

Wave and Motion: Rest of Optics – Typical Questions

No of Questions: 55

Time Allotted: 4 Hours

All questions are compulsory

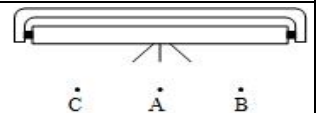
[Note: (a) Figures are conceptual only and not to the scale]

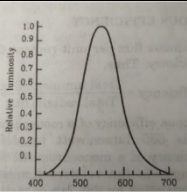
[(c) It is advised to attempt question under examination conditions]

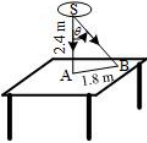
Q-1	The speed of sound in air is 332 m/s. Is it advisable to define the length 1m as the distance travelled by sound in $1/332$ s?
Q-2	Consider Galileo's method of measuring speed of light using two lanterns. To get an accuracy of about 10%, the time taken by experimenter in closing or opening the shutter for about one tenth of the time taken by the light in going from one experimenter to the other. Assume that it takes $1/100$ second for an experimenter to close or open the shutter. How far should the two experimenters be to get a 10% accuracy? What are the difficulties in having this separation?
Q-3	In Fizeau method of measuring the speed of light, the toothed wheel is placed in the focal plane of converging lens. How would the experiment be affected if the wheel is slightly away from the focal plane?
Q-4	In the original Fizeau method, the light travelled 8.6 km and then returned. What could be the difficulty of this distance is taken as 8.6 m?
Q-5	What is the advantage of using a polygonal mirror with a larger number of faces in Michelson method of measuring speed of light?
Q-6	Light passes through a closed cylindrical tube containing a gas. If the gas is gradually pumped out, the speed of light inside the tube will (a) Increase (b) decrease (c) remain constant (d) First increase and then decrease
Q-7	The speed of red light and yellow light are exactly same (a) in vacuum but not in air (b) in air but not in vacuum (c) in vacuum as well as in air (d) neither in vacuum nor in air
Q-8	An illuminated object is placed on the principal axis of a converging lens so that a real image is formed on the other side of the lens. If the object is shifted a little, (a) the image will be shifted simultaneously with the object (b) the image will be shifted a little later than the object (c) the image will be shifted a little earlier than the object (d) the image will not shift.
Q-9	The speed of light is 299,792,458 m/s (a) with respect to earth (b) with respect to sun (c) with respect to a train moving on the earth (d) with respect to a spaceship going in outer space

Q-10	Which of the following methods can be used to measure the speed of light in laboratory? (a) Roemer method (b) Fizeau method (c) Foucault method (c) Michelson method
Q-11	Which of the following can be used to measure speed of light in water? (a) Roemer method (b) Fizeau method (c) Foucault method (c) Michelson method
Q-12	In an experiment to measure the speed of light by Fizeau's apparatus, following data are used: Distance between mirrors = 12.0 km Number of teeth in the wheel = 180 Find the minimum angular speed of the wheel for which image is not seen.
Q-13	In an experiment to measure the speed of light by Foucault's apparatus, following data are used: Distance between the rotating and fixed mirror = 16 m Distance between the lens and the rotating mirror = 6 m Distance between the source and the lens = 2m When the mirror is rotated at a speed of 356 revolutions per second, the image shifts by 7.0 mm. Calculate the speed of light from these data
Q-14	In a Michelson experiment for measuring speed of light, the distance travelled by light between two reflections from the rotating mirrors is 4.8 km. The rotating mirror has a shape of a regular octagon. At what minimum angular speed of the mirror (other than zero) the image is formed at the position where a non-rotating mirror forms it?
Q-15	What is the luminous flux of a source emitting radio waves?
Q-16	The luminous flux of a 1W sodium vapour lamp is more than that of a 10 kW source of ultraviolet radiation. Comment.
Q-17	Light is incident normally on a small plane surface. If the surface is rotated by an angle of 30° about the incident light, does the illumination of the surface increase or remain same? Does your answer change if light did not fall normally on the surface?
Q-18	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?
Q-19	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?
Q-20	Why is luminous efficiency small for a filament bulb as compared to a mercury vapour lamp?
Q-21	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 the source?
Q-22	The parameter that determines the brightness of a source sensed by an eye is (a) Energy of radiation entering the eye per second (b) Wavelength of the light (c) Total radiant flux entering the eye (d) Total luminous flux entering the eye
Q-23	The 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) $X_B > X_A$, $X_B > X_C$ (d) $X_B > X_A$, $X_C > X_B$

Q-24	As the wavelength is increased from violet to red, the luminosity (a) Continuously increases (b) Continuously decreases (c) increases then decreases (d) decreases then increases
Q-25	An electric bulb is hanging over a table 1m 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 point will be about (a) 10 lux (b) 14 lux (c) 20 lux (d) 28 lux
Q-26	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) 0.5% (b) 1% (c) 2% (d) 4%
Q-27	A battery-operated torch is adjusted to send an almost parallel beam of light. It produces an illuminance of 40 lux when the light falls on a wall 4 m away is close to (a) 40 lux (b) 20 lux (c) 10 lux (d) 5 lux
Q-28	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
Q-29	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) 3 s (b) 12 s (c) 24 s (d) 48 s
Q-30	A photographic plate is placed directly in front of a small diffused source in the shape of a cylindrical disc. It takes 12 s to get a good exposure. If the source is rotated by 60° about one of its diameters, the time needed to get the same exposure will be (a) 6 s (b) 12 s (c) 24 s (d) 48 s
Q-31	A point source of light moves in a straight line parallel 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 distance from the source as (a) $\frac{1}{r}$ (b) $\frac{1}{r^2}$ (c) $\frac{1}{r^3}$ (d) $\frac{1}{r^4}$
Q-32	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) $B = C < A$
Q-33	The brightness 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



Q-34	A room is illuminated by an extended source. The illuminance at a particular portion of a wall can be increased by (a) moving the source (b) rotating the source (c) bringing some mirrors in proper positions (d) changing the colour of the source
Q-35	Mark the correct options (a) The luminous efficacy of a monochromatic source is always greater than that of a white source of same power (b) Luminous efficacy of a monochromatic source of wavelength 555 nm is always greater than that of a white light source of same power. (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) The illuminating power of a monochromatic source is always greater than that of a white light source of same power.
Q-36	Mark the correct options (a) Luminous flux and radiant flux have same dimensions (b) Luminous flux and luminous intensity have the same dimensions (c) Radiant flux and power have same dimensions (d) Relative luminosity is a dimensionless quantity
Q-37	A source emits 45 joules of energy in 15 s. What is the radiant flux of the source?
Q-38	A photographic plate records sufficiently intense lines when it is exposed for 12 s to a source of 10 W. How long should it be exposed to a 12W source radiating the light of the same colour to get equally intense lines?
Q-39	Using figure find the relative luminosity of wavelength (a) 480 nm (b) 520 nm (c) 580 nm (d) 600 nm
	
Q-40	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.
Q-41	The luminous flux of a monochromatic source of 1 W is 450 lumens/watt. Find the relative luminosity at the wavelength emitted.
Q-42	A source emits light of wavelengths 555 nm and 600 nm. The radiant flux of the 555 nm 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 capacity
Q-43	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 efficiency.
Q-44	A light source emits 31.4 W of the radiant flux distributed in all directions. The luminous efficiency is 60 lumen/watt. What is the luminous intensity of the source?
Q-45	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.

Q-46	The illuminance of a small area changes from 900 lumen/m^2 to 400 lumen/m^2 when it is shifted along its normal by 10 cm. Assume that it is illuminated by a point source placed on the normal to the area. Find the distance between the source and the area in the original position.
Q-47	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.
Q-48	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?
Q-49	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 center 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?
Q-50	Figure shows a small diffused plane source S placed over a horizontal table-top at a distance of 2.4 m with its plane parallel to the table-top. The illuminance at point A directly below the source is 25 lux. Find the illuminance at a point B of the table at a distance 1.8 m from A .
	
Q-51	An electric lamp and a candle produce equal illuminance at a photometer screen when they are placed at 80 cm and 20 cm from the screen respectively. The lamp is now covered with a thin paper which transmits 49% of the luminous flux. By what distance should the lamp be moved to balance the intensities at the screen again?
Q-52	Two light sources of intensities 80 cd and 20 cd are placed on the same side of a photometer screen at a distance of 40 cm from it. Where should a 80 cd source be placed to balance the illuminance?
Q-53	At a height of one meter above the center of a circular table of diameter 4m, a bulb of 100 W hangs. If the intensity at a point on its rim is I_0 , then what is the intensity at the center of the table? a. I_0 b. $2\sqrt{5} I_0$ c. $2 I_0$ d. $5\sqrt{5} I_0$
Q-54	Lux is a unit of which of the following? a. Illuminance on a surface b. Luminous intensity of a source c. Luminous efficiency of the source of light d. Transmission coefficient of a surface
Q-55	If a lamp has a luminous efficiency of Five lumen/watt and a luminous intensity of 35 candela. What is the power of the lamp? a. 176 W b. 88 W c. 36 W d. 80 W