



MADHYAMIK 2024 SUGGESTION

PHYSICAL SCIENCE

Periodic table and periodicity of the elements

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Periodic table and periodicity of the elements:

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1. Short Answer Based Questions: (Marks 2)

(a) What is ionization energy?

Ans: It is the amount of energy required by an electron in a gaseous atom or ion to come out of the orbit.

(b) What is meant by electronegativity?

Ans: Electronegativity is a measure of an atom's ability to attract shared electrons to itself.

(c) What is meant by transuranic element? Give an example of an element.

Ans: Elements with atomic numbers greater than 92, are called transuranic elements. These elements don't exist alone. They are formed by the disintegration of other atoms.

An example of an such element is Rubidium.

(d) Write the modern periodic law.

Ans: Modern Periodic Law states that "Physical and chemical properties of an element are the periodic function of their atomic number."

(e) What is meant by the periodic properties of elements? Refers to a property that is not periodic property.

Ans: By periodic law, we know the properties of an element are the periodic function of their atomic number. These properties again reappear after an interval. This phenomenon is called the periodic property of elements.

Radioactivity is not a periodic property.

(f) An atom of any element has 11 electrons and 12 neutrons. The position of the element in Mendeleev's periodic table cannot be determined by the number of particles. In which period and in which group is the element located in Mendeleev's periodic table?

Ans: Since the element has 11 electrons i.e. its atomic number is 11. Now 12 neutrons and 11 electrons together make 23 which becomes the mass number.

Atomic number 11 gives electronic configuration as 2,8,1. So 3 shells are there i.e. 3rd period and 1 outermost electron indicates 1st group.

so, the final position of the element is the 3rd period and 1st group.

(g) Arrange the given elements according to the decreasing ion strength: Cs, K, Li, Na, Rb.

Ans: $Cs < Rb < K < Na < H$

(h) Name a chalcogen element and a solid halogen element.

Ans: Chalcogen element: Group 16 elements are called chalcogen elements. Example Oxygen.

Solid Halogen Element: Iodine

Liquid Halogen Element: Bromine

Gaseous Halogen Element: Chlorine

(i) Why are group 2 elements called alkaline earth metals in the modern periodic table?

Ans: Group 2 elements are present on the earth's crust, so they are called so.

(j) In writing two properties of conjugate elements.

Ans:

Long answer-based questions: (Question 3).

(a) State Newland's octet rule. Give an example of a periodic property.

Ans: Newland's octet rule states that "every eighth element has same physical and chemical property when the elements are arranged in increasing order of their atomic mass."

Atomic radius is a periodic property.

(b) What is the unit of ionization energy? What kind of change can be noticed across the period and group?

Ans: unit of ionization energy: Kilojoule/mol (kJ/mol)

Down a Group: Decreases

Along a Period: Increases

(c) Mention two errors of Mendeleev's periodic table. In which group and period is it reasonable to place the element 18 X 40?

Ans: Errors of Mendeleev's periodic table:

- (i) Placement of isotopes can not be explained.
- (ii) Placement of Hydrogen can not be explained
- (iii) Gold and Platinum have the same chemical property but placed in different groups.

Group and period are it reasonable to place the element 18 X 40:

From 18 X 40 it is clear that

atomic Number = 18 = Number of electron = Number of proton

mass Number = 40 = Number of Electron + Number of Neutron

So, Number of neutron = $40 - 18 = 22$

Electronic Configuration of atomic number 18 = 2,8,8

So, Number of shell = 3

Outer Most electron = 8

Group = Outer Most electron = 18 (as outer most shell is stable)

Period = number of shell = 3

(d) If the atomic numbers of the three elements A, B and C are 6, 8 and 10 respectively

- (i) Which element has higher electronegativity?**
- (ii) Which element has a larger atom size?**
- (iii) In which group does element B belong?**

Ans: (i) C (A higher atomic number higher electronegative)

(ii) A (Across a Period atomic Mass Decreases)

(iii) Electronic Configuration of 8 = 2,6

So, Period= 2 Group= 16

(e) The atomic number of the elements X, Y, and Z are (a -1), a and (a + 1), Y is an inert element in the second period.

(i) Which metal, which non-metal?

(ii) What is their legitimacy?

(iii) Is the compound formed by X and Z ionic or covalent?

Ans: Y is an inert element in the second period i.e. atomic number of Y is 10. So, the atomic number of X is 9 and that of Z is 11.

(i) X is nonmetal as it is on the right side of periodic table and Z is metal as it is on the left side of the periodic table.

(ii)

(iii) Z can give its outermost 1 electron and X can accept that 1 to become stable. So, they will form an ionic compound.

(f) Mention the dissimilarity of properties of Hydrogen with one property of group 1 element and two property of group 17 elements.

Ans: Dissimilarities with Group 1 (Alkali Metals):

Outer Shell Electrons: While Hydrogen possesses a single electron in its outer shell, alkali metals, which are Group 1 elements, also have one electron in their outermost shell but with filled inner shells.

Dissimilarities with Group 17 (Halogens):

Electronegativity: The electronegativity of Hydrogen is 2.20 according to the Pauling scale, whereas halogens are characterized by their elevated electronegativities.

Reactivity: Hydrogen exhibits low reactivity under standard conditions. Conversely, halogens, which are non-metals, are highly reactive. They form halides by reacting with both metals and non-metals.

(g) Write down Dobereiner's law of triads. Arrange Cl, Br, I, F in increasing order of their oxidizing power.

Ans: Dobereiner's law of triads: Dobereiner's Law of Triads is a principle that suggests that when elements are organized by increasing atomic weights, sets of three elements, or 'triads', can be identified. These triads exhibit similar chemical behaviors. The atomic weight of the central element in a triad is roughly the average of the atomic weights of the other two elements. This principle can also be applied to other measurable properties of elements, such as density. This was one of the initial attempts to categorize elements based on their characteristics.

Increasing order of their oxidizing power: $I < Br < Cl < F$

(h) What is meant by ionization energy of an atom of an element? Arrange Li, Rb, K and Na in the increasing order of their ionization energy?

Ans: The ionization energy of an atom refers to the minimum amount of energy needed to detach the least tightly bound electron from a neutral, isolated gaseous atom or ion. It essentially measures how hard it is to remove an electron from an atom or ion. The ionization energy can provide insights into the reactivity of chemical compounds and can be used to gauge the strength of chemical bonds.

The increasing order of their ionization energy : $\text{Rb} < \text{K} < \text{Na} < \text{Li}$

(i) Write with an example what is meant by periodic property of element? mention a property which is not periodic?

Ans: The term “**periodic property**” of an element refers to the tendency of certain characteristics of elements to repeat at regular intervals when the elements are arranged in order to increase atomic number. This is known as the periodicity of elements. The reason behind this periodicity is the repetition of similar electronic configurations, i.e., having the same number of electrons in the outermost shell.

Take atomic radius as an example. Typically, the atomic radius decreases as you move from left to right across a period and increases as you move down a group.

Radioactivity

(j) Mention similarity of properties of Hydrogen with one property of group one element and two properties of group 17 elements?

Ans: Hydrogen exhibits properties that are similar to both Group 1 and Group 17 elements on the periodic table.

Similarity with Group 1 (Alkali Metals):

Outer Shell Electrons: Like the alkali metals, hydrogen also has a single electron in its outermost shell. This is why it's often placed at the top of Group 1 in the periodic table.

Similarities with Group 17 (Halogens):

Electronegativity: Hydrogen's electronegativity, which is 2.20 on the Pauling scale, is like that of the halogens.

Reactivity: Hydrogen, like halogens, is highly reactive. It can readily form compounds with most other elements.

(k) What is the important conclusion of Moseley's experiment. What is the importance of this conclusion regarding the periodic table?

Ans: Important conclusion of Moseley's experiment: The key conclusion of Moseley's experiment is that the atomic number of an element, which is the number of protons in an atom's nucleus, determines the properties of that element. This conclusion led to the modern definition of the atomic number and gave the periodic table its current form.

The **importance of this conclusion regarding the periodic table** is significant. Before Moseley's work, the elements in the periodic table were arranged based on atomic weight. However, this led to inconsistencies where elements with similar properties were not grouped

together. Moseley's conclusion that each element has a unique atomic number, which determines its properties, allowed for the reorganization of the periodic table. Elements were then grouped by atomic number, resulting in a more accurate classification system where elements with similar properties were grouped together. This also helped predict the properties of elements that had not yet been discovered.

(l) Arrange as directed

(a) Na 11, K 19, Li 3, Rb 37 belonging to group one of the long periodic table according to decreasing order of atomic radius.

Ans: Rb 37 > K 19 > Na 11 > Li 3

(b) S 16, O 8, Te 52, Se 34 belonging to group 16 of the long periodic table according to increasing order of electronegativity.

Ans: Te 52 > Se 34 > S 16 > O 8

(c) Ca 20, Be 4, Sr 38, Mg 12 belonging to group 2 of the long periodic table according to decreasing order of reducing power.

Ans: Sr 38 > Ca 20 > Mg 12 > Be 4

(the atomic number have been given with in first bracket after the symbol of the element)

(m) What is meant by electro negativity of an element? How does electro negativity of group one element of the long periodic table change from top to bottom?

Ans: Electronegativity refers to an atom's ability to attract a pair of electrons that form a bond. It is denoted by the Greek letter χ . An atom with a higher electronegativity has a stronger pull for electrons. Factors such as the atomic number and the distance between the valence electrons and the nucleus influence this property. Electronegativity is a dimensionless property, meaning it only represents a tendency, not a measurable quantity. Various scales are used to measure electronegativity, with the Pauling scale being the most used.

Periodic table change from top to bottom: Decreases.