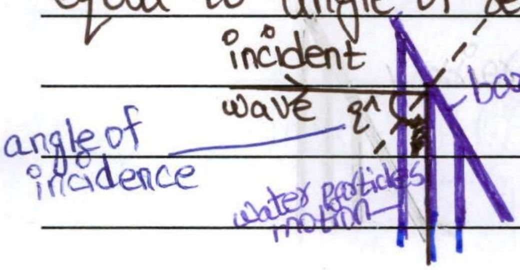
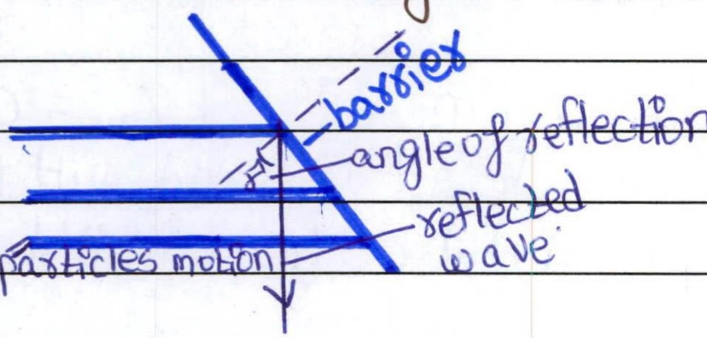
(Section B)

Q. No. 2 (i) Phenomenon of reflection of water waves:-

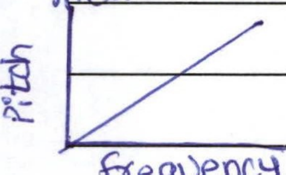
If we place a barrier in the ripple tank, the water waves will reflect from the barrier. If the barrier is placed at an angle to the wavefronts then reflected water waves can be seen to obey the laws of reflection i-e the angle made by the incident wave along the normal will be equal to the angle made by reflected wave along the normal. Hence, we define the phenomenon of reflection as: "When the waves travelling in one medium fall on the surface of another medium, they bounce back into the first medium such that angle of incidence is equal to angle of reflection".

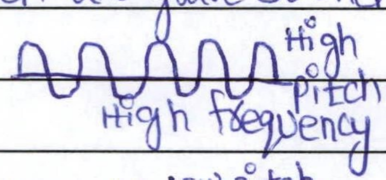




Q. No. 2 (ii)

Pitch	Quality
① Pitch is the characteristic of sound by which shrill and grave sounds can be distinguished.	The characteristic of sound which is used to distinguish the two sounds of same loudness and pitch is called quality.
② It depends upon frequency.	② It depends upon waveform.
③ High frequency means high pitch and shrill sound, low frequency means low pitch and grave sound.	③ Standing outside a room, we can distinguish between the notes of flute and piano ~~beig~~ being played inside the room, it is due to





Q. No. 2 (iii)

Lowest audible frequency = $f_1 = 20Hz$

Highest audible frequency = $f_2 = 20,000Hz$

Speed of sound in air = $v = 332 ms^{-1}$

wavelength ~~$\lambda_1 = ?$~~ of $f_1 = \lambda_1 = ?$

Wavelength of $f_2 = \lambda_2 = ?$

$v = f_1\lambda_1$	$v = f_2\lambda_2$
$332 = 20 \times \lambda_1$	$332 = 20,000 \times \lambda_2$
$\frac{332}{20} = \lambda_1$	$\lambda_2 = \frac{332}{20,000}$
$\lambda_1 = 16.6m$	$\lambda_2 = 0.016m$

So wavelength of sound with lowest audible frequency is 16.6m and that of highest audible frequency is 0.016m

Q. No. 2 (iv)

Q. No. 2 (v) q = charge = +2C

$V_1 = 100V$

$V_2 = 50V$

Energy supplied by charge = E = ?

Energy supplied by charge = $E = q(V_1 - V_2)$

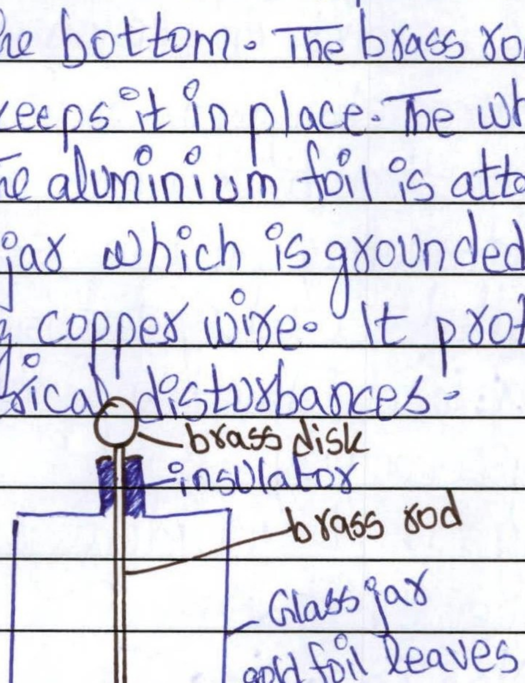
$= +2(100-50)$

$= 2(50)$

$= 100J$

The energy supplied by the charge is 100J.

Q. No. 2 (vi) **Gold leaf electroscope:** It is a sensitive instrument that is used to detect the presence of charges. It consists of a brass rod with ~~bab~~brass disk at the top and two thin leaves of gold foil hanging at the bottom. The brass rod is passing through an insulator which keeps it in place. The whole assembly is set up in a glass jar. The aluminium foil is attatched in the lower portion of the glass jar which is grounded to the Earth by the means of conducting copper wire. It protects the leaves from external electrical disturbances.



Q. No. 2 (vii)

Q. No. 2 (viii) **Working principle of transformer:** Transformer is the practical application of mutual induction. It is used to increase or ~~and~~ decrease the AC voltage. That is why it is used in AC circuit. An AC source is connected to primary coil which produces changing magnetic field which is carried to the secondary coil through iron core. The changing magnetic field produces alternating emf in secondary coil. ~~A~~ This AC voltage is called secondary voltage (V_s.)

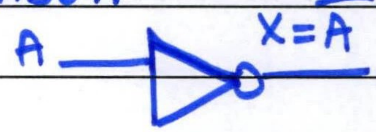
Ideal transformer: In an Ideal transformer, the electrical power delivered by secondary circuit is equal to electrical power supplied to primary circuit. An ideal transformer ~~that~~ does not dissipates power by itself. For such a transformer, we can write: $V_p I_p = V_s I_s$

Q. No. 2 (ix) **NOT operation:** A NOT operation consists of a single input either "0" or "1". The NOT operation inverts the input.

NOT gate (inverter): The digital circuit which implements the NOT operation is called NOT gate. It is called an inverter because it inverts the input. The output is 0 when input is 1. The output is 1 when input is 0.

Boolean expression: The NOT operation is represented by a bar or arrow over the symbol. Its boolean expression is $X = \overline{A}$ and it is read as "X equals A NOT".

Symbol:

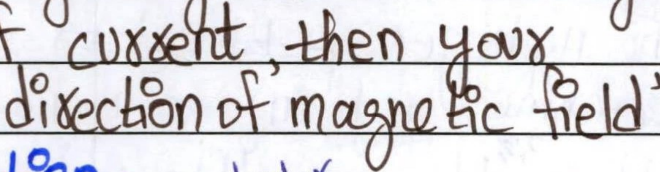


Truth table:

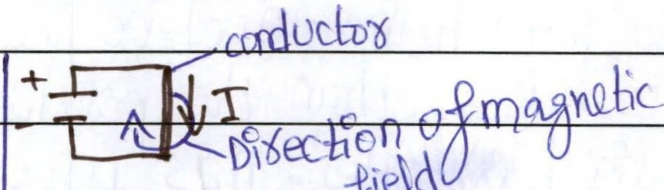
A	$X = \overline{A}$
0	1
1	0

Q. No. 2 (x) Direction of magnetic field around a straight current-carrying conductor can be found by right hand rule.
"Grasp a current carrying wire with your right hand such as your thumb points in the direction of current, then your curling fingers will tell the direction of magnetic field".

a) Current is in upward direction.
By applying right hand grip rule, we see that magnetic field is in anticlockwise direction if current is moving upward.



b) Downward direction
By applying right hand rule, we come to know that magnetic field is



Q. No. 2 (xi)

Q. No. 2 (xii) Nuclear fusion: When two lighter nuclei combine to form a heavy nucleus, the process is called nuclear fusion.

The Hydrogen ~~protium (^1_1H) and~~ deuterium (^2_1H) and tritium (^3_1H) combine to form an alpha particle or helium nuclei with energy.

$$^2_1H + ^3_1H \longrightarrow ^4_2He + ^1_0n + \text{Energy}$$

Such reaction is supposed to be occuring on moon and stars. The temperature at centre of ~~Earth~~ sun is 200 million kelvin which is favourable for it. In this process, two hydrogen nuclei combine to form helium nucleus. The mass of the final larger nuclei is less than the product of original masses of lighter nuclei. This process releases 25.7 MeV

Q. No. 2 (xiii) Radius of curvature = R = 38cm

a) focal length of mirror = $f = \frac{R}{2} = \frac{38}{2} = 19cm$.

b) $p = 50cm$, $q = ?$

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

$$\frac{1}{19} = \frac{1}{50} + \frac{1}{q}$$

$$\frac{1}{19} - \frac{1}{50} = \frac{1}{q}$$

$$\frac{1}{q} = 0.0526 - 0.02$$

$$\frac{1}{q} = 0.0326$$

$$q = \frac{1}{0.0326} = 30.6 ~~7~~ cm$$

ⓒ As q (image distance) is positive so image will be ~~upright and virtual~~ inverted and real.

....

Q. No. 2 (xiv) $C_1 = 3\mu F = 3\times10^{-6}F$

$C_2 = 4\mu F = 4\times10^{-6}F$.

$C_{eq} = \frac{60}{47}\mu F$

$C_3 = ?$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$\frac{60}{47} = \frac{1\times4}{3\times4} + \frac{1\times3}{4\times3} + \left(\frac{1}{C_3}\right)$$

$$\frac{60}{47} = \frac{7}{12} + \frac{1}{C_3}$$

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

$$\frac{1}{C_3} = 0.6932$$

$$C_3 = 1.44\mu F$$

$$C_3 = 1.44\times10^{-6}F$$

Q. No. 2 (xv) **Intensity Level:** The difference $L - L_0$ between the loudness of an unknown sound and the loudness L_0 is called intensity level of unknown sound.

Intensity Level = ~~$10 \frac{I}{I}$~~ $10 \log \frac{I}{I_0}$ (dB)

SI unit: The SI unit for Intensity level is bel. If it is measured in bel then,

$$\text{Intensity level} = \log \frac{I}{I_0} \text{ (bel)}$$

bel is a very large unit, we use a small unit called decibels (dB). 1 bel = 10 dB. Therefore if it is measured in dB, then:

$$\text{Intensity level} = 10 \log \frac{I}{I_0} \text{ (dB)}$$

....

Q. No. 3 (Page 1/4)

(a) Resistance:-

The ability of a substance which provides opposition to the flow of charges through it is called resistance.

SI unit: The SI unit of resistance is Ohm (Ω)

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

Factors affecting resistance:

The resistance of a metallic wire depends upon both its cross-sectional area and the length. Long wires have more resistance than short ~~thin~~ wires. Thick wires have less resistance than the thin wires. Copper wire has less resistance as compared to the steel wire of the same size. Resistance also depends upon nature of metal and temperature. At certain temperature, for a particular substance. The resistance R of a wire is directly proportional to the length of wire.

$R \propto L$ —— (i)

If the length of wire is doubled, the resistance will be doubled too. And if the length is halved, the resistance will also become one half.

The resistance R is inverse!y proportional to the area of wire. $R \propto \frac{1}{...}$ (ii)

Q. No. 3 (Page 2/4)

By combining (i) and (ii), we get:-

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

$R = \rho \frac{L}{A}$

where ρ is the proportionality constant and ~~is~~ it is called specific resistance or of resistivity. It is equal to Ωm (ohm meter). It depends upon nature of conductor. Steel copper and silver wires have different value of Ω

If we put $L = 1m$, $A = 1m^2$, then $R = \rho$. This means that the resistance of a $1m^3$ of substance is equal to its specific resistance.

(b)

Power = $P = 500 MW = 500 \times 10^6 W$

Current = $I = ?$

Voltage = ~~R~~ $V = 250kV = 250 \times 10^3 W$

$P = IV$

$\frac{P}{V} = I$

$I = \frac{500 \times 10^6}{250 \times 103}$

Q. No. 3 (Page 3/4)

Q. No. 3 (Page 4/4)

Q. No. 4 (Page 1/4)

(a) We know that during the process of radioactivity, the unstable radioactive nuclei tries to become more stable nuclei by emitting radiations.

"The spontaneous process in which unstable parent nuclide changes into more stable daughter nuclide with the emission of radiations is called nuclear transmutation"

Now, we represent the radioactive decays by the means of nuclear equation in which the unstable parent nuclei ${}^{A}_{Z}X$ changes into more stable daughter nuclei ${}^{A}_{Z}Y$ by emitting ~~α, β~~ alpha, beta or gamma radiations.

Three radioactive decays:

① Alpha decay: (α decay):

General equation:- ${}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He +$ energy

Example: ~~${}^{226}_{88}Ra \longrightarrow {}^{222}_{86}Fr + {}^{4}_{2}He +$ Energy~~

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

Parent nuclei — daughter nuclei

In alpha decay, the proton number or atomic number of the parent unstable nuclei decreases by 2 and its mass number decreases by 4.

② Beta decay: (β decay):

General equation:-

$$^{A}_{Z}X \rightarrow ^{A}_{Z+1}Y + ^{0}_{-1}e + energy$$

Example:

$$^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e + energy$$

Parent nuclei — daughter nuclei

In beta decay the proton number or atomic number of parent nuclei increases by 1 while its atomic mass number remains ~~&~~ same.

③ Gamma decay: (γ decay):

General equation:-

$$^{A}_{Z}X^{*} \rightarrow ^{A}_{Z}X + ^{0}_{0}\gamma + energy$$

Example:

$$^{60}_{27}Co^{*} \rightarrow ^{60}_{27}Co + ^{0}_{0}\gamma + energy.$$

In gamma decay, both proton number or atomic number and mass number of excited nuclei remains Unchanged.

~~The gamma rays are~~

The gamma decay is always followed by an emission of alpha or beta particle.

Q. No. 4 (Page 3/4)

(b)

$R_1 = 2\,\Omega$

$R_2 = 3\,\Omega$

$R_3 = 6\,\Omega$

It is parallel combination of resistors.

Voltage = 6V

Voltage will be same for each resistor.

(i) Req = ?

$$\frac{1}{Req} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{Req} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6}$$

$$\frac{1}{Req} = 0.5 + 0.33 + 0.166$$

$$\frac{1}{Req} = 0.996$$

$$Req = \frac{1}{0.996}$$

$Req = 1.004\,\Omega$

(ii) $I_1 = ?$, $I_2 = ?$

For R_1:-

$V = I_1 R_1$

$$\frac{V}{R_1} = I_1$$

$$I_1 = \frac{\cancel{6}\,3}{\cancel{2}\,1} = 3A$$

For R_2:

Q. No. 4 (Page 4/4)

For R_3:

$I_3 = \frac{V}{R_3} = \frac{6}{6} = 1A$

(iii) Total current ~~pa~~ of circuit = $I = I_1 + I_2 + I_3$

$I = 3A + 2A + 1A$

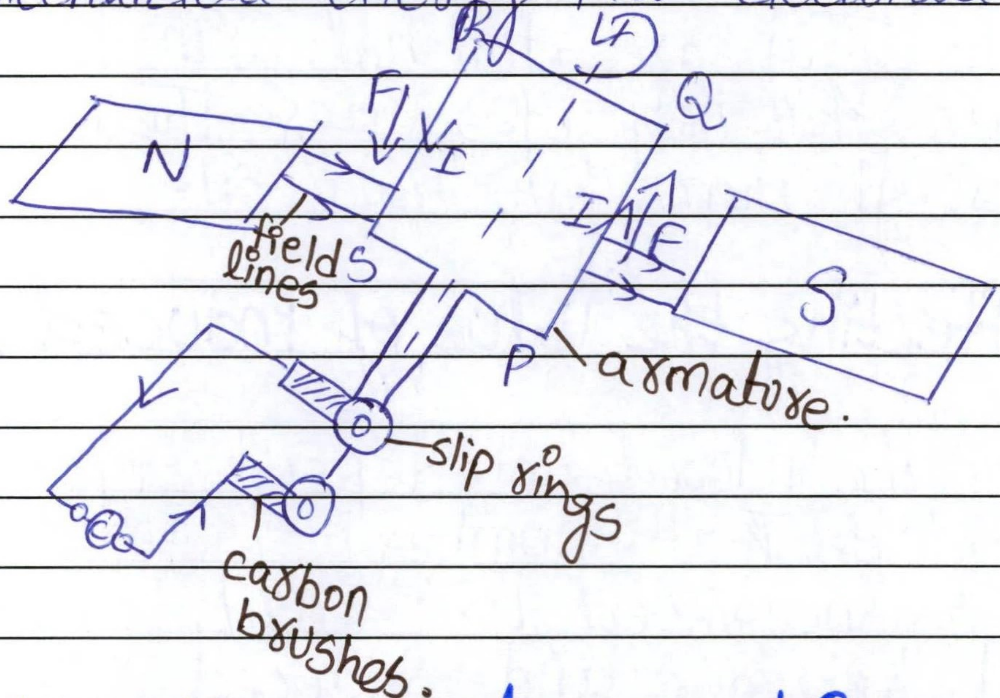
$I = 6A$

Q. No. 5 (Page 1/4)

@ AC generator:- ~~Ande electi~~ A device which generates an alternating emf is called AC generator. It converts mechanical energy into electrical energy.

Working principle:

An AC generator consists of a coil and a magnet. The coil is made to rotate continuously in the magnetic field. It is perpendicular to the magnetic field. When it rotates, the magnetic flux changes and an alternating emf is induced in it. In this way, an AC generator converts the ~~ma~~ mechanical energy into electrical energy.



Construction and workings-

① Armature: A rectangular current carrying coil called armature is placed in the magnetic field. The current is flowing through it. Due to it the force acts on the PQ side of coil

Q. No. 5 (Page 2/4)

coil in downward direction. These two forces are equal in magnitude but opposite in direction. These two forces form a couple due to which turning effect is produced and coil rotates. The number of magnetic lines of force passing through it changes and an alternating ~~cur~~ emf is induced in it.

② Slip rings:

The two ends of the coil are connected with the slip rings fixed at the arms of coil.

③ Carbon brushes: Carbon brushes are made up of graphite. They are attatched with the slip rings with the help of springs. The current flows through them into the coil.

Factor affecting the value of induced emf:

The value of the induced emf depends upon the length of wire. If number of turns on the armature is increased, the length of the wire will increase and induced emf will increase too.

Changes in the value and direction of induced current:

Q. No. 5 (Page 3/4) When AC generator is connected in the closed circuit. The induced emf produces an alternating current. The value and direction of this induced alternating current will change as follows:-

* **Minimum induced emf:** When the coil is in vertical position. When the plane of the loop is perpendicular to the magnetic field. The number of magnetic lines of force passing through it is maximum but change in the magnetic lines of force is ~~mini~~ minimum, so induced emf is minimum.
* **Increase in emf:** When the coil moves from vertical to horizontal position, the number of magnetic lines of force passing through it changes. So induced emf increases.
* **Maximum induced emf:** When the loop is in horizontal position, when plane of loop is parallel to the magnetic field, the value of induced emf and induced alternating current is maximum.

Direction of induced emf: As the coil rotates, the segment that was moving up begins to move down, so the direction of the induced current is reversed. This change in the direction of current takes place each time the coil turns through 180°. So this means that value of induced emf also increases from

Q. No. 5 (Page 4/4) back to 0 after each half turn and direction of the induced current is also reversed.

(b)

Number of waves = n = 100 waves.
time = t = 20s
Frequency of wave = f = ?
Time period = t = ?
wavelength = λ = 6cm = $\frac{6}{100}$ = 0.06m
wave speed = v = ?

$f = \frac{\text{No. of waves}}{\text{total time}} = \frac{100}{20} = 5Hz$.

Time period = $T = \frac{1}{f}$

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

Time period = T = 0.2s.

$v = f\lambda$
$v = 5 \times 0.06$
$v = 0.3ms^{-1}$
wave speed = 0.3m/s.