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Periodic Trends: Radius, Ionization Energy, Electronegativity & More

Exam — Periodic Table & Trends

High-school/pre-med-beginner practice on periodic trends with conceptual traps: atomic/ionic radius, effective nuclear charge, shielding, first ionization energy (including common exceptions), electron affinity, electronegativity, and metallic character. Emphasis on reasoning, not memorization.

40 items — Printable Exam

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1 Across a period from left to right (main-group elements), atomic radius generally decreases primarily because:

- A** Electrons are added to new shells, pushing the outer electrons farther out
- B** The number of protons increases while electrons are added to the same shell, increasing effective nuclear charge
- C** The number of neutrons decreases, shrinking the nucleus
- D** Atoms lose electron shells as you move right
- E** Electrons become heavier across a period



2 Down a group, atomic radius generally increases mainly because:

- A** Effective nuclear charge increases strongly down the group
- B** Electron shells are added, and shielding increases
- C** Atoms lose protons down the group
- D** Valence electron number increases down the group
- E** Atoms become less stable and fall apart



3 Which element has the largest atomic radius?

- A** Li
- B** Na
- C** K
- D** Mg
- E** Cl





4 Which has the smallest atomic radius?



- A Na
- B Mg
- C Al
- D Si
- E Cl

5 Which statement best defines effective nuclear charge (Z_{eff}) as experienced by a valence electron?



- A The total number of neutrons in the nucleus
- B The actual charge of the nucleus (atomic number) with no corrections
- C The net positive pull from the nucleus after accounting for shielding by inner electrons
- D The attraction between two atoms in a covalent bond
- E The number of electrons in the outer shell

6 Across a period, first ionization energy generally increases because:



- A Atomic radius increases, so electrons are harder to remove
- B Effective nuclear charge increases, so electrons are held more tightly
- C Shielding increases dramatically, making electrons harder to remove
- D Valence electrons move into a completely new shell each step
- E Protons disappear as you move right





7 Down a group, first ionization energy generally decreases because:



- A The nucleus becomes less positive down the group
- B Electrons are added to higher shells farther from the nucleus and more shielded
- C Atoms become smaller down the group
- D Valence electron number decreases down the group
- E The octet rule stops applying

8 Which element is expected to have the highest first ionization energy?



- A Na
- B Mg
- C Al
- D Cl
- E Ne

9 A student expects ionization energy to increase smoothly across Period 3 from Na to Ar. But there are small “drops” (exceptions). Which pair best represents a well-known drop in first ionization energy?



- A Na → Mg
- B Mg → Al
- C Al → Si
- D Si → P





E Cl → Ar

10 Another classic dip in first ionization energy in Period 3 occurs between:



- A Na → Mg
- B Mg → Al
- C P → S
- D S → Cl
- E Cl → Ar

11 Which statement best describes electronegativity?



- A The tendency of an atom to lose electrons to form a cation
- B The tendency of an atom to attract bonding (shared) electrons
- C The energy needed to remove an electron from a gaseous atom
- D The number of protons in an atom
- E The mass number of an atom

12 Electronegativity generally:



- A Decreases left to right and increases down a group
- B Increases left to right and decreases down a group
- C Increases left to right and increases down a group





- D Decreases left to right and decreases down a group
- E Has no relationship to periodic position

13 Which element is the most electronegative?



- A O
- B F
- C Cl
- D Na
- E Ne

14 Which bond is expected to be the most polar (largest electronegativity difference)?



- A H-H
- B C-H
- C H-F
- D Cl-Cl
- E N-N

15 Which element most readily forms a 1+ ion (loses one electron easily)?



- A Na





- B Mg
- C Al
- D Cl
- E Ar

16 Which element most readily forms a $1-$ ion (gains one electron easily)?



- A Na
- B Mg
- C Cl
- D Ar
- E Al

17 Which species is larger in radius?



- A Na
- B Na^+
- C They are equal because they have the same nucleus
- D Cannot be compared
- E Na^+ is larger because it is charged

18 Which species is larger in radius?





- A Cl
- B Cl⁻
- C They are equal because they have the same nucleus
- D Cl is larger because atoms are always larger than ions
- E Cl⁻ is smaller because negative charge pulls electrons inward

19 O²⁻, F⁻, Ne, Na⁺, and Mg²⁺ are isoelectronic (10 electrons). Which is the smallest?



- A O²⁻
- B F⁻
- C Ne
- D Na⁺
- E Mg²⁺

20 Which has the highest electronegativity?



- A Li
- B C
- C O
- D F
- E Na





21 Which element is the most metallic (most likely to lose electrons) among these?



- A Na
- B Si
- C P
- D Cl
- E Ar

22 Which element is the best oxidizing agent (most likely to gain electrons) among these?



- A Na
- B Mg
- C Cl
- D Ar
- E Al

23 Which statement best describes electron shielding?



- A Valence electrons block protons from attracting neutrons
- B Inner electrons repel outer electrons, reducing the nucleus's pull on valence electrons
- C Neutrons repel electrons, pushing them outward
- D Electrons become heavier in larger atoms
- E Shielding occurs only in ions, not atoms





24 Which element would you expect to have the lowest first ionization energy?



- A Li
- B Na
- C K
- D Mg
- E Cl

25 Which comparison is correct for atomic radius?



- A Na is smaller than Cl because Na is more metallic
- B Na is larger than Cl because atomic radius decreases across a period
- C Na and Cl are the same size because they are in the same period
- D Cl is larger than Na because Cl has more protons
- E Cl is larger than Na because electronegativity increases

26 Which set of trends is generally correct as you move left → right across a period (main group)?



- A Atomic radius increases; electronegativity decreases
- B Atomic radius decreases; ionization energy increases; electronegativity increases
- C Atomic radius decreases; ionization energy decreases; electronegativity decreases
- D Atomic radius increases; ionization energy increases; electronegativity decreases
- E No consistent trends exist





27 Which set of trends is generally correct as you move down a group?



- A Atomic radius decreases; ionization energy increases; electronegativity increases
- B Atomic radius increases; ionization energy decreases; electronegativity decreases
- C Atomic radius increases; ionization energy increases; electronegativity increases
- D Atomic radius decreases; ionization energy decreases; electronegativity increases
- E Trends only apply to noble gases

28 Which is more likely to form a negative ion based on periodic trends?



- A Na
- B Mg
- C Al
- D Cl
- E Ar

29 Which statement best explains why noble gases have very low tendency to gain electrons (low electron affinity, conceptually)?



- A They have empty valence shells
- B They already have a full valence shell, so adding an electron would require a new, higher-energy shell
- C They are metals and metals cannot gain electrons
- D They have no protons





- E Their nuclei are negatively charged

30 A student says: “Higher electronegativity means higher ionization energy.” Which response is most accurate?



- A Always true with no exceptions
- B Usually correlated across a period because both reflect stronger attraction to electrons, but they are different properties
- C Always false because electronegativity and ionization energy are opposites
- D Only true for metals, not nonmetals
- E Only true for noble gases

31 Which species is expected to have the largest radius?



- A Mg^{2+}
- B Na^+
- C Ne
- D F^-
- E O^{2-}

32 Which element would you expect to have the strongest tendency to form a $2+$ ion (lose two electrons) based on periodic position?



- A Na





- B Mg
- C Al
- D Cl
- E Ar

33 Which element would generally have the greatest tendency to attract electrons in a bond among Period 3 elements?



- A Na
- B Mg
- C Si
- D S
- E Cl

34 Which pair best illustrates that ionization energy is NOT perfectly smooth because of subshell effects?



- A Li → Be
- B Be → B
- C C → N
- D F → Ne
- E Ne → Na





35 Which pair best illustrates an ionization energy dip due to electron pairing in the same subshell?



- A N → O
- B O → F
- C F → Ne
- D Li → Be
- E Be → B

36 Why do alkali metals tend to have low first ionization energies?



- A They have nearly full valence shells and strongly attract electrons
- B They have one valence electron that is relatively far from the nucleus and well-shielded
- C They have no inner electrons, so there is no shielding
- D They have the highest electronegativity in each period
- E They are noble gases

37 Which statement best explains why fluorine is very reactive as a nonmetal?



- A It easily loses electrons to form F^+
- B It has low electronegativity so it doesn't attract electrons strongly
- C It has high electronegativity and strongly attracts one electron to complete its valence shell
- D It has a full valence shell already
- E It is a metal with many delocalized electrons





38 Which species would have the strongest attraction between its nucleus and its outer electrons (conceptually)?



- A K
- B Na
- C Li
- D F
- E He

39 Which comparison is most accurate for ionic radii in the same period?



- A Cations are generally larger than their neutral atoms
- B Anions are generally smaller than their neutral atoms
- C Cations are generally smaller than their neutral atoms; anions are generally larger
- D Ionic size depends only on neutrons
- E Ionic size is always the same as atomic size

40 Why does electronegativity usually decrease down a group?



- A Because the nucleus becomes less positive
- B Because valence electrons move closer to the nucleus
- C Because the atom becomes larger and shielding increases, so the nucleus attracts bonding electrons less strongly
- D Because the number of valence electrons changes from 1 to 8
- E Because the octet rule stops applying down groups







#	Ans	Answer Text
1	B	The number of protons increases while electrons are added to the same sh...
2	B	Electron shells are added, and shielding increases
3	C	K
4	E	Cl
5	C	The net positive pull from the nucleus after accounting for shielding by...
6	B	Effective nuclear charge increases, so electrons are held more tightly
7	B	Electrons are added to higher shells farther from the nucleus and more s...
8	E	Ne
9	B	Mg → Al
10	C	P → S
11	B	The tendency of an atom to attract bonding (shared) electrons
12	B	Increases left to right and decreases down a group
13	B	F
14	C	H-F
15	A	Na
16	C	Cl
17	A	Na
18	B	Cl-
19	E	Mg ²⁺
20	D	F
21	A	Na
22	C	Cl
23	B	Inner electrons repel outer electrons, reducing the nucleus's pull on va...
24	C	K
25	B	Na is larger than Cl because atomic radius decreases across a period
26	B	Atomic radius decreases; ionization energy increases; electronegativity ...
27	B	Atomic radius increases; ionization energy decreases; electronegativity ...
28	D	Cl
29	B	They already have a full valence shell, so adding an electron would requ...
30	B	Usually correlated across a period because both reflect stronger attract...
31	E	O ²⁻
32	B	Mg
33	E	Cl
34	B	Be → B
35	A	N → O
36	B	They have one valence electron that is relatively far from the nucleus a...
37	C	It has high electronegativity and strongly attracts one electron to comp...
38	F	He



