1. A Lamp working on an AC voltage of 250 volts takes a current of 0.8 A. It radiates a flux of 3000 lumens. Cal. the luminous efficiency. Find MSCP and express it in terms of perwatt.

→ luminous flux = 3000 lumens

Power of lamp = VI = 250 × 0.8
= 200 watts

$$MSCP = \frac{\phi}{4\pi} = \frac{3000}{4\pi} = 240$$

$$\text{mscp per watt} = \frac{240}{200} = 1.2$$

$$\text{Luminous efficiency} = \frac{\text{lumens}}{\text{watt}}$$

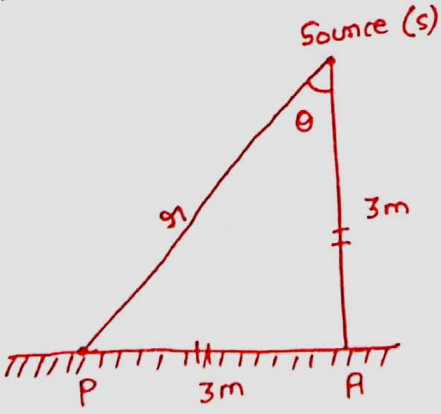
$$= \frac{3000}{200} = 15 \text{ lumens/watt.}$$

2. A Light Source of 1000 watts having MSCP = 2500 is suspended 3m above the working plane. Find the following:

a) Illumination in Lux directly below the lamp on the working Plane.

b) Lamp efficiency in Lumens / watt

c) Illumination 3m away on the horizontal plane from vertically below the lamp



a) To find illumination below the source i.e. at point A we have to use inverse square law.

i.e. $E_A = \frac{I}{h^2} = \frac{2500}{3^2} = 277.77$ lux

b) Lamp efficiency $= \frac{\text{luminous flux}}{\text{watt}}$

& we know $MSCP = \frac{\phi}{4\pi}$

$\therefore \phi = MSCP \times 4\pi$

$= \frac{MSCP \times 4\pi}{\text{watt}}$

$= \frac{2500 \times 4\pi}{1000}$

$= 31.416$ lumens / watt

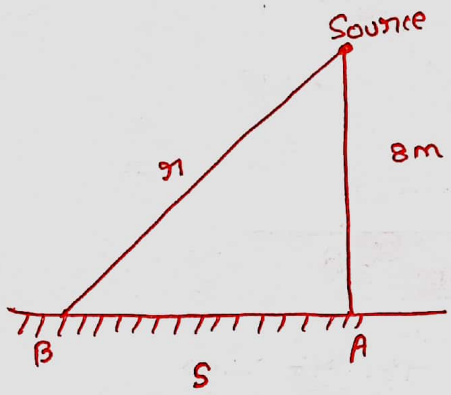
c) Illumination at point P 'E_P' $= \frac{I \cdot \cos^3\theta}{n^2}$

$= \frac{2500 \times (\cos 45^\circ)^3}{3^2}$

$= \frac{2500 \times (0.707)^3}{9}$

$= 98.165$ LUX.

3. A small light source with intensity of light uniform in all direction is mounted at a height of 8m above the horizontal plane surface. The two points A and B both lies on the surface with point A directly beneath the source. How far is point B from point A if the illumination of B is only one half as great as at A ?



→ Illumination at A = $\frac{I}{h^2} = \frac{I}{8^2} = \frac{I}{64}$

Illumination at point B = $\frac{I \cos^3\theta}{h^2}$

$= \frac{I}{64} \times \left(\frac{8}{\sqrt{8^2+s^2}}\right)^3$

$= \frac{8 \times I}{(8^2+s^2)^{3/2}}$

But given that $E_b = \frac{E_A}{2}$

$\frac{8 \times I}{(8^2+s^2)^{3/2}} = \frac{I}{64 \times 2}$

$s = 6.15$ m

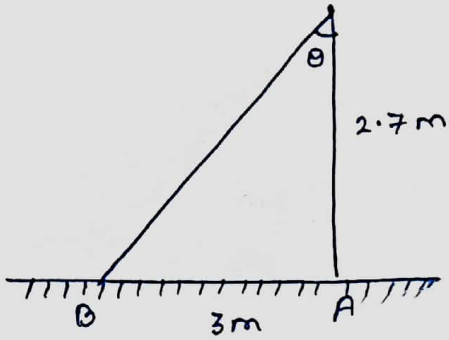
∴ i.e. distance at B from A is 6.15 m.

4. A Lamp of 500 W having a mscp of 1250 is suspended 2.7 m above the working plane. calculate

i) illumination directly below the lamp at the working plane.

ii) Lamp efficiency

iii) illumination at a point 3m away on the horizontal Plane from vertically below the lamp.



i) $E_A = \frac{1250}{(2.7)^2} = 171.47$ lux

ii) Lamp efficiency $= \frac{\text{Luminous flux}}{\text{watt}}$

$= \frac{4\pi \times \text{mscp}}{\text{watt}}$

$= \frac{4\pi \times 1250}{500}$

$= 31.42$ lumens/watt

iii) $E_B = \frac{I \cos^3\theta}{h^2} = \frac{1250}{(2.7)^2} \times \frac{(2.7)^3}{(3^2+2.7^2)^{3/2}}$

$= 51.33$ lux

5. A room of size 20m x 5m is illuminated by 20 number of 200 watt lamps. The MSCP of each lamp is 250. Assume utilization factor = 0·6 and depreciation factor = 1·2. Find average illumination produced on the floor.

→ Area of the room = 20 x 5 = 100 m^2

MSCP of each lamp = 250

Lumens given out by each lamp = MSCP x 4π

= 250 x 4π

= 3140 lumens

Total lumens = 3140 x 20

= 62800 lumes.

∴ Lumens utilized = $\frac{\text{Lumens produced} \times \text{utilisation factor}}{\text{Depriciation factor}}$

= $\frac{62800 \times 0.6}{1.2}$

= 31400 lumens

Average illumination = $\frac{31400}{100}$

= 314 lumens/m^2

6. Estimate the number and wattage of each lamp which would be required to illuminate a workspace 60 x 15 m by means of lamps mounted 5m above the working plane. The average illumination required is about 100 lux, coefficient of utilization is 0·4, luminous efficiency is 16 lumens/watt. Assume a space height ratio of unity and candle power depriciation of 20%.

→ Total lumes required for illumination

$$\phi = \frac{\text{Area to be illuminated} \times \text{average illumination}}{\text{co-efficient of illumination} \times \text{Maintenance factor}}$$
$$\text{utilization}$$

$$= \frac{60 \times 15 \times 100}{0.4 \times (1-0.2)}$$

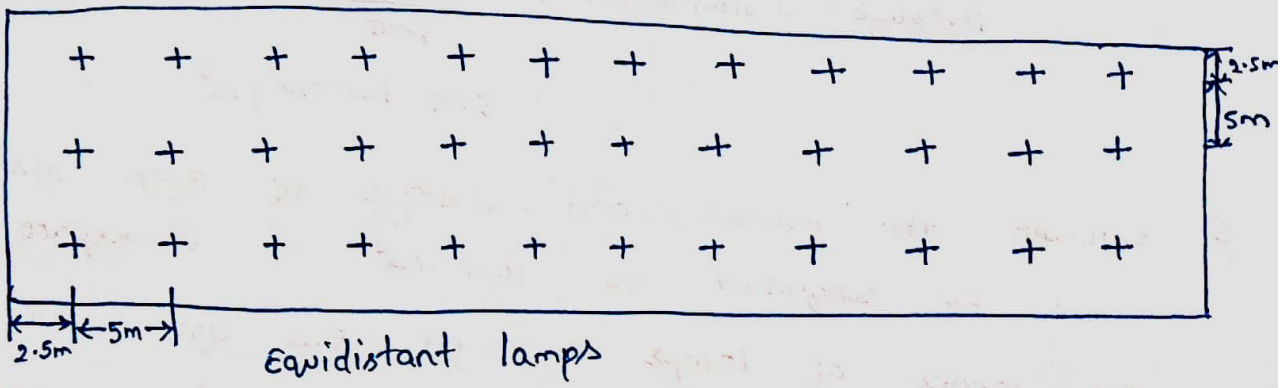
$$= 281250$$

Luminous $\eta = \frac{\phi}{\text{wattage}}$ $\qquad \phi = MSCP \times 4\pi$

$$\text{wattage} = \frac{281250}{16}$$

$$= 17578 \text{ watts}$$

As per the dimension of the room for space to height ratio as unity 3 lamps can be accomodated @ width and 12 @ the lengths.



Equidistant lamps

∴ Total no. of lamps required = $12 \times 3 = 36$ lamps.

∴ wattage of each lamp : $\frac{17578}{36}$ watts

$$= 488.3 \approx 500 \text{ watts}$$