

Dual Nature of Radiation and Matter

1. **Assertion (A):** Two photons having equal wavelengths have equal linear momentum.
Reason (R): When monochromatic light shows its photon character, each photon has a linear momentum $p = \frac{h}{\lambda}$.
- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false
2. **Assertion (A):** If the accelerating potential of a X-Ray tube is increased then the characteristic wavelength decreases.
Reason (R): The cut-off wavelength for a X-ray tube is given by $\lambda_{\min} = \frac{hc}{eV}$, where V is accelerating potential.
- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false
3. A photon and an electron both have energy 50 eV.
Assertion (A): Both have different wavelengths.
Reason (R): Wavelength depends on energy and not on mass.
- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false
4. **Assertion (A):** Wave velocity is equal to group velocity in a non-dispersive medium.
Reason (R): A non dispersive medium is one in which the wave velocity is frequency dependent.
- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false
5. **Assertion (A):** In photoelectric effect, cathode or emitter plate is usually coated with barium oxide, barium sulphide or strontium oxide.
Reason (R): Coating prevents cathode from erosion.
- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false
6. **Assertion (A):** A particle at rest breaks into two particles of different masses. They fly off in different directions. Their de Broglie wavelengths will be different.
Reason (R): Their speed will be different.
- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false
7. **Assertion (A):** Photo cell is also called electric eye.
Reason (R): Photo cell can see the things placed in front of it.
- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false



8. **Assertion (A):** In photon-particle collision the total energy and total momentum are conserved.
Reason (R): The number of photons are conserved in a collision.
 (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
 (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
 (3) (A) is true but (R) is false
 (4) Both (A) and (R) are false
9. **Assertion (A):** Cut-off wavelength of x-ray is independent of type of target metal
Reason (R): Wavelength of K_{α} x-ray depends upon type of target metal.
 (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
 (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
 (3) (A) is true but (R) is false
 (4) Both (A) and (R) are false
10. **Assertion (A):** The stopping potential increases, when frequency of incident rays are increased.
Reason (R): Stopping potential is directly proportional to the frequency of incident radiation.
 (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
 (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
 (3) (A) is true but (R) is false
 (4) Both (A) and (R) are false
11. **Assertion (A):** A metallic surface is irradiated by monochromatic light of frequency $\nu > \nu_0$ (the threshold frequency). The maximum kinetic energy and stopping potential are K_{\max} and V_s respectively. If the frequency of incident on the surface is doubled, both K_{\max} & V_s are more than doubled.
Reason (R): The maximum kinetic energy and the stopping potential of photoelectrons emitted from a surface are linearly dependent on the frequency of incident light.
 (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
 (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
 (3) (A) is true but (R) is false
 (4) Both (A) and (R) are false
12. **Assertion (A):** When ultraviolet light incident on a photo cell, its stopping potential is V_s and the maximum kinetic energy of photoelectrons is K_{\max} . When the ultraviolet light is replaced by X-rays, both V_s and K_{\max} increases
Reason (R): Photo electrons are emitted with speed ranging from zero to a maximum value because of the range of frequencies present in the incident light.
 (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
 (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
 (3) (A) is true but (R) is false
 (4) Both (A) and (R) are false
13. **Assertion (A):** By de-Broglie hypothesis, $p = h/\lambda$ for both the electron and the photon.
Reason (R): If an electron has the same wavelength as a photon, they have the same energy.
 (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
 (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
 (3) (A) is true but (R) is false
 (4) Both (A) and (R) are false
14. **Assertion (A):** Charge of a photon is zero.
Reason (R): Rest mass of a photon is zero.
 (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
 (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
 (3) (A) is true but (R) is false
 (4) Both (A) and (R) are false
15. **Assertion (A):** The relative velocity of two photons travelling in opposite directions is c .
Reason (R): The rest mass of a photon is zero.
 (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
 (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
 (3) (A) is true but (R) is false
 (4) Both (A) and (R) are false

16. Assertion (A): In the process of photo electric emission, all the emitted photoelectrons have same KE.

Reason (R): According to Einstein's photo electric equation $KE = h\nu - \phi$.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
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- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

17. Assertion (A): In photo electric effect, photo electrons come out from inner orbits of atom.

Reason (R): Free electrons of the metal can not absorb energy of a photon.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

18. Assertion (A): In photoelectric effect, on increasing the intensity of light, both the number of electrons emitted and kinetic energy of each of them get increased but photoelectric current remains unchanged.

Reason (R): The photoelectric current depends only on wavelength of light.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

19. Assertion (A): The smaller the wavelength of a photon, the more energy it has.

Reason (R): The smaller the wavelength of a photon, the less momentum it has.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

20. Assertion (A): An electron microscope is based on de Broglie's hypothesis of matter waves.

Reason (R): Higher the accelerating potential, smaller is the de Broglie wavelength of the electron.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

21. Assertion (A): Photons do not carry momentum

Reason (R): A photon is a material particle.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

22. Assertion (A): Increase in intensity of light increases the kinetic energy of photoelectrons.

Reason (R): At stopping potential, no current flows in the circuit.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

23. Assertion (A): Work function of a metal increases with increase in intensity of incident light.

Reason (R): Maximum kinetic energy of ejected photoelectrons depends upon the intensity of incident light.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

24. Assertion (A): Kinetic energy of photoelectrons emitted by a photosensitive surface depends upon the intensity of incident photon.

Reason (R): The ejection of electrons from metallic surface is possible with frequency of incident photon below the threshold frequency.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

25. Assertion (A): Photoelectrons have a range of kinetic energy.

Reason (R): The work function varies as a function of depth from the surface.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

26. Assertion (A): Photoelectric effect demonstrates the wave nature of light.

Reason (R): The number of photoelectrons is proportional to the frequency of light.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

27. Assertion (A): On increasing the frequency of incident light, the photoelectric current increases.

Reason (R): Photoelectric current depends upon the wavelength of incident light.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

28. Assertion (A): In photoelectric effect, the number of photoelectrons emitted is always equal to number of photons incident.

Reason (R): All the photons falling on the surface will eject photoelectrons.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

29. Assertion (A): Electron from metal surface ejects only when light of particular wavelength will fall on surface.

Reason (R): Light shows wave nature.

- (1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
- (2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
- (3) (A) is true but (R) is false
- (4) Both (A) and (R) are false

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	4	4	3	3	4	4	3	3	2	3	2	3	3	1	2	4	4	4	3	2
Que.	21	22	23	24	25	26	27	28	29											
Ans.	4	4	4	4	3	4	4	4	4											