|↑] [↑|↑|↑]
$_{16}S = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$ [↑|↑] [↑|↑] [↑|↑|↑] [↑|↑] [↑|↑|↑]
Imp $_{24}Cr = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$
$_{29}Cu = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$
$_{47}Ag = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^1\ 4d^{10}$
Gold $_{79}Au = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^1\ 4f^{14}\ 5d^{10}$

SET II Polynomials

$\alpha+\beta+\gamma = -\frac{b}{a}$

$\alpha+\beta = \frac{-b}{a}$

$\alpha\beta = \frac{c}{a}$ | $\alpha\beta+\beta\gamma+\gamma\alpha = \frac{c}{a}$

Formula :-

$\alpha^2+\beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$

$(\alpha-\beta)^2 = (\alpha+\beta)^2 - 4\alpha\beta$

$\alpha^3+\beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$

$\alpha\beta\gamma = -\frac{d}{a}$

Q→1 If α, β are the roots of $P(x) = x^2+4x-3$ then find the value of

(a) $\alpha+\beta$ (d) $\alpha^3+\beta^3$

(b) $\alpha\beta$ (e) $\alpha^2\beta+\alpha\beta^2$

(c) $\alpha^2+\beta^2$ (f) $\frac{1}{\alpha}+\frac{1}{\beta}$

Ans (a) $\alpha+\beta = \frac{-b}{a} = \frac{-4}{1} = -4$

(b) $\alpha\beta = \frac{c}{a} = \frac{-3}{1} = -3$

(c) $\alpha^2+\beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$
$= (-4)^2 - 2\times(-3) = 16+6 = 22$

(d) $\alpha^3+\beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$
$= (-4)^3 - 3\times(-3)(-4) = 64-36 = 28$

(e) $\alpha^2\beta+\alpha\beta^2 = \alpha\beta(\alpha+\beta)$
$= -3(-4) = 12$

(f) $\frac{1}{\alpha}+\frac{1}{\beta} = \frac{\beta+\alpha}{\alpha\beta} = \frac{-4}{-3} = 4/3$

Q→2 If $P(x) = x^2-kx+3$. One zero is negative to other. Find k?

Ans $P(x) = x^2-kx+3$
$\alpha = \alpha$
$\beta = -\alpha$

$\alpha+\beta = \frac{-b}{a}$
$\alpha-\alpha = \frac{-(-k)}{1}$
$\boxed{0 = k}$

Q→3 If $P(x) = x^2+3x-2k$. One zero is reciprocal to other, find k?

Ans $P(x) = x^2+3x-2k$
$\alpha = \alpha$
$\beta = \frac{1}{\alpha}$

$\alpha\beta = \frac{c}{a}$
$\alpha\cdot\frac{1}{\alpha} = \frac{-2k}{1}$

$-2k = 1$
$\boxed{k = -\frac{1}{2}}$

Q→1 ~~Formula~~ If α, β, γ are the zeros of $P(x) = x^3-3x^2-3x+1$. Then find the value of :- (i) $\alpha+\beta+\gamma$ (ii) $\alpha\beta+\beta\gamma+\gamma\alpha$ (iii) $\frac{1}{\alpha}+\frac{1}{\beta}+\frac{1}{\gamma}$

(iv) $\alpha^2\beta\gamma+\alpha\beta^2\gamma+\alpha\beta\gamma^2$ (v) $\frac{1}{\alpha\beta}+\frac{1}{\beta\gamma}+\frac{1}{\gamma\alpha}$ (vi) $\alpha\beta\gamma$

a b c d

Ans (i) $\alpha+\beta+\gamma = \frac{-b}{a} = \frac{-(-3)}{1} = 3$

(ii) $\alpha\beta+\beta\gamma+\gamma\alpha = \frac{c}{a} = \frac{-3}{1} = -3$

(vi) $\alpha\beta\gamma = -\frac{d}{a} = -\frac{(1)}{1} = -1$

(iii) $\frac{1}{\alpha}+\frac{1}{\beta}+\frac{1}{\gamma}$

$\frac{\beta\gamma+\alpha\gamma+\alpha\beta}{\alpha\beta\gamma} = \frac{\frac{c}{a}}{\frac{-d}{a}} = \frac{\frac{-3}{1}}{\frac{-(1)}{1}} = \frac{-3}{-1} = 3$

(iv) $\alpha^2\beta\gamma+\alpha\beta^2\gamma+\alpha\beta\gamma^2$

$\alpha\beta\gamma(\alpha+\beta+\gamma) = -\frac{d}{a}\left(\frac{-b}{a}\right) = \frac{-(-1)}{1}\left(\frac{-(-3)}{1}\right) = -1\times3 = -3$

(v) $\frac{1}{\alpha\beta}+\frac{1}{\beta\gamma}+\frac{1}{\gamma\alpha}$

$\frac{\gamma+\alpha+\beta}{\alpha\beta\gamma} = \frac{\frac{-b}{a}}{-\frac{d}{a}} = \frac{\frac{-(-3)}{1}}{\frac{-(1)}{1}} = \frac{\frac{3}{1}}{\frac{-1}{1}} = \frac{3}{-1} = -3$

Q→2 Find a cubic polynomial with a sum, sum of the product of its zeros taken two at a time and the product of its zeros as 2, -7, -14 respectively.

Ans 2 (Sum of the zeroes) $\alpha+\beta+\gamma = 2$

(Sum of the product of its zeroes taken two at a time) $\alpha\beta+\beta\gamma+\gamma\alpha = -7$

(product of its zeroes) $\alpha\beta\gamma = -14$

$$P(x) = x^3 - (\alpha+\beta+\gamma)x^2 + (\alpha\beta+\beta\gamma+\gamma\alpha)x - \alpha\beta\gamma$$
$$= x^3 - 2x^2 - 7x + 14$$

Q→3 If the zeroes of $P(x) = x^3 - 3x^2 + x + 1$ are $a-b, a, a+b$. Find a and b

Ans

$P(x) = x^3 - 3x^2 + x + 1$

$\alpha = a-b$

$\beta = a$

$\gamma = a+b$

$\alpha+\beta+\gamma = \frac{-b}{a} = \frac{-(-3)}{1}$

$a-b+a+a+b = 3$

$3a = 3$

$\boxed{a=1}$

$\alpha\beta\gamma = \frac{-d}{a} = \frac{-1}{1}$

$(a-b)(a)(a+b) = -1$

$(1-b)(1)(1+b) = -1$

$(1-b)(1+b) = -1$

$1-b^2 = -1$

$-b^2 = -1-1 = -2$

$\boxed{b = \pm\sqrt{2}}$

Q→4 If the squared difference for polynomial $p(x) = x^2 - px + 45$ is 144, Find

Ans

Given,

$(\alpha-\beta)^2 = 144$

$P(x) = x^2 - Px + 45$

we know that

$\alpha+\beta = \frac{-b}{a} = \frac{-(-P)}{1} = P$

$\alpha\beta = \frac{c}{a} = \frac{45}{1} = 45$

$(\alpha-\beta)^2 = (\alpha+\beta)^2 - 4\alpha\beta$

$144 = P^2 - 4\times45$

$144 = P^2 - 180$

$P^2 = 324$

$P = \sqrt{324}$

$\boxed{P=18}$

Q→5 A Sum of the square of zeroes of $P(x) = x^2 - 8x + K$ is 40. Find K.

Ans

Given,

$\alpha^2+\beta^2 = 40$

$\alpha+\beta = \frac{-b}{a} = \frac{-(-8)}{1} = 8$

$\alpha\beta = \frac{c}{a} = \frac{K}{1} = K$

we know that,

$(\alpha+\beta)^2 = \alpha^2+\beta^2+2\alpha\beta$

$(8)^2 = 40+2K$

$64-40 = 2K$

$2K = 24$

$\boxed{K=12}$

Q→6 If the two zeroes of $P(x) = x^4 - 6x^3 - 26x^2 + 138x - 35$ are $2\pm\sqrt{3}$. Find other zeroes,

$P(x) = x^4 - 6x^3 - 26x^2 + 138x - 35$

Ans ~~g(x)~~ $\alpha = 2+\sqrt{3}$, $\beta = 2-\sqrt{3}$

$g(x) = x^2 - (\alpha+\beta)x + \alpha\beta$

$= x^2 - (2+\sqrt{3}+2-\sqrt{3})x + (2+\sqrt{3})(2-\sqrt{3})$

$= x^2 - 4x + 2^2 - (\sqrt{3})^2$

$= x^2 - 4x + 4 - 3 = x^2 - 4x + 1$

$$\begin{array}{l|l} x^2-4x+1 & x^4-6x^3-26x^2+138x-35 \quad (x^2-2x-35 \\ & -x^4 \pm 4x^3 \pm x^2 \\ & -2x^3 - 27x^2 + 138x - 35 \\ & -2x^3 \pm 8x^2 \mp 2x \\ & -35x^2 + 140x - 35 \\ & -35x^2 + 140x - 35 \\ & 0 \end{array}$$

$x^2-2x-35 = 0$

$x^2-7x+5x-35 = 0$

$x(x-7)+5(x-7) = 0$

$(x-7)(x+5) = 0$

$x-7 = 0$ $\quad$ $x+5 = 0$

$x = 7$ $\quad$ $x = -5$

$(7, -5)$ Ans

Q→7 If the polynomial $x^4 - 6x^3 + 16x^2 - 25x + 10$ is divided by $x^2 - 2x + K$. and the remainder comes out $x+a$. Find K and a.

Ans

$$\begin{array}{l|l} x^2-2x+K & x^4-6x^3+16x^2-25x+10 \quad (x^2-4x+(8-K) \\ & -x^4 \pm 2x^3 \pm Kx^2 \\ & -4x^3 + (16-K)x^2 - 25x \\ & -4x^3 \pm 8x^2 \mp 4Kx \\ & (8-K)x^2 + (4K-25)x + 10 \\ & (8-K)x^2 - (-16+2K)x + (8K-K^2) \\ & (2K-9)x + K^2 - 8K + 10 \end{array}$$

Reminder $= x+a$

$(2K-9)x = x$

$2K-9 = 1$

$2K = 10$

$\boxed{K=5}$

$K^2 - 8K + 10 = a$

$(5)^2 - 8\times5 + 10 = a$

$25 - 40 + 10 = a$

$\boxed{-5 = a}$

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Limiting Reagent → The reactant which is consumed first and limits the amount of product formed is called limiting Reagent.

$D_m = (n-1)A$

$i = \frac{A+D}{2}$

$r = A/2$

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Physics Formula :-

$q = ne$

$I = \frac{q}{t}$

$V = W/q$

ohm's law $V = ir$

$R = \rho\left(\frac{l}{A}\right)$

series $R = R_1 + R_2 + R_3$

Parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$P = \frac{W}{t}$ or $\frac{V^2}{R}$ or VI

Heat $E = Vit$ or I^2RT or Pt

no. of units of Electric Energy $= \frac{\text{watt} \times \text{hours} \times \text{days}}{1000}$

$1\,kWh = 3.6 \times 10^6\,J$

$f = R/2$

$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ (mirror formula)

$m = \frac{h_2}{h_1} = -\frac{v}{u}$ (magnification)

Convex mirror	Concave mirror
$u = -ive$	$u = -ive$
$f = +ive$	$f = -ive$
$v = +ive$	$v = -ive$ (Real Image)
formed virtual image always	$v = +ive$ (virtual Image)

Constant $(n) = \frac{\sin i}{\sin r}$ / $n = \frac{c}{v}$ (air) (any medium)

${}_wn_g = \frac{n_g}{n_w}$ or $\frac{1}{{}_gn_w}$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ (lens formula) / $m = \frac{h_2}{h_1} = \frac{v}{u}$

Convex lens	Concave lens
$u = -ive$	$u = -ive$
$f = +ive$	$f = -ive$
$v = +ive$ (Real)	$v = -ive$ (always virtual)
$v = -ive$ (virtual)	

$P = \frac{1}{f}$ (in metre) (for convex lens $P = +ive$, for concave lens $P = -ive$)

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ and $P = P_1 + P_2$

critical Angle $(n) = \frac{1}{\sin C}$

$F = iBl\sin\theta$ | Force maximum → 90° ⊥

$F = qVB\sin\theta$ | Force minimum → 0° =

$B = \frac{\mu_0}{4\pi} \times \frac{iAd\sin\theta}{r^2}$ $\left(\frac{\mu_0}{4\pi} = 10^{-7}\right)$ Bio Savart law

e.m.f $(e) = N\left(\frac{\Delta\phi}{\Delta t}\right)$ | N = no. of turn in Coil, $\Delta\phi$ = Change in flux

$\phi = BA$

magnetic field in different shapes,

circular Coil - $B = 2\pi \times 10^{-7}\left(\frac{i}{r}\right)$

Straight wire - $B = 2 \times 10^{-7}\left(\frac{i}{r}\right)$

Solenoid -

$a = \frac{v-u}{t}$

Eqn of motion:

I → $v = u + at$

II → $s = ut + \frac{1}{2}at^2$

III → $v^2 = u^2 + 2as$

In circular coil → $v = \frac{2\pi r}{t}$

Average speed → $v_{av} = \frac{2v_1 v_2}{v_1 + v_2}$

$p = mv$

$F = ma$

Conservation law of momentum → $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$W = F \times S$ | $W = FS\cos\theta$ | $W = mgh$ | $W = mgh\sin\theta$

$P = W/T$

$P = E/T$

$K = \frac{1}{2}mv^2$ | $W = K_f - K_i$ or $\frac{1}{2}mv^2 - \frac{1}{2}mu^2$

$K = \frac{p^2}{2m}$ | $P.E = mgh$ | $K.E + P.E = \text{Constant}$

semi molar = $\frac{1}{2}$ M

deci molar = $\frac{1}{10}$ M

centi molar = $\frac{1}{100}$ M

$1\ cm^3$ - 1 ml

$1\ cm^3$ - $\frac{1}{1000}$ l

light optics part 9

mirror formula —> reqd

magnetism part 1

magnetism part 2 —> reqd

Potassium dichromate - $K_2Cr_2O_7$

Potassium permagaanate - $KMnO_4$

Sodium bicarbonate - $NaHCO_3$

Mohr's Salt - $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$

Sodium thiosulphate - $Na_2S_2O_3 \cdot 5H_2O$

Sugar - $C_{12}H_{22}O_{11}$

marble/ chalk/ lime stone - $CaCO_3$

$Ca(OH_2)$ - Slaked lime

Quick lime (lime water) - CaO

Baking Soda - $NaHCO_3$

Washing Soda - Na_2CO_3

Urea - NH_2CONH_2