CHAPTER 7 – A QUANTUM MODEL OF ATOMS

Electromagnetic Radiation and the Photoelectric Effect

1. KYZZ radio in San Angelo broadcasts Tejano music at a frequency of 100.1 MHz. What is the wavelength of this station?

A. 3.34×10^{-3} m
B. 0.334 m
C. 3.00×10^{10} m
D. 3.00 m
E. 3.00×10^{16} m

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2. A green laser pointer emits light with a frequency of 5.64×10^{14} s^{-1}. Calculate the wavelength of this light in units of nm.

A. 5.64×10^{5} nm
B. 5.32×10^{-7} nm
C. 532 nm
D. 1.77×10^{-15} nm
E. 1.69×10^{23} nm

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3. Of the following regions of the electromagnetic spectrum, which one has the shortest wavelength?

A. X-rays
B. radio waves
C. gamma rays
D. microwaves
E. ultraviolet waves

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4. What is the energy (in kJ/mol) of X-ray radiation having a wavelength of 0.155 nm?

A. 772,000 kJ/mol
B. 539,000 kJ/mol
C. 125,000 kJ/mol
D. 552,000 kJ/mol
E. 95,200 kJ/mol

Quantum Numbers and Orbitals

5. The rule that no two electrons in an atom can have the same values for all four quantum numbers is called

A. The Aufbau Principle
B. The Heisenberg Uncertainty Principle
C. The Pauli Exclusion Principle
D. Hund's Rule
E. The DeBroglie Relationship
F. The Bourne Identity

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6. What physical feature of an orbital is related to the angular momentum quantum number, *l*?

A. the orientation in space of the orbital
B. the shape of the orbital
C. the orientation of the spin axis of the electron
D. the size and energy of the orbital
E. the number of valence electrons an atom has

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7. Which one of the following combinations of *n* and *l* represents an orbital which cannot exist?

A. 1s
B. 3f
C. 4p
D. 5s
E. 4f

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8. What is the maximum number of electrons that can be held in a set of 3*d* orbitals?

A. 2
B. 6
C. 10
D. 14
E. 30

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9. How many 4*p* orbitals does an atom possess?

A. 1
B. 3
C. 5
D. 7
E. 9

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10. What is the orbital designation for the quantum numbers $n = 2$, $l = 1$?

A. 3s
B. 2d
C. 3p
D. 2s
E. 2p

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11. What are the possible values of the angular momentum quantum number, *l*, when the principal quantum number, *n*, is 1?

A. 0, 1, 2
B. 0, 1
C. 0
D. -1, 0, +1
E. +½, -½

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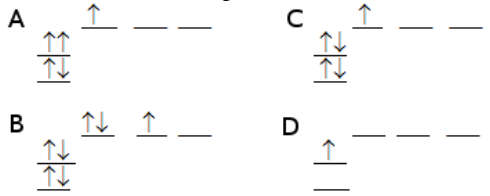
12. Which set of orbital diagrams shows a violation of the Pauli Exclusion Principle?



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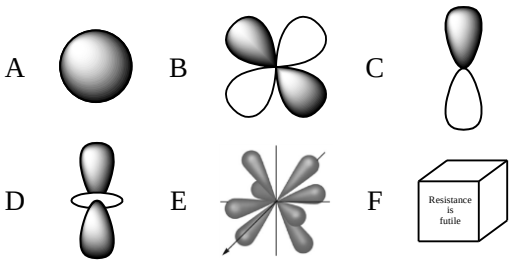
13. Which one of the following represents the shape of a *p* orbital?



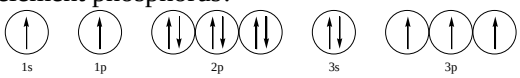
Electron Configurations

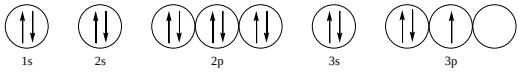
Directions for NEXT THREE Questions: Answer the following questions about the electron configuration of the element **phosphorus**.

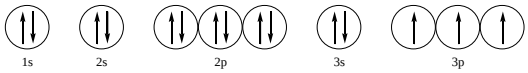
14. What is the complete electron configuration of the element phosphorus?

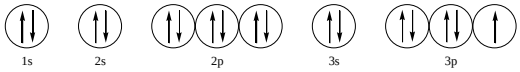
A. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
B. $1s^1\ 1p^1\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
C. $1s^2\ 2s^6\ 2p^{10}\ 3d^3$
D. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$
E. $1s^2\ 2p^6\ 3s^2\ 3d^3$

15. What is the orbital diagram or energy level diagram of the element phosphorus?

A. 

B. 

C. 

D. 

E. none of the above

16. Is phosphorus diamagnetic or paramagnetic?

A. diamagnetic
B. paramagnetic

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17. Which of the following elements have **one** unpaired electron in the ground state electron configuration?

A. Mg
B. S
C. Al
D. P
E. Si

NOTE: One way you can solve this problem would be to write electron configurations and orbital diagrams for all of these atoms, and examine the number of unpaired electrons. But if you understand the relationship between electron configurations and the periodic table, you can answer this question by simply glancing at the periodic table. Do you know how to do it that way?

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18. What is the abbreviated electron configuration for selenium (Se)?

A. [Ar] $4s^2\ 4d^{10}\ 4p^4$
B. [Ar] $4s^2\ 3d^{10}\ 4p^6$
C. [Ar] $3d^{10}\ 4p^4$
D. [Ar] $4s^2\ 3d^{10}\ 4p^4$
E. [Ar] $4s^2\ 3d^{10}$

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19. Name an element in the fourth period (row) of the periodic table with two 4s electrons and four 4p electrons

A. Ca
B. Ti
C. Cr
D. Ge
E. Se

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20. What is the abbreviated electron configuration for the Ti^{2+} ion?

A. [Ar] $3d^2\ 4s^2$
B. [Ar] $4s^2$
C. [Ar] $3d^2$
D. [Ar] $3d^4\ 4s^2$
E. [Ar] $3d^{10}\ 4s^2$

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21. Write an abbreviated electron configuration for the Co^{3+} ion:

A. [Ar] $4s^2\ 3d^7$
B. [Ar] $4s^2\ 3d^4$
C. [Ar] $3d^7$
D. [Ar] $3d^6$
E. [Ar] $4s^2\ 3d^{10}$

22. Why does sulfur form an anion with a 2- charge?

A. Sulfur has two electrons in its valence shell that can be lost to make a 2- charge.
B. Sulfur has four electrons in its valence shell, and needs to lose two electrons to form an octet.
C. Sulfur needs two additional electrons to fill the 4s orbital.
D. Sulfur is only two electrons away from having a complete outer shell of 8 electrons.
E. none of the above

Periodic Properties

23. Which of the following isoelectronic species has the largest radius?

A. Ne
B. F^-
C. Mg^{2+}
D. N^{3-}
E. O^{2-}

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24. Which ONE of the following has the **correct** relationship between the atoms or ions that are being compared?

A. $Ca < Ca^{2+}$
B. $S^{2-} > P^{3-}$
C. $Fe^{2+} < Fe^{3+}$
D. $Br > Br^-$
E. $Mg^{2+} < Na^+$

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25. Arrange the following elements in order of increasing atomic radius: Br, Cl, Se

Smallest $\xrightarrow{\text{to}}$ Largest

A. Cl < Br < Se
B. Br < Se < Cl
C. Se < Cl < Br
D. Br < Cl < Se
E. Se < Br < Cl

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26. Which atom would have a second-ionization energy drastically greater than the first?

A. Li
B. Be
C. B
D. C
E. N

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27. Which of the following has the smallest value of the first ionization energy?

A. Ar
B. Cs
C. N
D. Cu
E. Rb

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28. Arrange the following elements in order of **increasing first ionization energy**: Si, In, N

Smallest $\xrightarrow{\text{to}}$ Largest

A. In < N < Si
B. Si < In < N
C. N < Si < In
D. N < In < Si
E. In < Si < N

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29. Arrange calcium, rubidium, sulfur, and arsenic in order of **decreasing** electronegativity.

Highest electronegativity → Lowest electronegativity

A. S > As > Rb > Ca
B. As > S > Rb > Ca
C. As > S > Ca > Rb
D. S > Ca > Rb > Ca
E. S > As > Ca > Rb

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30. Given the electronegativities below, which of the following covalent single bonds is most polar?

Element:	H	C	N	O
Electronegativity:	2.1	2.5	3.0	3.5

A. C-H
B. N-H
C. O-H
D. O-N
E. O-C
