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PHYSICS

BOOKS - HC VERMA PHYSICS (ENGLISH)

PHOTOMETRY

Work Out Examples

1. A source emits 12.0 J of lightof wavelength 620 nm and 8.0 J of light of wavelength 580

nm per second. The relative luminosilty at 620 is 25% and that at 580 nm is 80%. Find a the total radiant flux, b. the total luminous flux and c. and luminous efficiency.

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2. A circular area of radius 1.0 cm is placed at a distance of 2.0 m from a poit source.Teh source emits light uniformluy in al directions. The line joining the sorce to the dcentre of the area is normal to the area. It ils found that

2.0×1^{-3} lumen of luminous flux is incident on the area. Calculate the total luminous flux emitted by the soure and teh luminous intensity of the source along the axis of the area.

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3. The overall luminous efficient of a 100 W electric lamp is 25 lumen W^{-1}. Assume that light is emitted by the lamp only in the forward half, and is uniformly distributed in al

diredctionsin this half. Calculate the luminous flux falling on a plane object of area $1cm^2$ placed at a distance of 50 cm from the lamp and perpendicular to the line joining the lamp and the object.

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4. A point source emitting uniformly in all directions is placed above a table top at a distance of 0.50 m from it. The luminous flux of the source is 1570 lumen. Find the

illuminance at a small surface area of the table to a.directly below the source and b. at as distance of 0.80 m from the source.

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5. The luminous intensity of a small plane source of light along the forward normal is 160 candela. Assume the source to be perfectly diffused, find the luminous flux emitted into a cone of solid angle 0.02 sr around a line making an angle of 60° with the forward

normal.

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Objective 1

1. The one parameter that determines that brightness of a light source sensed by an eye is

A. energy of light entering the eye per second

B. wavelength of the light

C. total radiant flux entering the eye

D. total luminous flux entering the eye

Answer: D

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2. Three light sources A,B, and C emit equal amount of radiant energy per unit time. The wavelength emitted by the three sources are 450 nm, 555 nm and 700 nm respectively. The brightness sensed by an eye for the sources are X_A, X_B and X_c respectively. Then

A. $X_A < X_B, X_C > X_B$

B. $X_A > X_B, X_B > X_C$

C. $X_B > X_A, X_C < X_B$

D. $X_B > X_A, X_C > X_B$

Answer: C

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3. As the wavelength in increased form violet to red, the luminosity

A. continously increases

B. continously decreases

C. increases then decreases

D. decreases then increases

Answer: C

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4. An electric bulb is hanging over a table at a height of 1 m above it. The illuminance on the table directly below the bulb is 40 lux. The illuminance at a point on the table 1 m away from the first point will be about

A. 1.10 lux

B. 2.14 lux

C. 3.20 lux

D. 4.28 lux

Answer: B

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5. Light from a point source falls on a screen. If the separation between the source and the screen is increased by 1%, the illuminance will decrease (nearly) by

A. 0.005

B. 0.01

C. 0.02

D. 0.04

Answer: C

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6. A battery operated tourch is adjusted to send and almost parallel beam of light. It produces an illuminance of 40 lux when the

light falls on a wal 2m away. The illuminance produced when it fals on a wal 4 m away is close to

A. 40 lux

B. 20 lux

C. 10 lux

D. 5 lux

Answer: A

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7. The intensity produced by a long cylindrical light source at a small distance r from the source is proportional to

A. $\frac{1}{r^2}$

B. $\frac{1}{r^3}$

C. $\frac{1}{r}$

D. none of these

Answer: C

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8. A photographic plate placed at a distance of 5 cm from a weak point source is exposed for 3 s. If the plate is kept at a distance of 10 cm from the source, the time needed for the same exposure is

A. A. 3s

B. B. 12s

C. C. 24s

D. D. 48s

Answer: B

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9. A point source of light moves ijn a straight line paralel to a plane table. Consider a small portion of the table directly below the line of movement of the source. The illuminance at this portion varies with its distasnce r from the source as

A. $I \propto \frac{1}{r}$

B. $I \propto \frac{1}{r^2}$

C. $I \propto \frac{1}{r^3}$

D. $I \propto \frac{1}{r^4}$

Answer: C

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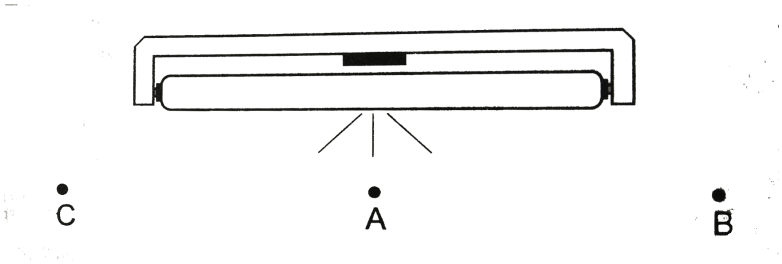
10. Figure shows a glowing mercury tube. The intensities at point A, B and C are related as



A. $B > C > A$

B. $A > C > B$

C. $B = C > A$

D. $B = C > A$

Answer: D

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Objective 2

1. The brightnes producing capacity of a source

A. does not depend on its power

B. does not depend on the wavelength emitted

C. depends on its power

D. depends on the wavelength emitted

Answer: C::D

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2. Mark the correct options

A. A) The luminous efficiency of a monochromatic source is always greater than that of a white light source of same power.

B. B) The luminous efficiency of a monochromatic source of wavelength 555 nm is always greater than that of white light source of same power.

C. C) The illuminating power of a monochromatic source of wavelength

555 nm is always greater than that of a white light source of same power.

D. D) The illuminating power of a monochromatic source is always greater than that of a white light source of same power.

Answer: B::C

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3. Mart out the correct options

A. Luminous flux and radian flux have same dimensions

B. Luminous flux and luminous intensity have same dimensions

C. Radiant flux and power have same dimensions

D. Relative luminosity is a dimensionless quantity.

Answer: B::C::D

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Exercises

1. A source emits 45 joules of energy in 15 s. What is the radiant flux of the source ?

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2. A photographic plate records sufficient intense lines when it is exposed for 12 s to a source of 10 W. How long should it be exposed to a 12 W source radiating the light of same colour to get equally intense lines ?

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3. Using figure 22.1, find the relative luminosity of wavelength (a) 480 nm, (b) 520 nm (c) 580 nm and (d) 600 nm.

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4. The relative luminosity of wavelength 600 nm is 0.6. Find the radiant flux of 600 nm needed to produce the same brightness sensation as produced by 120 W of radiant flux at 555 nm.

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5. The luminous flux of a monochromatic source of 1 W is 450 lumen W^{-1}. Find the

relative luminosity at the wavelength emitted.

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6. A source emits light of wavelengths 555 nm and 600 nm. The radiant flux of the 555 nm part is 40 W and of the 600 nm part is 30 W. The relative luminosity at 600 nm is 0-6. Find (a) the total radiant flux, (b) the total luminous flux, (c) the luminous efficiency.

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7. A light source emits monochromatic light of wavelength 555 nm. The source consumes 100 W of electric power and emits 35 W of radiant flux. Calculate the overall luminous efficiency.

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8. A source emits 31.4 W of radiant flux distributed uniformly in all directions. The luminous efficiency is 60 lumen watt. What is the luminous intensity of the source ?

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9. A point source emitting 628 lumen of luminous flux uniformly in all directions is placed at the origin. Calculate the illuminance on a small area placed at (1.0 m, 0, 0) in such a way that the normal to the area makes an angle of 37° with the X-axis.

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10. The illuminance of a small -2 area changes from 900 lumen m^-2 to 400 lumen m^-2 when it is shifted along its normal by 10 cm. Assuming that it is illuminated by a point source placed on the normal, find the distance between the source and the area in the original position.

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11. A point source emitting light uniformly in all directions is placed 60 cm above a table-top. The illuminance at a point on the table-top, directly below the source, is 15 lux. Find the illuminance at a point on the table-top 80 cm away from the first point.

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12. Light from a point source falls on a small area placed perpendicular to the incident

light. if the area is rotated about the incident light by an angle of ~60∘, by what fraction will the illuminance change ?

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13. A student is studying a book placed near the edge of a circular table of radius R. A point source of light is suspended directly above the centre of the table. What should be the height of the source above the table so as to produce

maximum illuminance at the position of the book ?

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Questions For Short Answer

1. What is the luminous flux of a source emitting radio waves ?

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2. The luminous flux of a 1 W sodium vapour lamp is more than that of a 10 kW source of ultraviolet radiation. Comment.

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3. A bulb is hanging over a table. At which portion of the table is the illuminance maximum '? If a plane mirror is placed above the bulb facing the table, will the illuminance on the table increase ?

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4. The sun is less bright at morning and evening as compared to at noon although its distance from the observer is almost the same. Why ?

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5. Why is the luminous efficiency small for a filament bulb as compared to a mercury vapour lamp ?

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6. The yellow colour has a greater luminous efficiency as compared to the other colours. Can we increase the illuminating power of a white light source by putting a yellow plastic paper around this source ?

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Others

1. Find the luminous flux of 10 W source of 600 nm. The relative luminosity at 600 nm is 0.6.

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