Test 4

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Which of the subshells below do not exist due to the constraints upon the azimuthal quantum number? 1) _____
   A) 4f
   B) 4p
   C) 4s
   D) 4d
   E) none of the above

2) Which set of three quantum numbers (n, l, m_l) corresponds to a 3d orbital? 2) _____
   A) 2, 3, 3 B) 3, 2, 2 C) 2, 1, 0 D) 3, 2, 3 E) 3, 3, 2

3) At maximum, an f-subshell can hold _____ electrons, a d-subshell can hold _____ electrons, and a p-subshell can hold _____ electrons. 3) _____
   A) 14, 8, 2 B) 2, 8, 18 C) 14, 10, 6 D) 2, 6, 10 E) 2, 12, 21

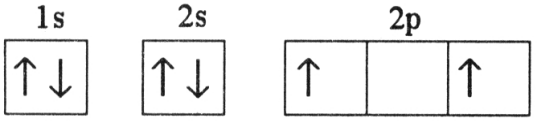
4) Which one of the following represents an acceptable set of quantum numbers for an electron in an atom? (arranged as n, l, m_l, and m_s) 4) _____
   A) 5, 4,- 5, 1/2
   B) 2, 2, -1, -1/2
   C) 1, 0, 0, 1/2
   D) 3, 3, 3, 1/2
   E) 3, 3, 3, -1/2

5) The valence shell of the element X contains 2 electrons in a 5s subshell. Below that shell, element X has a partially filled 4d subshell. What type of element is X? 5) _____
   A) alkali metal
   B) main group element
   C) halogen
   D) chalcogen
   E) transition metal

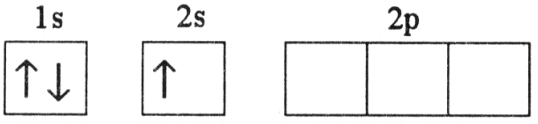
6) In which set of elements would all members be expected to have very similar chemical properties? 6) _____
   A) Na, Mg, K
   B) O, S, Se
   C) S, Se, Si
   D) Ne, Na, Mg
   E) N, O, F

7) Which electron configuration represents a violation of the Pauli exclusion principle? 7) _____

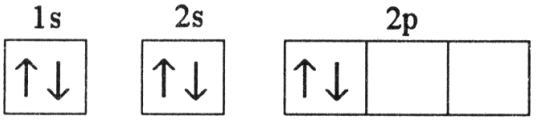
A)



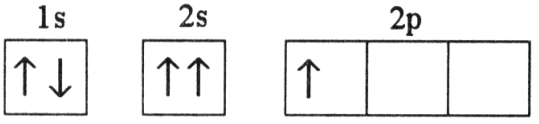
B)



C)

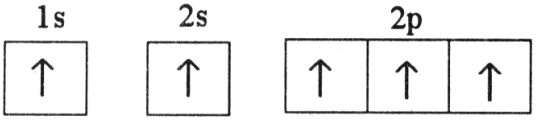


D)



Answer

E)



8) Screening of the nuclear charge by core electrons in atoms is _____. 8) _____

A) responsible for a general decrease in atomic radius going down a group
B) less efficient than that by valence electrons
C) more efficient than that by valence electrons
D) essentially identical to that by valence electrons
E) both essentially identical to that by valence electrons and responsible for a general decrease in atomic radius going down a group

9) Which isoelectronic series is correctly arranged in order of increasing radius? 9) _____

A) $K^+ < Ca^{2+} < Ar < Cl^-$
B) $Ca^{2+} < K^+ < Cl^- < Ar$
C) $Ca^{2+} < Ar < K^+ < Cl^-$
D) $Ca^{2+} < K^+ < Ar < Cl^-$
E) $Cl^- < Ar < K^+ < Ca^{2+}$

10) Which equation correctly represents the first ionization of aluminum? 10) _____

A) $Al\,(g) + e^- \rightarrow Al^-\,(g)$
B) $Al^+\,(g) + e^- \rightarrow Al\,(g)$
C) $Al\,(g) \rightarrow Al^+\,(g) + e^-$
D) $Al\,(g) \rightarrow Al^-\,(g) + e^-$
E) $Al^-\,(g) \rightarrow Al\,(g) + e^-$

Consider the following electron configurations to answer the questions that follow:

(i) $1s^2\ 2s^2\ 2p^6\ 3s^1$
(ii) $1s^2\ 2s^2\ 2p^6\ 3s^2$
(iii) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$
(iv) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$
(v) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

11) The electron configuration belonging to the atom with the highest second ionization energy is _____. 11) _____
A) (i) B) (ii) C) (iii) D) (iv) E) (v)

12) Which is the correct ground-state electron configuration for silver _____ ? 12) _____
A) $[Kr]5s^14d^{10}$
B) $[Xe]5s^24d^9$
C) $[Xe]5s^14d^{10}$
D) $[Kr]5s^24d^{10}$
E) $[Kr]5s^24d^9$

13) Which one of the following compounds would produce an acidic solution when dissolved in water? 13) _____
A) MgO B) CO_2 C) CaO D) SrO E) Na_2O

14) This element is more reactive than lithium and magnesium but less reactive than potassium. This element is _____. 14) _____
A) Be B) Ca C) Rb D) Na E) Fr

15) The reaction of alkali metals with oxygen produce _____. 15) _____
A) peroxides
B) oxides
C) superoxides
D) all of the above
E) none of the above

16) Element M reacts with oxygen to form an oxide with the formula MO. When MO is dissolved in water, the resulting solution is basic. Element M could be _____. 16) _____
A) N B) Ba C) C D) Na E) S

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

17) First ionization energies tend to increase across a period.
But in period , ___ has a higher first ionization energy than ____,
Explain with the drawing of the orbital diagram for the elements.

CHOOSE YOUR ANSWER.
I DO NOT HAVE THE ORBITAL DIAGRAM HERE

Be has a stable closed subshell configuration, which is disrupted by losing an electron. By contrast, B can achieve a fully-filled subshell configuration by losing the lone electron in the 2*p* subshell. This makes ionization of Be a little higher than usual, and ionization of B a little lower than usual. This causes the reversal of trend (the “jog” in the plot) across these two elements.

Between N and O. N has a stable half-filled 2*p* subshell, and O can achieve a stable half-filled subshell by losing an electron. Thus, the ionization energy of N is higher than O, resulting in a “jog” in the plot of ionization energies across these two elements.

Mg has a stable closed subshell configuration, which is disrupted by losing an electron. By contrast, Al can achieve a fully-filled subshell configuration by losing the lone electron in the 2*p* subshell. This makes ionization of Mg a little higher than usual, and ionization of Al a little lower than usual. This causes the reversal of trend (the “jog” in the plot) across these two elements.

Between P and S. N has a stable half-filled 2*p* subshell, and S can achieve a stable half-filled subshel by losing an electron. Thus, the ionization energy of P is higher than S, resulting in a “jog” in the plo of ionization energies across these two elements.

18)

Calculate the energy associated with a transition of an electron from $n_i =$ to $n_f =$

What is the wavelength of the radiation emitted?

Answer (CHECK YOUR NUMBERS. -1 SIG FIG, -1 WRONG ANS)

$\Delta E = (-2.18 \times 10^{-18} J)\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = (-2.18 \times 10^{-18})\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$

$(-2.18 \times 10 -18J)^{(0.75)} = -1.635$ E-18 Joules

E emitted = 1.635 E-18 Joules

$= 1.64 \times 10^{-18}$ Joules

$E = h\nu = hc/\lambda$

$\lambda = hc/E = \frac{(6.626*10^{-34} J.s)*(3*10^8 m/s)}{1.635E-18J} \quad \frac{1.9878E-25}{=1.635\ E-18\ Joules}$

$= 1.22 \times 10^{-7}$ meters

= 122 nm

Calculate the energy associated with the transition of an electron from $n_i = 3$ to $n_f = 2$.

What is the wavelength of the radiation emitted?

Answers

$\Delta E = (-2.18 \times 10 -18J)\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = (-2.18 \times 10 -18)\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

(-2.18 x 10 -18J)$^{(0.1389)}$ = -3.0278E-19Joules

E emitted = 3.03 x 10^{-19} Joules

E= hν = hc/λ

λ = hc/ E = $\frac{(6.626*10^{-34}J.s)*(3*10^{8}m/s)}{3.027E-19J} = \frac{1.9878\ E-25}{3.027E-19}m$

= 6.56 x 10^{-7} meters

= 656nm

Calculate the energy associated with the transition of an electron from n_i =3 to n_f = 1.

What is the wavelength of the radiation emitted?

Answers

ΔE = (-2.18 x 10 -18J)$\left(\frac{1}{n_f^2}-\frac{1}{n_i^2}\right)$ = (-2.18 x 10 -18)$\left(\frac{1}{1^2}-\frac{1}{3^2}\right)$

(-2.18 x 10 -18J)$^{(0.8889)}$ = -1.9378E-18Joules

E emitted = 1.94 x 10^{-18} Joules

E= hν = hc/λ

$\lambda = hc/E = \frac{(6.626\times10^{-34}\,J.s)\times(3\times10^{8}\,m/s)}{1.938E-18\,J} \quad \frac{1.9878E-25}{=1.938E-18\ \text{Joules}}$

= 1.03x 10 $^{-7}$ meters

= 103 nm

Calculate the energy associated with the transition of an electron from n_i =4 to n_f = 3.

What is the wavelength of the radiation emitted?

Answers

ΔE = (-2.18 x 10 -18J)$\left(\frac{1}{n_f^2}-\frac{1}{n_i^2}\right)$ = (-2.18 x 10 -18)$\left(\frac{1}{3^2}-\frac{1}{4^2}\right)$

(-2.18 x 10 -18J)$(4.861\ E-19\ )$ = -1.05972 E - 19Joules

E emitted = 1.06 x10 $^{-19}$ Joules

Corresponding wavelength:

E= hν = hc/λ

$\lambda = hc/E = \frac{(6.626\times10^{-34}\,J.s)\times(3\times10^{8}\,m/s)}{1.06E-19J} \quad \frac{1.9878E-25}{=1.06\,E-19\ \text{Joules}}$

= 1.88 x 10 $^{-6}$ meters

= 1880 nm