

Chem. 201
Spring 2005
Quiz 1

Time: 55 minutes

Chemistry 201
Quiz 1

March 24, 2005

Name: KEY

Student No: _____

Signature: _____

Grade: _____ / 100

Instructions:

- There are 20 multiple-choice-type questions. There is **only one** correct answer. Circle the letter corresponding to the correct answer.

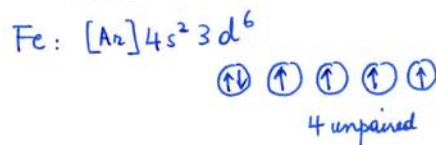
Useful information:

- Avogadro's number: $N_A = 6.023 \times 10^{23} \text{ mol}^{-1}$
- Speed of light: $c = 2.998 \times 10^8 \text{ m s}^{-1}$
- Planck's constant: $h = 6.626 \times 10^{-34} \text{ J s}$

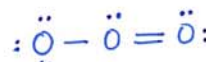
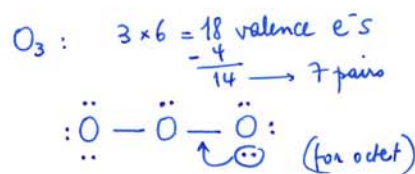
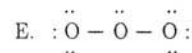
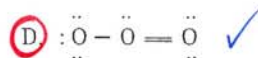
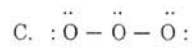
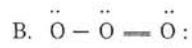
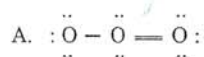
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- An atom of iron has ___ unpaired electrons and is ____.

- A. 0, diamagnetic
- B. 6, diamagnetic
- C. 3, paramagnetic
- D. 5, paramagnetic
- E. 4, paramagnetic**

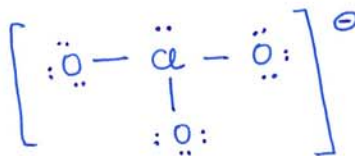
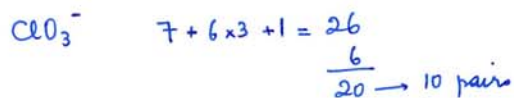


- Which one is a correct Lewis structure for ozone, O_3 ?



- The Lewis structure for a chlorate ion, ClO_3^- should show ___ single bond(s), ___ double bond(s), and ___ lone pair(s).

- A. 2, 1, 10
- B. 3, 0, 9
- C. 2, 1, 8
- D. 3, 0, 10**
- E. 2, 1, 10



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Quiz I

- Calculate the wavelength, in nanometers, of the light emitted by a hydrogen atom when its electron falls from the $n = 7$ to the $n = 4$ principal energy level. Recall that the energy levels of the H atom are given by

$$E_n = -2.178 \times 10^{-18} \text{ J}(1/n^2)$$

- A. $4.45 \times 10^{-20} \text{ nm}$
- B. $2.17 \times 10^{-6} \text{ nm}$
- C. $9.18 \times 10^{-20} \text{ nm}$
- D. $1.38 \times 10^{14} \text{ nm}$
- E. $2.17 \times 10^3 \text{ nm}$**

$$h\nu = R_H \left(\frac{1}{16} - \frac{1}{49} \right) \equiv \frac{hc}{\lambda}$$

$$\begin{aligned} \lambda &= \frac{hc}{R_H \left(\frac{1}{16} - \frac{1}{49} \right)} = \frac{6.626 \times 10^{-34} \times 2.998 \times 10^8}{2.178 \times 10^{-18} (0.0625 - 0.0204)} \\ &= 2.17 \times 10^{-6} \text{ m} = \boxed{2.17 \times 10^3 \text{ nm}} \end{aligned}$$

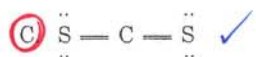
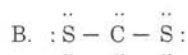
- Calculate the wavelength associated with a $^{20}\text{Ne}^+$ ion moving at a velocity of $2.0 \times 10^5 \text{ m/s}$. The atomic mass of Ne -20 is 19.992 amu.

- A. $1.0 \times 10^{-14} \text{ m}$
- B. $1.0 \times 10^{-16} \text{ m}$
- C. $1.0 \times 10^{-18} \text{ m}$
- D. $9.7 \times 10^{12} \text{ m}$
- E. $2.0 \times 10^{-13} \text{ cm}$
- F. $1.0 \times 10^{-13} \text{ m}$**

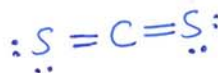
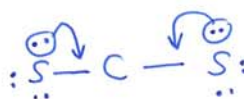
$$\lambda = \frac{h}{mv}$$

$$\begin{aligned} &= \frac{6.626 \times 10^{-34}}{\frac{19.992}{6.023 \times 10^{23}} \times 10^{-3} \times 2.0 \times 10^5} = \frac{9.98 \times 10^{-14}}{1} \text{ m} \\ &\equiv 1.0 \times 10^{-13} \text{ m} \end{aligned}$$

- The Lewis structure for CS_2 is:



$$\text{CS}_2 : 4 + 2 \times 6 = \frac{16}{4}$$



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- According to the VSEPR theory, which one of the following species should be linear?

- A. H₂S
- B. HCN
- C. BF₃
- D. H₂CO
- E. SO₂

H-C≡N: only Lewis structure with no lone pair(s) on the central atom!

- What is the energy in joules of a mole of photons associated with red light of wavelength 7.00×10^2 nm?

- A. 256 kJ
- B. 1.71×10^5 J
- C. 4.72×10^{-43} J
- D. 12.4 kJ
- E. 2.12×10^{42} J

$$E = h\nu \times N_A = 6.626 \times 10^{-34} \times \frac{2.998 \times 10^8}{7.00 \times 10^{-7}} \times 6.023 \times 10^{23}$$
$$= \boxed{1.71 \times 10^5 \text{ J}}$$

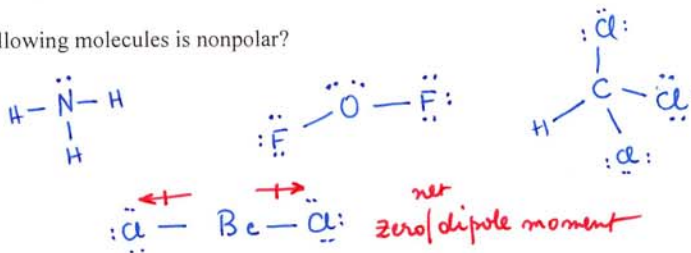
- Which one of the following is most likely to be a covalent compound?

- A. Rb₂S
- B. SrCl₂
- C. H₂S
- D. CaO
- E. MgI₂

All others are ionic!

- Which one of the following molecules is nonpolar?

- A. NH₃
- B. OF₂
- C. CH₃Cl
- D. H₂O
- E. BeCl₂



- Which molecule has a Lewis structure that does not obey the octet rule?

- A. N₂O
- B. CS₂
- C. PH₃
- D. CCl₄
- E. NO₂

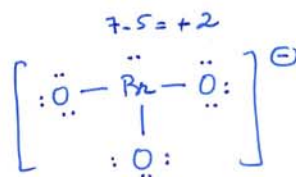
← only molecule with odd # of electrons
(5 + 12 = 17)

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- The formal charge on the bromine atom in BrO_3^- drawn with three single bonds is

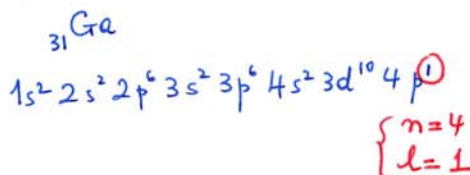
- A. -2
- B. -1
- C. 0
- D. +1
- E. +2**

$$7 + 6 \times 3 = \frac{26}{6} + 1 = 20$$



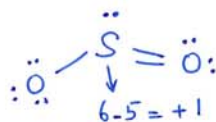
- A possible set of quantum numbers for the last electron added to complete an atom of gallium Ga in its ground state is

	n	l	m_l	m_s
A.	4	0	0	-1/2
B.	3	1	0	-1/2
C.	4	1	0	+1/2
D.	3	1	1	+1/2
E.	4	2	1	+1/2



- The formal charge on the sulfur atom in the resonance structure of SO_2 which has one single bond and one double bond is:

- A. 0
- B. +1**
- C. -1
- D. +2
- E. -2

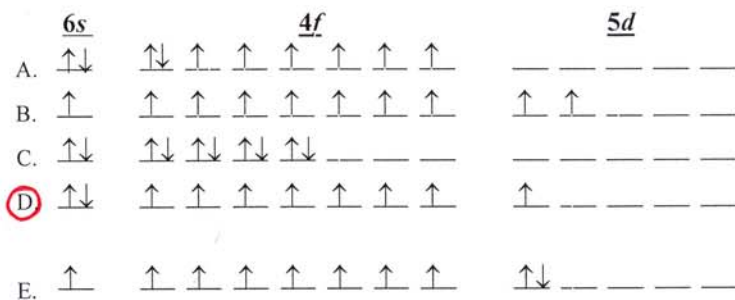


$$6 + 2 \times 6 = 18$$

$$\frac{4}{14}$$

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- The orbital diagram for a ground state Gadolinium Gd atom is:



- Which one of the following is most likely to be an ionic compound?

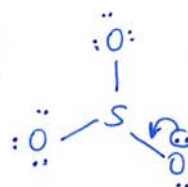
- A. GaAs
- B.** SrBr₂
- C. NO₂
- D. CBr₄
- E. H₂O

Look at locations of atoms in the periodic table to gauge the difference in electronegativity.

- According to the VSEPR theory, the geometry of the SO₃ molecule is

- A. pyramidal.
- B. tetrahedral.
- C.** trigonal planar.
- D. distorted tetrahedron.
- E. square planar.

$$SO_3 \quad 6 + 6 \times 3 = \frac{24}{6} = 4$$



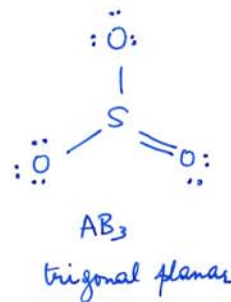
- Which of the following statements is **false** about a 3p_z atomic orbital?

- A. The orbital has one angular node.
- B. The orbital has two nodes overall (radial + angular)
- C. The electron density regions are directed along the z-axis.
- D. The angular part of the wave function has a $\cos \theta$ term.
- E.** The radial part of the wave function is quadratic. \times

one radial node only

$$3 - 1 - 1 = 1$$

$$(n - l - 1)$$



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- Which realization did the experiment by Davisson and Germer mostly put in evidence?

A. The existence of photons
B. The wave properties of particles
C. The particle properties of light
D. Atoms emit light when excited to high energy levels
E. The photoelectric effect
F. A photon possesses mass

- What is the number of electrons with $m_l = 0$ in the ground state of the element manganese ${}_{25}\text{Mn}$?

A. 13 electrons
B. 11 electrons
C. 9 electrons
D. 8 electrons
E. 5 electrons

