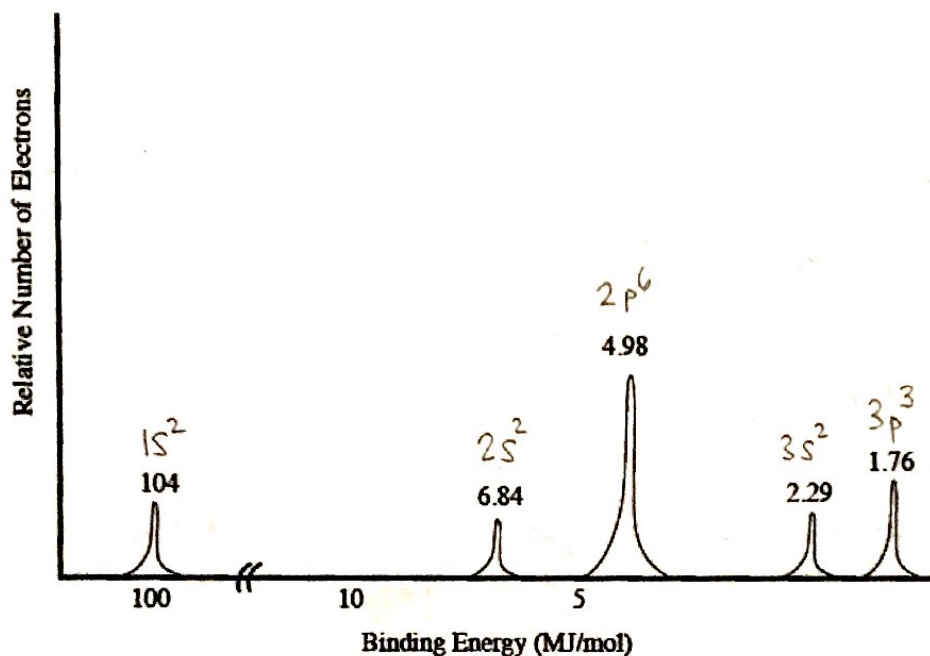


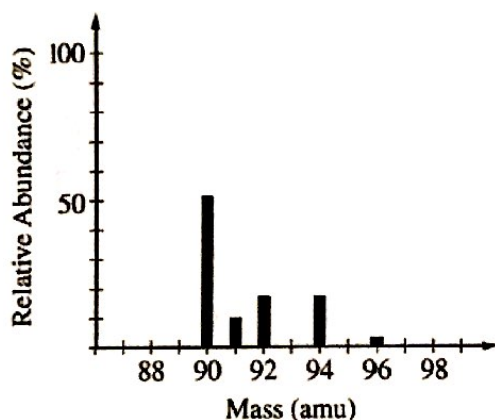
Unit 8 Multiple Choice Practice

1. If europium (Eu) consists of two naturally occurring isotopes, ^{151}Eu with a percent abundance of 48.05% and ^{153}Eu with a percent abundance of 51.97%, what is the average atomic mass of europium?
- a. 152.00 amu c. 151.96 amu
b. 152.48 amu d. 152.04 amu

Use the PES spectra below to answer questions 2-5.



2. What element does this spectrum represent?
- a. Boron b. Nitrogen c. Aluminum d. Phosphorus
3. Which peak represents the 2s subshell?
- a. The peak at 104 MJ/mol c. The peak at 2.29 MJ/mol
b. The peak at 6.84 MJ/mol d. The peak at 1.76 MJ/mol
4. An electron from which peak would have the greatest velocity after ejection?
- a. The peak at 104 MJ/mol c. The peak at 4.98 MJ/mol
b. The peak at 6.84 MJ/mol d. The peak at 1.76 MJ/mol
5. How many valence electrons does this atom have?
- a. 2 b. 3 c. 4 d. 5

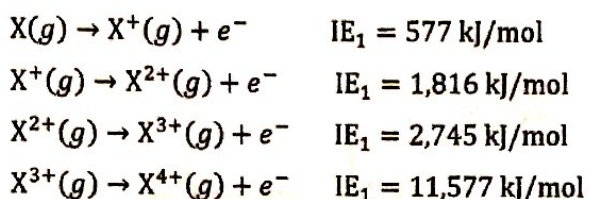


6. Given the mass spectrum on the left of an unknown element, which of the following is a true statement about this element?
- The element can be identified as a transition metal, and each peak represents a possible oxidation state.
 - The element must have five distinct electron subshells (or sublevels).
 - The element's atomic mass is 90 amu.
 - The element's atomic mass falls between 90-92 amu.
7. The effective nuclear charge experienced by the outermost electron of Na is different than the effective nuclear charge experienced by the outermost electron of Ne. This difference best accounts for which of the following?
- Na has a greater density at standard conditions than Ne.
 - Na has a lower first ionization energy than Ne.
 - Na has a higher neutron-to-proton ratio than Ne.
 - Na has fewer naturally occurring isotopes than Ne.
8. What of the following represents the ground state electron configuration for the Mn^{3+} ion?
- $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^2$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^1$
9. Which neutral atom of the following elements would have the most unpaired electrons?
- Titanium
 - Manganese
 - Nickel
 - Zinc
10. What is the energy of a photon of yellow light having a wavelength of $5.80 \times 10^{-7} \text{ m}$?
- $3.42 \times 10^{-19} \text{ J}$
 - $3.84 \times 10^{-27} \text{ J}$
 - $1.14 \times 10^{-27} \text{ J}$
 - $1.74 \times 10^3 \text{ J}$

$$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.998 \times 10^8 \text{ m/s})}{5.80 \times 10^{-7} \text{ m}} \approx \frac{(7 \times 10^{-26})}{2} \text{ J}$$

$$= 3.5 \times 10^{-19} \text{ J}$$

11. The first ionization energy for a neutral atom of chlorine is 1.25 MJ/mol and the first ionization energy for a neutral atom of argon is 1.52 MJ/mol. How would the first ionization energy for a neutral atom of potassium compare to those values?
- It would be greater than both because potassium carries a greater nuclear charge than either chlorine or argon.
 - It would be greater than both because the size of a potassium atom is smaller than an atom of either chlorine or argon.
 - It would be less than both because there are more electrons in potassium, meaning they repel each other more effectively and less energy is needed to remove one.
 - It would be less than both because a valence electron of potassium is farther from the nucleus than one of either chlorine or argon.



12. For the element X represented above, which of the following is the most likely explanation for the large difference between the third and fourth ionization energies?
- The Coulombic attraction between the nucleus and outermost electrons decreases with successive ionizations.
 - The shielding of outer electrons increases with successive ionizations.
 - The electron removed during the fourth ionization is, on average, much closer to the nucleus than the first three electrons removed.
 - The ionic radius increases with successive ionizations.
13. What is the most likely electron configuration for a sodium ion?
- $1s^2 2s^2 2p^5$
 - $1s^2 2s^2 2p^6$
 - $1s^2 2s^2 2p^6 3s^1$
 - $1s^2 2s^2 2p^6 3s^2$

14. An atom of silicon in its ground state is subjected to a frequency of light that is high enough to cause electron ejection. An electron from which subshell of silicon would have the highest kinetic energy after ejection?
- 1s
 - 2p
 - 3p
 - 4s
- ⇒ requires least energy to remove!*

15. Examining data obtained from mass spectrometry supports which of the following?
- The common oxidation states of elements
 - Atomic size trends within the periodic table
 - Ionization energy trends within the periodic table
 - The existence of isotopes.

16. In general, do metals or nonmetals from the same period have higher ionization energies? Why?
- Metals have higher ionization energies because they usually have more protons than nonmetals.
 - Nonmetals have higher ionization energies because they are larger than metals and harder to ionize.
 - Metals have higher ionization energies because their valence electrons are further from the nucleus than those of nonmetals.
 - Nonmetals have higher ionization energies because their valence electrons experience greater Coulombic attraction to the nucleus than those of metals.
17. Which of the following ions would have the most unpaired electrons?
- Mn^{2+}
 - Ni^{3+}
 - Ti^{2+}
 - Cr^{6+}

Use the following information to answer questions 17–19.

The radius of atoms and ions is typically measured in Angstroms (\AA), which is equivalent to 1×10^{-10} m. Below is a table of information for three different elements.

Element	Atomic Radius (\AA)	Ionic Radius (\AA)
Ne	0.38	n/a
P	0.98	1.00
Zn	1.42	1.35

18. The phosphorus ion is larger than a neutral phosphorus atom, yet a zinc ion is smaller than a neutral zinc atom. Which of the following statements best explains why?
- The zinc atom has more protons than the phosphorus atom.
 - The valence electrons in a phosphorus atom are closer to the nucleus than those of a zinc atom.
 - Phosphorus gains electrons when forming an ion, but zinc loses them.
 - Phosphorus has a greater electronegativity than zinc.
19. Neon has a smaller atomic radius than phosphorus because:
- Unlike neon, phosphorus has electrons present in its third energy level.
 - Phosphorus has more protons than neon, which increases the repulsive forces in the atom.
 - The electrons in a neon atom are all found in a single energy level.
 - Phosphorus can form anions, while neon is unable to form any ions.
20. Which of the following represents the correct electron configuration for the zinc ion, Zn^{2+} ?
- $[\text{Ar}]3d^{10}$
 - $[\text{Ar}]4s^23d^8$
 - $[\text{Ar}]4s^24d^8$
 - $[\text{Ar}]4d^{10}$

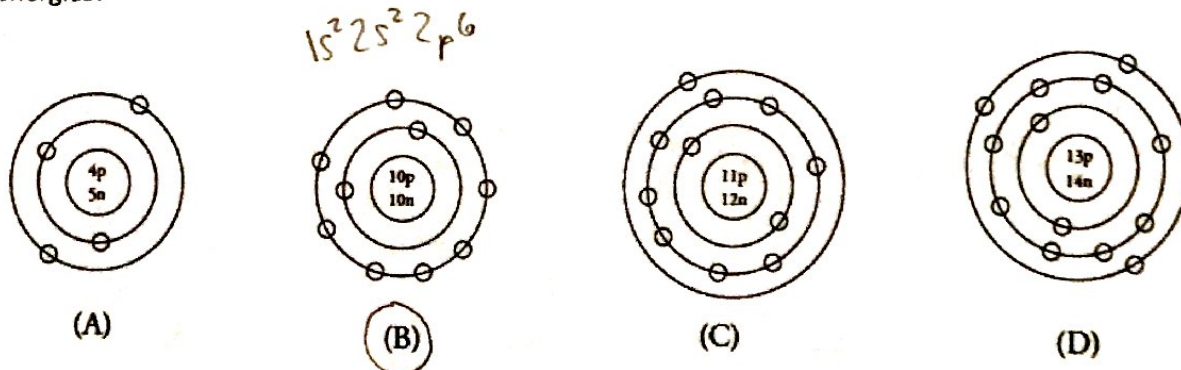
21. Which of the following, calcium or strontium, has greater metallic character and why?

- a. Calcium, because calcium has fewer principal energy levels than strontium.
- b. Calcium, because calcium has a lower effective nuclear charge than strontium.
- c. Strontium, because strontium has a greater electronegativity than calcium.
- d. Strontium, because strontium has a lower first ionization energy than calcium.

22. Neutral atoms of chlorine are bombarded by high-energy photons, causing the ejection of electrons from the various filled subshells. Electrons from which subshell would have the highest velocity after being ejected?

- a. 1s
- b. 2p
- c. 3p
- d. 3d

23. A photoelectron spectrum for which of the following atoms would show peaks at exactly three different binding energies?



24. Most transition metals share a common oxidation state of +2. Which of the following best explains why?

- a. Transition metals all have a minimum of two unpaired electrons.
- b. Transition metals have unstable configurations and are very reactive.
- c. Transition metals tend to gain electrons when reacting with other elements.
- d. Transition metals will lose their outermost s-block electrons when forming bonds.

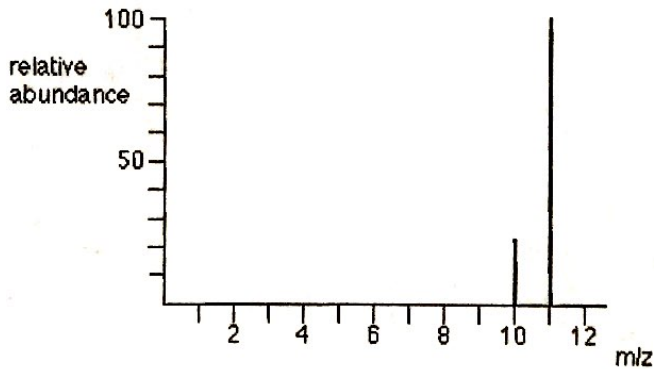
25. Some properties of scandium are determined by the electron arrangement within scandium. What is the ground state electron configuration of scandium?

- a. $[Ar] 4s^2 3p^1$
- b. $[Ar] 4s^2 3d^1$
- c. $[Ar] 4s^2 4p^1$
- d. $[Ar] 4s^2 4d^1$

26. Which of the following nuclei has 3 more neutrons than protons?

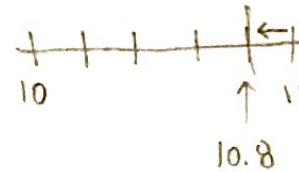
- a. ^{11}B
- b. ^{37}Cl
- c. ^{24}Mg
- d. ^{70}Ga

27. Given the mass spectrum and data for boron below, estimate the average atomic mass of boron.



Isotope	Peak Intensity
boron-10	23%
boron-11	100%

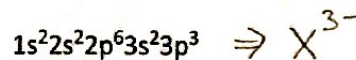
- a. 10.20 amu
 b. 10.81 amu
 c. 10.98 amu
 d. 13.30 amu



28. Which of the following could have the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6$?

- I. Mg^{2+} X IV. Al^{3+} X
 II. Cl^- ✓ V. S^{2-} ✓
 III. K^+ ✓

- a. II and V only
 b. I, II, and IV only
 c. II, III, and V only
 d. I, IV, and V only



29. Atoms of an element, X, have the electronic configuration shown above. The compound most likely formed with magnesium is:

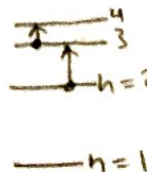
- a. Mg_2X b. MgX_2 c. MgX_3 d. Mg_3X_2

30. In which of the following groups are the three species isoelectronic?

- a. S^{2-} , K^+ , Ca^{2+} c. Sc , Ti , V^{2+}
 b. Mg^{2+} , Ca^{2+} , Sr^{2+} d. Cs , Ba^{2+} , La^{3+}

31. Which of the following hydrogen electron transitions will result in the absorption of light with the highest energy?

- a. $n = 2$ to $n = 3$ c. $n = 3$ to $n = 4$
 b. $n = 3$ to $n = 2$ d. $n = 4$ to $n = 3$



32. Which is an electron configuration of a neon atom in the excited state?

- a. $1s^2 2s^2 2p^4$ c. $1s^2 2s^2 2p^4 3s^1$
 b. $1s^2 2s^2 2p^5$ d. $1s^2 2s^2 2p^5 3s^1$

33. Which of the following elements has the lowest first ionization energy?

- a. arsenic c. silicon
 b. selenium **(d.) iodine** ↑*n*

34. Consider the halogens chlorine and bromine. Which has a larger atomic radius and why?

- a. Chlorine has a larger atomic radius because it has an increased number of principal energy levels.
 b. Chlorine has a larger atomic radius because it has a higher effective nuclear charge.
(c.) Bromine has a larger atomic radius because it has an increased number of principal energy levels.
 d. Bromine has a larger atomic radius because it has a higher effective nuclear charge.

35. Which of the following elements has the smallest atomic radius?

- a. nitrogen **(c.) oxygen**
 b. phosphorus d. sulfur

36. Which of the following elements has the highest first ionization energy?

- a. magnesium c. sulfur
 b. aluminum **(d.) argon**

37. Which of the following, sodium or magnesium, has a lower IE_1 and why?

- a. Sodium, because sodium has fewer principal energy levels than magnesium.
(b.) Sodium, because sodium has a lower effective nuclear charge than magnesium.
 c. Magnesium, because of the repulsion of magnesium's paired 4s electrons.
 d. Magnesium, because magnesium has a greater effective nuclear charge than sodium.

38. Silicon has a larger atomic radius than phosphorus. Why?

- a. more principal energy levels c. a larger nuclear charge
 b. fewer principal energy levels **(d.) a smaller nuclear charge**

39. Which element forms an ion that is smaller than its atom?

- (a.) sodium** c. chlorine
 b. oxygen d. phosphorus

40. Which family tends to form ions that are larger than their neutral atoms?

- a. transition metals c. halogens
 b. alkaline metals d. noble gases

41. Which of the following species has the greatest radius? (isoelectronic!)

- a. S^{2-} c. Ar
 b. Cl^{-} d. K^{+}

42. Which of the following, Sr^{2+} and Sr, has a larger radius and why?

- a. Sr, because neutral Sr has more principal energy levels than Sr^{2+} .
 b. Sr, because neutral Sr has more protons than Sr^{2+} .
 c. Sr^{2+} , because Sr^{2+} has fewer principal energy levels than neutral Sr.
 d. Sr^{2+} , because Sr^{2+} has fewer electrons than neutral Sr.

43. Which of the following, lithium or gallium, has a lower electronegativity and why?

- a. Lithium, because lithium has fewer principal energy levels than gallium.
 b. Lithium, because lithium has a smaller effective nuclear charge than gallium.
 c. Gallium, because gallium has more principal energy levels than lithium.
 d. Gallium, because gallium has a larger effective nuclear charge than lithium.

44. Which of the following elements has the highest first ionization energy?

- a. Na
 b. K

c. P
 d. S] P^4 glitch!

45. Which of the following is an accurate description of the electronegativities of elements in the periodic table?

- a. The electronegativity of bromine is greater than that of chlorine.
 b. The electronegativity of argon is greater than that of chlorine.
 c. The electronegativity of calcium is greater than that of potassium.
 d. The electronegativity of aluminum is greater than that of sulfur.

46. Which of the following species is NOT isoelectronic to Br^{-} ?

- a. Se^{2-} c. Kr
 b. Rb^{+} d. K^{+}