Periodic Table of the Elements

1A (1)												3A (13)	4A (14)	5A (15)	6A (16)	7A (17)	8A (18)
1 H 1.0079	2A (2)																2 He 4.0026
3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
11 Na 22.9898	12 Mg 24.3050	3B (3)	4B (4)	5B (5)	6B (6)	7B (7)	8	8B (9)	10	1B (11)	2B (12)	13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.9961	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.82	50 Sn 118.710	51 Sb 121.75	52 Te 127.60	53 I 126.9045	54 Xe 131.39
55 Cs 132.9054	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.9665	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.9804	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)									

58 Ce 140.115	59 Pr 140.9076	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.965	64 Gd 157.25	65 Tb 158.9253	66 Dy 162.50	67 Ho 164.9303	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.967
90 Th 232.0381	91 Pa 231.0359	92 U 238.0289	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 (260)

This print-out should have 30 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering. V1:1, V2:1, V3:1, V4:1, V5:2.

ACAMP 02 0001

08:02, general, multiple choice, > 1 min, fixed.

001 (part 1 of 1) 6 points

A 200 nm photon has how many times the energy of a 700 nm photon?

1. 3.5 **correct**

2. 4.2

3. 0.29

4. 0.24

5. 9.93×10^{-19}

6. 2.84×10^{-19}

Explanation:

Energy of Light: $E = \dfrac{hc}{\lambda}$

For the 200 nm photon:

$$E = \frac{hc}{\lambda}$$
$$= \frac{(6.626 \times 10^{-34}\ \text{J} \cdot \text{s})(3 \times 10^{8}\ \text{m} \cdot \text{s}^{-1})}{200 \times 10^{-9}\ \text{m}}$$
$$= 9.94 \times 10^{-19}\ J$$

For the 700 nm photon:

$$E = \frac{hc}{\lambda}$$
$$= \frac{(6.626 \times 10^{-34}\ \text{J} \cdot \text{s})(3 \times 10^{8}\ \text{m} \cdot \text{s}^{-1})}{700 \times 10^{-9}\ \text{m}}$$
$$= 2.84 \times 10^{-19}\ \text{J}$$

Thus

$$\frac{9.94 \times 10^{-19}\ \text{J}}{2.84 \times 10^{-19}\ \text{J}} = 3.5$$

ChemPrin3e T01 26

08:05, general, multiple choice, < 1 min, fixed.

002 (part 1 of 1) 6 points

Which of the following emission lines corresponds to part of the Balmer series of lines in the spectrum of a hydrogen atom?

A) $n = 2 \rightarrow n = 1$
B) $n = 4 \rightarrow n = 2$
C) $n = 4 \rightarrow n = 1$
D) $n = 3 \rightarrow n = 2$
E) $n = 4 \rightarrow n = 3$

1. B and D only **correct**

2. A, D, and E only

3. A and C only

4. E only

5. B and C only

6. D and E only

7. B, C, and E only

Explanation:

The Balmer series is produced by electronic transitions which either begin (absorption spectra) or end (emission spectra) at the energy level $n = 2$. These correspond mostly to the visible region.

ChemPrin3e 01 30

08:05, general, numeric, > 1 min, normal.

003 (part 1 of 1) 6 points

In the spectrum of atomic hydrogen, a violet line is observed at 434 nm. What are the beginning and ending energy levels of the electron during the emission of energy that leads to this spectral line?

1. $n = 5$, $n = 2$ **correct**

2. $n = 6$, $n = 2$

3. $n = 6$, $n = 3$

4. $n = 5$, $n = 3$

5. $n = 4$, $n = 2$

6. $n = 4$, $n = 3$

Explanation:
$\lambda = 434 \text{ nm} = 4.34 \times 10^{-7} \text{ m}$

Because the line is in the visible part of the spectrum, it belongs to the Balmer series for which the ending n is 2.

For the starting value of n,

$$\nu = \frac{c}{\lambda} = \frac{3 \times 10^8 \text{ m/s}}{4.34 \times 10^{-7} \text{ m}} = 6.909 \times 10^{14} \text{ s}^{-1}$$

Using the Ryberg formula,

$$\nu = (3.29 \times 10^{15} \text{ s}^{-1}) \left(\frac{1}{n_2^2} - \frac{1}{n_1^2} \right)$$

$$\begin{aligned} \frac{\nu}{3.29 \times 10^{15} \text{ s}^{-1}} &= \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \\ \frac{1}{n_2^2} &= \frac{1}{n_1^2} - \frac{\nu}{3.29 \times 10^{15} \text{ s}^{-1}} \\ &= \frac{1}{4} - \frac{6.909 \times 10^{14} \text{ s}^{-1}}{3.29 \times 10^{15} \text{ s}^{-1}} \\ &= 0.04 \\ n_2^2 &= \frac{1}{0.04} \\ n_2 &= 5 \end{aligned}$$

OneD Ground State

08:06, general, multiple choice, < 1 min, fixed.

004 (part 1 of 1) 6 points

If a particle is in a one-dimensional box and is in its ground state, where would you MOST probably find the particle?

1. in the center of the box **correct**

2. at the two ends of the box

3. either side of the center of the box

4. anywhere in the box

Explanation:

ChemPrin3e T01 78

08:03, general, multiple choice, < 1 min, fixed.

005 (part 1 of 1) 6 points

Estimate the minimum uncertainty in the position of an electron of mass 9.109×10^{-31} kg if the error in its speed is 300000 m/s.

1. 386 pm

2. 386×10^{-12} m

3. 193 pm **correct**

4. 1.93×10^{-12} m

Explanation:
$\text{m} = 9.109 \times 10^{-31} \text{ kg} \qquad \Delta v = \pm 300000 \text{ m/s}$

$$\begin{aligned} \Delta x &= \frac{\hbar}{2 \, \text{m} \, \Delta v} \\ &= \frac{1.055 \times 10^{-34} \text{ J} \cdot \text{s}}{2 \, (9.109 \times 10^{-31} \text{ kg}) \, (300000 \text{ m/s})} \\ &= (1.93033 \times 10^{-10} \text{ m}) \left(\frac{10^{12} \text{ pm}}{1 \text{ m}} \right) \\ &= 193.033 \text{ pm} \, . \end{aligned}$$

DeBroglie Wavelength 03

08:03, general, multiple choice, < 1 min, fixed.

006 (part 1 of 1) 6 points

What is the de Broglie wavelength of Schrodinger's cat, Albert, running to his food bowl. Albert has a mass of 5200 g and is running at 1.6 m/s.

1. 7.964×10^{-35} m **correct**

2. 7.964×10^{-38} m

3. 4.978×10^{-35} m

4. 5.513×10^{-33} m

Explanation:

$$\begin{aligned} \lambda = \frac{h}{p} &= \frac{h}{m \cdot v} \\ &= \frac{6.626 \times 10^{-34} \, \frac{\text{kg} \cdot \text{m}^2}{\text{s}}}{(5.2 \text{ kg}) \, (1.6 \text{ m/s})} \\ &= 7.96394 \times 10^{-35} \text{ m} \end{aligned}$$

Schrodinger Eq 01

08:06, general, multiple choice, < 1 min, fixed.

007 (part 1 of 1) 6 points

Which of the following applications of the Schrodinger equation includes a potential energy term with both attractive and repulsive terms?

1. $V(r)$ for electrons in the helium atom **correct**

2. $V(x)$ for a particle in a box

3. $V(r)$ for the electron in the hydrogen atom

4. $V(x)$ for the standing wave of a plucked guitar string

5. None of these

Explanation:

ChemPrin3e T01 38

08:07, general, multiple choice, < 1 min, fixed.

008 (part 1 of 1) 6 points

The three quantum numbers for an electron in a hydrogen atom in a certain state are $n = 4$, $\ell = 1$, $m_\ell = 1$. The electron is located in what type of orbital?

1. $4s$

2. $3p$

3. $3d$

4. $4d$

5. $4p$ **correct**

Explanation:

The notation is n_ℓ, where $n = 1, 2, 3, 4, 5, ...$, $\ell = 0, 1, 2, ..., (n-1)$ represented as a letter: $\ell = 0 \rightarrow s$, $\ell = 1 \rightarrow p$, $\ell = 2 \rightarrow d$, $\ell = 3 \rightarrow f$, $\ell = 4 \rightarrow g$, $\ell = 5 \rightarrow h$, *etc*, and $m_\ell = -\ell, -(\ell-1), -(\ell-2), ..., 0, ..., +(\ell-2), +(\ell-1), \ell$.

The value of m_ℓ is not needed to determine the orbital type, as long as it is valid.

Quantum Number 01

08:08, general, multiple choice, < 1 min, fixed.

009 (part 1 of 1) 6 points

What is the total number of orbitals found in the $n = 1$ through $n = 4$ shells?

1. 30 **correct**

2. 16

3. 60

4. 10

5. None of these

Explanation:

Degenerate Energy Levels

08:12, general, multiple choice, < 1 min, fixed.

010 (part 1 of 1) 6 points

Which of the subshells possess degenerate energy levels?

1. All except for s subshells **correct**

2. Only s subshells

3. Only subshells found in the periodic table

4. Only the $2p$ subshells

5. All of them

Explanation:

Electron Config 01

08:13, general, multiple choice, < 1 min, fixed.

011 (part 1 of 1) 6 points

Which of the following ions or neutral atoms does NOT possess the electronic configuration $[\mathrm{Ar}]\, 4s^2 3d^2$?

1. V^- **correct**

2. Fe^{4+}

3. Ti

4. H^{21-}

5. Ca^{2-}

Explanation:

ChemPrin3e T01 41

08:12, general, multiple choice, < 1 min, fixed.

012 (part 1 of 1) 6 points

Write the ground-state electron configuration of a chromium atom.

1. [Ar] $4s^2\,3d^4$

2. [Ar] $4s^1\,3d^5$

3. [Ar] $3d^5\,4s^1$ **correct**

4. [Ar] $3d^6$

5. [Ar] $3d^4\,4s^2$

Explanation:

The Aufbau order of electron filling is $1s$, $2s$, $2p$, $3s$, $3p$, $4s$, $3d$, $4p$, $5s$, $4d$, $5p$, $6s$, $4f$, $5d$, $6p$, *etc.*

s orbitals can hold 2 electrons, p orbitals 6 electrons, and d orbitals 10 electrons. Note some exceptions do occur in the electron configuration of atoms because of the stability of either a full or half-full outermost d-orbital, so you may need to account for this by 'shuffling' an electron from the $(n-1)\,s$ orbital. Finally use noble gas shorthand to get the answer: [Ar] $3d^5\,4s^1$.

Valence Config 01

08:13, general, multiple choice, < 1 min, fixed.

013 (part 1 of 1) 6 points

Which of the following valence configurations is INCORRECT?

1. Tl^{2+} : s^2d^{10} **correct**

2. Cu : s^1d^{10}

3. Bi^{2+} : $s^2d^{10}p^1$

4. Sb^{5+} : d^{10}

5. Pt : d^{10}

Explanation:

Periodic Table 01

08:11, general, multiple choice, < 1 min, fixed.

014 (part 1 of 1) 6 points

Which of the following statements that describe the periodic table is true?

1. The first family of elements on the periodic table is the alkali metals. **correct**

2. Rows of the periodic table are referred to as families.

3. An element with an s^2p^5 valence shell is a noble gas.

4. There are three blocks represented on the periodic table of the elements.

5. The main group elements are found in the s, p and d blocks.

Explanation:

ACAMP304 E2 01

09:03, general, multiple choice, < 1 min, fixed.

015 (part 1 of 1) 6 points

Why is it harder to remove an electron from fluorine than from carbon, or, to put it another way, why are the valence electrons of fluorine more strongly bound than those of carbon?

1. Fluorine has more valence elctrons than does carbon.

2. Carbon has a lower atomic mass than does fluorine.

3. The valence electrons of both fluorine and carbon are found at about the same distance from their respective nuclei but the greater positive charge of the fluorine nucleus attracts its valence electrons more strongly. **correct**

4. The statement is false; it takes very nearly the same energy to remove an electron from (ionize) both elements.

5. Fluorine has a nearly filled octet, which is always more stable than a partially filled octet.

Explanation:

For each element, the valence electrons are in the $2s$ and the $2p$ orbitals:

C : $1s^2 2s^2 2p^2$; 6 protons in the nucleus; 6 electrons (total); 4 valence electrons.

F : $1s^2 2s^2 2p^5$; 9 protons in the nucleus; 9 electrons (total); 7 valence electrons.

The effective nuclear charge felt by the valence electrons of fluorine is greater than the effective nuclear charge felt by the valence electrons of carbon. Therefore, the valence electrons of fluorine experience a greater Coulombic attractive force and are harder to remove.

Msci 06 0201

09:01, general, multiple choice, > 1 min, fixed.

016 (part 1 of 1) 6 points

For which of the following elements would the size of the neutral atom (atomic radius) be largest?

1. Rb **correct**

2. K

3. Na

4. Sr

5. Ca

Explanation:

Atomic radii become larger as you move from right to left across a row, and also larger as you move *down* a column. Diagonal relationships can be tricky, especially when you have to decide which of the two relationships will be the most important. Here, luckily, the comparion works well. With each successive member of a column, you are introducing a new energy level, farther and farther from the nucleus. The largest radius here would then belong to the element which sits closest to the bottom left corner of the periodic table, which is Rb in this example.

Ionization Energy

09:03, general, multiple choice, < 1 min, fixed.

017 (part 1 of 1) 6 points

Rank Na, Mg, Al and Si in terms of increasing ionization energy.

1. Na < Al < Mg < Si **correct**

2. Na < Mg < Al < Si

3. Si < Mg < Al < Na

4. Si < Al < Mg < Na

5. Na < Si < Mg < Al

Explanation:

Mlib 07 0225

11:02, general, multiple choice, > 1 min, fixed.

018 (part 1 of 1) 6 points

Which of the following is the best representation of the compound potassium sulfide?

1. $2\,K^+$, $\left[:\ddot{\underset{\ddot{}}{S}}: \right]^{2-}$ **correct**

2. K^{2+} , $2\left[:\ddot{\underset{\ddot{}}{S}}: \right]^{-}$

3. K^+ , $\left[:\ddot{\underset{\ddot{}}{S}}: \right]^{-}$

4. K^{2+} , $\left[:\ddot{\underset{\ddot{}}{S}}: \right]^{2-}$

5. $3\,K^{2+}$, $2\left[:\ddot{\underset{\ddot{}}{S}}: \right]^{3-}$

6. None is appropriate because potassium sulfide is a covalent compound.

Explanation:

The best drawing will show the valence elec-

trons, the charges, and the appropriate ratio of ions for K_2S.

ChemPrin3e T02 07

10:05, general, multiple choice, < 1 min, fixed.

019 (part 1 of 1) 6 points

Which of the following has the highest lattice energy?

1. NaCl

2. KI

3. MgO **correct**

4. BaO

5. CaO

Explanation:

Mg^{2+} and O^{2-} have the highest charge densities.

DAL 07 013

11:07, general, multiple choice, > 1 min, fixed.

020 (part 1 of 1) 6 points

In the following group of compounds,

O_3, SO_2, SO_3, I_3^-, CO_3^{2-}

identify those that exhibit resonance.

1. All exhibit resonance

2. O_3, SO_2, SO_3, CO_3^{2-} only **correct**

3. SO_3, I_3^-, CO_3^{2-} only

4. CO_3^{2-} only

5. SO_2, SO_3 only

Explanation:

All except I_3^- exhibit resonance. Resonance occurs when more than one structure can be drawn for a compound involving changing the position of double bonds. O_3 has 2 resonance structures, SO_2 has 2 resonance structures, SO_3 has 3 resonance structures, and CO_3^{2-} has 3 resonance structures. I_3^- has 2 single bonds and no double bonds; there is no resonance for this structure.

ChemPrin3e T02 22

11:04, basic, multiple choice, < 1 min, fixed.

021 (part 1 of 1) 6 points

How many lone pairs of electrons are found in the Lewis structure of hydrazine (H_2NNH_2)?

1. 8

2. 4

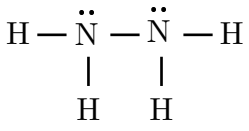
3. 1

4. 0

5. 2 **correct**

Explanation:

The Lewis structure is



ChemPrin3e 02 52

11:09, general, multiple choice, < 1 min, fixed.

022 (part 1 of 1) 6 points

Which of the species

NO, BrO, CH_3^+, BF_4^-

are radicals?

1. NO and BrO only **correct**

2. NO and CH_3^+ only

3. BrO and CH_3^+ only

4. BrO and BF_4^+ only

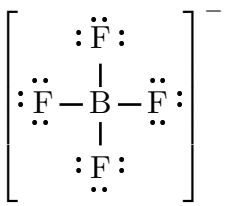
5. NO, CH_3^+ and BF_4^- only

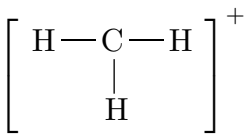
6. BrO, CH_3^+ and BF_4^- only

7. NO and BF_4^- only

Explanation:

The Lewis structures are





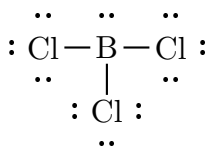
Radicals are species with an unpaired electron, so only NO and BrO are radicals.

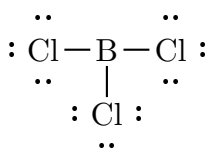
Lewis BCl3 dash

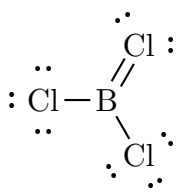
11:05, general, multiple choice, < 1 min, fixed.

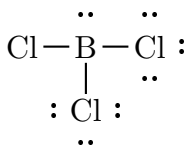
023 (part 1 of 1) 6 points

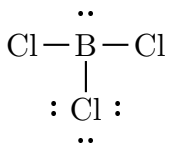
Which of the following is the correct Lewis formula for boron trichloride (BCl_3)?

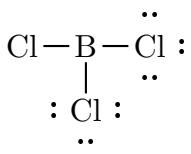
1. 

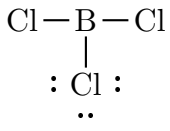
2.  **correct**

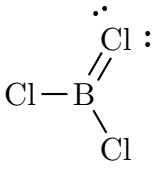
3. 

4. 

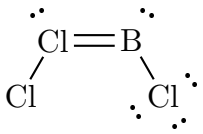
5. 

6. 

7. 

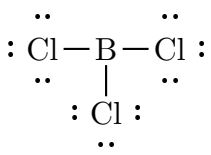
8. 

9.

10. 

Explanation:

B contributes 3 valence e^- and each Cl contributes 7 valence e^- for a total of 24 e^-. B is a known exception to the octet rule and can form stable with 6 valence e^-:



JJL 70401b

11:04, general, multiple choice, > 1 min, wording-variable.

024 (part 1 of 1) 6 points

Which of these substances has a Lewis formula incorporating a double bond?

1. C_2H_4 **correct**

2. HBr

3. CS

4. H_2Te

5. SbH_3

6. HCl

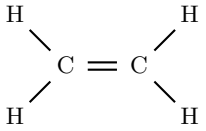
7. PH_3

8. HF

9. HI

10. AsH_3

Explanation:
The structure for C_2H_4 is



Each C has 4 valence e^- and each H has 1 for a total of 12 e^-.

Mlib 76 1067

11:06, general, multiple choice, > 1 min, fixed.

025 (part 1 of 1) 6 points

Which one of the following compounds does NOT obey the octet rule?

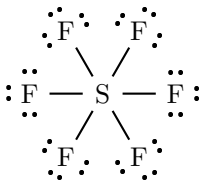
1. SF_6 **correct**

2. H_2O

3. CH_4

4. NH_3

Explanation:
S has 6 valence e^-
F has 6×7 valence e^-
Total = 48 valence e^-



SF_6 has 48 e^- but S has an expanded valence shell containing 12 e^-, thus violating the octet rule.

Lone Pairs 02

11:06, general, multiple choice, < 1 min, fixed.

026 (part 1 of 1) 6 points

How many lone electron pairs are found on the central atom of IF_2^-?

1. 3 **correct**

2. 1

3. 2

4. 4

5. 5

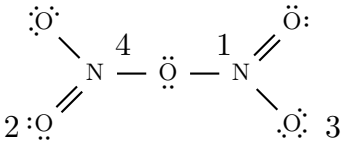
Explanation:

Msci 15 0006

11:08, general, multiple choice, > 1 min, wording-variable.

027 (part 1 of 1) 6 points

For the electron dot representation



of N_2O_5, what are the formal charges on each atom going from 1 to 4 in order?

1. 1, 0, −1, 1 **correct**

2. 0, 0, 1, −1

3. 0, 0, −1, 0

4. 1, 0, 0, −1

5. 0, 0, 0, 0

6. −1, 2, 1, 0

Explanation:
The formal charge is calculated by
FC = group #
$-$(# bonds + # unshared e^-)
Thus

$$FC_1 = 5 - (4 + 0) = 1$$
$$FC_2 = 6 - (2 + 4) = 0$$
$$FC_3 = 6 - (1 + 6) = -1$$
$$FC_4 = 5 - (4 + 0) = 1$$

ChemPrin3e T02 30

11:08, general, multiple choice, < 1 min, fixed.

028 (part 1 of 1) 6 points

Write three Lewis structures for the cyanate ion NCO^- where the arrangement of atoms

is N, C, and O, respectively. In the most plausible structure using formal charges,

1. there is a triple bond between N and C. **correct**

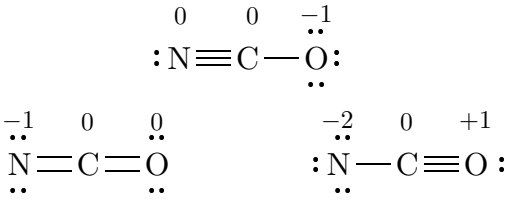
2. there are two double bonds.

3. there is a triple bond between C and O.

4. the formal charge on O is +1.

5. the formal charge on N is −1.

Explanation:



Bond Lengths

10:09, general, multiple choice, < 1 min, fixed.

029 (part 1 of 1) 6 points

Using polarizabilty arguments, rank the bond lengths from longest to shortest for the H atom attached to a halogen atom.

1. HI > HBr > HCl > HF **correct**

2. HI > HCl > HF > HBr

3. HF > HCl > HBr > HI

4. HCl > HF > HI > HBr

Explanation:

Electronegativity Diff 01

09:05, general, multiple choice, < 1 min, fixed.

030 (part 1 of 1) 6 points

For which of the following bonds is the difference in electronegativity the largest?

1. H — F **correct**

2. H — H

3. H — C

4. H — Si

5. H — Cl

Explanation: