Physicsaholics

DPP – 1

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Q 1. Mark the correct statement
(a) Rest Mass of photon is zero.
(b) Number of photons is a conserved quantity
(c) Momentum of photon is zero.
(d) None of these

Q 2. For given energy of photon, E = 3.03×10^{-19} J corresponding wavelength will be: (h = 6.6×10^{-34} sec, C = 3×10^{8} m/sec.)
(a) 65.6 nm (b) 6.56 nm
(c) 3.4 nm (d) 656 nm

Q 3. A moving hydrogen atom absorbs a photon of wavelength 122 nm and comes to rest. Then speed of moving hydrogen was
(a) 3.25 m/s (b) 6.5 m/s
(c) 1.75 m/s (d) 8.25 m/s

Q 4. The number of photons of light having wavelength 100nm which can provide 1J energy is nearly:
(a) 10^{7} photons (b) 5×10^{20} photons
(c) 5×10^{17} photons (d) 5×10^{7} photons

Q 5. The equation E = pc is valid -
(a) for an electron as well as for photon
(b) for an electron but not for a photon
(c) for a photon but not for an electron
(d) neither for an electron nor for a photon

Q 6. The energy of photon of visible light (400 nm to 700 nm) with maximum wavelength in eV is
(a) 1 (b) 1.77 (c) 3.2 (d) 7

Q 7. What is the momentum of a photon having frequency 1.5×10^{13} Hz?
(a) 3.3×10^{-29} kg m/s (b) 3.3×10^{-34} kg m/s
(c) 6.6×10^{-34} kg m/s (d) 6.6×10^{-30} kg m/s

Q 8. The energy of photon having λ = 620Å in eV is
(a) 10
(b) 20
(c) 2

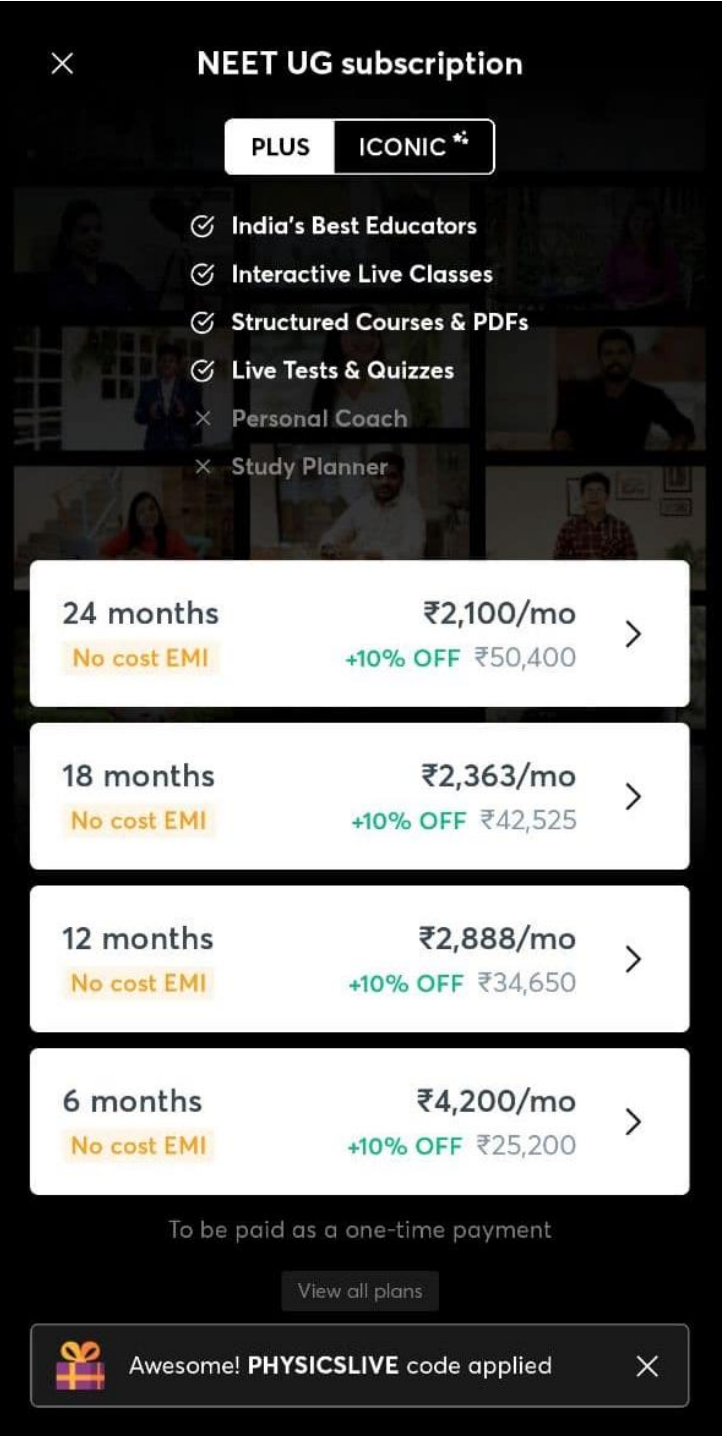
(d) 1

Q 9. A TV station is operated at 100 MW with a signal frequency of 10 Mhz. Calculate the number of photons radiated per second by its antenna?
(a) 2.5×10^{34}
(b) 1.5×10^{34}
(c) 5×10^{34}
(d) 6×10^{34}

Q 10. Wavelength emitted by a bulb is halved and power is doubled then number of photons emitted (per second) by it will
(a) Halved
(b) Doubled
(c) Quadrupled
(d) Remain same

Answer Key

Q.1 a	**Q.2 d**	**Q.3 a**	**Q.4 c**	**Q.5 c**
Q.6 b	**Q.7 a**	**Q.8 b**	**Q.9 b**	**Q.10 d**



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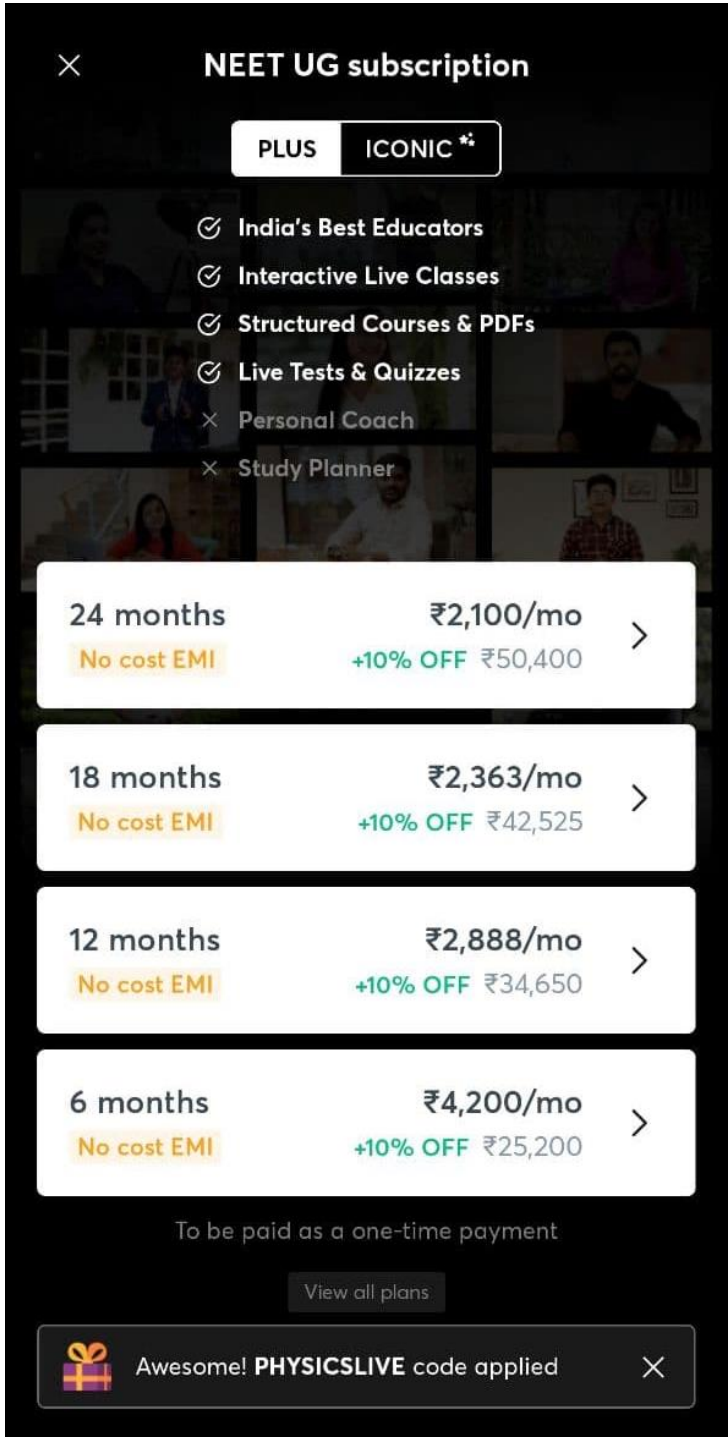

Written Solution

DPP 1 –Modern Physics | PEE - Photon Theory

By Physicsaholics Team

Solution: 1

Rest mass of photon is zero.

A valance electron may absorb a photon completely.

$\Rightarrow$ no of photon is not a conserved quantity.

Momentum of photon $= h/\lambda$

Ans. a

Solution: 2

$$E = \frac{hc}{\lambda}$$

$$3.03 \times 10^{-19} = \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{\lambda}$$

$$\lambda = \frac{6.6 \times 3 \times 10^{-26}}{3.03 \times 10^{-19}}$$

$$\lambda = 6.56 \times 10^{-7}$$

$$\lambda = 656 \times 10^{-9}\ m$$

$$\boxed{\lambda = 656\ nm}$$ Ans.

Ans. d

Solution: 3

by Conservation of momentum we can say that H atom & photon must have equal & opposite momentum.

$$\frac{h}{\lambda} = mv$$

(m → mass of H atom)

$$\Rightarrow v = \frac{h}{m\lambda} = \frac{6.6 \times 10^{-34}}{1.6 \times 10^{-27} \times 122 \times 10^{-9}}$$

$$= 3.25 \text{ m/s}$$

Ans. a

Solution: 4

Let no. of photons = n

then, $E = n \frac{hc}{\lambda}$

$E = 1\,J = n \times \frac{6.67 \times 10^{-34} \times 3 \times 10^{8}}{100 \times 10^{-9}}$

$1 = n \times \frac{6.67 \times 3 \times 10^{-26}}{10^{-7}}$

$n = \frac{10^{-7}}{6.67 \times 3} \times 10^{26}$

$n = \frac{10^{19}}{6.67 \times 3} = \frac{100 \times 10^{17}}{6.67 \times 3}$

$n \simeq 5 \times 10^{17}$ Ans

Ans. c

Solution: 5

$E = pc$

is valid for photon. It is not valid for a particle having mass.

Ans. c

Solution: 6

$$E = \frac{hc}{\lambda}$$

$$E_{max} = \frac{hc}{\lambda_{min}} = \frac{1240 \text{ nm eV}}{700 \text{ nm}}$$

$$= 1.77 \text{ eV}$$

Ans. b

Solution: 7

$$p = \frac{h}{\lambda} = \frac{hc}{\lambda} \times \frac{1}{c} = \frac{h\nu}{c}$$

$$= \frac{6.6 \times 10^{-34} \times 1.5 \times 10^{13}}{3 \times 10^{8}}$$

$$= 3.3 \times 10^{-29} \ kg\ m/sec$$

Ans. a

Solution: 8

$$E = \frac{hc}{\lambda} = \frac{12400\ \text{Å eV}}{620}$$

$$= 20\ \text{eV}$$

Ans. b

Solution: 9

$$\text{no of photons emitted/sec} = \frac{\text{Energy emitted per sec}}{\text{Energy of one photon}}$$

$$= \frac{100 \times 10^{6}}{6.6 \times 10^{-34} \times 10 \times 10^{6}}$$

$$= \frac{10}{6.6} \times 10^{34}$$

$$= 1.5 \times 10^{34}$$

Ans. b

Solution: 10

n ↑ no of photons emitted/sec.

$$P = n\left(\frac{hc}{\lambda}\right)$$

$$\Rightarrow \quad n = \frac{P\lambda}{hc} \propto P\lambda$$

Ans. d

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