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# Atoms, Periodicity & the Octet Rule

**Exam — Periodic Table & Trends**

Foundations of chemistry for beginners: atomic structure, isotopes and ions, periodic table groups/periods, key periodic trends, and the octet rule (including common exceptions).

**40 items — Printable Exam**

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**1** What determines which element an atom is (e.g., carbon vs nitrogen)?



- A** The number of neutrons
- B** The number of protons
- C** The number of electrons only
- D** The mass number
- E** The number of electron shells

**2** The atomic number of an element is equal to the number of:



- A** Neutrons
- B** Protons
- C** Protons + neutrons
- D** Electrons + neutrons
- E** Electron shells

**3** The mass number of an atom is equal to the number of:



- A** Protons only
- B** Neutrons only
- C** Electrons only
- D** Protons + neutrons
- E** Protons + electrons





4 Two atoms are isotopes of the same element if they have the same number of protons but different numbers of:



- A Electrons
- B Neutrons
- C Shells
- D Valence electrons
- E Protons

5 Which statement correctly describes a cation?



- A A cation has gained electrons and is negatively charged
- B A cation has lost electrons and is positively charged
- C A cation has gained protons and is positively charged
- D A cation has lost neutrons and is positively charged
- E A cation is always neutral

6 Chlorine has atomic number 17. How many electrons does a chloride ion ( $\text{Cl}^-$ ) have?



- A 16
- B 17
- C 18
- D 34
- E 35





7 A neutral atom has equal numbers of:



- A Neutrons and electrons
- B Protons and neutrons
- C Protons and electrons
- D Shells and protons
- E Mass number and atomic number

8 Calcium has atomic number 20. How many electrons does  $\text{Ca}^{2+}$  have?



- A 20
- B 22
- C 18
- D 40
- E 2

9 What is the maximum number of electrons in the first energy level (first shell)?



- A 1
- B 2
- C 8
- D 10
- E 18





**10** Valence electrons are the electrons:



- A** In the nucleus
- B** In the innermost shell only
- C** In the outermost occupied shell
- D** That determine the mass number
- E** That are always paired

**11** For main-group elements (groups 1–2 and 13–18), the group number is most useful for predicting:



- A** The number of neutrons
- B** The number of valence electrons
- C** The melting point
- D** The atomic mass
- E** The number of electron shells

**12** The period number (row) of an element in the periodic table is most closely related to the number of:



- A** Protons
- B** Valence electrons
- C** Occupied electron shells (energy levels)
- D** Neutrons





E Isotopes

13 Which group contains the alkali metals (very reactive metals like Li, Na, K)?



- A Group 1
- B Group 2
- C Group 17
- D Group 18
- E Group 14

14 Which ion is most commonly formed by magnesium (Mg), a group 2 metal?



- A  $\text{Mg}^-$
- B  $\text{Mg}^+$
- C  $\text{Mg}^{2+}$
- D  $\text{Mg}^{3+}$
- E  $\text{Mg}^{2-}$

15 Noble gases (group 18) are generally unreactive mainly because they:



- A Have the largest atoms
- B Have a full valence shell
- C Have no protons





- D Have no electrons
- E Always form 3<sup>-</sup> ions

**16** Metalloids (like silicon) are typically found:



- A Only in group 1
- B Only in group 18
- C Along the “staircase” boundary between metals and nonmetals
- D Only in the center transition metal block
- E Only in period 1

**17** Which general trend is correct for atomic radius (size) in the periodic table?



- A Increases left to right across a period and decreases down a group
- B Decreases left to right across a period and increases down a group
- C Increases left to right across a period and increases down a group
- D Decreases left to right across a period and decreases down a group
- E Has no pattern

**18** Which general trend is correct for first ionization energy (energy required to remove one electron)?



- 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

**19** Which element is the most electronegative (strongest tendency to attract bonding electrons) in the periodic table?



- A** Sodium (Na)
- B** Oxygen (O)
- C** Fluorine (F)
- D** Chlorine (Cl)
- E** Neon (Ne)

**20** Which element is most likely to have the greatest tendency to gain an electron (highest electron affinity, conceptually)?



- A** Sodium (Na)
- B** Magnesium (Mg)
- C** Argon (Ar)
- D** Chlorine (Cl)
- E** Neon (Ne)





21 Which statement best describes the trend in metallic character?



- A Metallic character increases up a group and increases left to right
- B Metallic character decreases down a group and increases left to right
- C Metallic character increases down a group and increases right to left across a period
- D Metallic character is highest at the top-right of the table
- E Metallic character does not relate to electron behavior

22 Which trend is correct for the reactivity of alkali metals (group 1) as you go DOWN the group?



- A Reactivity decreases because they hold electrons more tightly
- B Reactivity increases because it becomes easier to lose the outer electron
- C Reactivity stays the same because they all have 1 valence electron
- D Reactivity is random
- E Reactivity increases because electronegativity increases down the group

23 Which trend is correct for the reactivity of halogens (group 17) as you go DOWN the group?



- A Reactivity increases because they gain electrons more easily
- B Reactivity decreases because their attraction for an added electron becomes weaker
- C Reactivity is highest at the bottom because atomic radius is largest
- D Reactivity stays constant because they all form  $-1$  ions
- E Reactivity decreases because they lose electrons more easily





24 The octet rule is the idea that many atoms tend to:



- A Have exactly 8 protons
- B Gain, lose, or share electrons to achieve 8 electrons in their valence shell
- C Always form 8 bonds
- D Have exactly 8 neutrons
- E Always become noble gases

25 Why is hydrogen often an exception to the octet rule?



- A Hydrogen prefers 8 electrons but cannot hold any electrons
- B Hydrogen's first shell is full with 2 electrons (duet rule)
- C Hydrogen has no nucleus
- D Hydrogen always forms ionic bonds only
- E Hydrogen usually wants 18 electrons

26 Which molecule can be drawn with ALL atoms obeying the octet rule (basic Lewis structure idea)?



- A BF<sub>3</sub>
- B BeCl<sub>2</sub>
- C CO<sub>2</sub>
- D NO
- E SF<sub>6</sub>





27 In the molecule  $\text{BF}_3$ , the boron atom has how many electrons around it in a typical Lewis structure?



- A 4
- B 6
- C 8
- D 10
- E 12

28 Which molecule is a classic example of an “expanded octet” on the central atom?



- A  $\text{CH}_4$
- B  $\text{NH}_3$
- C  $\text{H}_2\text{O}$
- D  $\text{SF}_6$
- E  $\text{BF}_3$

29 Which element is NOT able to show an expanded octet in a basic Lewis structure model because it is in period 2?



- A Phosphorus (P)
- B Sulfur (S)
- C Chlorine (Cl)
- D Nitrogen (N)





E Xenon (Xe)

30 Which molecule has an odd number of total valence electrons and therefore cannot satisfy the octet rule for all atoms at once?



- A CO<sub>2</sub>
- B CH<sub>4</sub>
- C NH<sub>3</sub>
- D NO
- E H<sub>2</sub>O

31 Which description best matches an ionic bond?



- A Sharing electrons equally between two nonmetals
- B Sharing electrons unequally between two nonmetals
- C Electrostatic attraction between oppositely charged ions formed by electron transfer
- D Attraction between neutrons and protons in the nucleus
- E A bond formed by overlapping electron shells only in noble gases

32 Magnesium forms Mg<sup>2+</sup> and chlorine forms Cl<sup>-</sup>. What is the correct formula for the compound formed from these ions?



- A MgCl
- B MgCl<sub>2</sub>





- C Mg<sub>2</sub>Cl
- D Mg<sub>2</sub>Cl<sub>2</sub>
- E MgCl<sub>3</sub>

33 Which pair is most likely to form a covalent bond (basic rule)?



- A Na and Cl
- B Mg and O
- C C and O
- D K and Br
- E Ca and F

34 Aluminum commonly forms Al<sup>3+</sup> and oxygen commonly forms O<sup>2-</sup>. What is the simplest neutral formula of aluminum oxide?



- A AlO
- B AlO<sub>2</sub>
- C Al<sub>2</sub>O<sub>3</sub>
- D Al<sub>3</sub>O<sub>2</sub>
- E Al<sub>6</sub>O<sub>6</sub>

35 Which element would you expect to have the highest first ionization energy?





- A Sodium (Na)
- B Magnesium (Mg)
- C Neon (Ne)
- D Helium (He)
- E Potassium (K)

36 Which is generally larger: a sodium atom (Na) or a sodium ion (Na<sup>+</sup>)?



- A Na<sup>+</sup> is larger because it has a positive charge
- B Na is larger because Na<sup>+</sup> has lost an electron shell (and electrons are pulled in more tightly)
- C They are the same size because the number of protons is unchanged
- D Na<sup>+</sup> is larger because it has fewer electrons
- E You cannot compare atom and ion sizes

37 Which is generally larger: a chlorine atom (Cl) or a chloride ion (Cl<sup>-</sup>)?



- A Cl is larger because atoms are always bigger than ions
- B Cl<sup>-</sup> is larger because adding an electron increases electron–electron repulsion and expands the electron cloud
- C They are equal in size because the nucleus is unchanged
- D Cl is larger because Cl<sup>-</sup> has more protons
- E Cl<sup>-</sup> is smaller because negative charge pulls electrons inward





**38**  $O^{2-}$ ,  $F^-$ , Ne,  $Na^+$ , and  $Mg^{2+}$  are all isoelectronic (same number of electrons). Which has the smallest radius?



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

**39** Atomic radius generally decreases from left to right across a period mainly because:



- A Atoms lose neutrons across a period
- B The number of shells decreases across a period
- C The effective nuclear charge increases, pulling electrons closer while shielding stays similar
- D Atoms gain many new electron shells across a period
- E Electrons become heavier across a period

**40** Helium is in group 18 but has only 2 valence electrons. Why is helium still very unreactive?



- A Because helium has no valence electrons
- B Because helium's first shell is full with 2 electrons (a stable duet)
- C Because helium always forms four bonds to reach an octet
- D Because helium is a metal and metals are unreactive
- E Because helium has the largest atomic radius







#	Ans	Answer Text
1	B	The number of protons
2	B	Protons
3	D	Protons + neutrons
4	B	Neutrons
5	B	A cation has lost electrons and is positively charged
6	C	18
7	C	Protons and electrons
8	C	18
9	B	2
10	C	In the outermost occupied shell
11	B	The number of valence electrons
12	C	Occupied electron shells (energy levels)
13	A	Group 1
14	C	Mg <sup>2+</sup>
15	B	Have a full valence shell
16	C	Along the “staircase” boundary between metals and nonmetals
17	B	Decreases left to right across a period and increases down a group
18	B	Increases left to right and decreases down a group
19	C	Fluorine (F)
20	D	Chlorine (Cl)
21	C	Metallic character increases down a group and increases right to left ac...
22	B	Reactivity increases because it becomes easier to lose the outer electro...
23	B	Reactivity decreases because their attraction for an added electron beco...
24	B	Gain, lose, or share electrons to achieve 8 electrons in their valence s...
25	B	Hydrogen's first shell is full with 2 electrons (duet rule)
26	C	CO <sub>2</sub>
27	B	6
28	D	SF <sub>6</sub>
29	D	Nitrogen (N)
30	D	NO
31	C	Electrostatic attraction between oppositely charged ions formed by elect...
32	B	MgCl <sub>2</sub>
33	C	C and O
34	C	Al <sub>2</sub> O <sub>3</sub>
35	D	Helium (He)
36	B	Na is larger because Na <sup>+</sup> has lost an electron shell (and electrons are p...
37	B	Cl <sup>-</sup> is larger because adding an electron increases electron-electron rep...
38	F	Mg <sup>2+</sup>



