

विध्न विचारत भीरु जन, नहीं आरम्भे काम,
विपति देख छोड़े तुरंत मध्यम मन कर श्याम।
पुरुष सिंह संकल्प कर, सहते विपति अनेक,
'बना' न छोड़े ध्येय को, रघुबर राखे टेक।।

रचित: मानव धर्म प्रणेता

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MODERN PHYSICS

Some questions (Assertion–Reason type) are given below. Each question contains STATEMENT – 1 (Assertion) and STATEMENT – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. So select the correct choice :

Choices are :

- (A) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1.
- (B) Statement – 1 is True, Statement – 2 is True; Statement – 2 is **NOT** a correct explanation for Statement – 1.
- (C) Statement – 1 is True, Statement – 2 is False.
- (D) Statement – 1 is False, Statement – 2 is True.

555. STATEMENT – 1

In H-atom, according to Bohr's theory, electron revolves around the nucleus in orbits in which the angular momentum of electron are as integral multiple of $h/2\pi$.

STATEMENT – 2

Mass of electron is equal to the mass of proton.

556. STATEMENT – 1

In photoelectric effect photoelectrons are emitted when the falling radiation has energy less than work function of metal surface.

STATEMENT – 2

Work function is the minimum energy needed to eject electrons from the surface of metal.

557. STATEMENT – 1

The Bohr's model cannot differentiate between the spectra of hydrogen and deuterium.

STATEMENT – 2

The Bohr's model considers the nucleus as infinitely massive in comparison to the orbiting electrons.

558. STATEMENT – 1

As the accelerating potential in a Coolidge tube is increased, the wavelengths of the characteristic X-rays decreases.

STATEMENT – 2

Increasing accelerating potential increases the kinetic energy and hence energy of emitted continuous X-rays.

559. STATEMENT – 1

Elements with high atomic numbers are suitable targets for producing X-rays.

STATEMENT – 2

Energy of the atom increases with increase in atomic number.

560. STATEMENT – 1

In α -emission, the α -particle carries the major share of the energy.

STATEMENT – 2

In α -decay, the α -particle being lighter has more velocity.

561. STATEMENT – 1

In β -decay, all the emitted electron do not have the same energy the same energy.

STATEMENT – 2

β -decay is not a two body decay process.

562. STATEMENT – 1

The number of photoelectrons emitted by a metal plate illuminated by light of a certain frequency, greater than the threshold of frequency, depends on the area of the plate.

STATEMENT – 2

The number of electrons emitted per second will depend on the number of photons falling on the plate per second.

563. STATEMENT – 1

An insulated metal plate emits photoelectrons when first illuminated by ultraviolet light but then the number of photoelectrons emitted per unit time decreases until it stops altogether.

STATEMENT – 2

As more and more electrons leave the plate, its potential increases, decreasing the number of free electrons and finally stopping them.

564. STATEMENT – 1

A hydrogen atom cannot absorb a photon whose energy is greater than 13.6 eV, its binding energy.

STATEMENT – 2

The extra energy will manifest as KE of the electron.

565. STATEMENT – 1

The frequency of K_α X-radiation is greater than K_β for a given target material.

STATEMENT – 2

K_α radiation is produced when an electron from $n = 2$ jumps into the vacancy in $n = 1$ orbit; whereas in K_β radiation the transition takes place from $n = 3$ to $n = 1$.

566. STATEMENT – 1

Electromagnetic waves exert pressure on the surface.

STATEMENT – 2

Photons do not have any mass.

567. STATEMENT – 1

An interference pattern can be obtained from an electron beam.

STATEMENT – 2

Electrons can behave like a wave.

568. STATEMENT – 1

In a photoelectric effect experiment different photoelectrons have different kinetic energy.

STATEMENT – 2

In the incident radiation different photons have different energy.

569. STATEMENT – 1

Nuclear fusion reaction takes place only at extremely high temperature.

STATEMENT – 2

At extremely high temperature atoms molecules acquires sufficiently high kinetic energy to overcome the electrostatic force due to each other.

570. STATEMENT – 1

Atoms of greater mass number are more stable.

STATEMENT – 2

Their mass defects are more.

- 571. STATEMENT – 1**
In photoelectric effect if both frequency and intensity of light is doubled. Current will become four times.
STATEMENT – 2
Increasing frequency of light will increase KE of emitted electrons.
- 572. STATEMENT – 1**
Energy is released in nuclear fission.
STATEMENT – 2
Total binding energy of the fission fragments is larger than the total binding energy of parent nucleus.
- 573. STATEMENT – 1 :** In a hydrogen atom energy of emitted photon corresponding to transition from $n = 2$ to $n = 1$ is much greater as compared to transition from $n = \infty$ to $n = 2$.
STATEMENT – 2 : Wavelength of photon is directly proportional to the energy of emitted photon.
- 574. STATEMENT – 1 :** Electron capture occurs more often than positron emission in heavy elements.
STATEMENT – 2 : Heavy elements exhibit radioactivity.
- 575. STATEMENT – 1 :** α and β particles are accelerated through same potential difference. Finally both particles have same linear momentum.
STATEMENT – 2 : Linear momentum = $\sqrt{KE \times 2 \times \text{mass}}$
Kinetic energy = charge \times accelerating voltage.
- 576. STATEMENT – 1 :** A photon (having wavelength less than threshold wavelength) is incident on a metallic surface. An electron must eject out of the metallic surface.
STATEMENT – 2 :
 $(KE)_{\max} = h\nu_0 - \phi$
 $(KE)_{\max} = \frac{hc}{\lambda_0} - \phi$
when $\frac{hc}{\lambda} > \phi$
then maximum possible kinetic energy of electron is $\frac{hc}{\lambda} - \phi$.
- 577. STATEMENT – 1 :** X-Ray travels with the speed of light.
STATEMENT – 2 : X-Rays are electromagnetic rays
- 578. STATEMENT – 1 :** Mass of moving photon varies inversely as the wavelength.
STATEMENT – 2 : Energy of the particle is equal to (mass \times (speed of light)²)
- 579. STATEMENT – 1 :** In photoelectric effect, the number photoelectrons emitted is always equal to number of photons incident.
STATEMENT – 2 : All the photons falling on the surface will eject photoelectrons, is not necessary.
- 580. STATEMENT – 1 :** When a nucleus undergoes α -decay the product atom become electrically charged.
STATEMENT – 2 : When a nucleus undergoes β -decay the product atom is electrically neutral.
- 581. STATEMENT – 1 :** In the photoelectric effect; the photoelectron current is increased when frequency of incident photons is doubled.
STATEMENT – 2 : Photoelectric effect follows the Einstein equation $h\nu = h\nu_0 + KE$.

582. **STATEMENT – 1** : If the accelerating voltage is doubled; then minimum wavelength of emitted continuous X-rays is halved.
STATEMENT – 2 : The wavelength of characteristic X-rays is independent of applied accelerating voltage.
583. **STATEMENT – 1** : Work function of different metals is different.
STATEMENT – 2 : Work function is the minimum energy required by an electron to just escape from the metal surface.
584. **STATEMENT – 1** : In hydrogen atom energy of emitted photon corresponding to transition from $n = 2$ to $n = 1$ is greater than energy of transition $n = 4$ to $n = 2$.
STATEMENT – 2 : Frequency of emitted photon is directly proportional to energy of photon.
585. **STATEMENT – 1** : Frequency of characteristic X-ray will change if atomic no is changed.
STATEMENT – 2 : When high energy electron strikes on X-ray plate then characteristics and continuous X-rays are emitted.
586. **STATEMENT – 1** : In radioactive decay of a radioactive atom, its stability increases.
STATEMENT – 2 : It is a spontaneous process.
587. **STATEMENT – 1** : Wavelength of continuous x-rays depends upon atomic number of the atom of target material.
STATEMENT – 2 : It is produced due to collision of electrons with the atoms of target atom.
588. **STATEMENT – 1** : For the scattering of α -particles at a large angles, the nucleus of the atom is responsible.
STATEMENT – 2 : Nucleus is very heavy in comparison to electrons.
589. **STATEMENT – 1** : Though light of a single frequency (monochromatic) is incident on a metal, the energies of emitted photo-electrons are different.
STATEMENT – 2 : The energy of electrons emitted from inside the metal surface is redistributed in collision with the other atoms in the metal.
590. **STATEMENT – 1** : Amongst α , β and γ -particles, α -particle has maximum penetrating power.
STATEMENT – 2 : The α -particle is heavier than β and γ -particle.
591. **STATEMENT – 1** : Work function of Aluminum is 4.2 eV. Emission of electron will not be possible if two photons each of energy 2.5 eV strike an electron of Aluminum.
STATEMENT – 2 : For photo-electric emission, the energy of each photon should be greater than the work function of Aluminum.

Hint & Solution

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|----------|----------------------|----------|----------|
| 555. (C) | 556. (D) | 559. (A) | 560. (B) |
| 557. (A) | 558. (D) | 563. (A) | 564. (D) |
| 561. (A) | 562. (B) | 567. (A) | 568. (C) |
| 565. (D) | 566. C | 571. (B) | |
| 569. (A) | 570. Both are false. | 574. (B) | 575. (D) |
| 572. (A) | 573. (C) | 578. (B) | 579. (D) |
| 576. (D) | 577. (A) | 582. (B) | 583. (B) |
| 580. (C) | 581. (D) | 586. (A) | 587. (D) |
| 584. (B) | 585. (B) | 590. (D) | 591. (A) |
| 588. (B) | 589. (A) | | |

555. Sol. Conceptual.

556. Sol. Basic.

559. X-rays are high energy radiation emitted by atoms.

561. Since had it been a two body decay process (like α -decay), the momentum and energy considerations fix the energy of the emitted particles.
562. The more the area of the plate, the more the number of photons falling on the plate per second.
563. With increasing potential of the plate, the less energetic electrons fall back on to the plate.
564. It can absorb a photon with energy greater than 13.6 eV, the balance showing up as KE.
565. K_β radiation represents greater level of energy than K_α and hence also a greater frequency ($E = h\nu$).

573. Photon energy $E = h\nu = \frac{hc}{\lambda}$

$$E \propto \frac{1}{r}, \text{ so reason is false.}$$

575.
$$p = \sqrt{2mKE}$$

$$p_\alpha = \sqrt{2m_\alpha KE}$$

$$p_\beta = \sqrt{2m_\beta KE}$$

KE is for α particles is two times the KE of β particles.

But $m_\alpha \gg m_\beta$

$\Rightarrow p_\alpha \neq p_\beta$.

576. When a photon of sufficient frequency strikes a metallic surface the electron may come out. If electron loose's energy during collisions then it is possible that electron may not come out of surface.

577. X-Ray lies in electromagnetic spectrum.

578. Mass of moving photon

$$m = \frac{h\nu}{c^2} = \frac{h}{c\lambda} \text{ and } E = mc^2$$

579. It's a probabilistic aspect that photon falling on surface can cause photoelectric emission.

580. When α -decay, the atom is left-with 2 orbital electrons and also in β -decay net single position charge is left.

581. The KE of photoelectron is increased and not is the increase of number of photo electron.

582.
$$\lambda_{\min} = \frac{12400\text{\AA}}{V(\text{ineV})} \text{ for continuous X-rays.}$$

583. Both statement I and statement II are true.

584.
$$\frac{\Delta E_1}{\Delta E_2} = \frac{E_0 \left(\frac{1}{1^2} - \frac{1}{2^2} \right)}{E_0 \left(\frac{1}{2^2} - \frac{1}{4^2} \right)}$$

$$hf = E.$$

586. In the spontaneous process potential energy decreases therefore stability increases.

587. Wavelength independent of Z of atom of target material.
588. An electron is very light particle as compared to α -particle. Hence e^- cannot scatter the α -particle at large angles, according to law of conservation of momentum.
On the other hand, mass of nucleus is comparable with the mass of α -particle, hence only the nucleus of atom is responsible for scattering of α -particles.
589. When a light of single frequency falls on the e^- of inner layer of metal, then this e^- comes out of the metal surface after a large number of collisions with atoms of its upper layer.
590. The penetrating power is maximum in case of γ -rays because γ -rays are an electromagnetic radiation of very small wavelength. Hence (D) is correct.