QB365 Question Paper Software
12th Standard - Physics
Dual Nature of Radiation and Matter Assertion and reason

Exam Time: 00:20 Hrs

Date: 2025-09-30

Total Marks: 10

Questions:

1. **Assertion (A)** : The threshold frequency of photoelectric effect supports the particle nature of light.
Reason (R) : If frequency of incident light is less than the threshold frequency, electrons are not emitted from metal surface.
Codes
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

2. **Assertion (A)** : Work function of aluminium is 4.2 ev' Emission of electrons will not be possible if two photons each of energy 2.5 eV stnike an electron of aluminium.
Reason (R) : For photoelectric emission the energy of each photon should be greater than the work function of aluminium.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

3. **Assertion (A)** : The de-Broglie wavelength of a neutron when its kinetic energy is K is λ. Its wavelength is 2λ when its kinetic energy is 4 K.
Reason (R) : The de-Broglie wavelength λ is directly proportional to square root of the kinetic energy.
Codes:
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false

4. **Assertion :** Though light of a single frequency (monochromatic) is incident on a metal, the energies of emitted photoelectrons are different.
Reason : The energy of electrons emitted from inside the metal surface, is lost in collision with the other atoms in the metal.
Codes:
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

5. **Assertion :** A photon has no rest mass, yet it carries definite momentum.
Reason : Momentum of photon is due to its energy and hence its equivalent mass.
Codes:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

6. **Assertion :** Two photons of equal wavelength must have equal linear momentum.
Reason : Two photons of equal linear momentum will have equal wavelength.
Codes:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

7. **Assertion :** The photon behaves like a particle.
Reason : If E and P are the energy and momentum of the photon, then $p = E / c$.
Codes:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

8. **Assertion** : The wavelength of electromagnetic radiation is directly proportional to its momentum.
Reason : According to de Broglie's hypothesis, the momentum of a particle (including photons) is inversely proportional to its wavelength.
Codes:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

9. **Assertion :** The wave nature of particles is observed in electron diffraction experiments.
Reason : In electron diffraction, electrons are diffracted as they pass through a crystal lattice, exhibiting wave-like interference patterns.
Codes:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

10. **Assertion :** The work function of a metal is the minimum energy required to release an electron from its surface.
Reason : For the photoelectric effect to occur, the energy of incident photons must be greater than or equal to the work function of the metal.
Codes:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

Answers Key:

1. **(b)**: There is no emission of photoelectrons till the frequency of incident light is less than a minimum frequency, however intense light it may be.In photoelectric effect, it is a single particle collision. Intensity is hv x N, where h» is the individual.energy of the photon and N is the total number of photon.In the wave theory, the intensity is proportional, not only to v^2 but also to the square of amplitude. For the same frequency, increase in intensity only increase the number of photons (in the quantum theory of Einstein).
2. **(a)**: This is because the probability is very low for two photons of energy 2.5 eV making a collision with the same electron in the metal simultaneously.
3. **(d) :** $\lambda = \frac{h}{\sqrt{2mK}}$, i.e., $\lambda \propto \frac{1}{\sqrt{K}}$

   $\therefore \ \frac{\lambda'}{\lambda} = \sqrt{\frac{K}{K'}} = \sqrt{\frac{K}{4K}} = \frac{1}{2}$ or $\lambda' = \frac{\lambda}{2}$
4. (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

   Explanation:

   When a light of single frequency falls on the electrons of inner layer of metal, then this electron comes out of the metal surface after a large number of collisions with atom of it's upper layer.
5. (a) Both A and R are true and R is the correct explanation of A.
6. (d) A is false and R is also false.
7. (a) Both A and R are true and R is the correct explanation of A.
8. (d) A is false and R is also false.
9. (a) Both A and R are true and R is the correct explanation of A.
10. (a) Both A and R are true and R is the correct explanation of A.