

Atomic Structure – Practice Questions

- Experiments performed to reveal the structure of atoms led scientists to conclude that an atom's
 - positive charge is evenly distributed throughout its volume
 - negative charge is mainly concentrated in its nucleus
 - mass is evenly distributed throughout its volume
 - volume is mainly unoccupied
- The modern model of the atom shows that electrons are
 - orbiting the nucleus in fixed paths
 - found in regions called orbitals
 - combined with neutrons in the nucleus
 - located in a solid sphere covering the nucleus
- An experiment in which alpha particles were used to bombard thin sheets of gold foil led to the conclusion that an atom is composed mostly of
 - empty space and has a small, negatively charged nucleus
 - empty space and has a small, positively charged nucleus
 - a large, dense, positively charged nucleus
 - a large, dense, negatively charged nucleus
- What is the atomic number of an element that has six protons and eight neutrons?
 - 6
 - 2
 - 8
 - 14
- An atom of fluorine has a mass of 19 atomic mass units. The total number of protons and neutrons in its nucleus is
 - 9
 - 10
 - 19
 - 28
- What is the total number of protons contained in the nucleus of a carbon-14 atom?
 - 6
 - 8
 - 12
 - 14
- What is the nuclear charge of an iron atom?
 - +26
 - +30
 - +56
 - +82
- Which of these elements has an atom with the most stable outer electron configuration?
 - Ne
 - Cl
 - Ca
 - Na
- How many electrons are in the outermost principal energy level of an atom of carbon in the ground state?
 - 6
 - 2
 - 3
 - 4
- Which electron configuration is correct for a sodium ion?
 - 2-7
 - 2-8
 - 2-8-1
 - 2-8-2

11. What is the electron configuration of a sulfur atom in the ground state?
 (1) 2-4 (2) 2-6 (3) 2-8-4 (4) 2-8-6
12. The nucleus of which atom contains 48 neutrons?
 (1) ${}_{16}^{32}\text{S}$ (2) ${}_{48}^{22}\text{Ti}$ (3) ${}_{37}^{85}\text{Rb}$ (4) ${}_{112}^{48}\text{Cd}$
13. The number of neutrons in the nucleus of an atom can be determined by
 (1) adding the atomic number to the mass number
 (2) subtracting the atomic number from the mass number
 (3) adding the mass number to the atomic mass
 (4) subtracting the mass number from the atomic number
14. When an atom loses an electron, the atom becomes an ion that is
 (1) positively charged and gains a small amount of mass
 (2) positively charged and loses a small amount of mass
 (3) negatively charged and gains a small amount of mass
 (4) negatively charged and loses a small amount of mass
15. In which pair of elements do the nuclei of the atoms contain the same number of neutrons?
 (1) ${}_{3}^7\text{Li}$ and ${}_{4}^9\text{Be}$ (3) ${}_{11}^{23}\text{Na}$ and ${}_{12}^{24}\text{Mg}$
 (2) ${}_{7}^{14}\text{N}$ and ${}_{8}^{16}\text{O}$ (4) ${}_{16}^{32}\text{S}$ and ${}_{17}^{35}\text{Cl}$
16. The characteristic spectral lines of elements are caused when electrons in an excited atom move from
 (1) lower to higher energy levels, releasing energy
 (2) lower to higher energy levels, absorbing energy
 (3) higher to lower energy levels, releasing energy
 (4) higher to lower energy levels, absorbing energy
17. Which Lewis electron-dot structure is drawn correctly for the atom it represents?
 (1) $\text{:}\ddot{\text{N}}$ (3) $\text{:}\ddot{\text{O}}\text{:}$
 (2) $\text{:}\ddot{\text{F}}\text{:}$ (4) $\text{:}\ddot{\text{Ne}}\text{:}$
18. When a lithium atom forms a Li^+ ion, the lithium atom
 (1) gains a proton (3) loses an electron
 (2) loses a proton (4) gains an electron
19. What is the total number of electrons in the valence shell of an atom of aluminum in the ground state?

- (1) 8 (2) 2 (3) 3 (4) 10

20. An electron in an atom moves from the ground state to an excited state when the energy of the electron

- (1) increases (2) decreases (3) remains the same

21. During a flame test, ions of a specific metal are heated in the flame of a gas burner. A characteristic color of light is emitted by these ions in the flame when the electrons

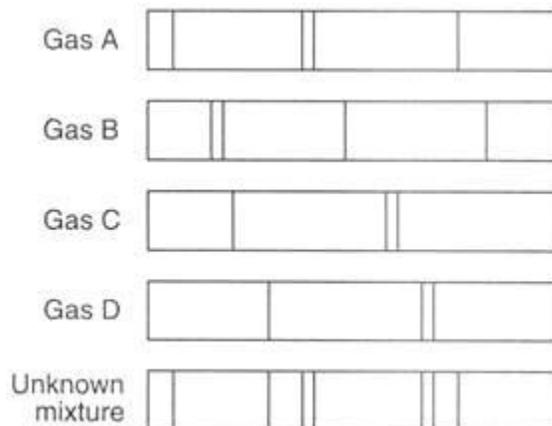
- (1) emit energy as they move to higher energy levels
(2) emit energy as they return to lower energy levels
(3) gain energy as they move to higher energy levels
(4) gain energy as they return to lower energy levels

22. What is the total number of electrons in a Cu^+ ion?

- (1) 36 (2) 29 (3) 30 (4) 28

Base your answers to questions 23 and 24 on the information and the bright-line spectra represented below.

Many advertising signs depend on the production of light emissions from gas-filled glass tubes that are subjected to a high-voltage source. When light emissions are passed through a spectroscope, bright-line spectra are produced.



23. Identify the two gases in the unknown mixture.

24. Explain the production of an emission spectrum in terms of the energy states of an electron.

Atomic Concepts Review – Cut from Jan 2007 – Jan 2008 Exams

- Which subatomic particles are located in the nucleus of a neon atom?
 - electrons and positrons
 - electrons and neutrons
 - protons and neutrons
 - protons and electrons
- The total mass of the protons in an atom of gold-198 is approximately
 - 79 atomic mass units
 - 119 atomic mass units
 - 198 atomic mass units
 - 277 atomic mass units
- In a calcium atom in the ground state, the electrons that possess the *least* amount of energy are located in the
 - first electron shell
 - second electron shell
 - third electron shell
 - fourth electron shell
- Which group of atomic models is listed in historical order from the earliest to the most recent?
 - hard-sphere model, wave-mechanical model, electron-shell model
 - hard-sphere model, electron-shell model, wave-mechanical model
 - electron-shell model, wave-mechanical model, hard-sphere model
 - electron-shell model, hard-sphere model, wave-mechanical model
- Which isotopic notation represents an atom of carbon-14?
 - ${}^6_8\text{C}$
 - ${}^8_6\text{C}$
 - ${}^6_{14}\text{C}$
 - ${}^{14}_6\text{C}$
- Which isotopic notation identifies a metalloid that is matched with the corresponding number of protons in each of its atoms?
 - ${}^{24}\text{Mg}$ and 12 protons
 - ${}^{28}\text{Si}$ and 14 protons
 - ${}^{75}\text{As}$ and 75 protons
 - ${}^{80}\text{Br}$ and 80 protons
- According to the wave-mechanical model of the atom, electrons in an atom
 - travel in defined circles
 - are most likely found in an excited state
 - have a positive charge
 - are located in orbitals outside the nucleus
- What is the total charge of the nucleus of a carbon atom?
 - 6
 - 0
 - +6
 - +12
- A sample composed only of atoms having the same atomic number is classified as
 - a compound
 - a solution
 - an element
 - an isomer
- Which two particles each have a mass approximately equal to one atomic mass unit?
 - electron and neutron
 - electron and positron
 - proton and electron
 - proton and neutron
- Which electron configuration could represent a strontium atom in an excited state?
 - 2-8-18-7-1
 - 2-8-18-7-3
 - 2-8-18-8-1
 - 2-8-18-8-2

12. What is the total number of neutrons in an

atom of $^{57}_{26}\text{Fe}$?

- (1) 26 (3) 57
(2) 31 (4) 83

13. What is the total number of electrons in a Mg^{+2} ion?

- (1) 10 (3) 14
(2) 12 (4) 24

14. What was concluded about the structure of the atom as the result of the gold foil experiment?

- (1) A positively charged nucleus is surrounded by positively charged particles.
(2) A positively charged nucleus is surrounded by mostly empty space.
(3) A negatively charged nucleus is surrounded by positively charged particles.
(4) A negatively charged nucleus is surrounded by mostly empty space.

15. An atom is electrically neutral because the (1)

- (1) number of protons equals the number of electrons
(2) number of protons equals the number of neutrons
(3) ratio of the number of neutrons to the number of electrons is 1:1
(4) ratio of the number of neutrons to the number of protons is 2:1

16. How do the energy and the most probable location of an electron in the third shell of an atom compare to the energy and the most probable location of an electron in the first shell of the same atom?

- (1) In the third shell, an electron has more energy and is closer to the nucleus.
(2) In the third shell, an electron has more energy and is farther from the nucleus.
(3) In the third shell, an electron has less energy and is closer to the nucleus.
(4) In the third shell, an electron has less energy and is farther from the nucleus.

17. What is the net charge on an ion that has 9 protons, 11 neutrons, and 10 electrons?

- (1) 1+ (3) 1-
(2) 2+ (4) 2-

18. Which value of an element is calculated using both the mass and the relative abundance of each of the naturally occurring isotopes of this element?

- (1) atomic number (3) half-life
(2) atomic mass (4) molar volume

19. Which two notations represent different isotopes of the same element?

- (1) ^6_4Be and ^9_4Be (3) $^{14}_7\text{N}$ and $^{14}_6\text{C}$
(2) ^7_3Li and ^7_3Li (4) $^{32}_{15}\text{P}$ and $^{32}_{16}\text{S}$

Base your answers to questions 20 through 22 on the information below.

The accepted values for the atomic mass and percent natural abundance of each naturally occurring isotope of silicon are given in the data table below.

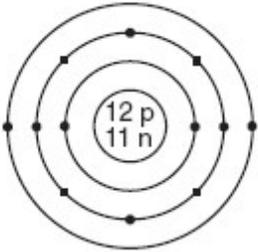
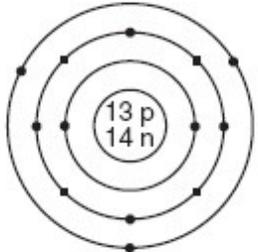
Naturally Occurring Isotopes of Silicon

Isotope	Atomic Mass (atomic mass units)	Percent Natural Abundance (%)
Si-28	27.98	92.22
Si-29	28.98	4.69
Si-30	29.97	3.09

20. Determine the total number of neutrons in an atom of Si-29. [1]
21. Show a correct numerical setup for calculating the atomic mass of Si. [1]
22. A scientist calculated the percent natural abundance of Si-30 in a sample to be 3.29%. Determine the percent error for this value. [1]
23. Write *one* electron configuration for an atom of silicon in an excited state.

Base your answers to questions 24 through 26 on the information below.

Atomic Diagrams of Magnesium and Aluminum

<p style="text-align: center;"><u>Key</u></p> <p style="text-align: center;">• = electron</p>	Element	Lewis Electron-Dot Diagram	Electron-Shell Diagram
	magnesium	Mg:	
	aluminum	Al:	

24. Identify *one* piece of information shown in the electron-shell diagrams that is *not* shown in the Lewis electron-dot diagrams. [1]

25. Determine the mass number of the magnesium atom represented by the electron-shell diagram. [1]

26. Explain why Lewis electron-dot diagrams are generally more suitable than electron-shell diagrams for illustrating chemical bonding. [1]