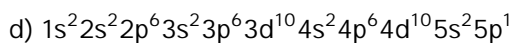
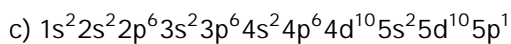
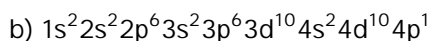
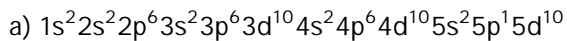


"What Do I Remember From Introductory Chemistry?" - A Problem Set

These problems review a portion of the material from introductory chemistry that you should be very familiar with.

1. The electron configuration of indium is:



e) none of these

2. From the following list of observations choose the one that most clearly supports the following conclusion: atoms contain electrons.

a) emission spectrum of hydrogen.

b) the photoelectric effect.

c) scattering of alpha particles by metal foil.

d) diffraction.

e) cathode "rays."

3. From the following list of observations choose the one that most clearly supports the following conclusion: the electrons in atoms have quantized energies.

- a) emission spectrum of hydrogen.
- b) the photoelectric effect.
- c) scattering of alpha particles by metal foil.
- d) diffraction.
- e) cathode "rays."

4. The electron configuration for Cr^{2+} is

- a) $[\text{Ar}]4s^23d^4$
- b) $[\text{Ar}]4s^13d^5$
- c) $[\text{Ar}]3d^4$
- d) $[\text{Ar}]4s^23d^2$
- e) none of these

5. Ti has _____ in its d orbitals

- a) 1 electron
- b) 2 electrons
- c) 3 electrons
- d) 4 electrons
- e) none of these

6. From the following list of observations choose the one that most clearly supports the following conclusion: electromagnetic radiation has particulate properties.

- a) emission spectrum of hydrogen.
- b) the photoelectric effect.
- c) scattering of alpha particles by metal foil.
- d) diffraction.
- e) cathode "rays."

7. Green light has a wavelength of 5.50×10^2 nm. The energy of a photon of green light is

- a) 3.64×10^{-38} J
- b) 2.17×10^5 J
- c) 3.61×10^{-19} J
- d) 1.09×10^{-27} J
- e) 5.45×10^{12} J

8. Consider the following orderings.

- I. Al < Si < P < S
- II. Be < Mg < Ca < Sr
- III. I < Br < Cl < F
- IV. $\text{Na}^+ < \text{Mg}^{2+} < \text{Al}^{3+} < \text{Si}^{4+}$

Which of these give(s) a correct trend in size?

- a) I
- b) II
- c) IV
- d) I, II
- e) II, IV

9. Which of the following statements about quantum theory is (are) incorrect?

- a) The energy and position of an electron cannot be determined simultaneously.
- b) Lower energy orbitals are filled with electrons before higher energy orbitals.
- c) When filling orbitals of equal energy, two electrons will occupy the same orbital before filling a new orbital.
- d) No two electrons can have the same four quantum numbers.
- e) All of these are correct.

10. Researchers in West Germany discovered the synthetic element with atomic number 109 (now called Meitnerium (do you know who it was named for?)). Which of the following elements would have chemical properties most similar to this new element

- a) W
- b) Rn
- c) Ir
- d) Lr
- e) U

11. Which of the following statements is (are) false?

- a) ionization energies are always positive.
- b) for any atom with at least two electrons, the first ionization energy is always smaller than the second ionization energy.
- c) electron affinities are usually negative.
- d) electron affinities are always negative.
- e) all are true.

12. The electron configuration of Ti^{2+} is

- a) $[\text{Ar}]4s^2$
- b) $[\text{Ar}]4s^13d^1$
- c) $[\text{Ar}]3d^2$
- d) $[\text{Ar}]4s^23d^2$
- e) none of these

13. How many electrons can be described by the quantum numbers $n=3$, $l=3$, $m_l=1$?

- a) 0
- b) 2
- c) 6
- d) 10
- e) 14

14. If an electron (mass = 9.11×10^{-31} kg) has an associated wavelength of 1.21×10^{-3} nm, what is the magnitude of the electron's velocity?

a) 1.66×10^{-9} m/sec

b) 6.01×10^8 m/sec

c) 1.66 m/sec

d) 1.14×10^6 m/sec

e) 6.01 m/sec

15. Which of the following statements is true?

a) The exact location of an electron can be determined if we know its energy.

b) An electron in a 2s orbital can have the same n , l , and m_l quantum numbers as an electron in a 3s orbital.

c) Ni has 2 unpaired electrons in its 3d orbitals.

d) In the build-up of atoms, electrons occupy the 4f orbitals before the 6s orbitals.

e) Only three quantum numbers are needed to uniquely describe an electron.

16. Which of the following atoms or ions has 3 unpaired electrons?

a) N

b) O

c) Al

d) S^{2-}

e) Zn^{2+}

17. Which of the following orbitals is highest in energy in the potassium atom?

- a) 1s
- b) 4s
- c) 3s
- d) 3d
- e) 3p

18. Consider the ionization energy (I.E.) of the magnesium atom. Which of the following is not true?

- a) The I.E. of Mg is lower than that of sodium.
- b) The I.E. of Mg is lower than that of neon.
- c) The I.E. of Mg is lower than that of beryllium.
- d) The I.E. of Mg is higher than that of calcium.
- e) The I.E. of Mg is lower than that of Mg^+ .

19. Which of the following electron configurations is correct?

- a) Ga: $[\text{Kr}]3d^{10}4s^24p^1$
- b) Mo: $[\text{Kr}]5s^24d^5$
- c) Ca: $[\text{Ar}]4s^13d^{10}$
- d) Br: $[\text{Kr}]3d^{10}4s^24p^7$
- e) Bi: $[\text{Xe}]6s^24f^{14}5d^{10}6p^3$

20. When ignited, a uranium compound burns with a green flame. The wavelength of the light given off by this flame is greater than that of:

- a) red light
- b) infrared light
- c) radio waves
- d) ultraviolet light
- e) none of these

21. Which of the following combinations of quantum numbers do not represent permissible solutions of the Schrodinger equation for the electron in the hydrogen atom [i.e., which combination of quantum numbers is NOT allowed]?

	n	l	m	s (or m_s)
a)	9	8	-4	1/2
b)	8	2	2	1/2
c)	6	6	-1	1/2
d)	6	5	-5	1/2
e)		all are allowed		

22. Which of the following statements are true?

1. An excited atom can return to its ground state by absorbing electromagnetic radiation.
2. The energy of an atom is increased when electromagnetic radiation is emitted from it.
3. The energy of electromagnetic radiation increases as its frequency increases.
4. An electron in the $n=4$ state in the hydrogen atom can go to the $n=2$ state by emitting electromagnetic radiation at the appropriate frequency.
5. The frequency and wavelength of electromagnetic radiation are inversely proportional to each other.

- a) 2,3,4
- b) 3,5
- c) 1,2,3
- d) 3,4,5
- e) 1,2,4

23. Which of the following statements is false?

- a) An orbital can accommodate at most two electrons.
- b) The electron density at a point is proportional to ψ^2 at that point.
- c) The spin quantum number of an electron must be either $+1/2$ or $-1/2$.
- d) A 2p orbital is more penetrating than a 2s; i.e., it has a higher electron density near the nucleus and inside the charge cloud of a 1s orbital.
- e) In the usual order of filling, the 6s orbital is filled before the 4f orbital.

24. Of the following types of radiation, how many have energies greater than that of visible blue light?

visible green, ultraviolet, infrared, x-rays, visible red

- a) 0
- b) 1
- c) 2
- d) 3
- e) 4

25. Which of the following is not determined by the principal quantum number, n , of the electron in a hydrogen atom?

- a) the energy of the electron
- b) the minimum wavelength of the light needed to remove the electron from the atom
- c) the size of the corresponding atomic orbital(s)
- d) the shape of the corresponding atomic orbital (s)
- e) all of the above are determined by n

26. From the following list of observations choose the one that most clearly supports the following conclusion: electromagnetic radiation has wave characteristics.

- a) emission spectrum of hydrogen.
- b) the photoelectric effect.
- c) scattering of alpha particles by metal foil.
- d) diffraction.
- e) cathode "rays."

27. An element E has the electron configuration $[\text{Kr}]4d^{10}5s^25p^2$. The formula for the fluoride of E is most likely

- a) EF_{14}
- b) EF_4
- c) EF
- d) EF_6
- e) EF_8

28. From the following list of observations choose the one that most clearly supports the following conclusion: most of the mass of the atom is located in the nucleus.

- a) emission spectrum of hydrogen.
- b) the photoelectric effect.
- c) scattering of alpha particles by metal foil.
- d) diffraction.
- e) cathode "rays.

29. From the following list of observations choose the one that most clearly supports the following conclusion: electrons have wave properties.

- a) emission spectrum of hydrogen.
- b) the photoelectric effect.
- c) scattering of alpha particles by metal foil.
- d) diffraction.
- e) cathode "rays."

30. How many f orbitals have $n = 3$?

- a) 0
- b) 3
- c) 5
- d) 7
- e) 1

31. In an investigation of the electronic absorption spectrum of a particular element, it is found that a photon having $\lambda = 500 \text{ nm}$ provides just enough energy to promote an electron from the second quantum level to the third. From this information, we can deduce

- a) the energy of the $n = 2$ level.
- b) the energy of the $n = 3$ level.
- c) the sum of the energies of $n = 2$ and $n = 3$.
- d) the difference in energies between $n = 2$ and $n = 3$.
- e) all of the above.

32. Of the following pairs of elements, which is most likely to show the same oxidation state?

- a) Ba, Ca
- b) Cl, P
- c) Si, P
- d) Ca, F
- e) Ba, F

33. Of the following types of radiation, how many have wavelengths longer than that of visible blue light?

visible green, ultraviolet, infrared, x-rays, visible red

- a) 0
- b) 1
- c) 2
- d) 3
- e) 4

34. Which of the following forms the most ionic bond with chlorine?

- a) K
- b) Al
- c) P
- d) Kr
- e) Br

35. Which of the following molecules contains a carbon atom with trigonal planar geometry?

The electronegativity values are:

C = 2.5, H = 2.2, Cl = 3.2, N = 3.0, and O = 3.4.

- a) CH₃CHO
- b) CO₂
- c) CH₃Cl
- d) C₂H₆
- e) none

36. Which of the following molecules shows the smallest number of lone pairs in its Lewis structure?

- a) CH₃CHO
- b) CO₂
- c) CH₃Cl
- d) C₂H₆
- e) none

37. What type of structure does the XeOF_2 molecule have?

- a) pyramidal
- b) tetrahedral
- c) T-shaped
- d) triangular
- e) octahedral

38. Which of the following molecules is the most polar? The electronegativity values are:

C = 2.5, H = 2.2, Cl = 3.2, N = 3.0, and O = 3.4.

- a) CH_3CHO
- b) CO_2
- c) CH_3Cl
- d) C_2H_6
- e) none

39. Which of the following statements (a through d) about BCl_3 is false?

- a) It is an electron-deficient compound.
- b) It has a dipole moment.
- c) It is trigonal planar in shape.
- d) It is likely to react with electron pair donor molecules.
- e) All statements (a through d) are true.

40. Which of the following species has an unpaired electron?

- a) NO_2^-
- b) NO_2
- c) NO_2^+
- d) NO^+
- e) none of these

41. What is the molecular structure for XeF_4 ?

- a) linear
- b) tetrahedral
- c) square planar
- d) octahedral
- e) none of these

42. Which of the following molecules has a nonlinear structure?

- a) XeF_2
- b) BeCl_2
- c) O_3
- d) CO_2
- e) N_2O (central atom is N)

43. Select the polar molecule among the following.

- a) CO_2
- b) SeO_3
- c) XeF_4
- d) SF_4
- e) BeCl_2

44. On the basis of the localized electron model, choose the correct statement regarding the following four molecules.

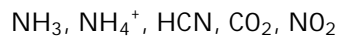
SiH_4 , SeCl_4 , XeCl_4 , OF_2

- a) The central atoms in all four compounds have lone pairs of electrons.
- b) Only SiH_4 and SeCl_4 have no net dipole moment.
- c) XeCl_4 and OF_2 have central atoms which are sp^3 hybridized.
- d) The central atoms in SeCl_4 and XeCl_4 use d orbitals for bonding.
- e) All atoms in XeCl_4 , OF_2 , and SeCl_4 lie in the same plane.

45. Which of the following compounds or ions violates the octet rule?

- a) SiCl_4
- b) PCl_4^+
- c) AlCl_4^-
- d) SCl_4
- e) OF_2

46. How many of the following molecules or ions are linear?



a) 0

b) 1

c) 2

d) 3

e) 4

47. As indicated by Lewis structures, which of the following would probably not exist as a stable molecule?

a) CH_3OH

b) CH_2O

c) CH_3O

d) C_2H_2

e) C_3H_4

48. What is the molecular structure for ClO_2^- ?

a) linear

b) tetrahedral

c) square planar

d) octahedral

e) none of these

49. The molecular structure of IF_4^- can best be described as

- a) octahedral
- b) trigonal bipyramidal
- c) square planar
- d) tetrahedral
- e) none of these

50. What is the molecular structure for NI_3 ?

- a) linear
- b) tetrahedral
- c) square planar
- d) octahedral
- e) none of these

51. What is the molecular structure for PCl_4^+ ?

- a) linear
- b) tetrahedral
- c) square planar
- d) octahedral
- e) none of these

52. What is the molecular structure for I_3^- ?

- a) linear
- b) tetrahedral
- c) square planar
- d) octahedral
- e) none of these

53. Choose the compound with the most ionic bond.

- a) LiCl
- b) KF
- c) NaCl
- d) LiF
- e) KCl

54. The correct statement is:

- a) H_2O is linear.
- b) The molecule ClO_2 cannot be accurately described by a Lewis structure consistent with the octet rule.
- c) The diatomic molecule Cl_2 is an example of a polar molecule.
- d) The bonds in LiF have more covalent character than those in F_2 .
- e) All these statements are false.

55. In the molecule XeF_2 , how many pairs of electrons surround Xe and what is the molecular geometry?

- a) 4, bent
- b) 4, pyramidal
- c) 5, linear
- d) 5, bent
- e) 6, linear

56. What is the molecular structure for XeF_6 ?

- a) linear
- b) tetrahedral
- c) square planar
- d) octahedral
- e) none of these

57. The geometry of AsCl_5 is:

- a) trigonal bipyramidal.
- b) square pyramidal.
- c) distorted tetrahedral.
- d) octahedral.
- e) none of these.

58. Which bond is most likely to be nonionic?

a) Pb-O

b) Cs-F

c) Li-I

d) Hg-S

e) Se-F

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