

This print-out should have 14 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points

Which phenomenon provides the best evidence that light can have particle properties?

1. Electromagnetic radiation
2. Electron diffraction
3. Photoelectric effect
4. Interference of light in thin films
5. X-ray diffraction

002 10.0 points

Which of the following is not a permitted combination of quantum numbers?

1. $n = 6, \ell = 5, m_\ell = -5, m_s = -\frac{1}{2}$
2. $n = 5, \ell = 3, m_\ell = -2, m_s = \frac{1}{2}$
3. $n = 3, \ell = 2, m_\ell = -2, m_s = \frac{1}{2}$
4. $n = 8, \ell = 0, m_\ell = 0, m_s = \frac{1}{2}$
5. $n = 4, \ell = 0, m_\ell = -2, m_s = -\frac{1}{2}$

003 10.0 points

How many electrons are in principle energy level 7 ($n = 7$)?

1. 28
2. 14
3. 98
4. 196
5. 49

004 10.0 points

What is the correct electronic configuration for a ground-state divalent Barium cation (Ba^{2+})?

1. $[\text{Rn}]$
2. $[\text{Rn}] 6s^2 5d^2$
3. $[\text{Xe}] 6s^1$
4. $[\text{Rn}] 6s^1$
5. $[\text{Xe}]$
6. $[\text{Xe}] 6s^2 4f^2$

005 10.0 points

Which of the following elements is not correctly paired with its group (family) name?

1. Radon (Rn), Noble gases
2. Bismuth (Bi), Halogens
3. Lithium (Li), Alkali metals
4. Strontium (Sr), Alkaline earth metals

006 10.0 points

Which of the following BEST describes the purpose of effective nuclear charge?

1. It is a measure of the effect of filled and half-filled subshells on the stability of atoms and ions.
2. It exists only to torture foolish CH 301 students who did not study.
3. It is used to determine the number of valence electrons of a given species.
4. It is used to rationalize chemical bonding in covalently bonded molecules.
5. It is a measure of how many protons a given atom has which is useful because of variations from isotope to isotope.

6. It is a method to evaluate how much attraction a given electron “feels” from the nucleus so that periodic trends can be predicted and rationalized.

007 10.0 points

Rank the following isoelectronic species from smallest to largest ionic radius: Ca^{2+} , S^{2-} , Cl^- , Ga^{3+} .

1. $\text{Cl}^- < \text{S}^{2-} < \text{Ca}^{2+} < \text{Ga}^{3+}$
2. $\text{S}^{2-} < \text{Cl}^- < \text{Ca}^{2+} < \text{Ga}^{3+}$
3. $\text{Ga}^{3+} < \text{Ca}^{2+} < \text{Cl}^- < \text{S}^{2-}$
4. $\text{Ga}^{3+} < \text{S}^{2-} < \text{Ca}^{2+} < \text{Cl}^-$
5. $\text{Ca}^{2+} < \text{Ga}^{3+} < \text{S}^{2-} < \text{Cl}^-$

008 10.0 points

Rank the following species in terms of increasing electron affinity: Sulfur (S), Rubidium (Rb), Germanium (Ge), Krypton (Kr), Fluorine (F)

1. $\text{Kr} < \text{Rb} < \text{Ge} < \text{S} < \text{F}$
2. $\text{F} < \text{Ge} < \text{S} < \text{Rb} < \text{Kr}$
3. $\text{Ge} < \text{Rb} < \text{S} < \text{F} < \text{Kr}$
4. Not enough information
5. $\text{Rb} < \text{Ge} < \text{S} < \text{F} < \text{Kr}$
6. $\text{Kr} < \text{Ge} < \text{Rb} < \text{S} < \text{F}$

009 10.0 points

What is the electronic configuration of a Copper atom (Cu)?

1. $[\text{Ar}] 4s^1 4d^9$
2. $[\text{Ne}] 4s^1 4d^{10}$
3. $[\text{Ar}] 4s^2 3d^5 4p^3$
4. $[\text{Ar}] 4s^2 3d^9$

5. $[\text{Ar}] 4s^1 3d^{10}$

010 10.0 points

The ionization energy of an Oxygen atom (O) is (equal to/greater than/less than) what you would predict based on simple effective nuclear charge arguments because the half-filled $2p$ orbital for O^+ is (more/less) stable.

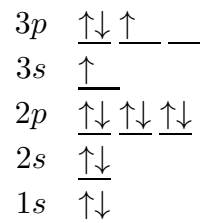
1. greater than, more
2. equal to, less
3. less than, more
4. greater than, less
5. less than, less
6. equal to, more

011 10.0 points

Which of the following types of electromagnetic radiation has the shortest wavelength?

1. $3.12 \times 10^{-19} \text{ J}$
2. $2.74 \times 10^{-19} \text{ J}$
3. $3.57 \times 10^{-19} \text{ J}$
4. $3.05 \times 10^{-19} \text{ J}$
5. $2.83 \times 10^{-19} \text{ J}$

012 10.0 points



Consider the electron filling diagram for a ground state atom illustrated above. Which of the following does it violate?

- I) The Aufbau principle
- II) Hund's rule
- III) The Pauli exclusion principle

1. I, II
2. III only
3. I only
4. II, III
5. I, III
6. II only
7. I, II, III

013 10.0 points

The transition metals are elements with partially filled

1. *s* subshells.
2. *p* subshells.
3. *f* subshells.
4. *d* subshells.

014 10.0 points

Due to the screening effect, the 3*s* electrons of magnesium (Mg) feel an effective nuclear charge (Z_{eff}) of

1. +1
2. +12
3. -2
4. +4
5. +2