492
version

last name _____ first name _____ signature _____

McCord CH301
49970 / 49975

Exam 2

Fall 2016

Remember that the bubble sheet has many conversion factors and constants on the back.

$c = 3.00 \times 10^{8}$ m/s

$h = 6.626 \times 10^{-34}$ J s

$R = 8.314$ J/mol K

$\mathcal{R} = 2.18 \times 10^{-18}$ J

$N_{\mathrm{A}} = 6.022 \times 10^{23}$ mol^{-1}

$m_{\mathrm{electron}} = 9.11 \times 10^{-31}$ kg

$m_{\mathrm{proton}} = 1.673 \times 10^{-27}$ kg

$m_{\mathrm{neutron}} = 1.675 \times 10^{-27}$ kg

$e^{-} = 1.602 \times 10^{-19}$ C

1 W = 1 J/s (power in watts, W)

1 eV $= 1.602 \times 10^{-19}$ J

NOTE: Please keep your Exam copy intact (all pages still stapled). You must turn in your exam copy plus your bubble sheet, and scratch paper.

This print-out should have 29 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 4.0 points

Which of the following elements would have the lowest first ionization energy?

1. Na

2. Cl

3. Rb

4. O

5. I

002 3.0 points

The speed of light in air

1. is independent of the wavelength and frequency of light.

2. depends only on the wavelength of light.

3. depends on both the wavelength and the frequency of light.

4. depends only on the frequency of the light.

003 3.0 points

Which of the following species has the greatest charge density?

1. K^+

2. Ca^{2+}

3. Al

4. Mg^{2+}

5. Cr^+

004 4.0 points

What is the expected ground state electron configuration for Zr^{2+} ?

1. [Kr] $5s^2 4d^2$

2. [Kr]

3. [Kr] $5s^2$

4. [Kr] $4d^2$

5. [Kr] $5s^1 4d^5$

6. [Xe]

7. [Kr] $5s^2 4d^4$

8. [Xe] $6s^2 5d^4$

9. [Xe] $5d^2$

10. [Xe] $6s^2$

005 3.0 points

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

1. $n = 3, \ell = 0, m_\ell = 0, m_s = \frac{1}{2}$

2. $n = 2, \ell = 1, m_\ell = -2, m_s = \frac{1}{2}$

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

4. $n = 4, \ell = 2, m_\ell = 1, m_s = \frac{1}{2}$

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

006 2.0 points

The organic compound $CH_3CH_2CH_3$ is called

1. pentane.

2. propane.

3. ethane.

4. butane.

5. methane.

007 3.0 points

What kind of radiation causes molecules to vibrate?

1. ultraviolet

2. x-rays

3. visible

4. microwave

5. infrared

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008 4.0 points

If a particle is confined to a one-dimensional box of length 300 pm, for Ψ_3 the particle has zero probability of being found at

1. 100 and 200 pm, respectively.

2. 75, 125, 175, and 225 pm, respectively.

3. 50, 150, and 250 pm, respectively.

4. 50 and 250 pm, respectively.

5. 150 pm only.

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009 4.0 points

What is the ground state electron configuration expected for germanium, Ge?

1. [Ar]

2. [Ar] $4s^2 3d^{10} 3p^2$

3. [Ar] $4s^2 3f^{10} 4p^2$

4. [Kr] $4s^1 3d^{10} 3p^3$

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

6. [Kr] $4s^2 3d^{10} 4p^2$

7. [Kr]

8. [Ar] $4s^2 4d^{10} 4p^2$

9. [Ar] $4s^2 3d^{10} 4p^2$

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010 4.0 points

What is the best explanation for the fact that the ionization energy of boron is lower than that of beryllium?

1. the radius of boron is smaller than that of beryllium making it easy to remove an electron

2. boron has a larger effective nuclear charge than beryllium.

3. the increased repulsion experienced by the electrons in beryllium

4. the quantum mechanical stability of the filled *s* subshell of beryllium

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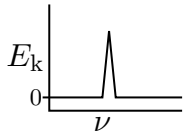
011 4.0 points

Consider an experiment depicting the photoelectric effect. The frequency of the incoming light is scanned and the resulting kinetic energy of the displaced electrons is measured. Which of the plots shown (E_k vs ν) is the correct plot for the data collected during this experiment?

1.


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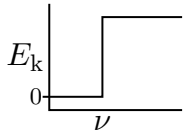

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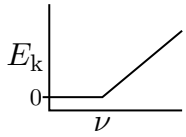

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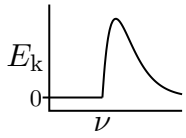

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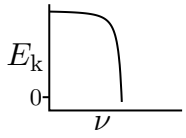

012 3.0 points

Which transition between energy levels in a hydrogen atom corresponds to the shortest wavelength of light.

1. $2 \rightarrow 4$

2. $3 \rightarrow 4$

3. $3 \rightarrow 5$

4. $2 \rightarrow 3$

5. $5 \rightarrow 6$

6. $2 \rightarrow 5$

013 3.0 points

The energy of a photon is

1. $\frac{c}{\lambda}$.

2. $n\lambda$.

3. $c\lambda$.

4. $\frac{hc}{\lambda}$.

5. $\frac{\lambda}{hc}$.

014 4.0 points

The lattice energy of calcium bromide is the energy change for the reaction

1. $Ca(s) + Br_2(\ell) \rightarrow CaBr_2(s)$

2. $CaBr_2(s) \rightarrow Ca(g) + 2\,Br(g)$

3. $CaBr_2(s) \rightarrow Ca^{2+}(g) + 2\,Br^{-}(g)$

4. $Ca(g) + 2\,Br(g) \rightarrow CaBr_2(g)$

5. $CaBr_2(s) \rightarrow Ca(g) + Br_2(g)$

015 2.0 points

What is the correct name for $(NH_4)_2CO_3$?

1. ammonium carbonate

2. ammonium carboxide

3. biammonium carbonate

4. ammonium bicarbonate

016 4.0 points

An electron in a hydrogen atom moves from the $n = 2$ to $n = 5$ level. What is the wavelength of the photon that corresponds to this transition and is the photon emitted or absorbed during this process?

1. 1875 nm; absorbed

2. 434 nm; absorbed

3. 1875 nm; emitted

4. 434 nm; emitted

5. 276 nm; emitted

6. 276 nm; absorbed

017 2.0 points

Which of the following is the correct formula for sodium hypochlorite?

1. $NaClO_2$

2. $NaClO_3$

3. $NaClO_4$

4. NaCl

5. NaClO

018 3.0 points

In reactions to form ionic compounds, metals generally

1. lose electrons.

2. gain electrons.

3. become non-metals.

4. do not react.

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019 4.0 points

For an isoelectronic series of ions, the ion that is the smallest is always

1. the ion with the fewest protons.

2. the ion with the most neutrons.

3. the least positively (or most negatively) charged ion.

4. the ion with the highest atomic number.

5. the ion with the most electrons.

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020 4.0 points

A low-pressure mercury-vapor lamp has a characteristic emission line at 253 nm. Knowing that this lamp is putting out 11.8 watts of light energy, how many mercury atoms are emitted per second during operation?

1. 1.50×10^{19} atoms

2. 5.25×10^{20} atoms

3. 4.73×10^{5} atoms

4. 7.86×10^{-19} atoms

5. 7.11×10^{24} atoms

6. 1.08×10^{17} atoms

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021 3.0 points

Compared to a 320 nm photon, a 280 nm photon has:

1. longer wavelength, lower frequency, higher energy

2. longer wavelength, lower frequency, lower energy

3. shorter wavelength, higher frequency, higher energy

4. shorter wavelength, lower frequency, lower energy

5. shorter wavelength, higher frequency, lower energy

6. longer wavelength, higher frequency, higher energy

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022 4.0 points

When a certain element is excited with electricity, we see three main lines in its emission spectrum: Two red lines and one orange line. What would the absorption spectrum of this element look like?

1. Similar to the emission spectrum with two red lines and one orange line, but with each of those shifted to lower wavelengths

2. A continuous spectrum broken by thin black lines at the same wavelengths as the red and orange lines in the emission spectrum

3. Identical to the emission spectrum, with two red lines and one orange line at the same wavelengths

4. It would have lines complementary to the emission spectrum colors, so it would have two green lines and one blue line.

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023 4.0 points

The wavelength of light with a frequency of $3.30 \times 10^{14}\ s^{-1}$ is

1. 909 nm.

2. 450 nm.

3. 200 nm.

4. 650 nm.

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024 4.0 points

Write an equation that represents the second ionization energy of copper.

1. $Cu(g) \longrightarrow Cu^{2+}(g) + 2\,e^-$

2. $Cu^{+}(g) \longrightarrow Cu^{2+}(g) + 2\,e^-$

3. $Cu(g) \longrightarrow Cu^{2+}(g) + e^-$

4. $Cu^{+}(g) \longrightarrow Cu^{2+}(g) + e^-$

5. $Cu(g) \longrightarrow Cu^{+}(g) + e^-$

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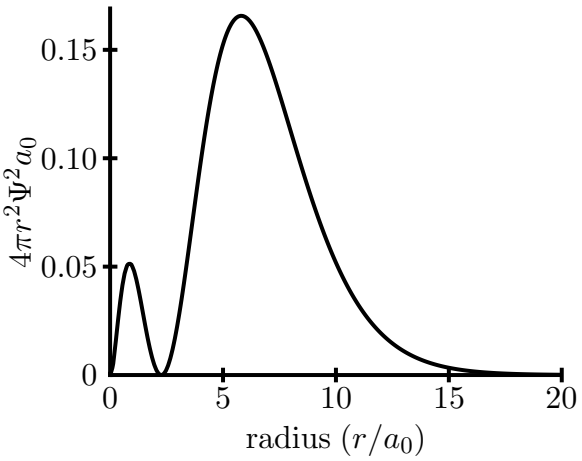
025 4.0 points

The radial distribution plot shown below could be from which hydrogen atom wavefunction?



1. $1s$

2. $2s$

3. $3d$

4. $2p$

5. $3s$

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026 4.0 points

A particular metal has a work function of 3.05 eV. A light is shined onto this metal with a corresponding wavelength of 524 nm. What is the maximum velocity of the photoelectrons produced?

1. 8.72×10^8 ms^{-1}

2. 9.12×10^5 ms^{-1}

3. No photoelectrons are produced.

4. 8.32×10^{11} ms^{-1}

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027 4.0 points

If the following crystallize in the same type of structure, which has the highest lattice energy?

1. KF

2. KCl

3. KBr

4. LiF

5. LiCl

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028 2.0 points

Give the formula for aluminum hydroxide.

1. $AlOH_3$

2. $Al(OH)_3$

3. AlH_3

4. AlOH

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029 4.0 points

Which of the following individual atoms has a paramagnetic electronic structure?

1. Mg

2. Li

3. He

4. Ne

5. Be