Chemistry Worksheets Class 11 on Chapter 3 Classification of Elements and Periodicity in Properties with Answers- Set 4

Q-1: Which of the following equations represents the first enthalpy of ionisation?
a) $Li\ (s) \rightarrow Li^+(g) + e^-$
b) $Li\ (l) \rightarrow Li^+(g) + e^-$
c) $Li^+(g) \rightarrow Li^{2+}(g) + e^-$
d) $Li\ (g) \rightarrow Li^+(g) + e^-$

Answer: d) $Li\ (g) \rightarrow Li^+(g) + e^-$
Explanation: Enthalpy of ionisation is the minimum energy required to remove an electron from the valence shell of an isolated gaseous atom. Since only in option d), the electron is removed from the gaseous state of Li. Therefore, equation $Li\ (g) \rightarrow Li^+(g) + e^-$ represents the first enthalpy of ionisation.

Q-2: Identify the least stable ion among the following.
a) Li^-
b) Be^-
c) C^-
d) B^-

Answer: b) Be^-
Explanation: Be is stable because of its fully filled electronic configuration, which is $1s^2 2s^2$. Its stability will disappear if it gains one electron to become Be^-. Be^- is, therefore, the least stable among all.

Q-3: Which of the following compounds has the minimum ionic radius of chromium?
a) CrF_3
b) K_2CrO_4
c) $CrCl_3$
d) CrO_2

Answer: b) K_2CrO_4
Explanation: Amongst the given molecules, the Cr has the maximum oxidation state of +6 in K_2CrO_4 and hence has the minimum ionic radius.

Q-4: An atom of an element has an electronic configuration 2,8,8,2. Which of the following statements is correct?
a) The valency of the element is 6

b) The element exists as a diatomic anion
c) The element forms a basic oxide
d) The element is a non-metal.

Answer: c) The element forms a basic oxide
Explanation: An atom of an element with an electronic configuration 2,8,8,2 represents the metal Ca. Ca, being a metal, creates a basic oxide of the type CaO.

Q-5: Which of the subsequent pairs of atomic numbers corresponds to atoms that are part of the same group?
a) 20, 38
b) 14, 34
c) 52, 37
d) 17, 36

Answer: a) 20, 38

Q-6: Which of the following statements is incorrect for isoelectronic ions?
a) Ions with the same electric charge are said to be isoelectronic.
b) Their nuclei are surrounded by an equal number of electrons.
c) Ions with both positive and negative charges may be present in an isoelectronic series.
d) The positive charge in a series of isoelectronic ions of the same period will increase with increasing atomic number.

Answer: a) Ions with the same electric charge are said to be isoelectronic.
Explanation: The ions with the same number of electrons are known as isoelectronic ions. For example, K^+, Ar, and S^{2-} are isoelectronic because they each possess 18 electrons. But we can see that they have different electrical charges and are not the same.

Q-7: Describe the high reactivity tendency for the elements that are located on the extreme left and right sides of the periodic table.
Answer: Alkali metals, found at the extreme left of the periodic table, are highly reactive because their low ionisation energy makes it easy for them to lose electrons. The halogens, on the other hand, are the extreme right-hand elements, and they are reactive because they have a propensity to gain electrons due to their high electronegativity and high electron gain enthalpy.

Q-8: In terms of electronic configuration, what do the elements of the given period and a group have in common?

Answer: For elements in a period, the number of shells is equal, and for elements in a group, the number of electrons in the outermost shell is the same.

Q-9: Consider the elements N, P, O, and S and arrange them in order of decreasing the first ionisation enthalpy.
Answer: The effective nuclear charge rises with ionisation energy, which falls as size increases. The elements are O < N < S < P when they are arranged according to the increasing size and decreasing effective nuclear charge. Therefore, O > N > S > P should be the proper order for the decreasing initial ionisation energy. However, because the N and P have half-filled 2p and 3p orbitals, respectively, their ionisation energy order now becomes: N > O > P > S.

Q-10: Explain the meaning of the positive electron gain enthalpy.
Answer: It is a process that occurs when an element shows some resistance to taking on a new electron, and the addition of the electron pushes the element in the direction of instability. Energy must be used, making the $\Delta_{eg}H$ positive while adding an electron.

Q-11: What traits do the elements of the s-block generally have?
Answer: S-block elements include both group-1, or alkali metals, and group-2, or alkaline earth metals, which have valence shell electronic configurations of ns^1 and ns^2, respectively.
The general traits of the s-block elements are:

1. The valency of elements in groups 1 and 2 is 1 and 2, respectively.
2. Their ionisation enthalpy is low.
3. They exhibit a great propensity for electron donation.
4. Due to their high reactivities, these elements are always found in combined states rather than in the free state.
5. With the exception of beryllium and lithium, the s-block elements primarily form ionic compounds.

Q-12: Why is potassium (atomic mass 39.10) placed after argon (atomic mass 39.94) in the periodic table?
Answer: This is because elements in the modern periodic table are listed in increasing order of their atomic numbers. Since argon (Z=18) has a lower atomic number than potassium (Z=19), it has been positioned ahead of the latter.

Q-13: What are transuranic elements?
Answer: The chemical elements with atomic numbers greater than 92 (the atomic number of uranium) are referred to as transuranic elements. These elements are all radioactively unstable and undergo radioactive decay.

Q-14: Discuss the anomalous behaviour between beryllium and boron.
Answer: While Be(Z=4) has a lower nuclear charge than B(Z=5), we find that beryllium has a higher ionisation enthalpy (899 kJ/mol) than boron (801 kJ/mol). The nucleus is more drawn to s-orbital

electrons than p-orbital electrons when the same primary quantum level is taken into account. The electron in boron must be removed from the p-orbital, but the electron in beryllium must be removed from the s-orbital. Since a 2s electron penetrates more deeply than a 2p electron, the 2p electron is subjected to more shielding from the nucleus by the inner core electrons than are the 2s electrons of beryllium. Therefore, the 2s-electron from beryllium is more difficult to extract than the 2p-electron from boron.

Q-15: Describe the main features of the long form of the periodic table.
Answer: The main features of the long form of the periodic table are as follows:

- It contains 7 horizontal rows called periods and 18 vertical columns called groups.
- Elements with similar valence shell electronic configurations are arranged in vertical columns called groups.
- Each period corresponds to the highest principal quantum number (n) of the elements in the period. The first period contains two elements. The subsequent periods consist of 8, 8, 18, and 32 elements, respectively. The seventh period is incomplete and theoretically can contain a maximum of 32 elements.
- Fourteen elements of both the sixth and seventh periods, that is, lanthanoids and actinoids, respectively, are placed in separate panels at the bottom.

Q-16: Which of the following species will have the largest and the smallest size?
Na, Na^+, Al and Al^{3+}

Answer: As is well known, the atomic radius decreases across the period. Since Al and Na are from the same period, Na will be bigger than Al.

Due to their larger effective nuclear charge, cations are smaller than their parent atoms. The isoelectronic species whose positive charge is higher will have a narrower radius. Hence, we can say out of Na, Na^+, Al and Al^{3+}, the largest size will be Na, and the smallest size is Al^{3+}.

Q-17: Account for the fact that the 4th period has eighteen and not eight elements.

Answer: When n = 4, the possible values for l is 0, 1, 2, 3. The order of the increasing energy orbitals is 4s< 3d < 4p. The total number of orbitals available is nine. The maximum number of electrons that can accommodate is 18. Therefore,18 elements are there in the 4th period.

Q-18: The valency of the representative elements is either equal to or eight minus the number of valence electrons. What underlies this rule?

Answer: Octet rule
Explanation: Valence electrons are the electrons that make up an atom's outermost orbit. The valency of the element is determined by using these electrons in bonding. The outermost orbit in the

representative elements contains electrons numbered 1 to 7 (i.e., ns^1 to $ns^2\,ns^5$). Therefore, to reach a full octet, it must either lose all of the electrons in its outermost orbit or gain electrons (depending on the necessity) from another atom. As a result, the valency of the elements in this class is determined by the number of valence electrons, or eight minus the number of valence electrons.

Q-19: The following table lists the three quantum numbers for the final electron in X and Y. Which periodic table families do these elements belong to?

	l	m	s
A	0	0	-1/2
B	2	-1	+1/2

Answer: The value of the quantum number, l, indicates either an s, p, d or f-subshell. Since the final electron in X and Y enter s (l=0) and d (l=2)subshells, respectively, this indicates that the elements A and B belong to the s and d-blocks.

Q-20: A diatomic anion contains 35 electrons and 42 neutrons. What is the atomic mass of the element, and in which group of the periodic table does it lie?

Answer: Number of the neutrons of the diatomic ion = 42
Number of electrons of the diatomic ion = 35
Therefore, the number of electrons of the diatomic atom = 35 - 2 = 33
Hence, the atomic number of the atom is 33.
Referring to the periodic table, the element is Arsenic (As), which belongs to group 15, the nitrogen family.
Number of protons = Number of electrons = 33.
As a result, atomic mass = Number of neutrons + number of protons = 42 + 33 = 75