PSI AP Chemistry Name _____
Unit 1
MC Homework

Laws of Multiple and Definite Proportions and Conservation of Mass

1. Dalton's atomic theory explained the observation that the percentage by mass of the elements in a compound is always the same, thus Dalton's atomic theory supports what Law?

   (A) The Law of Definite Composition
   (B) The Law of Conservation of Mass
   (C) The Law of Conservation of Energy
   (D) The Law of Multiple Proportions
   (E) The Law of Chemical Compounds

2. Which pair of substances could be used to illustrate the law of multiple proportions?

   (A) SO_2, H_2SO_4
   (B) CO, CO_2
   (C) H_2O, O_2
   (D) CH_4, $C_6H_{12}O_6$
   (E) NaCl, KCl

Use the following information to answer questions 3-5.

Two experiments were carried out in the laboratory in which oxygen gas was reacted with carbon under different conditions to form two different oxides. The following data was obtained.

Experiment 1:

Mass of carbon reacting (g)	*Mass of oxygen reacting (g)*
12	32
24	64
36	96

Experiment 2:

Mass of carbon reacting (g)	*Mass of oxygen reacting (g)*
12	16
24	32
36	48

3. Based on the results from experiment 1, the amount of oxygen that reacts with the given amount of carbon for each trial is best explained by:

   (A) The Law of Multiple Proportions
   (B) The Law of Definite Composition
   (C) The Law of Conservation of Mass
   (D) Both A and B
   (E) Both A and C

4. The difference in mass percentages of the reacting carbon and oxygen between the two experiments is best supported by:

   (A) The Law of Multiple Proportions
   (B) The Law of Definite Composition
   (C) The Law of Conservation of Mass
   (D) Not enough information is given

5. What is the ratio of reacting oxygen for the oxides formed from experiments 1 and 2, respectively?

   (A) 1:1
   (B) 1:2
   (C) 2:1
   (D) 1:4
   (E) 4:1

6. Iron(III) Chloride is 34.43% iron with the rest being chlorine. How many grams of chlorine would be present in a pure 150. gram sample of iron(III) chloride?

   (A) 51.6 g Cl
   (B) 65.6 g Cl
   (C) 2.29 g Cl
   (D) 98.4 g Cl
   (E) None of the above

7. Tin(II) oxide (stannous oxide)is 88.10% tin and 11.90% oxygen. If 20.0 grams of this material was analyzed, what masses of tin and oxygen must be present to establish if the substance is pure?

   (A) 88.10 g Sn, 11.90 g O
   (B) 44.05 g Sn, 5.95 g O
   (C) 17.62 g Sn, 2.38 g O
   (D) 2.38 g Sn, 17.62 g O
   (E) 4.41 g Sn, 0.595 g O

8. Laughing gas is a compound formed from nitrogen and oxygen in which there are 1.75 g of nitrogen to 1.00 g of oxygen. Below are given the compositions of several nitrogen and oxygen compounds. Which of these is laughing gas?

   (A) 6.35 g nitrogen, 7.26 g oxygen
   (B) 4.63 g nitrogen, 10.58 g oxygen
   (C) 8.84 g nitrogen, 5.05 g oxygen
   (D) 9.62 g nitrogen, 16.5 g oxygen
   (E) 14.3 g nitrogen, 40.9 g oxygen

9. Tin forms two compounds with chlorine, $SnCl_2$ and $SnCl_4$. When combined with the same mass of tin, what would be the ratio of masses of chlorine, respectively, for the two compounds?

    (A) 2:1
    (B) 1:2
    (C) 4:1
    (D) 1:4
    (E) 1:1

10. A compound of nitrogen and oxygen has the formula NO. In this compound there are 1.143 g of oxygen for each 1.00g of nitrogen. A different compound of nitrogen and oxygen has the formula NO_2. How many grams of oxygen would be combined with each 1.00 g of nitrogen in NO_2?

    (A) 2.286 g O
    (B) 0.5715 g O
    (C) 2.000 g O
    (D) 1.000 g O
    (E) 4.572 g O

Atomic Masses

11. The atomic mass unit (unified mass unit) is presently based on assigning an exact integral mass (in amu) to an isotope of _____.

    (A) Hydrogen - 1
    (B) Carbon - 12
    (C) Sodium - 23
    (D) Oxygen - 16
    (E) Helium - 4

12. Vanadium has two naturally occurring isotopes, ^{50}V with an atomic mass of 49.9472 amu and ^{51}V with an atomic mass of 50.9440. The atomic weight of vanadium is 50.9415. The percent abundances of the vanadium isotopes are _____% ^{50}V and _____% ^{51}V.

    (A) 0.25, 99.75
    (B) 99.75, 0.25
    (C) 49, 51
    (D) 1.0, 99
    (E) 99, 1.0

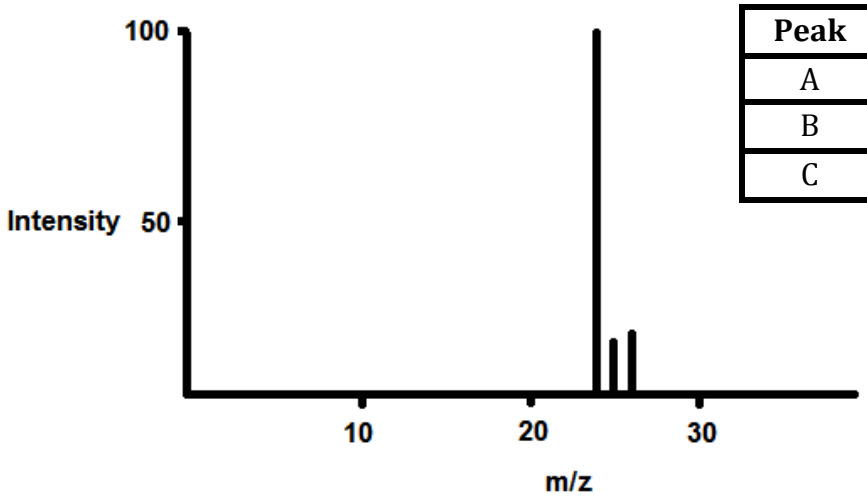
13. An unknown element is found to have three naturally occurring isotopes with atomic masses of 35.9675 (0.337%), 37.9627 (0.063%), and 39.9624 (99.600%). Which of the following is the unknown element?

(A) Ar
(B) K
(C) Cl
(D) Ca
(E) None of the above could be the unknown element.

14. There are two principal isotopes of indium (atomic weight = 114.82 amu). One of these, $^{113}_{49}\text{In}$, has an atomic mass of 112.9043 amu. The second isotope is most likely to be:

(A) $^{111}_{49}\text{In}$
(B) $^{112}_{49}\text{In}$
(C) $^{114}_{49}\text{In}$
(D) $^{115}_{49}\text{In}$

Use the mass spectrum of the unknown element below to answer questions 15- 18.



Peak	m/z	Intensity
A	24	100
B	25	12.7
C	26	14.1

15. How many stable isotopes are represented on the mass spectrum?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

16. What is the relative abundance of peak B?

(A) 12.7
(B) 10.02
(C) 11.12
(D) 78.86
(E) 14.1

17. What is the average atomic mass based on the mass spectrum data?

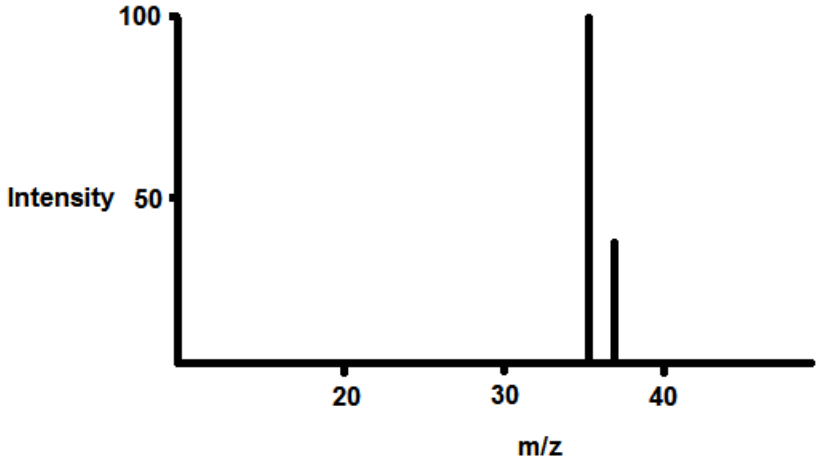
(A) 24.32 amu
(B) 22.99 amu
(C) 30.84 amu
(D) 25.00 amu
(E) None of the above

18. To which element does this mass spectrum belong?

(A) Na
(B) Mg
(C) Al
(D) Ne
(E) P

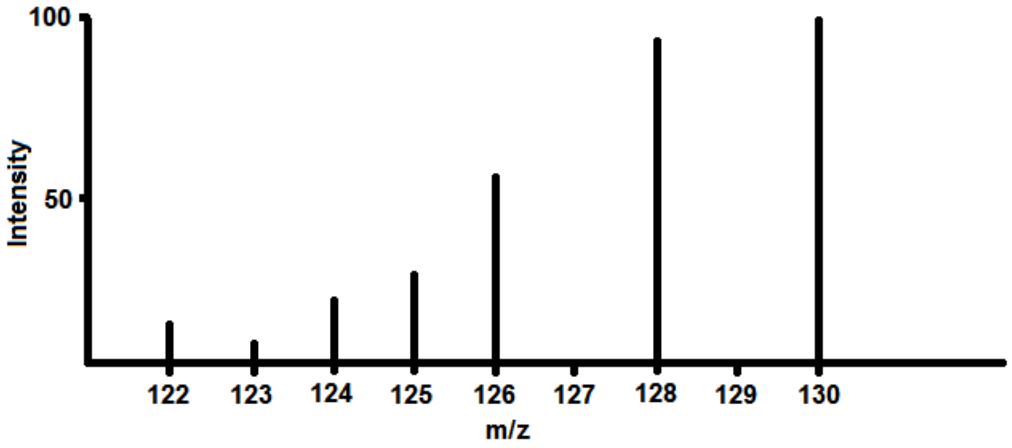
19. Chlorine consists of two isotopes, Cl-35 (34.97 u) and Cl-37 (36.97 u). If the relative intensity of Cl-35 was 100 on the mass spectrum, what would be the relative intensity of the Cl-35 peak? Use the average atomic mass of chorine from the periodic table.

(A) 30.97
(B) 24.00
(C) 31.58
(D) 35.45
(E) 34.97



Peak A: 34.97 u, Intensity = 100
Peak B: 36.97 u, Intensity = ?

20. The elements I and Te have similar average atomic masses. A sample that was believed to be a mixture of I and Te was run through a mass spectrometer, resulting in the following data. All of the following statements are true. Which would be the best basis for concluding that the sample was pure Te?



(A) Te forms ions with a -2 charge, whereas I forms ions with a -1 charge.
(B) Te is more abundant than I in the universe
(C) I consists of only one naturally occurring isotope with 74 neutrons, whereas Te has more than one isotope.
(D) I has a higher first ionization energy that Te does

Rutherford and Bohr Models

21. Rutherford's experiments on the scattering of a particles by thin metal foils established that:

(A) The mass and charge of an atom are concentrated in a nucleus.
(B) Electrons are fundamental particles of all matter.
(C) All electrons have the same charge.
(D) Atoms are electrically neutral.

22. Which of the following is an ***incorrect*** statement about the Rutherford scattering experiment?

(A) Most of the alpha particles directed at a very thin gold foil passed right through the foil, undeflected from their straight-line path
(B) As a result of the experiment, the atom is pictured as consisting mostly of open space
(C) The few alpha particles that were on a collision course with the gold electrons were repelled backward at acute angles
(D) The experiment led to the conclusion that the nucleus of an atom contains all of the atom's positive charge
(E) The experiment provided a partial understanding of the location and charge of the particles within the atom

23. Which of the following statements is/are incorrect?

I. The Bohr model successfully predicts energies in the ultraviolet portion of the hydrogen spectrum
II. The Bohr model successfully predicts energies and frequencies of hyperfine spectral lines
III. The Bohr model associates electron energy with the radius at which an electron orbits the nucleus
IV. The Bohr model does not explain the failure of an electron to lose energy as it travels a circular path around a nucleus

(A) I. only
(B) II. only
(C) III. only
(D) IV. only
(E) III. and IV.

24. What color of visible light has the highest energy?

(A) Violet
(B) Blue
(C) Red
(D) Green
(E) Yellow

25. Of the following transitions in the Bohr hydrogen atom, the _____ transition results in the emission of photon with the longest wavelength.

(A) $n = 1 \rightarrow n = 6$
(B) $n = 1 \rightarrow n = 4$
(C) $n = 6 \rightarrow n = 1$
(D) $n = 3 \rightarrow n = 6$
(E) $n = 6 \rightarrow n = 3$

26. The energy (J) required for an electronic transition in a Bohr hydrogen atom from n = 2 to n = 3 is _____ J.

(A) 4.00×10^{-19}
(B) 3.00×10^{-19}
(C) -3.00×10^{-19}
(D) -7.90×10^{-19}
(E) 4.60×10^{14}

27. Calculate the wavelength of the spectral line in the spectrum of hydrogen for which $n_i = 1$ and $n_f = 3$. Will this produce an emission or absorption spectral line?

(A) 277 nm, absorption
(B) 103 nm, absorption
(C) 103 nm, emission
(D) 397 nm, absorption
(E) 397 nm, emission

Photoelectron Spectroscopy

Use the following answer choices to complete questions 28-29

I. Atomic mass
II. Atomic number
III. Occupied Bohr orbit
IV. Number of electrons in a particular Bohr orbit
V. Coulombic forces

28. Influences the energy of a PES peak.

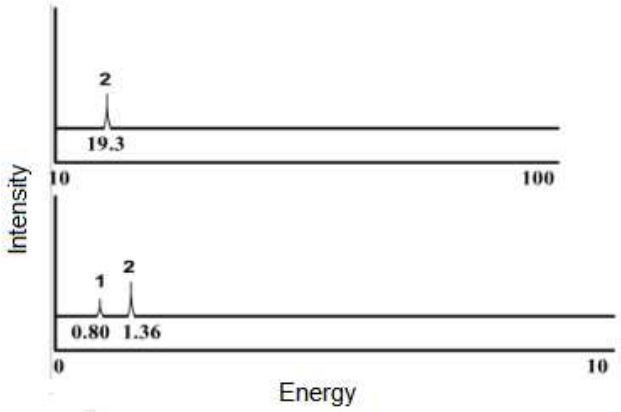
(A) II only
(B) II and IV
(C) II, III, and V
(D) IV only
(E) II and III

29. Influences the intensity of a PES peak.

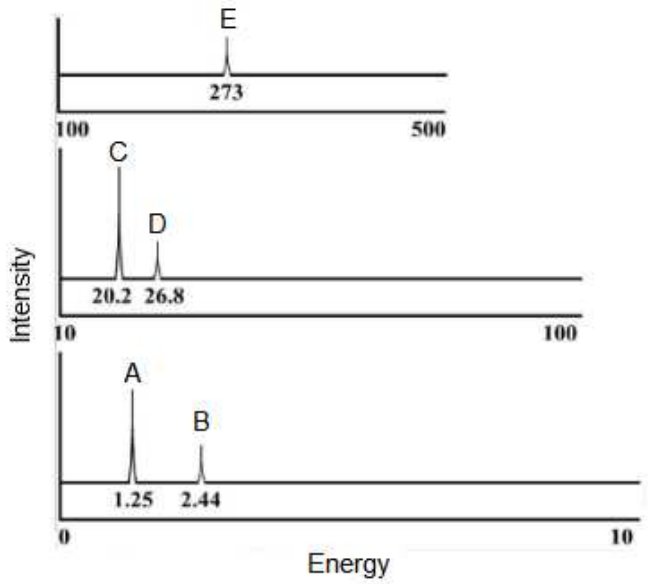
(A) I only
(B) II only
(C) III only
(D) IV only
(E) II and III

30. What element is represented by the PES spectrum below?

(A) He
(B) Li
(C) B
(D) Be
(E) C



Use the PES spectrum of Chlorine below to answer questions 31 – 36 below.



31. _____ Which peak is produced by the orbital furthest from the nucleus?

32. _____ Which peak is produced by the ionization of 5 valence electrons?

33. _____Which peak is produced by the 2s orbital?

34. _____Which peak represents electrons in the lowest energy Bohr orbital?

35. Which of the following correctly describes the ratio of the intensities of peaks **C** and **D**?

(A) 2:3
(B) 3:1
(C) 3:2
(D) 5:1
(E) 5:2

36. Which orbital and how many electrons are represented by peak **B** in the PES spectrum of chlorine above?

(A) 1s, 2 electrons
(B) 2s, 2 electrons
(C) 3s, 2 electrons
(D) 1s, 1 electron
(E) 3s, 1 electron

37. The PES spectrum of carbon (C) should have how many distinct peaks?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

Quantum Model and Electron Configurations

38. The failure of the Bohr model to explain the stability of the Bohr orbits was best resolved by which hypothesis?

(A) Rutherford's nuclear model
(B) Quantum numbers
(C) Heisenberg's Uncertainty Principle
(D) Pauli Exclusion Principle
(E) de-Broglie's Wave Equation

Use the following to answer question 39-40.

I. The model was based on the wave properties of the electron.
II. The electron behaved as a particle and can exist only in discrete states
III. Describes the orientation of electrons around a nucleus
IV. Describes the location of the electron as an orbital in which there is a high probability of finding an electron
V. Explains the degenerate nature of s, p, d, and f suborbitals

39. Which of the above statements applies to the Quantum model?

(A) I and II
(B) I, III, IV, and V
(C) IV and V
(D) V only
(E) All of the above

40. Which of the above statements applies to the Bohr model?

(A) I and II
(B) I and III
(C) II and III
(D) IV and V
(E) II only

Use the following choices to answer questions 41-44 below.

(A) $1s^2 2s^2 2p^1$
(B) $1s^2 2p^1$
(C) $1s^2 2s^2 2p^6 3s^2$
(D) $1s^2 2s^2 2p^7 3s1$
(E) $1s^2 2s^2 2p^6$

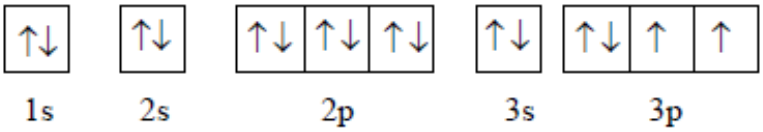
41. _____ Corresponds to a noble gas

42. _____ Represents an impossible configuration

43. _____ Ground state configuration for Mg

44. _____ Represents and atom in an excited state

45. What element has the following electron orbital notation?



(A) Cl
(B) Be
(C) S
(D) Ti
(E) Se

46. Which one of the following electron configurations for the species in their ground state is not correct?

(A) Ca: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
(B) Bi: $[Xe] 6s^2 4f^{14} 5d^{10} 6p^3$
(C) As: $[Ar] 4s^2 3d^{10} 4p^3$
(D) Br: $[Ar] 4s^2 3d^{10} 4p^5$
(E) P: $1s^2 2s^2 2p^6 3p^5$

47. Which of the following is the correct electronic configuration for the iron(III) ion?

(A) $[Ar]\ 3d^5$
(B) $[Ar]\ 4s^2\ 3d^3$
(C) $[Kr]\ 4s^2\ 3d^3$
(D) $[Kr]\ 3d^5$
(E) $[Ar]\ 4s^2\ 3d^6$

48. Which of the following is an isoelectronic series?

(A) B^{5-}, Si^{4-}, As^{3-}, Te^{2-}
(B) F^{-}, Cl^{-}, Br^{-}, I^{-}
(C) S, Cl, Ar, K
(D) Si^{2-}, P^{2-}, S^{2-}, Cl^{2-}
(E) O^{2-}, F^{-}, Ne, Na^{+}

49. A correct description for the electron configuration of a selenium atom is

(A) [Ar] $4s^1$ $3d^{10}$ $4p^5$, paramagnetic.
(B) [Ar] $4s^2$ $3d^{10}$ $4p^4$, paramagnetic.
(C) [Ar] $4s^2$ $3d^8$ $4p^6$, paramagnetic.
(D) [Ar] $3d^{10}$ $4p^6$, diamagnetic.
(E) [Ar] $4s^1$ $3d^9$ $4p^6$, paramagnetic.

50. Which of the following ions would **not** be attracted to a magnetic field?

(A) Ti^{2+}
(B) Mg^{2+}
(C) V^{2+}
(D) Zr^{2+}
(E) Fe^{2+}

51. How many valence electrons are present in a Cd atom?

(A) 12
(B) 10
(C) 8
(D) 6
(E) 2

PSI AP Chemistry Name _____**Key**_____
Unit 1
MC Homework

Laws of Multiple and Definite Proportions and Conservation of Mass

1. Dalton's atomic theory explained the observation that the percentage by mass of the elements in a compound is always the same, thus Dalton's atomic theory supports what Law?

   (A) The Law of Definite Composition
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Experiment 2:

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36	48

3. Based on the results from experiment 1, the amount of oxygen that reacts with the given amount of carbon for each trial is best explained by:

   (A) The Law of Multiple Proportions
   (B) The Law of Definite Composition
   (C) The Law of Conservation of Mass
   (D) Both A and B
   (E) Both A and C

4. The difference in mass percentages of the reacting carbon and oxygen between the two experiments is best supported by:

   (A) The Law of Multiple Proportions
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   (C) The Law of Conservation of Mass
   (D) Not enough information is given

5. What is the ratio of reacting oxygen for the oxides formed from experiments 1 and 2, respectively?

   (A) 1:1
   (B) 1:2
   (C) 2:1
   (D) 1:4
   (E) 4:1

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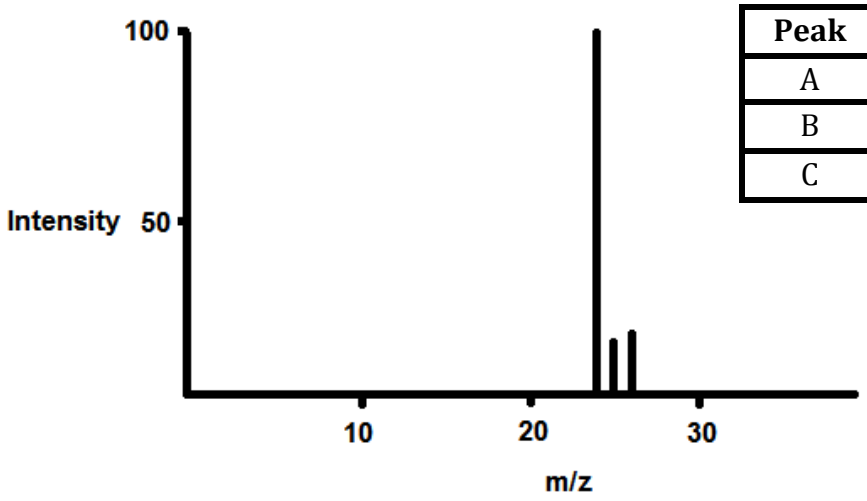

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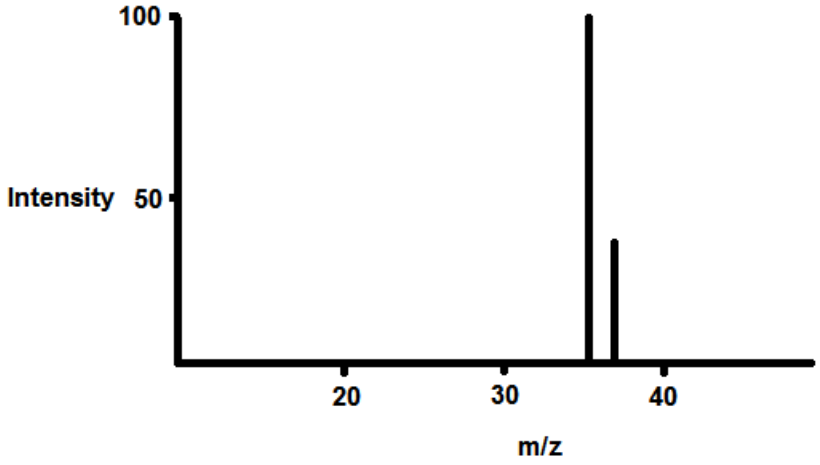

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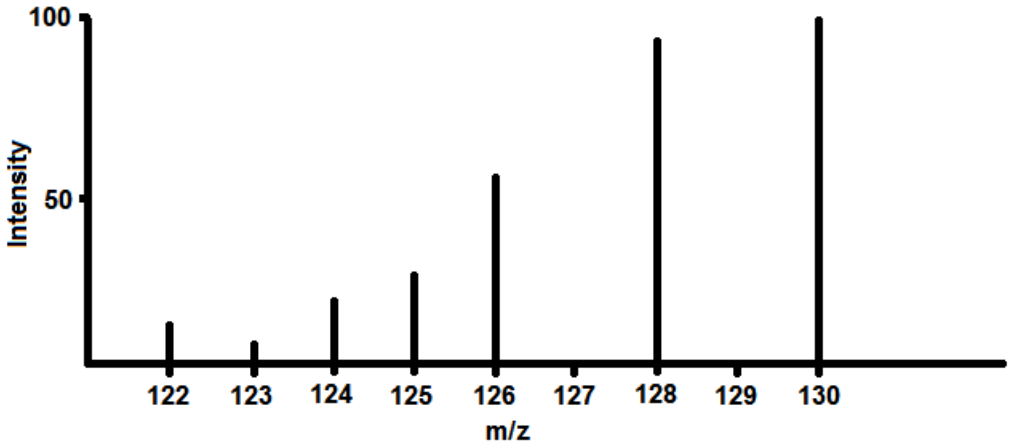

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(D) IV. only
(E) III. and IV.

24. What color of visible light has the highest energy?

(A) Violet
(B) Blue
(C) Red
(D) Green
(E) Yellow

25. Of the following transitions in the Bohr hydrogen atom, the _____ transition results in the emission of photon with the longest wavelength.

(A) $n = 1 \rightarrow n = 6$
(B) $n = 1 \rightarrow n = 4$
(C) $n = 6 \rightarrow n = 1$
(D) $n = 3 \rightarrow n = 6$
(E) $n = 6 \rightarrow n = 3$

26. The energy (J) required for an electronic transition in a Bohr hydrogen atom from n = 2 to n = 3 is _____ J.

(A) 4.00×10^{-19}
(B) 3.00×10^{-19}
(C) -3.00×10^{-19}
(D) -7.90×10^{-19}
(E) 4.60×10^{14}

27. Calculate the wavelength of the spectral line in the spectrum of hydrogen for which $n_i = 1$ and $n_f = 3$. Will this produce an emission or absorption spectral line?

(A) 277 nm, absorption
(B) **103 nm, absorption**
(C) 103 nm, emission
(D) 397 nm, absorption
(E) 397 nm, emission

Photoelectron Spectroscopy

Use the following answer choices to complete questions 28-29

VI. Atomic mass
VII. Atomic number
VIII. Occupied Bohr orbit
IX. Number of electrons in a particular Bohr orbit
X. Coulombic forces

28. Influences the energy of a PES peak.

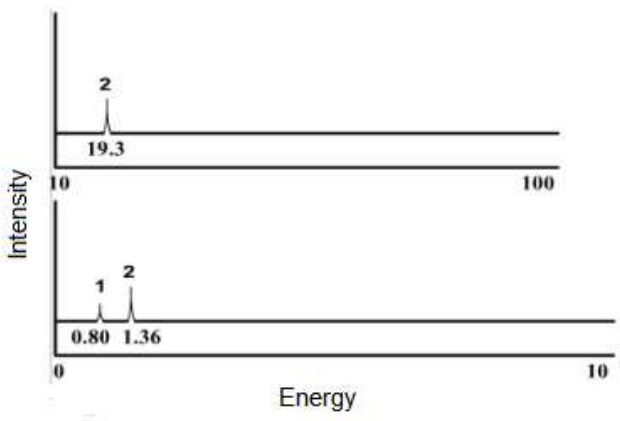
(A) II only
(B) II and IV
(C) II, III, and V
(D) IV only
(E) II and III

29. Influences the intensity of a PES peak.

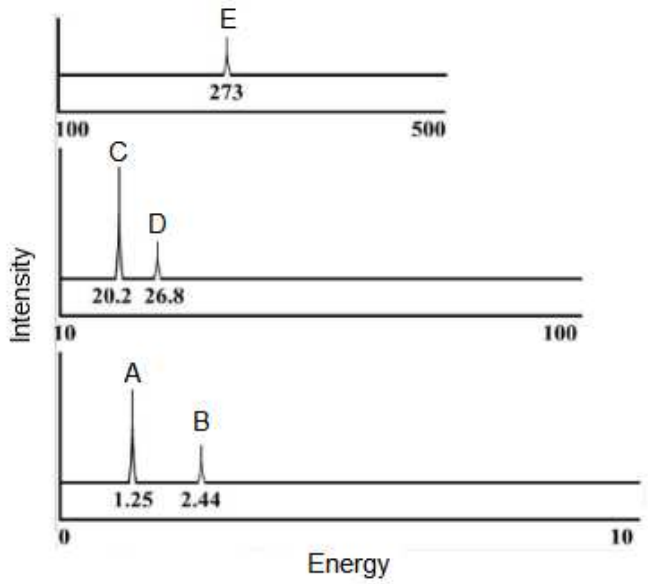
(A) I only
(B) II only
(C) III only
(D) IV only
(E) II and III

30. What element is represented by the PES spectrum below?

(A) He
(B) Li
(C) B
(D) Be
(E) C



Use the PES spectrum of Chlorine below to answer questions 31 – 36 below.



31. __**A**__ Which peak is produced by the orbital furthest from the nucleus?

32. __**A**__ Which peak is produced by the ionization of 5 valence electrons?

33. __**D**__ Which peak is produced by the 2s orbital?

34. __**E**__ Which peak represents electrons in the lowest energy Bohr orbital?

35. Which of the following correctly describes the ratio of the intensities of peaks **C** and **D**?

(A) 2:3
(B) 3:1
(C) 3:2
(D) 5:1
(E) 5:2

36. Which orbital and how many electrons are represented by peak **B** in the PES spectrum of chlorine above?

(A) 1s, 2 electrons
(B) 2s, 2 electrons
(C) 3s, 2 electrons
(D) 1s, 1 electron
(E) 3s, 1 electron

37. The PES spectrum of carbon (C) should have how many distinct peaks?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

Quantum Model and Electron Configurations

38. The failure of the Bohr model to explain the stability of the Bohr orbits was best resolved by which hypothesis?

(A) Rutherford's nuclear model
(B) Quantum numbers
(C) Heisenberg's Uncertainty Principle
(D) Pauli Exclusion Principle
(E) de-Broglie's Wave Equation

Use the following to answer question 39-40.

VI. The model was based on the wave properties of the electron.
VII. The electron behaved as a particle and can exist only in discrete states
VIII. Describes the orientation of electrons around a nucleus
IX. Describes the location of the electron as an orbital in which there is a high probability of finding an electron
X. Explains the degenerate nature of s, p, d, and f suborbitals

39. Which of the above statements applies to the Quantum model?

(A) I and II
(B) I, III, IV, and V
(C) IV and V
(D) V only
(E) All of the above

40. Which of the above statements applies to the Bohr model?

(A) I and II
(B) I and III
(C) II and III
(D) IV and V
(E) II only

Use the following choices to answer questions 42-44 below.

(A) $1s^2 2s^2 2p^1$
(B) $1s^2 2p^1$
(C) $1s^2 2s^2 2p^6 3s^2$
(D) $1s^2 2s^2 2p^7 3s1$
(E) $1s^2 2s^2 2p^6$

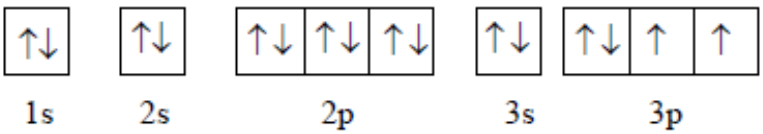
41. __**E**__ Corresponds to a noble gas

42. __**D**__ Represents an impossible configuration

43. __**C**__ Ground state configuration for Mg

44. __**B**__ Represents and atom in an excited state

45. What element has the following electron orbital notation?



(A) Cl
(B) Be
(C) S
(D) Ti
(E) Se

46. Which one of the following electron configurations for the species in their ground state is not correct?

(A) Ca: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
(B) Bi: $[Xe] 6s^2 4f^{14} 5d^{10} 6p^3$
(C) As: $[Ar] 4s^2 3d^{10} 4p^3$
(D) Br: $[Ar] 4s^2 3d^{10} 4p^5$
(E) P: $1s^2 2s^2 2p^6 3p^5$

47. Which of the following is the correct electronic configuration for the iron(III) ion?

(A) [Ar] $3d^5$
(B) [Ar] $4s^2$ $3d^3$
(C) [Kr] $4s^2$ $3d^3$
(D) [Kr] $3d^5$
(E) [Ar] $4s^2$ $3d^6$

48. Which of the following is an isoelectronic series?

(A) B^{5-}, Si^{4-}, As^{3-}, Te^{2-}
(B) F^-, Cl^-, Br^-, I^-
(C) S, Cl, Ar, K
(D) Si^{2-}, P^{2-}, S^{2-}, Cl^{2-}
(E) O^{2-}, F^-, Ne, Na^+

49. A correct description for the electron configuration of a selenium atom is

(A) [Ar] $4s^1\ 3d^{10}\ 4p^5$, paramagnetic.
(B) [Ar] $4s^2\ 3d^{10}\ 4p^4$, paramagnetic.
(C) [Ar] $4s^2\ 3d^8\ 4p^6$, paramagnetic.
(D) [Ar] $3d^{10}\ 4p^6$, diamagnetic.
(E) [Ar] $4s^1\ 3d^9\ 4p^6$, paramagnetic.

50. Which of the following ions would **not** be attracted to a magnetic field?

(A) Ti^{2+}
(B) Mg^{2+}
(C) V^{2+}
(D) Zr^{2+}
(E) Fe^{2+}

51. How many valence electrons are present in a Cd atom?

(A) 12
(B) 10
(C) 8
(D) 6
(E) 2