1. The momentum of a photon is $3.3\times10^{-29}\, kg - m/sec$. Its frequency will be

(a) $3\times10^{3}\, Hz$ (b) $6\times10^{3}\, Hz$

(c) $7.5\times10^{12}\, Hz$ (d) $1.5\times10^{13}\, Hz$

2. The energy of a photon of wavelength λ is given by

(a) $h\lambda$ (b) $ch\lambda$

(c) λ / hc (d) hc/λ

3. The momentum of a photon is 2×10^{-16} *gm-cm/sec*. Its energy is

(a) $0.61\times10^{-26}\, erg$ (b) $2.0\times10^{-26}\, erg$

(c) $6\times10^{-6}\, erg$ (d) $6\times10^{-8}\, erg$

4. The rest mass of the photon is

(a) 0

(b) ∞

(c) Between 0 and ∞

(d) Equal to that of an electron

5. The momentum of the photon of wavelength $5000\mathring{A}$ will be

(a) $1.3\times10^{-27}\, kg\text{-}m/sec$ (b) $1.3\times10^{-28}\, kg\text{-}m/sec$

(c) $4\times10^{29}\, kg\text{-}m/sec$ (d) $4\times10^{-18}\, kg\text{-}m/sec$

6. The momentum of a photon of energy $h\nu$ will be

(a) $h\nu$ (b) $h\nu / c$

(c) $h\nu c$ (d) h/ν

7. A photon in motion has a mass

(a) $c/h\nu$ (b) h/ν

(c) $h\nu$ (d) $h\nu/c^2$

8. If the momentum of a photon is *p*, then its frequency is

(a) $\frac{ph}{c}$ (b) $\frac{pc}{h}$

(c) $\frac{mh}{c}$ (d) $\frac{mc}{h}$

Where *m* is the rest mass of the photon

9. An AIR station is broadcasting the waves of wavelength 300 metres. If the radiating power of the transmitter is 10 *kW*, then the number of photons radiated per second is

(a) 1.5×10^{29} (b) 1.5×10^{31}

(c) 1.5×10^{33} (d) 1.5×10^{35}

10. The energy of a photon is $E = h\nu$ and the momentum of photon $p = \frac{h}{\lambda}$, then the velocity of photon will be

(a) *E/p* (b) *Ep*

(c) $\left(\frac{E}{p}\right)^2$ (d) $3\times10^{8} m/s$

11. The approximate wavelength of a photon of energy 2.48 eV is

(a) 500 $Å$ (b) 5000 $Å$
(c) 2000 $Å$ (d) 1000 $Å$

12. An important spectral emission line has a wavelength of 21 cm. The corresponding photon energy is

(a) $5.9\times10^{-4} eV$ (b) $5.9\times10^{-6} eV$
(c) $5.9\times10^{-8} eV$ (d) $11.8\times10^{-6} eV$

$(h = 6.62\times10^{-34} Js;\ c = 3\times10^{8} m/s)$

13. The momentum of a photon in an X-ray beam of 10^{-10} metre wavelength is

(a) $1.5\times10^{-23} kg-m/sec$ (b) $6.6\times10^{-24} kg-m/sec$
(c) $6.6\times10^{-44} kg-m/sec$ (d) $2.2\times10^{-52} kg-m/sec$

14. The energy of a photon of light with wavelength 5000 Å is approximately 2.5 eV. This way the energy of an X-ray photon with wavelength 1Å would be

(a) 2.5/5000 eV (b) $2.5/(5000)^2 eV$
(c) $2.5\times5000\ eV$ (d) $2.5\times(5000)^2 eV$

15. Energy of a quanta of frequency 10^{15} Hz and $h = 6.6\times10^{-34} J\text{-sec}$ will be

(a) $6.6\times10^{-19} J$ (b) $6.6\times10^{-12} J$
(c) $6.6\times10^{-49} J$ (d) $6.6\times10^{-41} J$

16. Momentum of a photon of wavelength λ is

(a) $\frac{h}{\lambda}$ (b) Zero
(c) $\frac{h\lambda}{c^2}$ (d) $\frac{h\lambda}{c}$

17. Wavelength of a 1 keV photon is $1.24\times10^{-9} m$. What is the frequency of 1 MeV photon

(a) $1.24\times10^{15} Hz$ (b) $2.4\times10^{20} Hz$
(c) $1.24\times10^{18} Hz$ (d) $2.4\times10^{23} Hz$

18. What is the momentum of a photon having frequency $1.5\times10^{13} Hz$

(a) $3.3\times10^{-29} kg\ m/s$ (b) $3.3\times10^{-34} kg\ m/s$
(c) $6.6\times10^{-34} kg\ m/s$ (d) $6.6\times10^{-30} kg\ m/s$

19. The energy of a photon of light of wavelength 450 nm is

(a) $4.4\times10^{-19} J$ (b) $2.5\times10^{-19} J$
(c) $1.25\times10^{-17} J$ (d) $2.5\times10^{-17} J$

20. Frequency of photon having energy 66 eV is

(a) $8\times10^{-15} Hz$ (b) $12\times10^{-15} Hz$
(c) $16\times10^{15} Hz$ (d) None of these

21. Which of the following statement is not correct
(a) Photographic plates are sensitive to infrared rays
(b) Photographic plates are sensitive to ultraviolet rays
(c) Infra-red rays are invisible but can cast shadows like visible light
(d) Infrared photons have more energy than photons of visible light

22. If we express the energy of a photon in KeV and the wavelength in angstroms, then energy of a photon can be calculated from the relation
(a) $E = 12.4 h\nu$ (b) $E = 12.4 h/\lambda$
(c) $E = 12.4/\lambda$ (d) $E = h\nu$

23. The frequency of a photon, having energy 100 eV is $(h = 6.6 10^{-34}\ J\text{-}sec)$
(a) $2.42\times10^{26}\ Hz$ (b) $2.42\times10^{16}\ Hz$
(c) $2.42\times10^{12}\ Hz$ (d) $2.42\times10^{9}\ Hz$

24. A photon of wavelength 4400 Å is passing through vacuum. The effective mass and momentum of the photon are respectively
(a) $5\times10^{-36} kg,\ 1.5\times10^{-27}\ kg\text{-}m/s$
(b) $5\times10^{-35} kg,\ 1.5\times10^{-26}\ kg\text{-}m/s$
(c) Zero, $1.5\times10^{-26}\ kg\text{-}m/s$
(d) $5\times10^{-36} kg, 1.67\times10^{-43} kg\text{-}m/s$

25. Which of the following is true for photon
(a) $E = \frac{hc}{\lambda}$ (b) $E = \frac{1}{2}mu^2$
(c) $p = \frac{E}{2v}$ (d) $E = \frac{1}{2}mc^2$

26. Which of the following is incorrect statement regarding photon
(a) Photon exerts no pressure
(b) Photon energy is hv
(c) Photon rest mass is zero
(d) None of these

27. If a photon has velocity c and frequency ν, then which of following represents its wavelength
(a) $\frac{hc}{E}$ (b) $\frac{h\nu}{c}$
(c) $\frac{h\nu}{c^2}$ (d) $h\nu$

28. The mass of a photo electron is
(a) $9.1\times10^{-27}\ kg$ (b) $9.1\times10^{-29}\ kg$
(c) $9.1\times10^{-31}\ kg$ (d) $9.1\times10^{-34}\ kg$

29. Energy of photon whose frequency is $10^{12}\ MHz$, will be
(a) $4.14\times10^{3} keV$ (b) $4.14\times10^{2} eV$

(c) $4.14\times10^{3}\,MeV$ (d) $4.14\times10^{3}\,eV$

30. There are n_1 photons of frequency γ_1 in a beam of light. In an equally energetic beam, there are n_2 photons of frequency γ_2. Then the correct relation is

(a) $\frac{n_1}{n_2}=1$ (b) $\frac{n_1}{n_2}=\frac{\gamma_1}{\gamma_2}$

(c) $\frac{n_1}{n_2}=\frac{\gamma_2}{\gamma_1}$ (d) $\frac{n_1}{n_2}=\frac{\gamma_1^2}{\gamma_2^2}$

1. (d) $p = \frac{h\nu}{c} \Rightarrow \nu = \frac{pc}{h} = \frac{3.3\times10^{-29}\times3\times10^{8}}{6.6\times10^{-34}} = 1.5\times10^{13}\,Hz$

2. (d)

3. (c) $p = \frac{E}{c} \Rightarrow E = p\times c = 2\times10^{-16}\times(3\times10^{10}) = 6\times10^{-6}\,erg.$

4. (a)

5. (a) $p = \frac{h}{\lambda} = \frac{6.6\times10^{-34}}{(5000\times10^{-10})} = 1.3\times10^{-27}\,kg\text{-}m/s$

6. (b) $p = \frac{E}{c} = \frac{h\nu}{c}$

7. (d) $E = h\nu = mc^2 \Rightarrow m = \frac{h\nu}{c^2}$

8. (b) $p = \frac{E}{c} = \frac{h\nu}{c} \Rightarrow \nu = \frac{pc}{h}$

9. (b) $P = \frac{W}{t} = \frac{nhc}{\lambda t} \Rightarrow \left(\frac{n}{t}\right) = \frac{P\lambda}{hc} = \frac{10\times10^{3}\times300}{6.6\times10^{-34}\times3\times10^{8}}$

$= 1.5\times10^{31}$

10. (a) Momentum of photon $p = \frac{E}{c}$

$\Rightarrow$ Velocity of photon $c = \frac{E}{p}$

11. (b) By using $E(eV) = \frac{12375}{\lambda(Å)}$

$\Rightarrow \lambda = \frac{12375}{2.48} = 4989.9\,Å \approx 5000\,Å$

12. (b) $E = \frac{hc}{\lambda} = \frac{3\times10^{8}\times6.62\times10^{-34}}{0.21\times1.6\times10^{-19}} = 5.9\times10^{-6}\,eV$

13. (b) Momentum of photon

$p = \frac{h}{\lambda} = \frac{6.6\times10^{-34}}{10^{-10}} = 6.6\times10^{-24}$ *kg - m/sec.*

14. (c) $E \propto \frac{1}{\lambda} \Rightarrow \frac{2.5}{E'} = \frac{1}{5000} \Rightarrow E' = (2.5)\times5000\,eV$

15. (a) $E = h\nu = 6.6\times10^{-34}\times10^{15} = 6.6\times10^{-19}\,J$

16. (a) Since $h\nu = mc^2$, hence $p = mc = \frac{h\nu}{c} = \frac{h}{\lambda}$

17. (b) $E = h\nu \Rightarrow \nu = \frac{E}{h} = \frac{1\times 10^{6}\times 1.6\times 10^{-19}}{6.6\times 10^{-34}} = 2.4\times 10^{20}\ Hz$

18. (a) $p = \frac{h\nu}{c} = \frac{6.6\times 10^{-34}\times 1.5\times 10^{13}}{3\times 10^{8}} = 3.3\times 10^{-29}\ kg\text{-}m/\sec$

19. (a) $E = \frac{hc}{\lambda} = \frac{6.62\times 10^{-34}\times 3\times 10^{8}}{450\times 10^{-9}} = 4.4\times 10^{-19}\ J$

20. (c) $E = h\nu \Rightarrow \nu = \frac{E}{h} = \frac{66\times 1.6\times 10^{-19}}{6.6\times 10^{-34}} = 16\times 10^{15}\ Hz$

21. (d) $E \propto \frac{1}{\lambda}$; also $\lambda_{\text{infrared}} > \lambda_{\text{visible}}$ so $E_{\text{infrared}} < E_{\text{visible}}$

22. (c) Energy of photon $E = \frac{hc}{\lambda}$ (Joules) $= \frac{hc}{e\lambda}(eV)$

$\Rightarrow E_{(eV)} = \frac{6.6\times 10^{-34}\times 3\times 10^{8}}{1.6\times 10^{-19}\times \lambda(Å)} = \frac{12375}{\lambda(Å)}$

$\Rightarrow E(keV) = \frac{12.37}{\lambda(Å)} \approx \frac{12.4}{\lambda}$

23. (b) $E = h\nu \Rightarrow 100\times 1.6\times 10^{-19} = 6.6\times 10^{-34}\times \nu$

$\Rightarrow \nu = 2.42\times 10^{16}\ Hz$.

24. (a) $p = \frac{h}{\lambda} = \frac{6.6\times 10^{-34}}{4400\times 10^{-10}} = 1.5\times 10^{-27}\ kg.m/s$

and mass $m = \frac{p}{c} = \frac{1.5\times 10^{-27}}{3\times 10^{8}} = 5\times 10^{-36}\ kg$

25. (a)

26. (a)

27. (a) $E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E}$

28. (c)

29. (d) $E(eV) = \frac{h\nu}{e} = \frac{6.0\times 10^{-34}\times 10^{12}\times 10^{6}}{1.6\times 10^{-19}} = 4.14\times 10^{3}\ eV$.

30. (c) $E = nh\nu \Rightarrow \nu \propto \frac{1}{n} \Rightarrow \frac{n_1}{n_2} = \frac{\gamma_2}{\gamma_1}$.