Session 11: Modern Physics
(Radiation Pressure)

Q 2). Bulb 1 → Emits red light → 1800J in1hr.

Bulb 2 → Emits blue light → 20mJ in 1sec.

What can be said about their powers ?

$P_1 = 0.5W$

$P_2 = 20mW$.

(A) $P_1 = P_2$

(B) $P_1 > P_2$

(C) $P_1 < P_2$

(D) Data not sufficient

Q 3). Which bulb emits more photons per second ?

(A) bulb1
(B) bulb2
(C) both equal
(D) 0 for both

$P_1 = 0.5\,W$

$P_2 = 20\,mW$

Q 3). Which bulb emits more photons per second ?

(A) bulb1 (B) bulb2

(C) both equal (D) 0 for both

red

blue.

Q 4). Let $\lambda_1 = 3\lambda_2$. What should be relation between the power of the bulbs so that they both emit equal number of photons per second ?

$$N_p = \frac{P}{(hc/\lambda)} = \frac{P\lambda}{hc}$$

(A) $3\ P_2 = P_1$

(B) $P_1 = P_2$

(C) $3\ P_1 = P_2$

(D) $2\ P_1 = P_2$

Q 4). Let $\lambda_1=3\lambda_2$. What should be relation between the power of the bulbs so that they both emit equal number of photons per second ?

(A) $3\ P_2=P_1$ (B) $P_1=P_2$

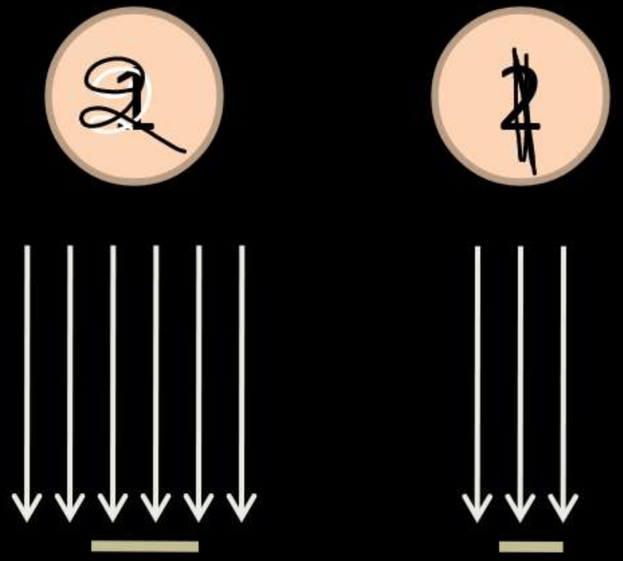
(C) $3\ P_1=P_2$ (D) $2\ P_1=P_2$

$$N_{p_1} = N_{p_2}$$

$$\frac{P_1 \lambda_1}{hc} = \frac{P_2 \lambda_2}{hc}$$

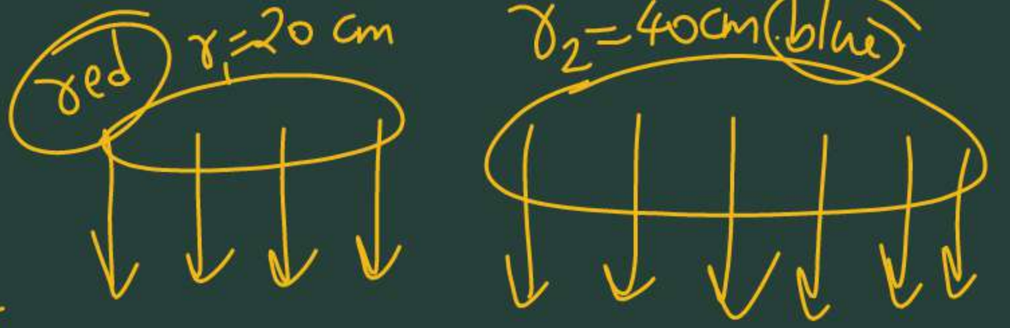
$$P_1 \times 3\lambda_2 = P_2 \lambda_2$$

Q 4). In the previous case, let the beams are of radius as below:
beam 1 → 20 cm, specimen 1 → 1π cm^2
beam 2 → 40 cm, specimen 2 → 2π cm^2
What will be the ratio of momentum transferred ?



(A) 2/3 (B) 3/2
(C) 1 (D) 1/2

$\lambda_1 = 3\lambda_2$. $N_{p_1} = N_{p_2} = N_p$



red

$$N_{p_{red}}^{striking} = \frac{N_p}{\pi(20)^2} \times \pi$$

$$= \frac{N_p}{400}$$

$$= \frac{4N_p}{1600}$$

$$N_{p_{blue}}^{striking} = \frac{N_p}{\pi(40)^2} \times 2\pi$$

$$= \frac{2N_p}{1600}$$

$1\pi\,cm^2$ $\qquad$ $2\pi\,cm^2$

Momentum transferred = $N_p \times h/\lambda$ (per sec)

$$p^{red} = \frac{4N_p}{1600} \times \frac{h}{\lambda_1}$$

$$p^{blue} = \frac{2N_p}{1600} \times \frac{h}{\lambda_2}$$

Ratio → $\frac{p^{red}}{p^{blue}} = \frac{4N_p h}{1600 \times 3\lambda_2} \times \frac{1600\lambda_2}{2N_p h}$

$= \frac{4N_p h}{1600 \times 3\lambda_2}$

$= 2/3$