IMPORTANT QUESTIONS FOR SECTION B: (THEORY)

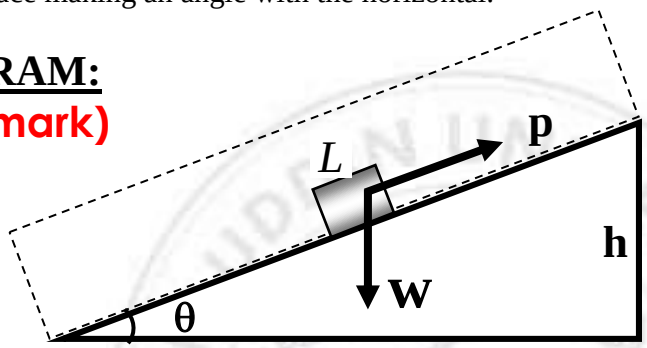
3 Marks for each question

1. **Define inclined plane and derive the equation for its mechanical advantage?**

INCLINED PLANE: (0.5 mark)

Inclined plane is a simple machine which help us in raising heavy loads it consist of simple plane surface making an angle with the horizontal.

DIAGRAM: (0.5 mark)



MECHANICAL ADVANTAGE: (02 marks)

If the weight W is raised to height h by applying effort P on it through a distance L then for ideal inclined plane,

OUTPUT = INPUT

Work done in raising the weight = work done by effort

W x h = P x L

$$\frac{W}{P} = \frac{L}{h}$$

$$\text{M.A} = \frac{L}{h} \quad \text{..... eq(i)}$$

$$\text{Since} \quad \sin\theta = \frac{P}{H}$$

$$\sin\theta = \frac{h}{L}$$

$$\frac{1}{\sin\theta} = \frac{L}{h} \quad \text{... eq (ii)}$$

By comparing eq (i) and eq (ii)

$$\text{M.A} = \frac{1}{\sin\theta}$$

With the help of above equation we can say that the smaller the value of angle, the greater will be the mechanical advantage.

2. **Define pulley and derive the equation for mechanical advantage of fixed pulley?**

PULLEY: (0.25 MARK)

A pulley is a grooved wheel supported in a frame which is called block. The wheel can turn about an axle in a block it can be suspended from a fixed beam by means of hooks. A rope can pass over the pulley.

FIXED PULLEY: (0.25 MARK)

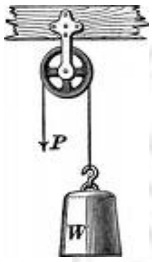
In fixed pulley the block of the pulley is fixed to a strong beam or ceiling. The pulley does not move and is called a fixed pulley. fixed pulley is often used for the purpose of raising loads.

WORKING: (0.25 MARK)

A load or weight W is tied at one end of the rope passing over pulley, while the effort is applied down ward at the other end.

DIAGRAM:

(0.25 MARK)



MECHANICAL ADVANTAGE: (02 MARKS)

If we ignore the weight of rope and force of friction between rope and the pulley then.

According to the principle of lever

Torque of Load = Torque of Effort

Load x Load Arm = Effort x Effort Arm

W x Load arm = P x Effort arm

$$\frac{W}{P} = \frac{\text{Effort arm}}{\text{Weight arm}}$$

$$M.A = \frac{OA}{OB}$$

$$M.A = 1$$

"In fixed pulley we have to apply the effort downwards to lift the load and this is to make it convenient."

3. State Quantum theory and wave theory.

QUANTUM THEORY OF LIGHT (02 MARKS)

According to Quantum theory of light

"Light consist of energy packets called "photon" or "Quanta". Energy of photon is directly proportional to the frequency of vibration."

Mathematically it can be expressed as:

$E \alpha \upsilon$

$E = h\upsilon$ **where h = plank's constant = 6.63×10^{-34} J/Sec.**

WAVE THEORY OF LIGHT(02 MARKS)

According to wave theory of light

i. Light consist of two waves electrical waves and magnetic waves, both waves are mutually perpendicular on each other.

ii. Light waves travel with the velocity of light.

iii. Light waves do not required material medium for their propagation, so light waves are electromagnetic in nature."

4. State and derive Coulomb's law.

COULOMB'S LAW:

DEFINITION: (01 MARK)

Coulomb stated that "Two unlike charges attract each other, and two like charges repel each other, with a force that is directly proportional to the product of the magnitude of charges and is inversely proportional to the square of the distance between them.

MATHEMATICAL EXPRESSION : (02 MARKS)

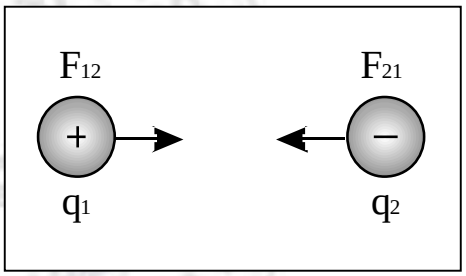
If two charges $q_1 \text{and} q_2$ are placed at a distance 'r' then according to the coulomb's law.

$$F \alpha q_1 q_2$$

$$F \alpha \frac{1}{r^2}$$

$$F \alpha \frac{q_1 q_2}{r^2}$$

$$F = \frac{k q_1 q_2}{r^2}$$



Where 'K' is constant & its value in SI units is 9×10^9 Nm^2/C^2. The constant 'K' is commonly expressed as follow: $K = \frac{1}{4\pi \in_0}$

Where is $\in_0$ Known as the permittivity of free space.

5. Name two main defects of Human eyes. Only with the help of ray diagram show the defect and correction of any one defect.

NAMES: (01 MARK)

1. Short-sightedness or Myopia.
2. Long-sightedness or Hypermetropia

SHORT-SIGHTEDNESS OR MYOPIA:

DEFINITION: (0.25 MARK)

It is disease in which a person can not see distant objects but can see near objects.

REASON: (0.25 MARK)

It occurs when the Eyeball becomes too converging or Eyeball becomes too long.

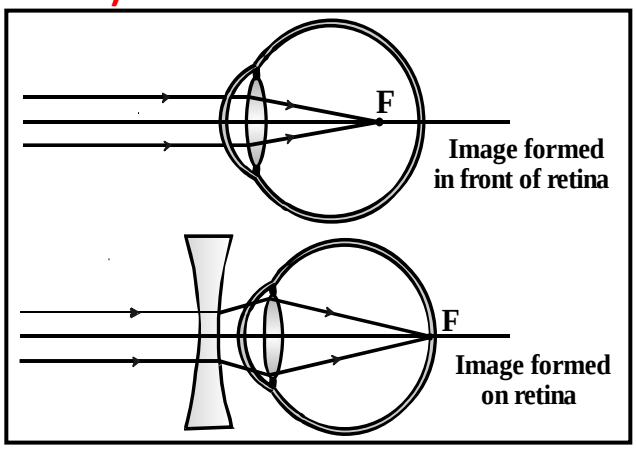
EFFECT: (0.25 MARK)

Due to above reasons the image of distant object is formed in front of the retina and thus can not be seen clearly.

CORRECTION: (0.25 MARK)

Short-sightedness of the eye can be corrected by using a concave lens of suitable focal length in front of the eye.

DIAGRAM: (01 MARK)

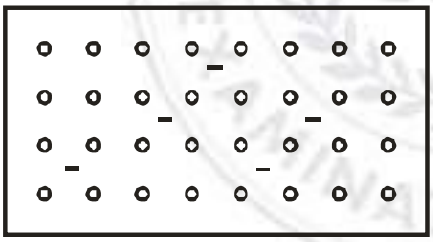
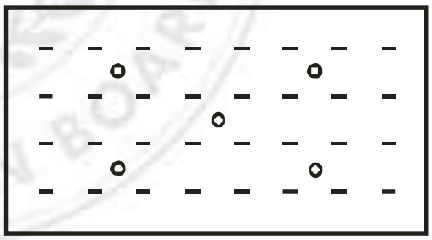


6. What are semiconducting materials? Define P-type and N-type materials.

SEMI – CONDUCTORS: (1 MARK)

The material whose conductivity lies between good conductors and bad conductors are called semi – conductors. These are the members of the 4th group of the periodic table, for examples: silicon & germanium are the important semi – conductors.

(2 MARKS)

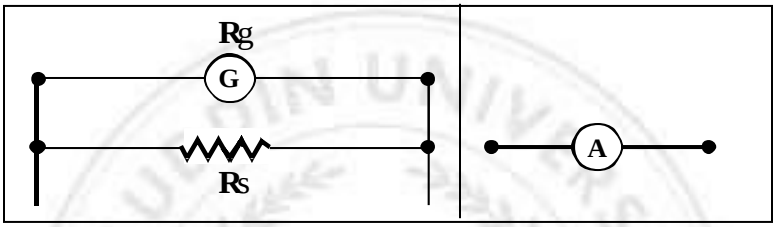
p –TYPE	n- TYPE
1. Such materials which can be formed by adding the impurity from the 3rd group of periodic table such as indium (trivalent) in the pure semi–conductor crystals known as p-type semi-conductors. 2. In p-type materials the majority charge carriers are positive and the minority charge carriers are negative. 3. p-type materials represented by hole (o) (+ve charge) 4. The p-type material can be sketch as: 	1. Such materials which can be formed by adding the impurity from the 5th group of the periodic table such as antimony (pentavalent) in the pure semi-conductor crystals known as n-type semi-conductors. 2. In n-type materials, the majority charge carriers are negative and the minority charge carriers are positive. 3. n-type materials represented by free electrons (-) 4. The n-type material can be sketch as: 

7. How galvanometer can convert to an ammeter and voltmeter.

AMMETER: (1 MARK)

"Ampere meter is electrical devices which help us to major amount of electric current".

A galvanometer can be converted into an ammeter by connecting low resistance in parallel with galvanometer and this resistance is called Shunt resistance.



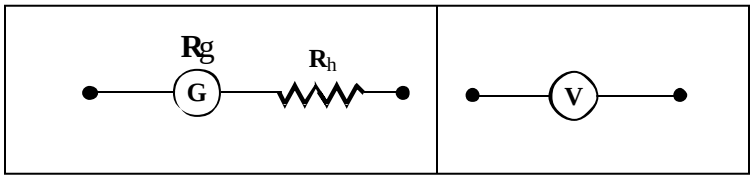
CONNECTION OF AMMETER (0.5 MARK)

An ammeter is always placed in series with other circuit components through which the current is to be measured.

VOLTMETER: (1 MARK)

"Voltmeter is electrical devices which help us to major amount of potential difference".

A galvanometer can be converted into voltmeter by connecting high resistance in series with galvanometer.



CONNECTION OF VOLTMETER (0.5 MARK)

In order to measure the potential difference of a resistor a voltmeter is always connected in parallel to the source.

8. Give difference between Voltmeter and ammeter **(1 MARK FOR EACH DIFFERENCE)**

VOLTMETER	AMMETER
It is used to measure potential difference between two points.	It is used to detect and measure electric current in a circuit.
A galvanometer can be converted into a voltmeter by connecting high resistances in series.	A galvanometer can be converted into an ammeter by connecting low resistances in parallel.
Voltmeter is connected in parallel with circuit.	Ammeter is connected in series with the circuit.

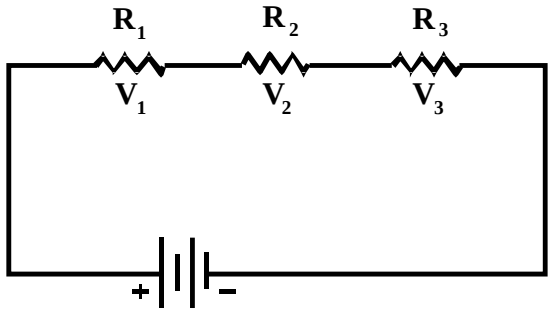
9. Define series combination and derive equation for equivalent resistance?

SERIES COMBINATION:

DEFINITION: (0.5 MARK)

Resistors are said to be connected in series, when they are connected end to end consecutively so that there is only one path for the flow of current and the same current flows through each resistor.

DIAGRAM: (0.5 MARK)



DERIVATION: (02 MARK)

Let three resistances R_1, R_2 and R_3 are connected in series across a battery of voltage 'V'. The potential difference across each of the resistor R_1, R_2 and R_3, is V_1, V_2 and V_3 respectively as shown in figure.

$$V_1 = IR_1$$
$$V_2 = IR_2$$
$$V_3 = IR_3$$

We can also represent this circuit by replacing the series combination by an equivalent resistance R. Now the potential difference across equivalent resistor is R. Same current 'I' flows through it, then

V = IR

As total voltage 'V' of the battery is divided among the resistors in series.

$$V = V_1 + V_2 + V_3$$
$$IR = IR_1 + IR_2 + IR_3$$
$$IR = I(R_1 + R_2 + R_3)$$
$$\frac{IR}{I} = (R_1 + R_2 + R_3)$$
$$R = R_1 + R_2 + R_3$$

If 'n' resistor are connected in series then

$$R = R_1 + R_2 + R_3 ..... + R_n$$

Equivalent resistors = Sum of the resistors connected in series

10.Define parallel combination and derive equation for equivalent resistance?

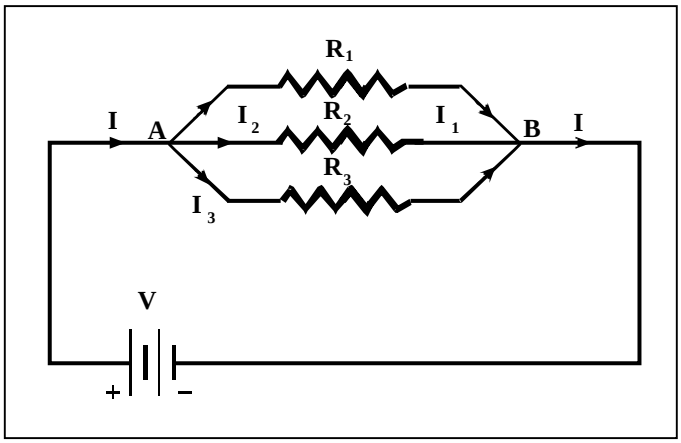
PARALLEL COMBINATION:

DEFINITION: (0.5 MARK)

Resistors are said to be connected in parallel when each of them is connected between the two common points. The same potential difference acts across each of the resistor but the total current is divided among the resistors connected in parallel accordingly.

DIAGRAM:

(0.5 MARK)



DERIVATION: (02 MARKS)

Resistance R_1, R_2 and R_3 are connected in parallel between the two common points A and B, A battery of voltage 'V' is connected across A and B as shown in fig. the main current I coming form the battery is divided into I_1, I_2 and I_3 among the resistors R_1, R_2 and R_3 respectively. The potential differences across each resistor remain same.

The sum of their current is equal to the total current I,

$$I = I_1 + I_2 + I_3 \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

According to Ohm's law

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

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

$$I_2 = \frac{V}{R_2}$$

$$I_3 = \frac{V}{R_3}$$

Substituting the value of I, I_1, I_2 and I_3 in equation (1) we get

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

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

$$\frac{V}{VR} = \frac{(1}{R_1} + \frac{1}{R_2} + \frac{1)}{R_3}$$

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

Reciprocal of equivalent resistance = Sum of reciprocal of individual resistances in parallel.