1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.20	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (267)	105 Db (268)	106 Sg (269)	107 Bh (270)	108 Hs (270)	109 Mt (278)	110 Ds (281)	111 Rg (282)	112 Cn (285)	113 Nh (286)	114 Fl (289)	115 Mc (290)	116 Lv (293)	117 Ts (294)	118 Og (294)

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (266)

constants

$R = 0.08206$ L atm/mol K

$R = 8.314$ J/mol K

$N_A = 6.022 \times 10^{23}$ /mol

$h = 6.626 \times 10^{-34}$ J·s

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

$g = 9.81$ m/s^2

conversions

1 atm = 760 torr

1 atm = 101325 Pa

1 atm = 1.01325 bar

1 bar = 10^5 Pa

°F = °C(1.8) + 32

K = °C + 273.15

conversions

1 in = 2.54 cm

1 ft = 12 in

1 yd = 3 ft

1 mi = 5280 ft

1 lb = 453.6 g

1 ton = 2000 lbs

1 tonne = 1000 kg

1 gal = 3.785 L

1 gal = 231 in^3

1 gal = 128 fl oz

1 fl oz = 29.57 mL

water data

$C_{s,ice} = 2.09$ J/g °C

$C_{s,water} = 4.184$ J/g °C

$C_{s,steam} = 2.03$ J/g °C

$\rho_{water} = 1.00$ g/mL

$\rho_{ice} = 0.9167$ g/mL

$\rho_{seawater} = 1.024$ g/mL

$\Delta H_{fus} = 334$ J/g

$\Delta H_{vap} = 2260$ J/g

$K_w = 1.0 \times 10^{-14}$

This extra practice set can be used to test your knowledge for the upcoming exam.

---

1. The following species are isoelectronic. Select the atom or ion that will have the largest radius.

a. K^+

●b. S^{2-}

c. Ar

d. Cl^-

e. Ca^{2+}

Explanation: Anions becomes larger with the addition of each electron due to electron repulsions in the valence shell. In this isoelectronic series, the sulfur ion has two extra electrons.

---

2. When an electron is excited to a higher energy level in a gas, the gas emits light when the electrons fall back down to the lower energy states. Upon closer inspection, you determine that the emitted light is a combination of violet, red, blue, and green light. For which color is the electron going down in energy the most?

●a. violet

b. green

c. red

d. blue

Explanation: The biggest energy gap correlates with the highest energy gas, which is violet.

---

3. It takes light with a frequency of approximately 2.687×10^{15} Hz to break the triple bond between carbon and oxygen in carbon monoxide. Calculate the energy (in kJ/mol) necessary to break one mole of carbon-oxygen triple bonds.

a. 4.455×10^{-17} kJ/mol

●b. 1072 kJ/mol

c. 687.2 kJ/mol

d. 1.780×10^{-18} kJ/mol

e. 945.2 kJ/mol

Explanation: $E = h\nu = (6.626 \times 10^{-34})(2.687 \times 10^{15})$

Next scale up by multiplying energy by N_{A} and divide by 1000 to convert from J/mol to kJ/mol:

$1072 \text{ kJ/mol} = E \times (6.022 \times 10^{23}) \times \frac{1 \text{ kJ}}{1000 \text{ J}}$

---

4. How many unique quantum number sets are possible for the 3d electrons in zinc?

a. 14

b. 8

c. 12

d. 6

●e. 10

Explanation: There are 10 total electrons in the 3d-set and each of those 10 electrons will have a unique quantum number set. All 10 electrons will have matching values of n and ℓ with values of 3 and 2 meaning a 3d orbital. The unique part is that m_ℓ will have 5 different values (-2,-1,0,+1,+2) and then each of those five will have one of two values for m_s (+1/2 and -1/2). Therefore 10 unique sets of quantum numbers for the 10 electrons in the 3d set.

---

5. What is the electron configuration for the oxide anion?

a. $1s^2 2s^2 2p^4$

b. $1s^2 2s^2 3p^4$

c. $1s^2 2s^2 3p^2$

d. $1s^2 2s^2 2p^2$

●e. $1s^2 2s^2 2p^6$

Explanation: Write the electron configuration for oxygen and then add two electrons for the two negative charges: $1s^2 2s^2 2p^6$

---

6. Identify the set that contains ONLY ionic compounds.

a. $CaCl_2$, HI, H_2O

●b. NaBr, Fe_2O_3, $CaCl_2$

c. $CuCl_2$, NaCl, $HClO_3$

d. HCl, AgCl, Al_2O_3

e. CH_3CH_2OH, Al_2O_3, CH_4

Explanation: Look for a metal bonded to a nonmetal. Remember that hydrogen is not a metal, even though it is positioned in the top left of the periodic table. The correct set is: NaBr, Fe_2O_3, $CaCl_2$.

---

7. Compared to yellow light, ultraviolet light will have a...

I. shorter wavelength

II. lower frequency

III. higher energy

IV. greater velocity

a. I, III, and IV

●b. I and III

c. I and IV

d. I, II, III, and IV

Explanation: Ultraviolet light will have a higher energy, higher frequency, and shorter wavelength than yellow light. The speed of light will be constant.

---

8. Which of the following is a true statement comparing the ionic radii to a set of isoelectronic species?

a. The smallest radius will be the ion with the greatest negative charge.

●b. The smallest radius will be the ion with the greatest positive charge.

c. There is no difference in the ionic radii for isoelectronic species.

d. The smallest radius will be the neutral species.

Explanation: The smallest ionic radius will always be the species with the greatest positive charge (less electron-electron repulsions due to fewer electrons compared to the atomic charge).

---

9. Which of the following types of radiation is capable of ionizing organic molecules like DNA?

●a. UV-C radiation

b. blue light

c. infrared radiation

d. orange light

e. radio waves

Explanation: The higher energy forms of radiation are capable of ionizing matter: UV, x-ray, and gamma.

---

10. What is the wavelength of a 2.45×10^9 Hz wave?

a. 1.62×10^{-24} m

●b. 0.122 m

c. 8.17×10^{-18} m

d. 0.753 m

e. 7.53 m

Explanation: $\lambda = \frac{c}{\nu} = \frac{3.00\times10^8}{2.45\times10^9} = 0.122$ m

---

11. Which effect on matter correlates with the highest frequency light?

a. vibration

b. replication

c. rotation

d. excitation

● e. ionization

Explanation: The strongest effect on matter (which would correlate with a higher frequency and higher energy) is ionization.

---

12. Carbon and oxygen form a polar covalent bond. Which of the following statements accurately uses the periodic table trends to explain why this type of bond forms?

a. Carbon has a greater electronegativity than oxygen, which pushes the shared electrons closer to oxygen.

● b. Oxygen has a greater electronegativity than carbon, which pulls the shared electrons closer to oxygen.

c. Carbon has a smaller radius than oxygen, which causes the electrons to be shared between the two atoms.

d. Oxygen and carbon have similar electronegativities, causing the electrons to be shared equally between the two atoms.

e. Oxygen has a greater ionization energy than carbon, which transfers electrons from carbon to oxygen.

Explanation: The polar bond forms based on the fact that oxygen has a greater electronegativity (electron withdrawing power) than carbon. This pulls the electrons closer to oxygen, creating a polar covalent bond.

---

13. Select the ionic compound with the highest lattice energy.

● a. MgO

b. NaF

c. $MgCl_2$

d. Na_2O

e. MgS

Explanation: Lattice energy depends on charge and radius. Look for the largest charges first. This reduces your choices to MgO and MgS. Now use the radius, knowing that the stronger lattice energy will be the smaller radius. The answer is MgO.

---

14. What is the ionic compound formed between Na and O?

● a. Na_2O

b. NaO_2

c. Na_3O_2

d. NaO

e. Na_2O_3

Explanation: Na is in group 1A and will ionize to form a +1 cation. Oxygen will ionize to form a -2 anion. After balancing the charges, you get: Na_2O

---

15. Name the salt with the strongest ionic bond strength:

$MgBr_2$ $CaCl_2$ $MgCl_2$ $CaBr_2$

● a. magnesium chloride

b. magnesium dichloride

c. calcium dichloride

d. magnesium dibromide

e. calcium bromide

f. calcium dibromide

Explanation: Choose the ionic compound with the greatest charge density: $MgCl_2$. Then name it properly: magnesium chloride.

---

16. Which subshell contains an electron with the following quantum number set?

$n = 4, \quad \ell = 0, \quad m_\ell = 0, \quad m_s = \frac{1}{2}$

a. 3s

b. 3p

c. 3d

d. 4f

●e. 4s

f. 4d

g. 4p

Explanation: The subshell is determined by the n and ℓ values. $n = 4$ and ℓ provides the shape, which is s when $\ell = 0$.

---

17. Which of the following incorrectly matches the polyatomic ion with its name?

a. permanganate: MnO_4^-

●b. phosphate: PO_3^{3-}

c. ammonium: NH_4^+

d. carbonate: CO_3^{2-}

e. sulfate: SO_4^{2-}

Explanation: All are correctly matched except for phosphate, which should be PO_4^{3-}. As written, the answer choice is phosphite.

---

18. What is the energy of a single 680 nm red light photon?

a. 2.66×10^{38} J

b. 4.51×10^{-40} J

c. 2.92×10^{-17} J

●d. 2.92×10^{-19} J

e. 3.88×10^{-21} J

Explanation: Use $E = \frac{hc}{\lambda}$

$2.92 \times 10^{-19}\ \text{J} = \frac{(6.626\times10^{-34})(3.00\times10^{8})}{6.80\times10^{-7}}$

---

19. Chromium(III) and sulfide (S^{2-}) form an ionic bond. What is the formula for the ionic compound?

a. Cr_2S

●b. Cr_2S_3

c. Cr_3S_2

d. CrS

e. CrS_3

Explanation: The least common multiple between the +3 and -2 charges is 6. Therefore, you will have 2 Cr and 3 S, resulting in Cr_2S_3.

---

20. Your chemist friend suggests that you tune the radio to 3.0333 m, but you know that radio stations are listed as frequencies in MHz. What radio station is this?

a. 101.5 KROX

●b. 98.9 KUT

c. 93.7 KLBJ

d. 93.3 KGSR

e. 103.5 BOB

Explanation: $\nu = \frac{c}{\lambda}$

$9.89 \times 10^7\ \text{Hz} = \frac{3.00\times10^8\ \text{m/s}}{3.03\ \text{m}}$

$= 98.9$ MHz

---

21. Complete the sentence regarding the energy levels of an electron in the hydrogen atom. As the principal quantum number increases,

●a. the spacing between successive energy levels decreases

b. the spacing between successive energy levels increases

c. the spacing between successive energy levels remains constant

d. the energy levels remain degenerate

Explanation: As n increases, the energy change between each energy level in the atom decreases.

---

22. Name the following compounds: $AlPO_4$ and SO_2?

a. aluminum phosphate and sulfur oxide

b. aluminum phosphoxide and sulfur dioxide

c. aluminum phosphite and sulfur oxide

d. aluminum phosphite and sulfur dioxide

e. aluminum phosphoxide and sulfur oxide

● f. aluminum phosphate and sulfur dioxide

Explanation: The correct names are: aluminum phosphate and sulfur dioxide.

---

23. What is the electron configuration for selenium, Se?

a. $[Ar]4s^2 4d^{10} 4p^6$

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

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

d. $[Ar]4s^2 4p^4$

● e. $[Ar]4s^2 3d^{10} 4p^4$

Explanation: Begin at [Ar] and include only the electrons that fill after. This will include the 3d electrons: $[Ar]4s^2 3d^{10} 4p^4$

---

24. Which of the following quantum number sets is not possible?

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

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

● c. $n = 4, \quad \ell = 2, \quad m_\ell = 3, \quad m_s = \frac{1}{2}$

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

e. $n = 4, \quad \ell = 3, \quad m_\ell = 0, \quad m_s = \frac{1}{2}$

Explanation: The one that violates the rules is: $n = 4, \quad \ell = 2, \quad m_\ell = 3, \quad m_s = \frac{1}{2}$. In this example, the m_ℓ value is greater than ℓ.

---

25. How many unpaired electrons will you find in the electronic configuration of nitrogen?

a. 5

b. 1

c. 0

d. 2

● e. 3

Explanation: Nitrogen has 5 valence electrons. You will fill the 2s first, then place three electrons in the three 2p orbitals. Following Hund's rule, you will see that all three 2p electrons are unpaired.

Remember to bubble in ALL your answers BEFORE time is called. Double check your name, uteid, and version number before you turn in your bubblesheet. You must keep your exam for future reference. Please do not lose it. We will not replace it.