

Print Name \_\_\_\_\_ Signature \_\_\_\_\_

This test is closed note/book. One 8.5 x 11 handwritten crib sheet (one sided) is permitted.

Use a #2 pencil. Calculators are permitted. Computers, PDAs, and other electronic devices with a keyboard are not. Please turn off your cell phone. Cell phones may not be used as calculators.

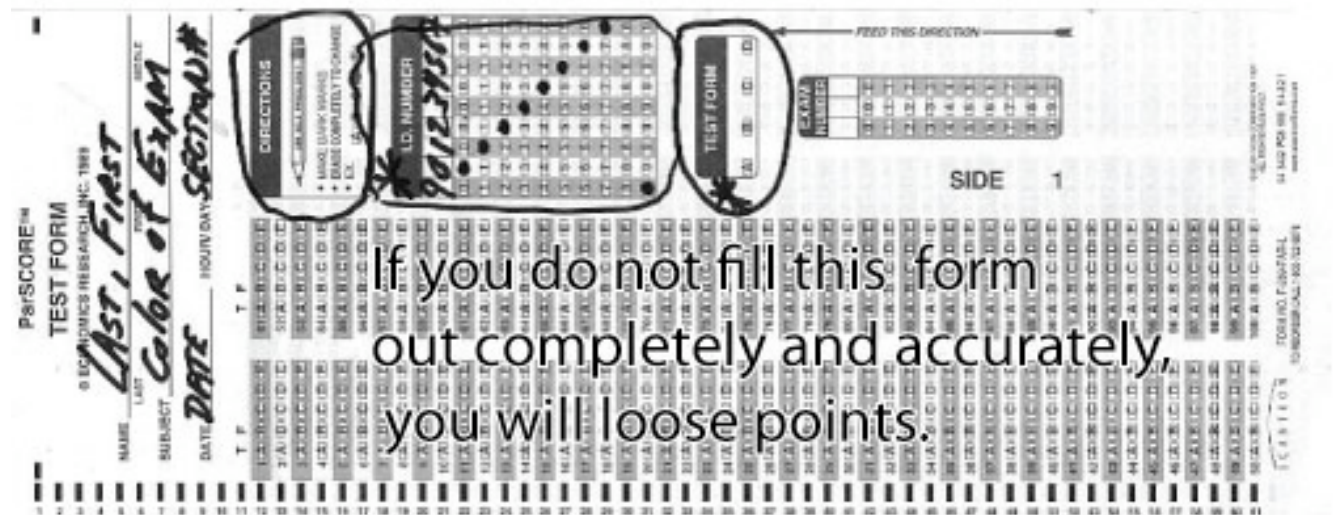
Write your name on every page of this exam. Complete the Scantron card as shown below. You must bubble in your ID number, write in your section number and identify your Test Form (see top of this page). Scantron errors and omissions are punishable by point deductions.

When you take the exam, bubble in the scantron form *and* circle your answers on this exam. You must hand in both the scantron and the exam.

A total of 50 minutes is allotted for the exam. There are 20 questions. Each is worth five points. Answer every question. There is no penalty for guessing.

**Circle Your Section Number**

A1	M 2-3PM	CoC 52
A2	M 2-3PM	CoC 53
A3	M 2-3PM	MSE 1201A
A4	M 2-3PM	MSE 1222
A5	M 2-3PM	MSE 1224
B1	M 3-4PM	CoC 52
B2	M 3-4PM	CoC 53
B3	M 3-4PM	MSE 12101A
B4	M 3-4PM	MSE 1222
B5	M 3-4PM	MSE 1224



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## PERIODIC TABLE OF THE ELEMENTS

http://www.ktf-split.hr/periodni/en/

**GROUP NUMBERS IUPAC RECOMMENDATION (1985)**  
**GROUP NUMBERS CHEMICAL ABSTRACT SERVICE (1986)**

**LEGEND:**  
 - ATOMIC NUMBER: 13  
 - SYMBOL: B  
 - ELEMENT NAME: BORON  
 - RELATIVE ATOMIC MASS (1): 10.811

(1) Pure Appl. Chem., 73, No. 4, 667-685 (2001). Relative atomic mass is shown with the significant figures. For elements having no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element.  
 However, three such elements (Tl, Po, and U) do have a characteristic (primary) isotopic composition, and for these an atomic weight is tabulated.

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Editor: Aditya Vardhan (advardhan@yahoo.com)

<p><b>Constants</b></p> <p>1 mole = <math>6.022 \times 10^{23}</math> atoms</p> <p>1 mole = <math>6.022 \times 10^{23}</math> molecules</p> <p>1 mole = <math>6.022 \times 10^{23}</math> ions</p> <p><math>h = 6.626 \times 10^{-34} \text{ Js}</math></p> <p>1 J (Joule) = <math>1 \text{ kg} \frac{\text{m}^2}{\text{s}^2}</math></p> <p><math>c = 3.0 \times 10^8 \text{ m/s}</math></p> <p>Mass of an Electron = <math>9.10939 \times 10^{-31} \text{ kg}</math></p> <p>Mass of a Proton = <math>1.67 \times 10^{-27} \text{ kg}</math></p> <p>Mass of a Neutron = <math>1.67 \times 10^{-27} \text{ kg}</math></p> <p><math>R = 0.0821 \frac{\text{Latm}}{\text{molK}}</math></p> <p><math>R = 8.31 \frac{\text{J}}{\text{molK}}</math></p>	<p><b>Quantum Mechanics</b></p> <p><math>c = \lambda \nu</math></p> <p><math>E = mc^2</math></p> <p><math>\lambda = \frac{h}{p}</math></p> <p><math>\hat{H}\psi = E\psi</math></p> <p><math>\Delta x * m\Delta v \geq \frac{h}{4\pi}</math></p> <p>Maximum Occupancy = <math>2n^2</math></p>	<p><b>Stoichiometry</b></p> <p><math>Density = \frac{mass}{volume}</math></p> <p><math>Molarity = M = \frac{\text{mole of solute}}{\text{L of solvent}}</math></p> <p><math>n \text{ (number of moles)} = \frac{mass}{\text{Molar Mass}}</math></p> <p><math>M_1V_1 = M_2V_2</math></p>
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1. What is the molar mass of ethanol ( $C_2H_5OH$ )?
- A) 45.07
  - B) 38.90
  - C) 46.07
  - D) 34.17
  - E) 62.07

Answer: C, Chapter 3;  $(2 \times 12) + 5 + 16 + 1 = 46 \text{g/mol}$

2. Phosphorus has the molecular formula  $P_4$  and sulfur has the molecular formula  $S_8$ . How many grams of phosphorus contain the same number of molecules as 6.41 g of sulfur?
- A) 3.10 g
  - B) 3.21 g
  - C) 6.19 g
  - D) 6.41 g
  - E) none of these

Answer: A, Chapter 3

$6.41 \text{g} / (8 \times 32.1 \text{g/mol}) = 0.025 \text{ mol } S_8$ ;  $(0.025 \text{mol})(4 \times 31 \text{g/mol}) = 3.1 \text{g}$

3. The atomic mass of rhenium is 186.2. Given that 37.1% of natural rhenium is rhenium-185, what is the other isotope?
- A)  $^{183}_{75}\text{Re}$
  - B)  $^{187}_{75}\text{Re}$
  - C)  $^{189}_{75}\text{Re}$
  - D)  $^{181}_{75}\text{Re}$
  - E)  $^{190}_{75}\text{Re}$

Answer: B, Chapter 3

$(0.371)(185 \text{g/mol}) + (1.000 - 0.371)(X) = 186.2 \text{g/mol}$ ;  $X = 186.9$

4. A sample of iron weighing 14.2 g contains how many moles of iron atoms?
- A) 3.93 moles
  - B) 0.254 moles
  - C) 0.0739 moles
  - D) 13.5 moles
  - E) none of these

Answer: B, Chapter 3

$14.2 \text{g} / 55.85 \text{g/mol} = 0.254 \text{ mol}$

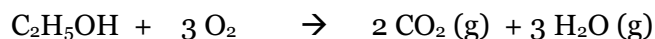
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5. Which of the following statements about water is false?
- A) Its density increases when it freezes
  - B) It has a high boiling point.
  - C) It has high surface tension.
  - D) It dissolves many salts and polar molecules.
  - E) It has high heat capacity

Answer: A, Chapter 4

6. For the reaction of 5.0 g ethanol with 1.0 g oxygen, calculate the theoretical yield of carbon dioxide (CO<sub>2</sub>).



- A) 4.7 grams of CO<sub>2</sub>
- B) 0.90 grams of CO<sub>2</sub>
- C) 2.3 grams of CO<sub>2</sub>
- D) 1.4 grams of CO<sub>2</sub>
- E) 3.1 grams of CO<sub>2</sub>

Answer: B, Chapter 3

C<sub>2</sub>H<sub>5</sub>OH: (5.0g)(46g/mol)<sup>-1</sup>=0.11 mol C<sub>2</sub>H<sub>5</sub>OH will consume 3 (1.1 mol) = 0.33 mol O<sub>2</sub>

Available O<sub>2</sub>: (1.0g)(32g/mol)<sup>-1</sup>=0.031. Since 0.031 < 0.33, O<sub>2</sub> is limiting.

CO<sub>2</sub>: (2/3)(0.031 mol)(44g/mol)=0.94 (the 2/3 comes from the stoic coeffs)

7. How much water must be added to 20.0 mL of a 9.50 M sulfuric acid solution to make a 0.480 M solution?
- A) 81.0 mL
  - B) 101 mL
  - C) 376 mL
  - D) 396 mL
  - E) none of these

Answer: C, Chapter

$M_1V_1=M_2V_2$ ; (20ml)(9.5mol/L)/0.48mol/L = 396 ml;  $V_{\text{add}}=396-20=376\text{ml}$

- 8A. Which of the following statements about the hydrogen atom is false?
- A) The electron occupies discrete energy levels.
  - B) When the primary quantum number (n) increases, light is emitted.
  - C) When light is absorbed, n must change.
  - D) Light is absorbed and emitted at discrete wavelengths
  - E) Light is absorbed and emitted at discrete energies

Answer: B, Chapter 12

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8B. Which of the following statements about electromagnetic radiation (in a vacuum) is false?

- A) The photon energy specifies the wavelength (i.e., if you know the wavelength you know the energy).
- B) The photon frequency specifies the wavelength.
- C) The photon energy specifies the amplitude.
- D) The photon frequency does not specify the phase.
- E) The wavelength emitted by an atom is determined by differences in energy levels.

Answer: C, Chapter 12

9. Which of the following statements about atomic orbitals is false?

- A) An orbital can hold two electrons.
- B) Orbitals do not have precise boundaries
- C) Hydrogen has fewer orbitals than lithium.
- D) An orbital is not an orbit.
- E) The number of probability nodes increases with increasing n (primary quantum number)

Answer: C, Chapter 12

10. Which of the following frequencies corresponds to light with the longest wavelength?

- A)  $3.00 \times 10^{13} \text{ s}^{-1}$
- B)  $8.50 \times 10^{20} \text{ s}^{-1}$
- C)  $4.12 \times 10^5 \text{ s}^{-1}$
- D)  $9.12 \times 10^{12} \text{ s}^{-1}$
- E)  $3.20 \times 10^9 \text{ s}^{-1}$

Answer: C, Chapter 12,  $c=v\lambda$ ,  $c=\text{const}$ , long wavelength ( $\lambda$ ) indicates low frequency ( $\nu$ )

11. Which of the following combinations of quantum numbers is not allowed?

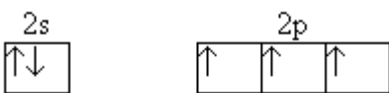



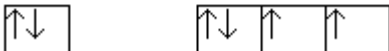
- |    | $n$ | $l$ | $m_{(l)}$ | $m_{(s)}$ |
|----|-----|-----|-----------|-----------|
| A) | 1   | 1   | 0         | 1/2       |
| B) | 3   | 0   | 0         | -1/2      |
| C) | 2   | 1   | -1        | 1/2       |
| D) | 4   | 3   | -2        | -1/2      |
| E) | 4   | 2   | 0         | 1/2       |

Answer: A, Chapter 12

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12. What is the correct electron arrangement of a neutral nitrogen atom in the ground state?

- a)  $2s$   $2p$   

- b) 
- c) 
- d) 
- e) 

Answer: A, Chapter 12

13. Which neutral atoms elements have the same number of valence electrons?

- A) N, As, Bi  
 B) P, S, Cl  
 C) Ag, Cd, Ar  
 D) Na, Ca, Ba  
 E) P, Se, I

Answer: A, Chapter 12

14. Which of the following molecules has a net dipole moment?

- A)  $\text{CBr}_4$   
 B)  $\text{NF}_3$   
 C)  $\text{CO}_2$   
 D)  $\text{BI}_3$   
 E)  $\text{NH}_4^+$

Answer: B, Chapter 13

15. Which bond has the smallest dipole moment?

- A) H-F  
 B) C-N  
 C) C-O  
 D) C-C  
 E) C-F

Answer: D, Chapter 13

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16. Which of the following statements is incorrect?

- A) Ionic bonding results from the transfer of one or more electrons from one atom to another.
- B) A bond dipole indicates the unequal distribution of electrons around the atoms in the bond.
- C) The electrons in a polar bond are found nearer to the more electronegative atom.
- D) A molecule with very polar bonds does not necessarily have a net dipole moment.
- E) Linear molecules cannot have a net dipole moment.

Answer: E, Chapter 13

17. The shape of  $\text{NH}_4^+$  is

- A) Square Pyramidal
- B) Tetrahedral
- C) Truncated Octahedral
- D) Distorted Tetrahedral
- E) Seriously Bent

Answer: B, Chapter 13

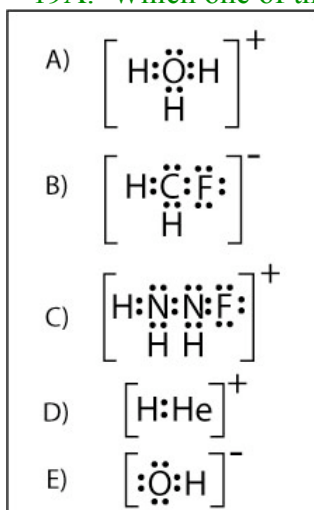
18. Which is an incorrect resonance structure of  $\text{N}_3^-$ ?

- A)  $\left[ \begin{array}{c} \cdot\cdot \\ \text{N} \\ \cdot\cdot \end{array} = \begin{array}{c} \cdot\cdot \\ \text{N} \\ \cdot\cdot \end{array} - \begin{array}{c} \cdot\cdot \\ \text{N} \\ \cdot\cdot \\ \cdot\cdot \end{array} \right]^-$
- B)  $\left[ \begin{array}{c} \cdot\cdot \\ \text{N} \\ \cdot\cdot \end{array} \equiv \text{N} - \begin{array}{c} \cdot\cdot \\ \text{N} \\ \cdot\cdot \\ \cdot\cdot \end{array} \right]^-$
- C)  $\left[ \begin{array}{c} \cdot\cdot \\ \text{N} \\ \cdot\cdot \\ \cdot\cdot \end{array} - \text{N} \equiv \text{N} \begin{array}{c} \cdot\cdot \\ \cdot\cdot \end{array} \right]^-$
- D)  $\left[ \begin{array}{c} \cdot\cdot \\ \text{N} \\ \cdot\cdot \end{array} = \text{N} = \begin{array}{c} \cdot\cdot \\ \text{N} \\ \cdot\cdot \end{array} \right]^-$
- E) all are correct

Answer: A, Chapter 13

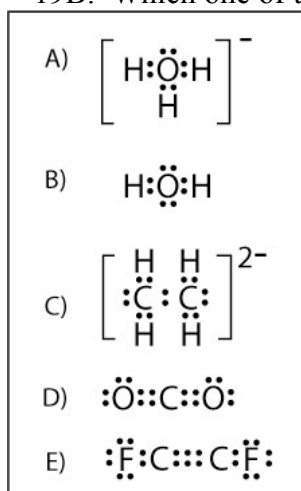
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19A. Which one of these structures is incorrect?



Answer: C, Chapter 13

19B. Which one of these structures is incorrect?



Answer: A, Chapter 13

20. This is Test Form (look at the top of the page):

- A) A
- B) B
- C) C
- D) D

answer C