SCIENCE 086

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SECTION-A (BIOLOGY)

1. (c) Asexual reproduction by breaking up of Spirogyra filaments into smaller parts.
2. (D) 1 : 2 : 1
3. (c) Chemotropism
4. (D) The guard cells have swelled due to inflow of water.
5. (c) Decrease in energy at higher levels.
6. (B) ii and iii
7. (B) T5
8. (b) Both A and R are true but R is not correct explanation of A
9. (c) A is true but R is false.
10. (b) Limitations of electrical impulses bring about the need for chemical coordination using hormones in the animal body. Two limitations:
    - An impulse reaches to only those tissues and organs to which the neurons are connected. It does not reach to every cell of the body the way hormones do.
    - Once an impulse is generated, it takes time for the neuron to reset its mechanism in order to produce another impulse. Electrical impulses cannot be

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continually generated.

11. No, all variations in a species do not have equal chances of surviving in the environment in which they find themselves :-

- Variations occur due to inaccuracies in DNA copying during reproduction. Some variations can be useful for a species in the long run.
  Ex. Some bacteria live in a particular niche (pond for example). If the temperature rises, many would die as they cannot adapt. However if some of them have a heat-resistant variation, they would survive.
- Sometimes, too many inaccuracies in DNA copying leads to such variations in which the DNA cannot work with the cellular apparatus it inherits. Such a cell will die.
- Certain variations make an organism unsuitable for surviving in that particular niche, causing it to die.

12. Two ways of dealing with waste generated at home :-

- Biodegradable kitchen wastes can be turned into compost and put into pits in soil. This would increase soil fertility and help in growth of vegetation.

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- Non-biodegradable wastes like plastics, could be reused by making useful items out of them. Else, they can be sent for recycling instead of dumping it here and there. This protects the environment.

13. (a) Changes observed :

- Limewater in all three cases, P, Q, and R, turns milky due to carbon dioxide being expelled into them. [$Ca(OH)_2 + CO_2 \rightarrow CaCO_3\downarrow + H_2O$]
- Milkiness is fastest and greatest in case Q, as exhaled air from a complex organism like human, has high concentration of CO_2.
- Case P is slower as atmospheric air injected by piston has lower CO_2 concentration.
- In case R, yeast respires anaerobically by using glucose from sugar solution, to release ethanol, CO_2 and energy. This CO_2 travels along the pipes and turns lime water milky. This is also slower than Q as lesser CO_2 concentration is there.

[In yeast: Glucose $\xrightarrow{\text{in cytoplasm}}$ Pyruvate $\xrightarrow{\text{in cytoplasm}}$ Ethanol + CO_2 + 2ATP]
This is called fermentation

(b) (i) Aerobic respiration occurs in case Q .. mammals and complex animals

respire using oxygen, to release high energy, CO_2 and water after complete glucose breakdown. Hence this case has more milkiness in limewater.

Glucose (6-carbon molecule) $\xrightarrow{\text{in cytoplasm}}$ Pyruvate (3-carbon molecule) $\xrightarrow{\text{in mitochondria}}$ $CO_2 + H_2O + 38ATP$.

(ii) Fermentation occurs in case B by yeast. It respires anaerobically i.e., without O_2, to produce ethanol, CO_2, and energy. CO_2 produced here is lesser than case A, making limewater less milky.

Glucose (from sugar solutions) $\xrightarrow{\text{in cytoplasm}}$ Pyruvate $\xrightarrow[\text{in cytoplasm}]{\text{incomplete breakdown}}$ Ethanol (2-carbon molecule) $+ CO_2 + 2ATP$.

14. (a) Sex of an organism's offsprings is not always genetically determined. Sometimes, it depends on environmental cues. In reptiles like turtles, the temperature at which the eggs are incubated determines the sex of the offspring. Higher or lower the temperature, the baby's sex becomes male or female.

In snails, sex can be changed by them in their life. It does not depend on genes as in humans.

(b) Sex chromosomes in human beings is not always a perfect pair:
- In males, there is a mismatched pair of sex chromosomes. It is XY, where the X chromosome is the normal sized one while the Y chromosome is slightly shorter than X.
- In females, the pair is perfect. Both chromosomes are X, making the pair XX.

Males	Females
– Mismatched pair	– Perfect pair
– XY chromosomes, where Y is shorter	– XX chromosomes of same size.
– Determines sex of baby.	– Doesn't determine baby's sex.

15. (b) (i) Two ways other than surgical methods for Radha to avoid unwanted pregnancies :-
- Mechanical Barriers – Using mechanical barriers like coverings called condoms on penis, or similar coverings worn in vagina, would prevent sperms to reach oviduct for fertilisation, during intercourse.
- Hormonal Alterations – Using oral contraceptives like pills would alter hormonal balance of the female body, preventing ovulation. No ovulation

means no release of egg, and hence no fertilisation.

(ii) Surgical methods:
- Vasectomy – Involves cutting and blocking of vas deferens in males to prevent transport of sperms to female body.
- Tubectomy – Involves cutting and blocking of oviduct in females to prevent sperms reaching ovum, or ovum reaching sperms. Stops transport of egg cell.

(iii) Bacteria – Gonorrhoea and Syphilis.
Virus – HIV-AIDS and warts.

16. (a) Voluntary actions: Actions that are in our conscious control by brain, and performed by voluntary skeletal muscles; are voluntary actions.

(b) Voluntary actions' precision is controlled by cerebellum in hind brain. It maintains balance, posture, and smooth and steady movements with precision.

(c) (ii) Movement of animal muscles :-

- When an electrical impulse reaches to the muscles, contractile proteins present in muscles change their shape and arrangement.
- New arrangement of proteins causes muscle cells to change shape and shorten, hence causing movement.

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SECTION-B (CHEMISTRY)

17. (B) Tartaric acid

18. (D) pH falls below 5.6

19. (D) ii and iii

20. (C) X - Hydrochloric Acid Y - Carbon dioxide

21. (B) Mg reacts with water to produce H_2 gas which helps in floating.

22. (B) The jewellery comes in contact with air, moisture and acids and corrodes.

23. (C) The green colour of the salt fades and a gas with the smell of burning sulphur is evolved.

24. (C) A is true but R is false.

25. (a) Chemical equations should be balanced to satisfy the law of conservation of mass. This law states that mass of atoms on reactant side should be same as mass of atoms in product side, as mass can not be created nor destroyed.
So, number of atoms of an element in reactant side should be equal to number of atoms of that element in product side.

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(b) $4Na + O_2 \longrightarrow 2Na_2O$

In the equation oxidation state of Sodium, Na, becomes +1 due to loss of electrons as it reacts. Oxidation is loss of electrons, hence sodium is oxidised and is reducing agent. (It forms Na^+ ion)

Oxygen goes from neutral state to oxidation state -2 by gaining electrons and forming O^{2-} ion. As it gains electrons, it is reduced. So, it is oxidising agent.

∴ Reducing agent → 4Na (reduces O_2)

Oxidising agent → O_2 (oxidises 4Na)

26. (a) Oxides of highly reactive metals like sodium (Na), potassium (K), aluminium (Al), etc., have higher affinity for oxygen than carbon. Due to this, carbon cannot reduce them from their oxides.

(b) Ionic compounds are formed by strong electrostatic forces between oppositely charged ions. The forces between molecules in ionic compounds is very strong, hence hard to break. Lots of heat is required to break the forces of attraction, hence giving high melting and boiling points.

(c) Solder, an alloy of lead and tin has altered properties, leading it to have low melting point. Low melting point helps in melting it easily for welding electrical wires, so that once it dries up, they get strongly attached.

27. (b) i. Metal sulphides and carbonates should be converted to their metal oxides during extraction. It is easier to extract a metal from its oxides, than from its sulphides and carbonates. Oxides can be reduced to metals easily using reducing agents. Hence, they are converted to oxides first.

ii. Aluminium oxide shows both acidic and basic character. It neutralises and reacts with both acids and bases to give salt and water. Hence it is an amphoteric oxide. Reactions:

Al_2O_3 + $6HCl$ $\rightarrow$ $2AlCl_3$ + $3H_2O$ } with acid.
Aluminium oxide; Hydrochloric acid; Aluminium chloride; water.

Al_2O_3 + $2NaOH$ $\rightarrow$ $2NaAlO_2$ + H_2O } with base.
Aluminium oxide; Sodium hydroxide; Sodium aluminate; water

This is nature of amphoteric oxides.

iii. Metals like Na, K, Ca and Mg lie in the top of the reactivity series. They are highly reactive metals, and hence unstable in the free state. Due to high reactivity, they react and combine with other elements in nature to form compounds. Hence, they are never seen in their free state.

28. (a) Gas X produced at anode is Chlorine (Cl_2)
Gas Y produced at cathode is Hydrogen (H_2)

(b) Substance Z is Sodium hydroxide (NaOH) and this process of its production is chlor-alkali process.
Process: Electricity is passed through brine solution, ~~saturated with~~ leading to production of NaOH and H_2 at cathode, and Cl_2 at anode.
Equation:

$$2NaCl(aq) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g) + Cl_2(g)$$

Sodium chloride; water; sodium hydroxide; hydrogen; chlorine.

(c) (i) (I) If a drop of red litmus solution is added to aqueous solution of Z, sodium hydroxide (NaOH), it will turn blue in colour. This

happens because NaOH is a base and base turns red litmus blue.

II. When CO_2 is passed through aqueous solution of brine saturated with ammonia, ammonium chloride (NH_4Cl) and sodium bicarbonate ($NaHCO_3$) are formed. This is Solvay process.

$$\underset{\text{sodium chloride}}{NaCl(aq)} + \underset{\text{water}}{H_2O(l)} + \underset{\text{ammonia}}{NH_3} + \underset{\text{carbon dioxide}}{CO_2(g)} \rightarrow \underset{\text{ammonium chloride}}{NH_4Cl} + \underset{\text{sodium bicarbonate}}{NaHCO_3}$$

29. (a) (i) Compound 'P' is Ethanol, CH_3CH_2OH or C_2H_6O.

(ii) When compound P, CH_3CH_2OH, is heated with conc. H_2SO_4 at 443K, it produces compound Q, which is ethene with formula C_2H_4.

(I) $$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443K]{\text{conc.}H_2SO_4 + \Delta} \underset{\text{Ethene}}{H-\overset{H}{\overset{|}{C}}=\overset{H}{\overset{|}{C}}-H} + \underset{\text{water}}{H_2O}$$

(II) Conc. H_2SO_4 plays the role of a dehydrating agent. It removes water from ethanol to give unsaturated ethene.

(iii) When compound P, ethanol, is heated with ethanoic acid in

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presence of an acid catalyst, an ester called ethyl ethanoate is formed. It is a sweet-smelling compound. This process is called esterification reaction. Equation:-

$$\underset{\text{Ethanol : ep'}}{CH_3CH_2OH} + \underset{\text{Ethanoic acid}}{CH_3COOH} \xrightleftharpoons[\text{catalyst}]{H_2SO_4 + \Delta} \underset{\substack{\text{Ethyl ethanoate} \\ \text{(ester)}}}{CH_3COOCH_2CH_3} + \underset{\text{water.}}{H_2O}$$

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Physics Section.

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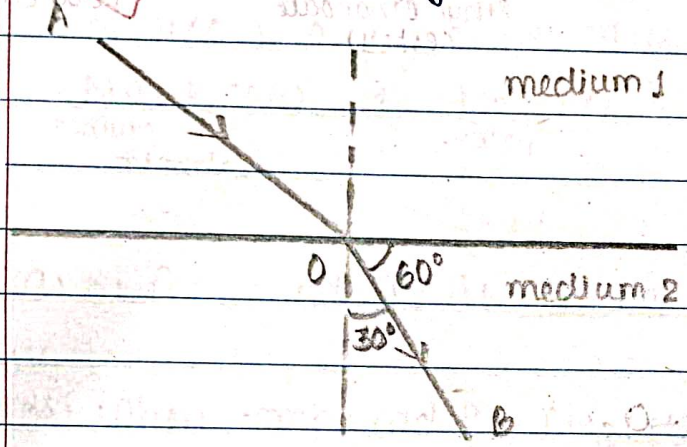
SECTION-C (PHYSICS)

30. (B) Red, Yellow, Green, Blue, Violet.

31. (A) Concave mirror; Nature of image – real.

32. (C) A true but R false.

33.



Given: R.I of n_2 w.r.t n_1 is $\sqrt{3}$.

Solution for $\angle i$:

As refracted ray forms 60° angle with the surface, angle of refraction would be 30°. Normal is perpendicular to interface separating the two media.

$\Rightarrow \angle r = 90° - 60° = 30°$.

By Snell's Law of Refraction, we know that ratio of sine of angle of incidence to sine of angle of refraction is a constant, which is refractive index of medium 2 w.r.t medium 1.

$\Rightarrow \frac{\sin i}{\sin r} = n_{21} \Rightarrow \frac{\sin i}{\sin 30°} = \sqrt{3} \Rightarrow \frac{\sin i}{1/2} = \sqrt{3}$ $(\because \sin 30° = 1/2)$

$\Rightarrow 2\sin i = \sqrt{3} \Rightarrow \sin i = \frac{\sqrt{3}}{2} \Rightarrow i = 60°$ $(\because \sin 60° = \sqrt{3}/2)$

$\therefore$ Angle of incidence = 60°

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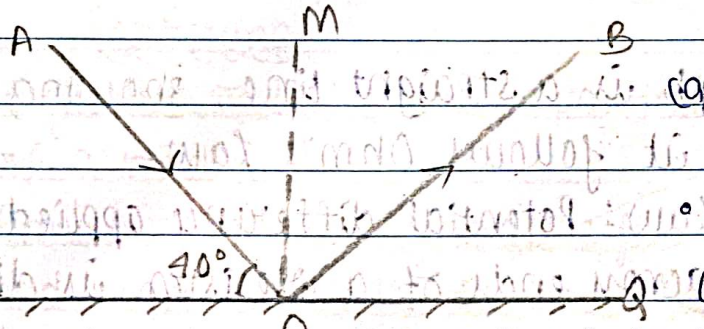
34. (a) Eye lens changes its shape to change focal length in order to view objects at different distances. This is called power of accommodation.
- When the object is at a far distance, the ciliary muscles in eye relax. The eye lens becomes thinner, its curvature reduces, and focal length increases. This helps to see distant objects.
- When the object is at a nearby distance, the ciliary muscles in eye contract. The eye lens contracts, becomes thicker, its curvature increases and focal length decreases. This helps to view nearby objects.

35. 

(a) There are two laws of reflection which will help to find $\angle i$ and $\angle r$:
- Incident ray, reflected ray, and normal at point of incidence all lie in the same plane
- Angle of incidence is equal to angle of reflection.

Also, the fact that normal is perpendicular to reflecting surface helps us in the calculation.

(b) As normal MO is perpendicular to reflecting surface PQ, $\angle POM = 90°$

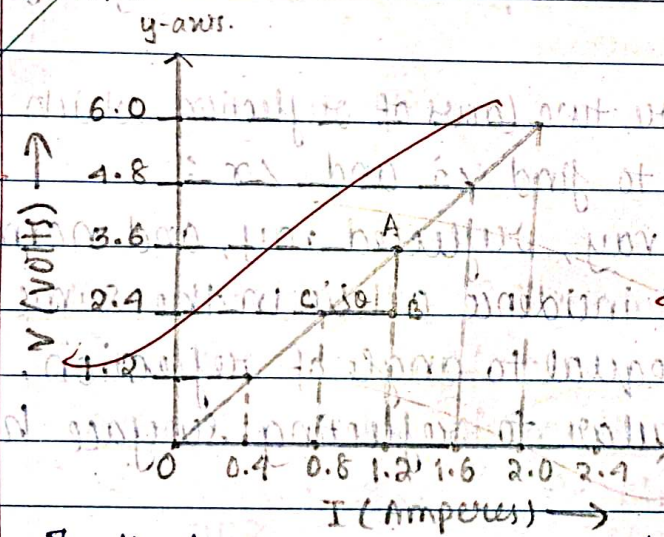
$\Rightarrow \angle POA + \angle AOM = 90° \Rightarrow 40° + \angle AOM = 90° \Rightarrow \angle AOM = 50°$

So, angle of incidence is equal to 50°.
As angle of incidence = angle of reflection,
Angle of reflection = 50°.
i.e. $\angle i = \angle r = 50°$

36.

I (Amperes) →	0.4	0.8	1.2	1.6	2.0
V (Volts) →	1.2	2.4	3.6	4.8	6.0

Graph: (V-I)



V-I graph is a straight line, showing that it follows Ohm's law.
(Ohm's law: Potential difference applied across ends of a resistor is directly proportional to current flowing across it)

To find resistance, we need slope of the graph.
Slope = tanθ in △ABC.

$$\tan\theta = \frac{AB}{BC} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(3.6 - 2.4)\,V}{(1.2 - 0.8)\,A} = \frac{1.2\,V}{0.4\,A} = 3\,\Omega$$

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We can check this by calculating individual resistances from each case. (Case 1 with $V = 1.2V$ and $I = 0.4A$: $R = \frac{1.2V}{0.4A} = 3\Omega$
Case 2 with $V = 2.4V$ and $I = 0.8A$: $R = \frac{2.4V}{0.8A} = 3\Omega$)
∴ Resistance = 3Ω.

37. The phenomenon in which light is deflected by the particles of the medium through which it travels is called scattering of light.

Difference between scattering and reflection :-

Scattering	Reflection
• Deflection of light due to particles of a medium.	• Bouncing back of light after hitting the surface of another medium.
• Random; causes Tyndall effect and beam of light to be visible.	• On smooth surfaces, reflection involves angle of incidence = angle of reflection.
• Particle size affects scattering of light colours. Different colours of light (VIBGYOR) can be visible due to scattering.	• Light's constituent colours are not visible. Light simply returns back to the same medium.
• Causes colour of sky, sun at sunset and sunrise, cloud colour, etc.	• Helps in objects to be seen, image of objects on mirror, etc.

OR 38. (a) Heating occurs due to the Heating effect of electric current and Joule's Law of Heating. The source of emf continuously expends energy to keep the flow of electric current intact. Some energy goes into doing useful work, while some dissipates as heat to raise temperature of the device.
Due to this, the fridge's metallic body gets heated up.

(b) When current = I, resistance = R, potential difference = V, and time = t :-
We know, $V = \frac{W}{Q} \Rightarrow W = VQ$. — (i)
Power is work done per unit time.
$\Rightarrow P = \frac{W}{t}$
From (i),
$P = \frac{VQ}{t} = VI$. — (ii)
Energy, or heat produced is P x t.
$\Rightarrow H = Pt$

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From (II),

$H = VIt$. ——— (IV).

Ohm's law derives that $V = IR$, where R is resistance and constant of proportionality for $V \propto I$.

Using Ohm's law in (III),

$H = (IR) \times It$ $(\because V = IR)$

$\Rightarrow H = I^2Rt$. (Joule's law of Heating)

$\therefore$ Heat produced, $H = I^2Rt$.

(c) (i) Practical applications of heating effect of electric current :-

- Electric Bulb: Filament of electric bulb should retain as much heat as possible, which is dissipated by the current, so that it glows to emit light and heat. Tungsten is used as it has high melting point.
- Electric Fuse: A conductor of appropriate melting point is taken to break circuit if high current flows. High current would generate too much heat, causing the fuse wire to melt and break the circuit, saving appliances.

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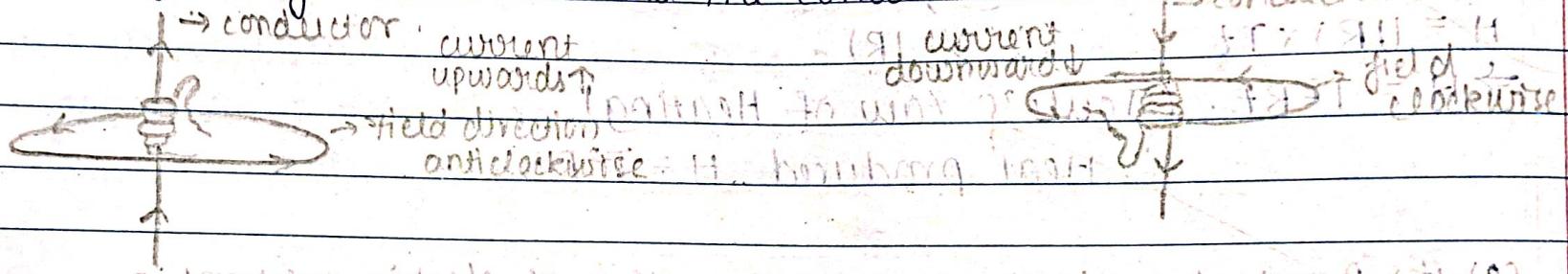
39. (a) (i) I. Right Hand Thumb Rule.

It states that, when you hold a straight current carrying conductor in your right hand with your thumb pointing in direction of current, the direction in which your other fingers naturally curl is the direction of magnetic field lines around the conductor.



II. Fleming's Left Hand Rule:

It states: Align your left hand's thumb, forefinger, and middle finger perpendicular to each other. If the forefinger points in direction of magnetic field, middle finger points in direction of current, then thumb would point in direction of force experienced by the conductor (current carrying).

(ii) I. Magnetic field lines due to current carrying solenoid is similar to magnetic field lines of a bar magnet.

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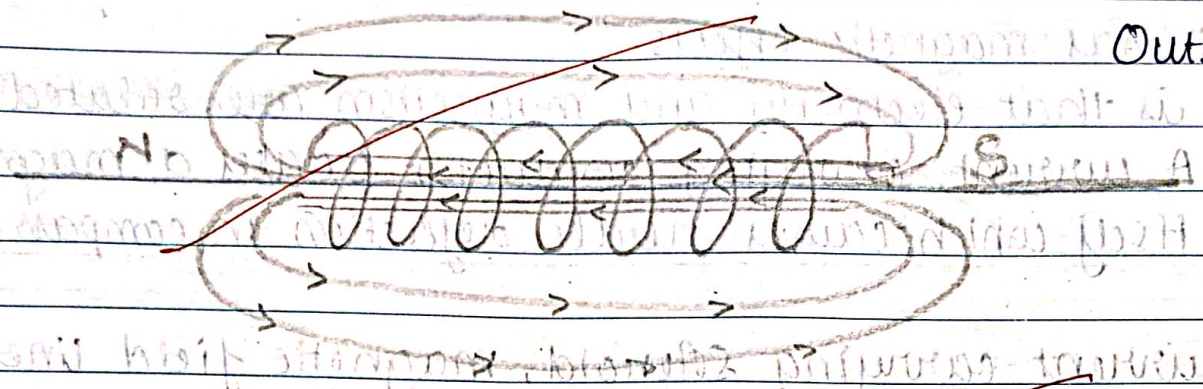

Outside solenoid:
North to South.
Within solenoid:
South to North.

II. Field strength is maximum at A, the point within the solenoid.
↳ within solenoid, the magnetic field lines are close, parallel and evenly spaced. There is uniform magnetic field with maximum strength.
Field strength minimum at B, outside the solenoid. At C, all field lines crowd together and enter inside, making it stronger. However B would have lesser crowded field lines, making it weaker than A and C.

OR.

(b) (i) I. The purpose of the arrangement is to prove that electricity is related to magnetism. Bringing compass close to the copper wire would show deflection in compass needle, proving that

electric current has magnetic effects.
II. Conclusion is that electricity and magnetism are related phenomena. A current carrying conductor creates a magnetic field around itself which causes needle deflection in compass.

(ii) I. In a current carrying solenoid, magnetic field lines move from north to south outside, and from south to north inside. This forms closed loops. At the ends of the solenoid, the field lines converge or diverge due to formation of such loop.
At north pole: diverge to go to south pole.
At south pole: converge from and enter solenoid.

II. Current carrying solenoid behaves like a bar magnet and has North and south poles. When suspended freely, its poles align in north-south direction due to its magnetic properties.

III. If a burnt fuse is replaced with another fuse of higher rating, then when high current flows, the fuse won't melt and the appliances will be damaged. Identical rating fuse

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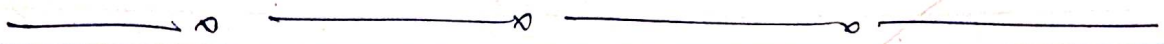
should be used for protecting appliances and ensuring that the minimum safe amount of current flows.



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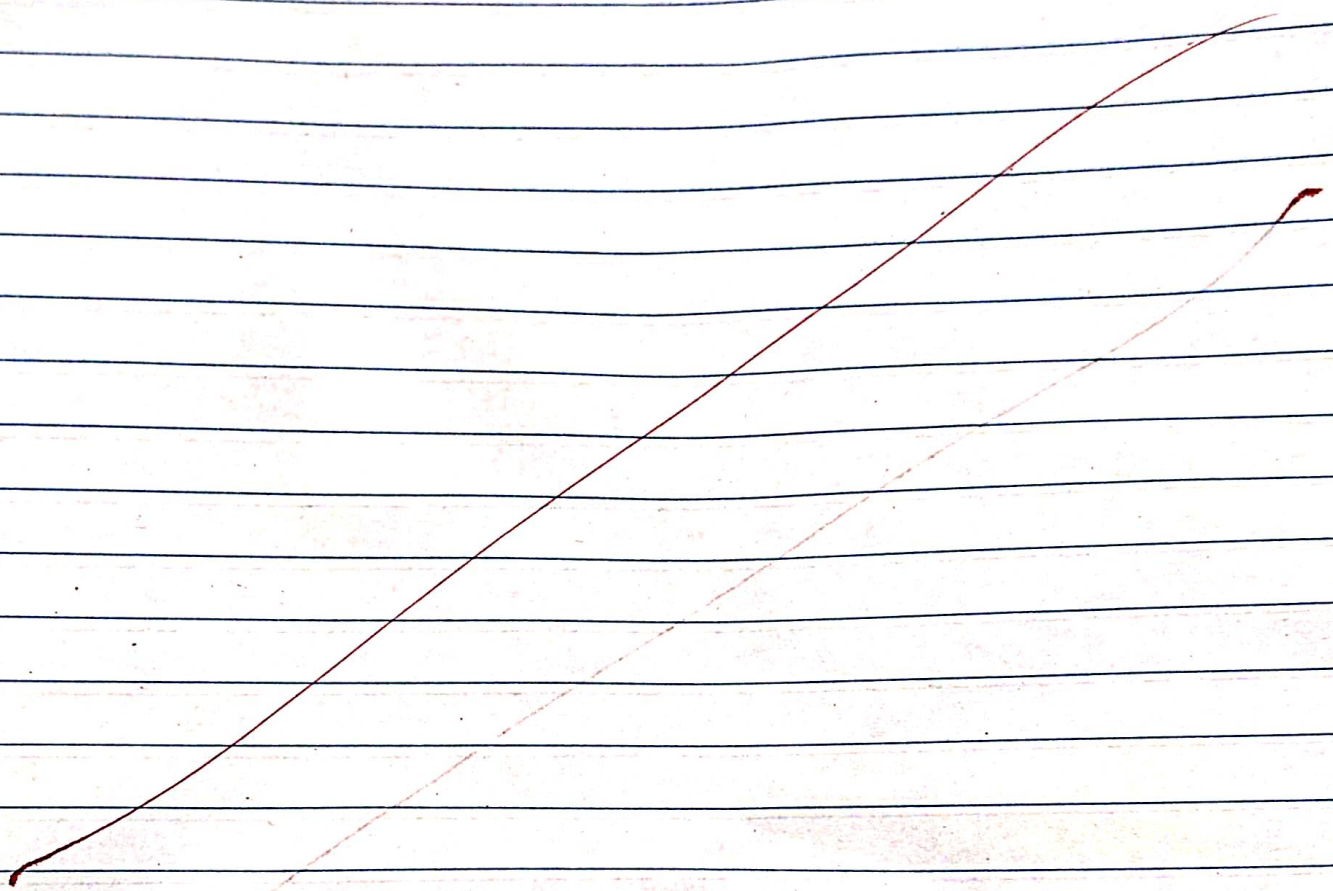

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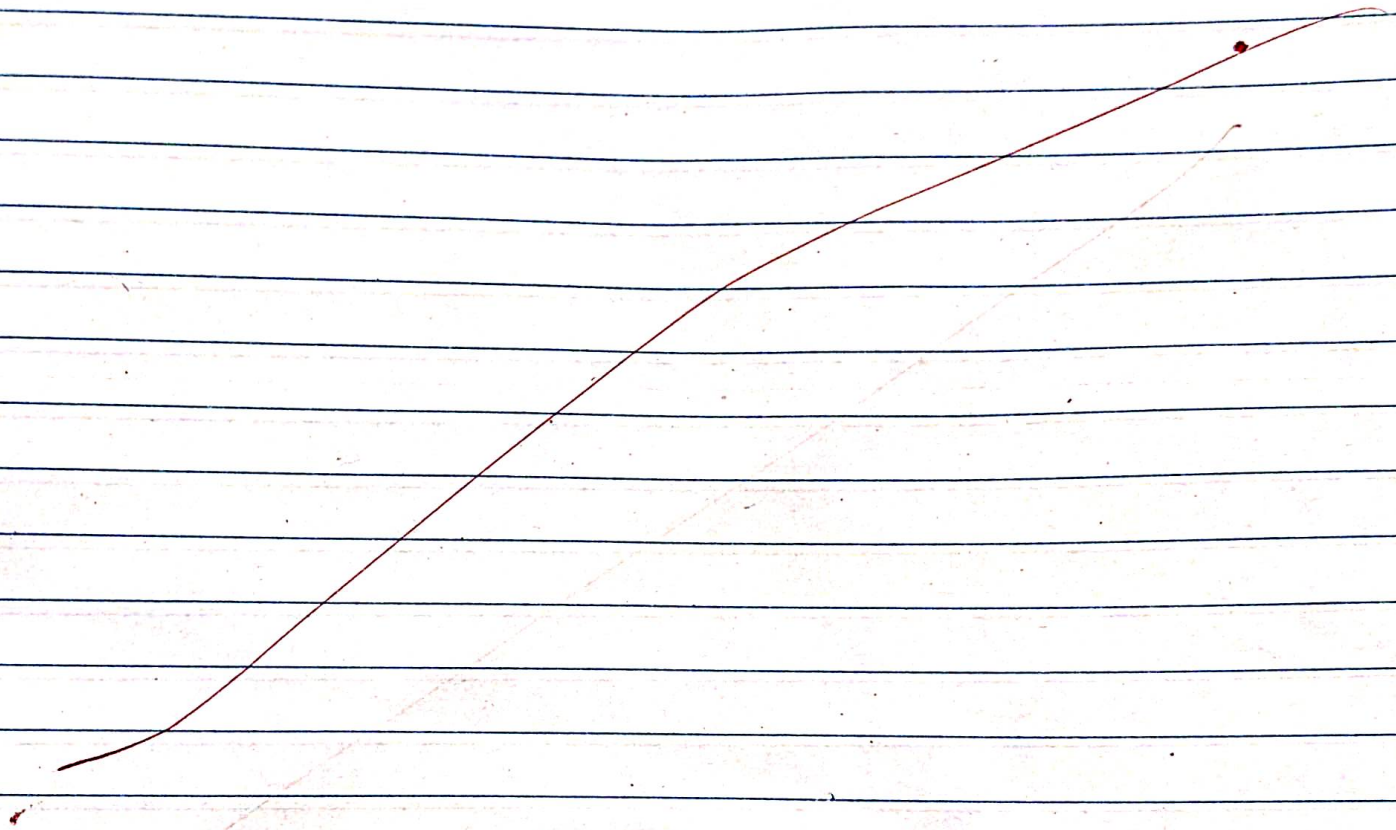

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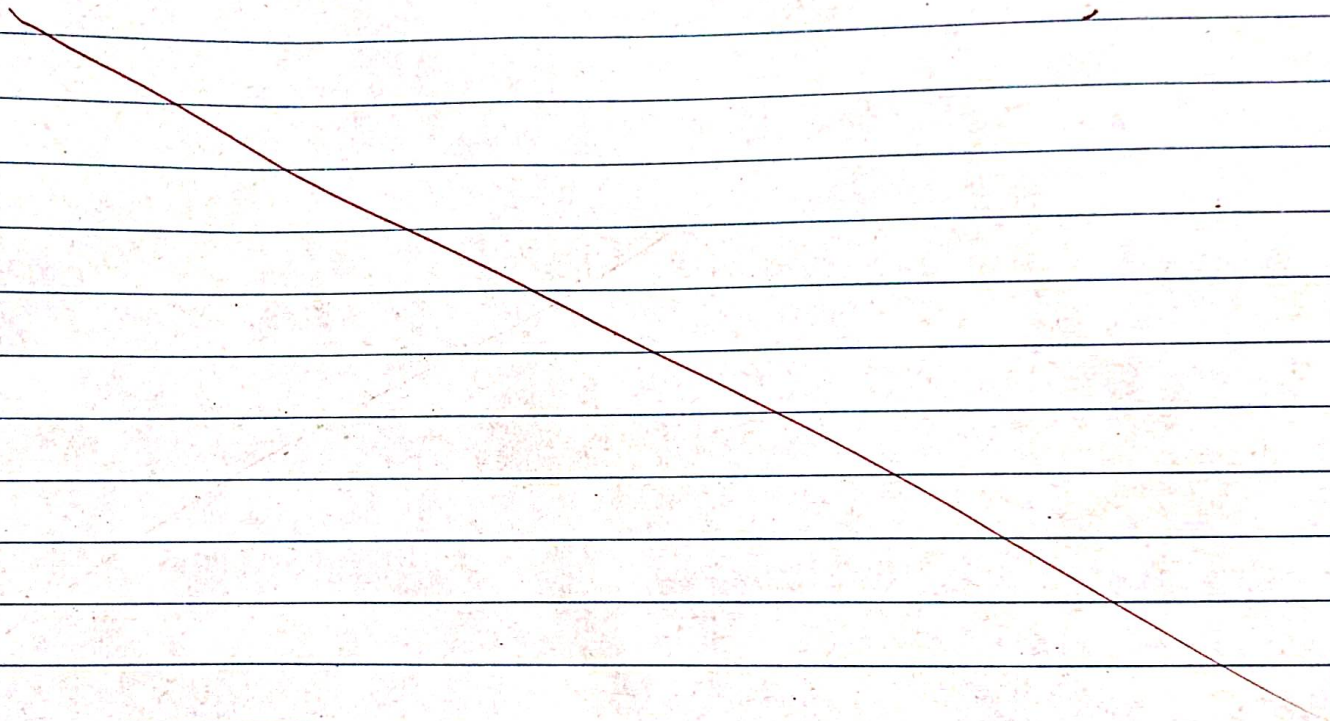

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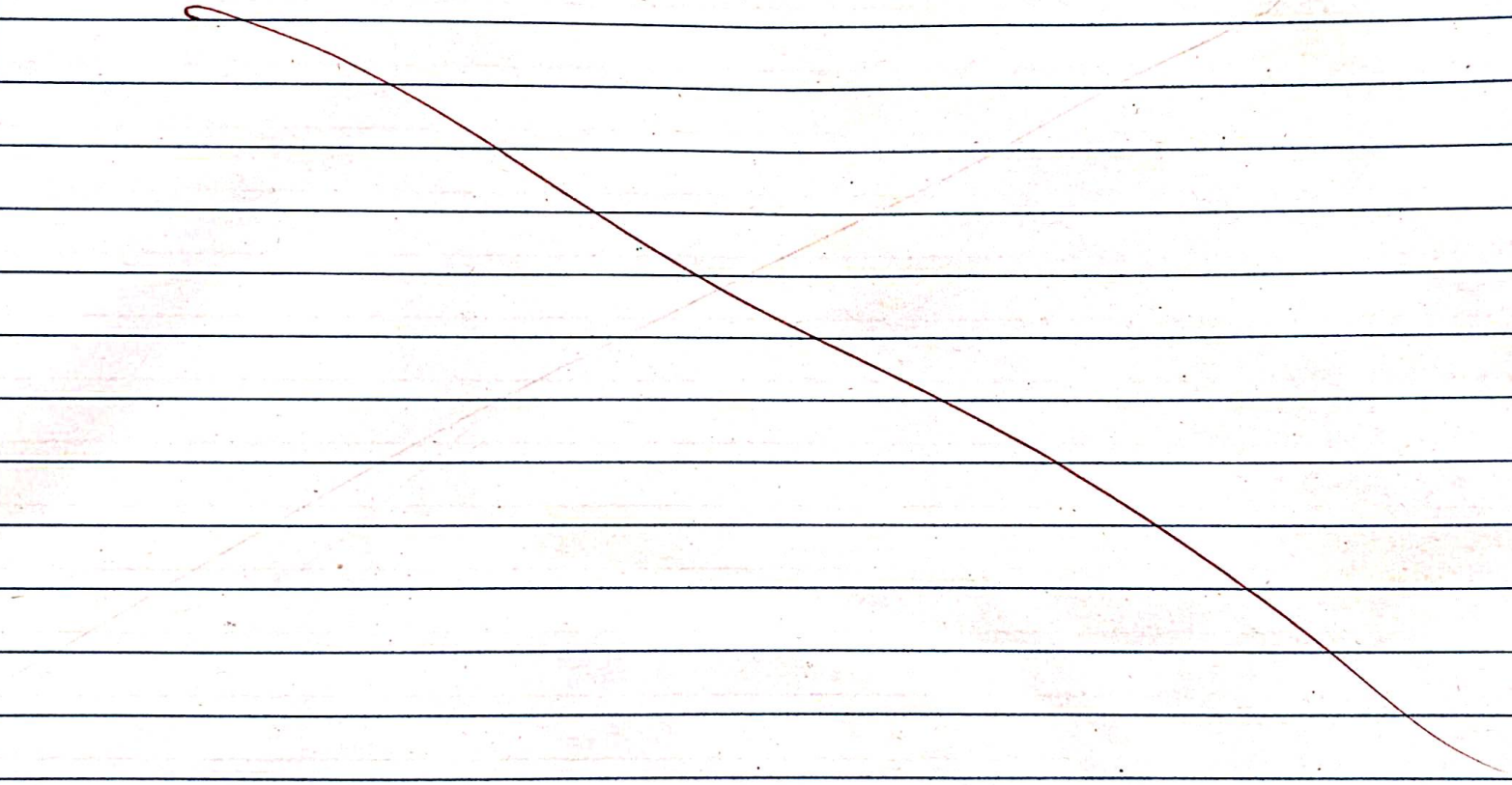

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