Structure of Atom

Assertion Reason Questions

In the following question no. (12-15), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices:

(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 but (R) is true.

1. Assertion (A): Violet colour is the most deviated one.
Reason (R): The shorter is the wave- length, the greater is the deviation.

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
Explanation: The violet colour is having a shorter wavelength 2 of 400nm. So when it travels from one medium to another, it will have a maximum value of angle of incidence. Also, the frequency is inversely proportional to the wavelength. When the wavelength is greater, the frequency will be lower. So the colour violet is most deviated.

2. Assertion (A): Value of work function for a few metals are given here: The work function value for alkali metals are decreasing down an alkali metal group.

Metal	Li	Na	K
W_o / eV	2.42	2.3	2.25

Reason (R): The size of the atom increases down a group

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
Explanation: Work function is nothing but the minimum energy required to liberate or eject an electron from a substance. As in the given elements, the size of the atom keeps increasing down a group therefore the electrons are free from the influence of the nucleus. So on moving down a group, the energy required to eject the electron from the surface decreases.

3. Assertion (A): Circular orbit can be calculated by $r_n = 0.529\ Å \left(\frac{n^2}{Z}\right)$, where Z = atomic number and n = 1, 2,3,...

Reason (R): The radius of the helium atom is 0.149 Å.

Ans. (c) (A) is true but (R) is false,

Explanation: $r_n = 0.529\ Å \left(\frac{n^2}{Z}\right)$

where Z = atomic number & n = 1,2,3,...

For Helium Z = 2 and n = 1

$$= 0.529Å \left(\frac{n^2}{Z}\right)$$

$$= 0.2645Å$$

4. Assertion (A): An ideal black body emits and absorbs radiation of all frequencies.

Reason (R): The frequency of radiation emitted by a body moves from a lower to a higher frequency with increased temperature.

Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

Explanation: The ideal body, which emits and absorb radiation of all frequency is called a black body. The exact frequency distribution of the emitted radiation from a black body depends only on its temperature. At a given temperature, Intensity of radiation emitted increases with decreases of wavelenth, reaches a maximum value at a given wavelenth and then starts decreasing with decrease of wavelength.

5. Assertion (A): The p-orbital has a dumb-bell shape.

Reason (R): Electrons present in the p-orbital can have any one of three values of magnetic quantum number,
i.e.+ 1, 0, -1.

Ans. (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

Explanation: The electrons present in p-orbitals have a dumb-bell shape. The 3p-orbitals lie along the three different mutually perpendicular axes that differ in

orientation. The three subshells are namely Px. Py, and pz. They have a magnetic quantum number equal to +1, 0 and -1.

6. Assertion (A): Angular momentum of d– orbitals are $\frac{6h}{\pi}$.

Reason (R): $\sqrt{l(l+1)}\frac{h}{2\pi}$ is the angular momentum of the orbit.

Ans. (d) (A) is false but (R) is true.

Explanation: The angular momentum of d– orbital is $\sqrt{6}\frac{h}{2\pi}$.

The angular momentum of the orbit is determined by the equation:

$$\sqrt{l(l+1)}\frac{h}{2\pi}$$

$$=\sqrt{2(2+1)}\frac{h}{2\pi}$$

$$=\sqrt{6}\frac{h}{2\pi}$$

7. Assertion (A): s-orbitals do not accommodate more than two electrons.
Reason (R): s-orbitals have a poor shielding effect as compared to d and f- orbitals.

Ans. (c) (A) is true but (R) is false.

Explanation: Magnetic fields occur in electrons as they are considered as magnets. There are only two possible orientations that exist in those fields, and a single orbital can be occupied by two electrons only if the two orientations are mutually opposed. Because the distance between the s- orbital and the nucleus is less than the orbital, the shielding depends on the electron density in an orbital. Hence, we can say that since d and f- orbitals are farther away from the nucleus, so they have a less shielding effect than s- orbital.

8. Assertion (A): It is impossible to determine the exact position and exact momentum of an electron simultaneously.
Reason (R): The path of an electron in an atom is clearly defined.

Ans. (c) (A) is true but (R) is false.
Explanation: According to the Heisenberg uncertainty principle, it is impossible to determine the exact position and momentum of an electron simultaneously. Thus, the path of an electron in an atom is not clearly defined as its position cannot be measured with absolute accuracy. The effect of the Heisenberg uncertainty principle is considerable for microscopic objects' motion and is negligible for the macroscopic objects.

9. Assertion (A): Isoelectronic species consist of different radii.
Reason (R): There are a different number of electrons in isoelectronic species.

Ans. (c) (A) is true but (R) is false.
Explanation: Isoelectronic species do not have the same radii as they have a dissimilar number of protons and neutrons. Moreover, these are the type of ions or atoms which contain the same number of electrons. For example, Mg2+, O2, Ne, etc.

10. Assertion (A): Electron gain enthalpy becomes less negative as we go down a group.
Reason (R): The size of the atom increases on going down the group and the added electron would be farther from the nucleus.

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
Explanation: Because the size of the atom increases as the electron is added farther away from the nucleus of the atom, on moving down the group, the screening effect increases resulting in making electron gain enthalpy less negative.

11. Assertion (A): Boron has a smaller first ionisation enthalpy than beryllium.
Reason (R): The penetration of a 2s electron to the nucleus is more than the 2p electron hence 2p electron is more shielded by the inner core of electrons than the 2s electrons.

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
Explanation: During ionisation, the electron removed in case of beryllium is from the s-orbital and the electron removed from the boron atom is from the p-orbital, and the penetration of 2s electron to the nucleus is more than that of 2p electron hence, 2p electron of boron is more shielded from the nucleus than the 2s electron.

12. Assertion (A): Generally, ionisation enthalpy increases from left to right in a period.
Reason (R): When successive electrons are added to the orbitals in the same principal quantum level, the shielding effect of the inner core of electrons does not increase very much to compensate for the increased attraction of the electron to the nucleus.

Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
Explanation: The minimum amount of energy required for the removal of the loosely bound electron from the isolated gaseous atom is referred to as lonisation enthalpy. Here because of the rise in the attraction of the nucleus resulting in a rising in ionisation enthalpy while moving along the period from left to right which is accurately explained in the reason. So, it is the correct explanation of the given assertion.