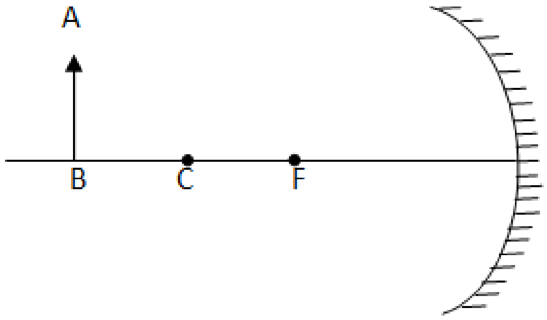
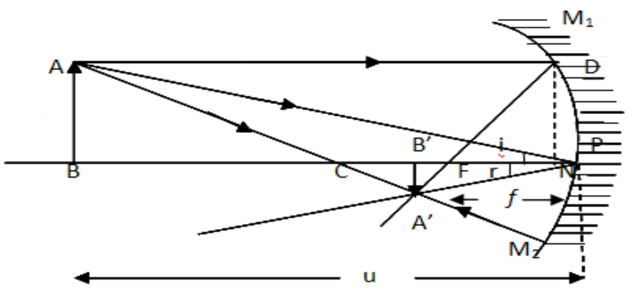
Q13. An object AB is kept in front of a concave mirror as shown in the figure.



a) Complete the ray diagram showing the image formation of the object.
b) How will the position and intensity of the image be affected if the lower half of the mirror's reflecting surface is painted black?

Answer: (a) Ray Diagram:

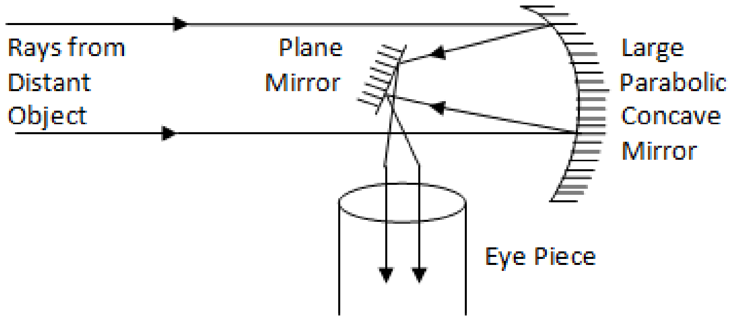


(b) On painting lower half black the ray AC will be absorbed and hence the intensity of the image will decrease, image will be formed in the same position.

Q14. Draw a labelled ray diagram of a reflective type telescope. Write its two advantages over refracting type telescope.

Answer:

Ray diagram:



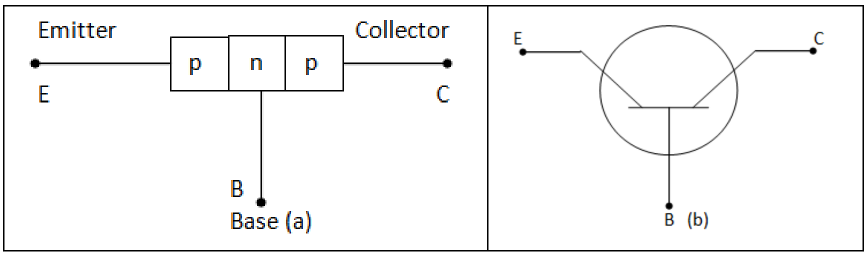
Two advantages:

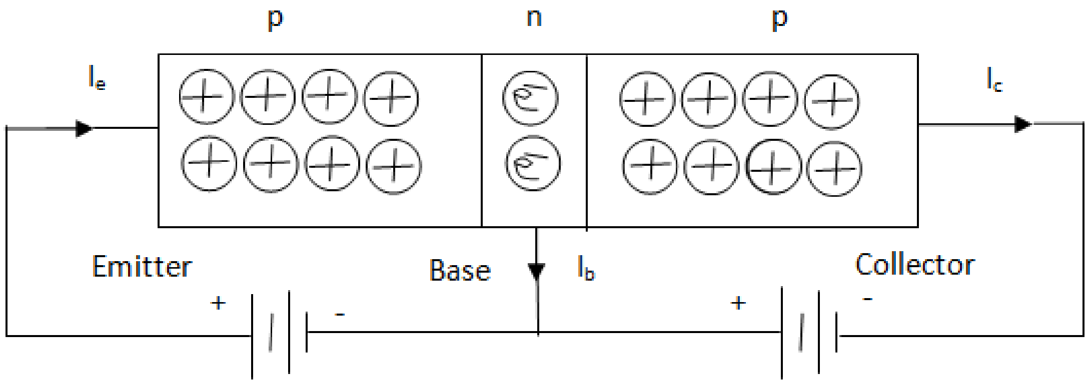
A. As a reflecting telescope has mirror objective, the brighter image formed is free from chromatic aberration.

B. It is comparatively cheaper than refracting type telescope.

Q15. Describe briefly with the help of a circuit diagram, how the flow of current carriers in a p-n-p transistor is regulated with emitter-base junction forward biased and base-collector junction reverse biased.

Answer: p-n-p transistor: It is a single crystal containing two p-n junctions such that there is a very thin central layer of n-type semiconductor enclosed on either side by p-type semiconductor. The central layer is called the base.

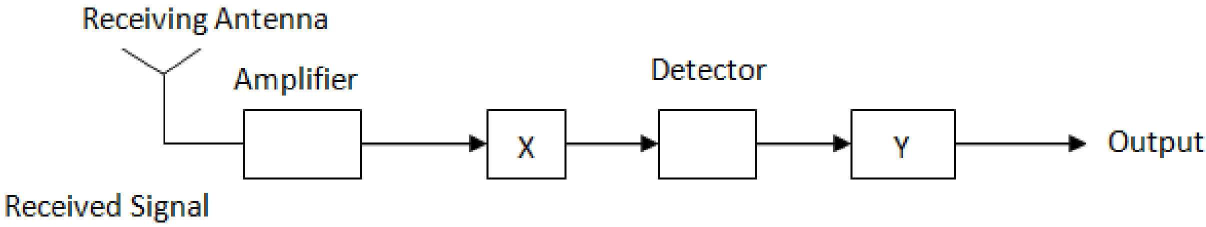




As shown above when p-n junction (emitter –base) junction is forward biased, p connective to positive terminal and n connected to negative terminal of battery. Holes from p moves towards n as emitter base junction is conducting through thin width layer. Some holes and electrons get neutralized and depletion layer is formed. A small current I_b flows, most of the holes moves towards collector giving collector current I_c. In the circuit above the base collector junction is reversed biased.Thus the current is from emitter to base.

Emitter current $I_e = I_b + I_c$

Q16. In the given block diagram of receiver, identify the boxes labelled as X and Y and write their function.



Answer: X is Intermediate Frequency (IF Stage) stage; here the received signal for antenna is converted to lower frequency signal call Intermediate Frequency.

Y is amplifier, which amplifies signal to produce desired output.

Q17. A light bulb is rated 100 W for 220 V ac supply of 50 Hz. Calculate

I. The resistance of the bulb;
II. The *rms* current through the bulb.

Answer:

I. The resistance of the bulb,

$$R = \frac{E^2}{P} = \frac{(220)^2}{100} = \frac{48400}{100} = 484\ \Omega$$

ii. $I_{rms} = \frac{E}{R} = \frac{220}{484}$=0.45 A

Or, An alternating voltage given by $V = 140 \sin 314\ t$ is connected across a pure resistor of $50\ \Omega$. Find

I. The frequency of the source.
II. The rms current throughout the resistor.

Answer: Given $V = 140 \sin 314\ t$, comparing with $e=e_o \sin\omega t$, here ω=314Hz and e_o =140 volt

I. Frequency source $f = \frac{\omega}{2\pi} = \frac{314}{2\times 3.14} = \frac{314\times 100}{314\times 2} = 50$ Hz

II. $e_{rms} = \frac{e_0}{\sqrt{2}} = \frac{140}{\sqrt{2}} = \frac{140}{1.41} = 99.29$ Hz.

rms value of current $i_{rms} = \frac{e_{rms}}{R} = \frac{99.29}{50} = 1.98$ A

Q18.A circular coil of N turns and radius R carries a current I. It is unwound and rewound to make another coil of radius R/2, current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil.

Answer: We know that Magnetic Moment of coil M = NIA

Where M = Magnetic Moment of coil

N = Number of turns

I = current through the coil

A= Area of the coil.

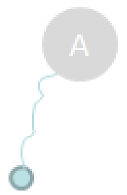
Let M' be the magnetic moment when radius changed to R/2 , therefore

Since length is same L = L', $2\pi RN = 2\pi R'N'$ but $R' = \frac{R}{2}$ therefore $2\pi RN = \frac{2\pi R}{2} N'$ so $N' = 2N$

So $M' = N'IA' = 2NI\pi\left(\frac{R}{2}\right)^2 = \frac{NIR^2}{2} = \frac{M}{2}$ so $\frac{M'}{M} = \frac{1}{2}$

Q19. Deduce the expression for the electrostatic energy stored in a capacitor of capacitance 'C' and having charge 'Q'. How will the (I) energy stored and (II) the electric field inside capacitor be affected when it is completely filled with a dielectric material of dielectric constant 'K'?

Answer: Expression for electrostatic energy stored in a capacitor

 	Given C = Capacitance of the body. V= Potential of the source Q= The maximum charge stored in the body when its potential rises to V Let during charging q be the charge stored in the body at any instant t and v be the potential of the body at that instant. $q = cv$ $v = \frac{q}{c} \rightarrow (1)$

The charge q which is already in the body will repel the like charge dQ as it comes from the Source hence work is to be done in storing the charge dQ

Hence total work done in storing the charge Q can be obtained by integrating equation(2)

$$W = \int dw = \int_0^Q \frac{q}{C} dQ = \frac{1}{2}\frac{Q^2}{C} \rightarrow (3)$$

This work done is stored in the charged body in the form of electrostatic potential energy.

$$\therefore E = \frac{1}{2}\frac{Q^2}{C} \rightarrow (4)$$

$$Q = CV$$

$$E = \frac{1}{2}\frac{C^2V^2}{C} = \frac{1}{2}CV^2$$

$$E = \frac{1}{2}C(Q/C)^2 = \frac{Q^2}{2C} \rightarrow (5)$$

Electric field inside a capacitor:

We know that capacitance of capacity $C = \frac{\varepsilon A}{d}$

When there is free space or air that is no dielectric between plates of capacitor then $C = \frac{\varepsilon_0 A}{d}$

When medium of dielectric constant K is introduced permittivity changes i.e. $\varepsilon = k\varepsilon_0$

Therefore $C' = \frac{k\varepsilon_0 A}{d} = kC$

If E and E' be the energy stored with free space and dielectric (K) then

$$E = \frac{Q^2}{2C}, E' = \frac{Q^2}{2C'} = \frac{Q^2}{2KC} = \frac{1}{K}E$$

Thus with the introduction of dielectric constant the energy of capacitor becomes 1/K times initial energy.