1. Radiant Flux = \( \frac{\text{Total energy emitted}}{\text{Time}} = \frac{45}{15} = 3 \text{ W} \)

2. To get equally intense lines on the photographic plate, the radiant flux (energy) should be same. 
\( 50 \times 10^7 \text{ W} \times 12 \text{ sec} = 12 \text{ W} \times t \) 
\( \Rightarrow t = \frac{10^7}{12} \text{ sec} = 10 \text{ sec.} \)

3. It can be found out from the graph by the student.

4. Relative luminosity = \( \frac{\text{Luminous flux of a source of given wavelength}}{\text{Luminous flux of a source of 555 nm of same power}} \)

Let the radiant flux needed be \( P \) watt.
\( A_0, 0.6 = \frac{\text{Luminous flux of source 'P' watt}}{685 \text{ P}} \)
\( \Rightarrow \text{Luminous flux of the source} = (685 \text{ P}) \times 0.6 = 120 \times 685 \)
\( \Rightarrow P = \frac{120}{0.6} = 200 \text{ W} \)

5. The luminous flux of the given source of 1W is 450 lumen/watt
\( \Rightarrow \text{Relative luminosity} = \frac{\text{Luminous flux of the source of given wavelength}}{\text{Luminous flux of 555 nm source of same power}} = \frac{450}{685} = 66\% \)
\( \Rightarrow \text{Since, luminous flux of 555nm source of 1W = 685 lumen] \)

6. The radiant flux is 555nm part is 40W and of the 600nm part is 30W
(a) Total radiant flux = 40W + 30W = 70W
(b) Luminous flux = \((L_{\text{Flux}})_{555\text{nm}} + (L_{\text{Flux}})_{600\text{nm}}\) 
\( = 1 \times 40 \times 685 + 0.6 \times 30 \times 685 = 39730 \text{ lumen} \)
(c) Luminous efficiency = \( \frac{\text{Total luminous flux}}{\text{Total radiant flux}} = \frac{39730}{70} = 567.2 \text{ lumen/W} \)

7. Overall luminous efficiency = \( \frac{\text{Total luminous flux}}{\text{Power input}} = \frac{35 \times 685}{100} = 239.75 \text{ lumen/W} \)

8. Radiant flux = 31.4W, Solid angle = 4\( \pi \)
Luminous efficiency = 60 lumen/W
So, Luminous flux = 60 \times 31.4 lumen
And luminous intensity = \( \frac{\text{Luminous Flux}}{4\pi} = \frac{60 \times 31.4}{4\pi} = 150 \text{ candela} \)

9. \( I = \text{luminous intensity} = \frac{628}{4\pi} = 50 \text{ Candela} \)
\( r = 1\text{m}, \quad \theta = 37^\circ \)
So, Illuminance, \( E = \frac{I \cos \theta}{r^2} = \frac{50 \times \cos 37^\circ}{1} = 40 \text{ lux} \)

10. Let, \( I = \text{Luminous intensity of source} \)
\( E_A = 900 \text{ lumen/m}^2 \)
\( E_B = 400 \text{ lumen/m}^2 \)
\( \text{Now, } E_A = \frac{I \cos \theta}{x^2} \text{ and } E_B = \frac{I \cos \theta}{(x+10)^2} \)
\( \Rightarrow I \frac{E_A x^2}{\cos \theta} = E_B \frac{(x+10)^2}{\cos \theta} \)
\( \Rightarrow 900x^2 = 400(x+10)^2 \Rightarrow \frac{x}{x+10} = \frac{2}{3} \Rightarrow 3x = 2x + 20 \Rightarrow x = 20 \text{ cm} \)
So, The distance between the source and the original position is 20 cm.
11. Given that, $E_s = 15 \text{ lux} = \frac{l_0}{60^2}$

$\Rightarrow l_0 = 15 \times (0.8)^2 = 5.4 \text{ candela}$

So, $E_s = \frac{l_0 \cos \theta}{(GB)^2} = \frac{5.4 \times \left( \frac{3}{5} \right)}{1^2} = 3.24 \text{ lux}$

12. The illuminance will not change.

13. Let the height of the source is $h'$ and the luminous intensity in the normal direction is $I_0$. So, illuminance at the book is given by,

$$E = \frac{l_0 \cos \theta}{r^2} = \frac{l_0 h'}{r^2} = \frac{l_0 h'}{(r^2 + h'^2)^{3/2}}$$

For maximum $E$, $dE \over dh' = 0 \Rightarrow \frac{l_0 (R^2 + h'^2)^{3/2} - \frac{3}{2} h \times (R^2 + h'^2) \times 2h}{(R^2 + h'^2)^3} = 0$

$\Rightarrow (R^2 + h'^2)^{3/2}[R^2 + h^2 - 3h'] = 0$

$\Rightarrow R^2 - 2h^2 = 0 \Rightarrow h = \frac{R}{\sqrt{2}}$