

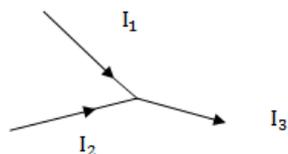


**Q9.** State the two Kirchhoff's rules used in electric networks. How are these rules justified?

**Answer:** In complicated networks to find current flowing through different branches we apply Kirchhoff's law.

**First law:** The algebraic sum of currents meeting at a point is zero. i.e.  $\sum i = 0$ .

In the given circuit, Considering outward direction of current as positive and inward as negative then at the point F



According to Kirchhoff's first law, at junction F

$$I_1 + I_2 = I_3$$

**Second law:** In a closed mesh of electrical conductors the algebraic sum of product of resistance and the respective current in the different branches is equal to the total e.m.f applied in the closed mesh.

$$\sum iR = \sum E$$

**Justification :** Kirchhoff's rule are in accordance with law of conservation of charge as at any junction of several circuit elements, the sum of currents entering the junction must equal the sum of currents leaving it so currents are steady, i.e. no charge piles up at the junction.

By analytic way we can find balance condition of wheatstone bridge and same result is obtained when we use Kirchoff's 2<sup>nd</sup> rule, this justifies 2<sup>nd</sup> law.



**Q10.** Write the important characteristic features by which the interference can be distinguished from the observed diffraction pattern.

**Answer: Important characteristic features:**

Interference	Diffraction
interference is the meeting of two waves.	Diffraction is the bending of waves around an obstacle.
Interference is due to superposition of two distinct waves coming from two coherent sources.	Diffraction is produced as a result of superposition of the secondary wavelets coming from different parts of the same wavefront.
The fringes may or may not be of the same width.	The fringes are always of varying width in diffraction.
There is a good contrast between the bright and dark fringes in the interference pattern.	The contrast between the bright and dark fringes in the diffraction pattern is comparatively poor.

**Or,** Explain the basic differences between the construction and working of a telescope and a microscope.

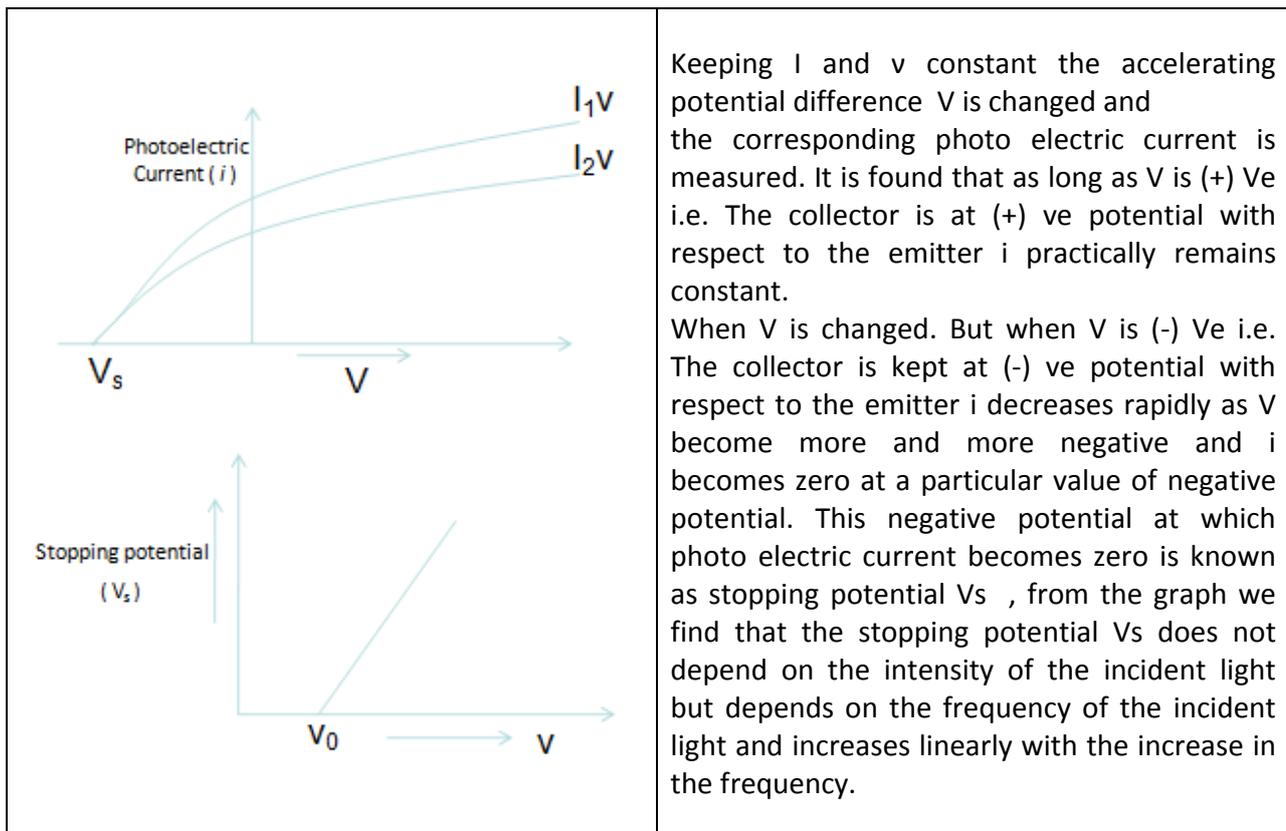
Telescope	Microscope
It is used for observing distant objects for example heavenly bodies such as stars and planets or watching distant object on earth.	It is used for observing magnifying images of tiny objects such as bacteria.
The objective lens has a large focal length and large aperture.	The objective lens has a small focal length and small aperture.
The eye lens used has small focal length and small aperture.	The eye lens used has moderate focal length and large aperture.
The distance between the objective lens and eye lens is adjusted to focus the object situated at infinity.	The objective and eye lens are kept at a fixed distance apart, light rays coming from infinity should meet at the focal plane of objective hence adjustment made at the objective.



**Q11.** Light of intensity ' $I$ ' and frequency ' $\nu$ ' is incident on a photosensitive surface and causes photoelectric emission. What will be the effect on anode current when (i) the intensity of light is gradually increased, (ii) the frequency of incident radiation is increased, and (iii) the anode potential is increased? In each case, all other factors remain the same. Explain, giving justification in each case.

**Answer:**

	<p>(i) Keeping the anode potential and the frequency of the incident radiation constant, if the intensity of the incident light is increased, the photoelectric current or the anode current increases linearly.</p> $i \propto I$ <p>This is because photoelectric current is directly proportional to the number of photoelectrons emitted per second which is directly proportional to the intensity of the incident radiation.</p>
	<p>(ii) For photoelectric emission to occur there is a minimum cut off frequency of the incident radiation called the threshold frequency below which no photoelectric emission occurs. This frequency is independent of the intensity of the incident light. With an increase in the frequency of the incident radiation, the kinetic energy of the photoelectrons ejected increases, whereas it is independent of the number of photoelectrons ejected. Hence, with the increase in the frequency of incident radiation, there will not be any change in the anode current.</p>





**Q12.** When is a transistor said to be in active state? Draw a circuit diagram of a p-n-p transistor and explain how it works as a transistor amplifier. Write clearly, why in the case of a transistor (i) the base is thin and lightly doped and (ii) the emitter is heavily doped.

**Answer:** When the bias of the emitter-base junction of a transistor is sufficient to send a forward current and the collector base junction is reversed biased, then the transistor is said to be in the active state.

<p style="text-align: center;">Circuit diagram of P-N-P common emitter transistor</p>	<p><b>Principle:</b> A weak input signal given to the base region produces an amplified output signal in the collector region.</p> <p>Emitter base junction is forward biased by connecting battery <math>V_B</math>. The emitter collector junction is reversed biased by connecting battery <math>V_C</math>. The e.m.f. of the batteries should be greater than the barrier potential across base-emitter and collector emitter junction.</p> <p>The output current produces a potential difference across the load resistance <math>R_L</math>. A signal to be amplified is applied between the base and the emitter. When the signal increases in the positive direction, the base current also increases.</p> $i_B = \beta i_C$ <p>The collector current flowing through the collector load resistance produces a voltage. This output voltage is equal to the collector current times the load resistance. Thus, an amplified output is obtained. The voltage gain = output voltage/input voltage.</p>
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- (i) Reason for base is thin and lightly doped – by doing this we ensure it contains smaller number of majority carriers. This reduces the recombination rate of free electrons and holes in the base region when the majority carriers go from the emitter to the collector.
- (ii) Emitter is heavily doped: by doing this we ensure that emitter supplies the majority carriers for the current flow.



**Q13.**

- a. State three important factors showing the need for translating a low frequency signal into a high frequency wave before transmission.
- b. Draw a sketch of a sinusoidal carrier wave along with a modulating signal and show how these are superimposed to obtain the resultant amplitude modulated wave.

**Answer:** Three important reasons for modulating a message signal is

- i. For sending message signal to long distance without loss - We modulate the carrier signal with your information signal (signal which is to be transmitted) and then use a transmitter to send so that your information can travel to a longer distance. At the receiver side of the communication system the demodulator separates the information signal from the carrier and then your information signal is processed, in absence of modulation message signal will attenuate and cannot be send to long distance.
- ii. Antenna Size: In signal transmission antenna size required is one-fourth of wave length  $h = \frac{\lambda}{4}$ , thus to transmit 60 KHz signal ( $\nu = 60 \times 1000 \text{ Hz}$ ,  $\lambda = \frac{3 \times 10^8}{60 \times 1000} = 0.5 \times 10000 \text{ m} = 5 \text{ KM}$ ,  $h = \frac{5}{4} = 1.25 \text{ KM}$ ), we require 1.25 KM antenna length, which is impractical to design and use. Modulation technique helps to reduce the frequency at the source hence low height antenna is required.
- iii. Modulation allows us to send a signal over a bandpass frequency range. If every signal gets its own frequency range, then we can transmit multiple signals *simultaneously* over a single channel, all using different frequency ranges.



(b) Diagrammatic representation of Amplitude Modulation

