

Practice Final #1 - 2013

Jim and Tim's Excellent Adventure's in Final Exam Preparation

Practice Final 1 2013

1. What type of orbital is designated by the quantum numbers  $n = 3$ ,  $l = 1$ , and  $m_l = 0$ ?
  - A. 4p
  - B. 1f
  - C. 3s
  - D. 3p
  - E. 3d
2. Use the noble-gas core to write the electron configuration for Tc.
  - A.  $[\text{Xe}]5s^24d^5$
  - B.  $[\text{Kr}]5s^22d^5$
  - C.  $[\text{Kr}]4d^7$
  - D.  $[\text{Kr}]5s^24d^5$
  - E.  $[\text{Kr}]5s^14d^6$
3. Praseodymium (Pr  $Z=59$ ) is one of the lanthanide (rare earth) elements. Which of the following statements is a TRUE statement about the orbital into which the last electron was filled for the element Pr?
  - A. The number of radial nodes is greater than the number of angular nodes
  - B. The orbital is a 5f orbital
  - C. The orbital contains valence electrons
  - D. The orbital is one member of a set of seven degenerate orbitals
  - E. none of the other four statements is true
4. Placing electrons into orbitals one by one from low energy to high energy is one way of stating
  - A. Aufbau principle.
  - B. Pauli exclusion principle.
  - C. Heisenberg's uncertainty principle.
  - D. Hund's rule.
  - E. Law of the Conservation of Energy
5. The electron in hydrogen is in the ground state. It absorbs enough energy so that its final energy is *greater than zero*. To what does this correspond?
  - A. The electron is free of the hydrogen nucleus and has extra kinetic energy.
  - B. The electron goes to the highest energy level.
  - C. Part of the energy goes into the energy level and part into the electron.
  - D. The energy goes into the Lyman series.
  - E. The electron can only have negative energies.



9. The ionic radii of the ions,  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$ , are different. Which of the two has the larger radius and why?

- A.  $\text{Fe}^{3+}$ . Although both the species have the same nuclear charge, more electrons are pulled in the case of  $\text{Fe}^{3+}$  than in  $\text{Fe}^{2+}$ .
- B. Neither  $\text{Fe}^{2+}$  nor  $\text{Fe}^{3+}$ , but  $\text{Fe}^{+1}$  has the larger ionic radius. Since the removal of only one valence electron from its outermost  $d$  orbitals, the species acquire a  $d^5$  configuration and thus give a greater stability to  $\text{Fe}^+$  cation (half-filled orbitals are as stable as the filled ones).
- C.  $\text{Fe}^{2+}$ . Although both the species have the same nuclear charge, more electrons are pulled in the case of  $\text{Fe}^{2+}$  than in  $\text{Fe}^{3+}$ .
- D. Both  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$  have the same atomic radius. Since both the species are derived from the same element with the same nuclear charge, the valence electrons are also pulled equally.

10. Which element below is *not* correctly paired with the noble-gas-core-abbreviated  $s p d f$  notation for the simple ion that is most likely to form from it?

- A. Ba, [Xe]
- B. K, [Ar]
- C. N, [Ne]
- D. Se, [Ar]
- E. I, [Xe]

11. Why does oxygen have a larger first ionization energy than beryllium?

- A. Oxygen wants to gain electrons more than beryllium does.
- B. Oxygen has more electrons.
- C. There is less unscreened nuclear charge for the electrons on oxygen.
- D. The electron removed in oxygen is closer to the nucleus.
- E. Ionization energies are greater to the right in the periodic table.

12. Predict the electron configuration of  $\text{Co}^{2+}$

- A.  $[\text{Ar}]4s^23d^7$
- B.  $[\text{Ar}]4s^23d^9$
- C.  $[\text{Ar}]3d^7$
- D.  $[\text{Ar}]4s^23d^4$
- E.  $[\text{Ar}]4s^13d^5$

13. Which one of the following has an electronic configuration different from the others?

- A.  $\text{K}^+$
- B.  $\text{Mg}^{2+}$
- C.  $\text{Sc}^{3+}$
- D.  $\text{S}^{2-}$
- E. Ar

14. The outermost electron(s) of which of the following experience the greatest effective nuclear charge?

- A. P
- B. Br
- C. Ca
- D. K
- E. All four experience the same effective nuclear charge.

15. Which of the following concerning size is correct?

- A.  $\text{Na}^+ > \text{K}^+$
- B.  $\text{Mg}^{2+} > \text{Rb}^+$
- C.  $\text{As}^{5+} > \text{Sb}^{3-}$
- D.  $\text{O} > \text{S}^{2-}$
- E.  $\text{Br}^- > \text{Cl}^-$

16. With one of the following bond descriptions is correct?

- A. CsF Pure covalent
- B.  $\text{F}_2$  Ionic
- C. NAs Pure covalent
- D. HCl Polar covalent
- E. BrCl Ionic

17. What is the formal charge on the nitrogen atom in the most plausible Lewis structure of  $[\text{CNO}]^-$  ?

- A. -2
- B. -1
- C. +1
- D. +2
- E. none of these

18. The correct Lewis structure for the  $\text{CCl}_4$  molecule shows:

- A. 1 double bond.
- B. 10 shared electrons.
- C. 5 bonds.
- D. no unshared electrons.
- E. 24 unshared electrons.

19. If atoms of the two elements in each set below are joined by a covalent bond, one atom will more strongly attract the electrons in the bond. Which choice below does not correctly identify this atom?

- A. S and O, O more strongly attracts the electrons.
- B. B and Cl, Cl more strongly attracts the electrons.
- C. N and S, S more strongly attracts the electrons.
- D. Te and Br, Br more strongly attracts the electrons.
- E. As and F, F more strongly attracts the electrons.

21. The molecular geometry around the central atom in SF<sub>4</sub> is

- A. tetrahedral
- B. square planar
- C. pyramidal
- D. T-shaped
- E. seesaw

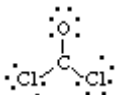
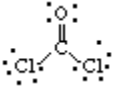
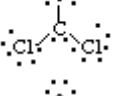
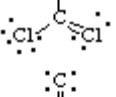
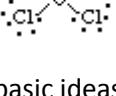
22. Which one of the following molecules is non-polar?

- A. BCl<sub>3</sub>
- B. H<sub>2</sub>O
- C. NCl<sub>3</sub>
- D. PCl<sub>3</sub>
- E. All are polar

23. According to the VSEPR theory, which of the following should NOT be linear?

- A. BeH<sub>2</sub>
- B. SO<sub>2</sub>
- C. CS<sub>2</sub>
- D. NNO
- E. ICl

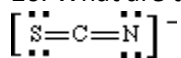
24. Which is the correct Lewis structure that follows the octet rule for COCl<sub>2</sub>?

- A. 
- B. 
- C. 
- D. 
- E. 

25. The basic ideas of, and uses for, VSEPR theory are all of the following **except**

- A. that electron pairs in the valence shell repel each other.
- B. predicting molecular geometry.
- C. predicting electronegativities.
- D. predicting bond angles.
- E. all of the above

26. What are the formal charges of the atoms in the thiocyanate ion? The thiocyanate ion is:



- A. S = 0, C = 0, N = 0
- B. S = 0, C = 0, N = -1
- C. S = -2, C = 0, N = -3
- D. S = 2, C = 4, N = 1

27. Three of the molecular shapes which a  $sp^3d$  hybridized molecule can have are:

- A. triangular, trigonal bipyramid, linear
- B. linear, square planar, T-shaped
- C. irregular tetrahedron, T-shaped, bent
- D. T-shaped, linear, trigonal bipyramid
- E. none of these is correct

28. The hybridization that agrees with the geometry around the central atom in the ion  $\text{I}3^-$  is

- A.  $sp$
- B.  $sp^2$
- C.  $sp^3$
- D.  $sp^3d$
- E.  $sp^3d^2$

29. What is the bond order of  $\text{N}_2$ ?

- A. 2
- B. 2.5
- C. 6
- D. 3
- E. 4

30. According to the molecular orbital (M.O.) theory, when two oxygen atoms bond together, their 2p orbitals combine to form

- A. two sigma M.O.'s and two pi M.O.'s.
- B. two sigma M.O.'s and four pi M.O.'s.
- C. one sigma and one pi M.O.'s.
- D. two sigma M.O.'s and two pi M.O.'s
- E. four pi M.O.'s only.

31. For the molecule  $\text{CH}_2=\text{CH}-\text{OH}$

- A. the geometry about O is linear.
- B. Both carbons are  $sp^2$  hybridized
- C. There are two pi bonds between the two carbons.
- D. the hybridization on O is  $sp$ .
- E. O is not hybridized.

32. The concept of an anti-bonding orbital is unique to the:

- A. theory of bond hybridization
- B. valence bond theory
- C. molecular orbital theory
- D. concept of resonance
- E. electrostatic repulsion theory

33. According to the M.O. theory the removal of an electron from the  $C_2$  molecule will have what effect? (pick the best answer)

- A. It will cause the bond order to increase and the ion will be diamagnetic
- B. It will cause the bond order to decrease and the ion will be diamagnetic.
- C. It will cause the bond order to increase and the ion will be paramagnetic.
- D. It will cause the bond order to decrease and the ion will be paramagnetic.
- E. It will cause the bond order to decrease but will have no effect on the magnetism.

34. Which of the following species has the highest bond order?

- A.  $O_2$
- B.  $O_2^{2-}$
- C.  $O_2^-$
- D.  $O_2^+$

35. In the HOCN molecule, the H-O-C bond angle is  $118^\circ$ , while the O-C-N bond angle is  $180^\circ$ . The hybridizations of carbon and oxygen are, respectively,

- A. C-sp, O- $sp^2$ .
- B. C- $sp^2$ , O- $sp^3$ .
- C. C- $sp^2$ , O- $sp^2$ .
- D. C-sp, O- $sp^3$ .
- E. C-sp, O-sp.

36. Which of the following is paramagnetic?

- a.  $He_2^{2+}$
- b.  $B_2$
- c.  $F_2$
- d.  $N_2^-$

- A. b and d
- B. a, b, d
- C. d only
- D. b only

37. What is the molecular shape of  $\text{BrF}_5$ ?

- A. linear
- B. square pyramid
- C. square planar
- D. octahedral
- E. trigonal bipyramid

38. In which of the following structures is the electron-group geometry different from the molecular geometry?

- A.  $\text{BI}_3$
- B.  $\text{SiCl}_4$
- C.  $\text{H}_2\text{Se}$
- D.  $\text{SF}_6$
- E. None of the above

39. Which of the following substances has the highest boiling point?

- A.  $\text{CH}_4$
- B.  $\text{CCl}_4$
- C.  $\text{CBr}_4$
- D.  $\text{CF}_4$

40. In which of the following compounds is hydrogen bonding not an important intermolecular force?

- A.  $\text{H}_2$
- B.  $\text{CH}_3\text{NH}_2$
- C.  $\text{HF}$
- D.  $\text{CH}_3\text{OH}$

41. Which of the following compounds would you expect to be the highest boiling and which the lowest boiling?

(a)  $\text{HF}$  (b)  $\text{HCl}$  (c)  $\text{HBr}$  (d)  $\text{HI}$

- A. a and b
- B. a and c
- C. b and c
- D. a and d
- E. c and d

42. Based on the electron-sea model for metals which of the following would be the correct order of increasing melting points.

- A. Na < Mg < Al
- B. Mg < Na < Al
- C. Al < Mg < Na
- D. Al < Na < Mg
- E. Na < Al < Mg

43. A reaction that is **not** typical of the alkali metals is

- A.  $2 M_2O_2 (s) + 2 CO_2 (g) \rightarrow 2 M_2CO_3 (s) + O_2 (g)$
- B.  $M_2O + H_2O \rightarrow 2 MOH$
- C.  $2 M + O_2 \rightarrow M_2O_2$
- D.  $M + X_2 \rightarrow MX_2$  (X = halogen)

44. The inclusion of a small amount of phosphorus in a crystal of pure germanium yields what kind of semiconductor?

- A. an insulator
- B. an amorphous solid
- C. n-type in which extra electrons carry the current
- D. p-type in which a deficiency of electrons carries the current
- E. p-n-p type

45. What is the primary method of producing the alkaline earth metals?

- A. precipitation
- B. neutralization
- C. oxidation
- D. reduction
- E. annihilation

46. Alkali metals

- A. conduct electricity better than copper.
- B. are softer than asphalt.
- C. are all denser than water.
- D. have high electronegativities.
- E. have high ionization energies.

47. Which is **not** primarily composed of aluminum oxide?

- A. garnet
- B. corundum
- C. ruby
- D. blue sapphire

48. Water mixed with a 1A element (M) gives what?
- $M(OH)_2$
  - $H_2$  and  $MOH$
  - $MH$  and  $OH^-$
  - $MH_2$  and  $O_2$
  - $MOH$  and  $H^+$
49. Which of the following is true of the  $Fe(CN)_6^{4-}$  ion?
- It can have cis and trans forms.
  - It has an octahedral shape.
  - It has bidentate ligands.
  - It has a tetrahedral shape.
50. What is the formula of aquapentaamminecobalt(III)chloride?
- $[Co(NH_3)_5]Cl_3(aq)$
  - $[Co(H_2O)(NH_3)_5]Cl_4$
  - $[CoCl_3]((H_2O)(NH_3)_5]$
  - $[Co(H_2O)(NH_3)_5]5Cl$
  - None of the above
51. How many unpaired electrons are in  $[VBr_6]^{4-}$ ?  $Br^-$  is a weak field ligand.
- 0
  - 1
  - 3
  - 2
52. An isolated nickel atom in its zero oxidation state has the electronic configuration  $d^8s^2$ . Which of the following configurations represents the orbital hybridization of nickel in the paramagnetic square planar complex ion  $[Ni(Cl)_4]^{2-}$ ?
- $sp^3$
  - $d^3sp^2$
  - $d^2sp^3$
  - $dsp^2$
53. What is the formula for potassium hexacyanomanganate(III)?
- $K[Mn(CN)_6]$
  - $K_3[Mn(CN)_6]$
  - $K_3[(CN)_6Mn_3]$
  - $K_3[(CN)_6MnO_4]$
  - None of the above

54. An aqueous solution of which of the following is most likely to be yellow?

- A.  $[\text{PtCl}_6]^{2-}$
- B.  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$
- C.  $[\text{FeF}_6]^{3-}$
- D.  $[\text{Cr}(\text{OH})_4]^-$
- E.  $[\text{Fe}(\text{CN})_6]^{4-}$

55. The bombardment of a boron-11 atom by an alpha particle yields a neutron and one other particle. What is the other particle?

- A.  ${}^{14}_7\text{N}$
- B.  ${}^{14}_6\text{C}$
- C.  ${}^{15}_6\text{C}$
- D.  ${}^{18}_9\text{F}$
- E. None of the above

56. About how long would be required for the activity of a sample of  ${}^{222}_{86}\text{Rn}$  to go from  $4.0 \times 10^{12}$  disintegrations per second to  $2.4 \times 10^{11}$  disintegrations per second? The half-life of  ${}^{222}_{86}\text{Rn}$  is 3.8 days

- A. about 23 days
- B. about 11 days
- C. about four days
- D. about 15 days
- E. None of the above

57. The half-life of iodine-131 is 8.04 d. We follow the activity of a sample of iodine-131 while it falls to 10.0% of its original value. Calculate the length of time required to drop to this level.

- A. 1.22 d
- B. 0.198 d
- C. 26.7 d
- D. 0.286 d
- E. It cannot be determined without knowing the original sample mass.

58. What is the product formed after  ${}^{228}_{89}\text{Ac}$  undergoes successive decays of  $\beta$ ,  $\alpha$ , and  $\alpha$ ?

- A.  ${}^{220}_{84}\text{Po}$
- B.  ${}^{220}_{86}\text{Rn}$
- C.  ${}^{219}_{86}\text{Rn}$
- D.  ${}^{220}_{87}\text{Fr}$
- E.  ${}^{223}_{85}\text{At}$

59. In electron capture:

- A. a covalent bond is formed.
- B. a positron is formed.
- C. an alpha particle is emitted.
- D. gamma rays are emitted.
- E. a neutron is formed.

60.  ${}^8_3\text{Li}$  decays to  ${}^8_4\text{Be}$ . What type of decay is this?

- A. beta decay
- B.  $\gamma$ -ray emission
- C. positron emission
- D. alpha decay
- E. electron capture