

Past Final Exam (Practice)

- Which of the following compounds could behave as a ligand to a transition metal
 - BH_3
 - CH_4
 - Na^+
 - PH_3
 - None of the listed compounds
- Which of the following coordination complexes can give rise to a set of geometric isomers
 - $[\text{Co}(\text{NH}_3)_5\text{NO}_2]^{+2}$
 - $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
 - $[\text{Pt}(\text{NH}_3)_3\text{SCN}]^+$
 - $[\text{Cr}(\text{H}_2\text{O})_6]^{+3}$
 - None of these
- Which metal complex below is chiral?
 - $[\text{cis-Fe}(\text{en})_2\text{I}_2]^+$
 - $[\text{Fe}(\text{NH}_3)_4\text{Cl}_2]^+$
 - $[\text{Fe}(\text{NH}_3)_6]^{3+}$
 - $[\text{trans-Fe}(\text{en})_2\text{I}_2]^+$
 - none of these complexes are chiral.
- The number of unpaired electrons in a coordination compound depends upon:
 - the identity of the central metal atom
 - the oxidation state of the central metal atom
 - the identity of the ligands
 - the coordination geometry
 - all of these
- In the coordination compound $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$, the coordination number and oxidation number of the central atom are, respectively
 - 2, 0.
 - 4, 4.
 - 5, 0.
 - 4, 2.
 - 6, 2.
- $[\text{CuCl}_4]^{2-}$ absorbs light in the blue part of the visible spectrum, thereby appearing to have the colour:
 - yellow
 - cyan
 - green
 - blue
 - red
- How many 3d electrons does a V^{3+} ion have?
 - 6.
 - 5.
 - 4.
 - 3.
 - 2.

8. The complex ion $[\text{Cr}(\text{CN})_6]^{4-}$ has magnetic properties that correspond to how many unpaired electrons?
- A. 0 B. 1 C. 2 D. 3 E. 4
9. Complexes with 8 d electrons prefer square planar rather than tetrahedral geometries. Which of the following complexes is square planar?
- A. $[\text{Rh}(\text{NH}_3)_4]^+$
B. $\text{Ni}(\text{CO})_4$
C. $[\text{FeCl}_4]^{2-}$
D. $[\text{Pd}(\text{H}_2\text{O})_6]^{2+}$
E. $[\text{Ag}(\text{NH}_3)_2]^+$
10. Which of the following will show the greatest energy increase when six ligands approach the central metal atom along the x, y, and z axes?
- A. d_{xy}
B. d_{yz}
C. d_{z^2}
D. d_{xz}
E. They should all be the same.
11. A compound contains platinum(II) with two ammonia molecules bonded to it. The compound also contains two moles of chloride (Cl^-) per mole of platinum. Treatment of the compound with silver nitrate does not result in the precipitation of silver chloride. The formula of the compound is:
- A. $[\text{Pt}(\text{NH}_3)_2]\text{Cl}_2$
B. $[\text{Pt}(\text{NH}_3)_2\text{Cl}]\text{Cl}$
C. $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
D. This cannot be determined from the available information.
E. None of these compounds is the correct formula.
12. Which one of the following is an example of a covalent network solid?
- A. SiO_2
B. K
C. I_2
D. CaCl_2
E. None of these form a covalent network solid.
13. Choose the INCORRECT statement.
- A. In a network covalent solid, covalent bonds extend throughout the crystalline solid.
B. In diamond the carbon atoms are sp^3 hybridized.
C. In graphite the carbon atoms are sp hybridized.
D. Fullerenes are recently discovered allotropic form of carbon.
E. Nanotubes are an allotropic form of carbon.

14. Which of the following would you expect to have the highest boiling point
- $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
 - $(\text{CH}_3)_2\text{CHNH}_2$
 - $\text{CH}_3\text{CH}_2\text{NHCH}_3$
 - $(\text{CH}_3)_3\text{N}$
15. Which of the following ionic compounds should have the highest melting point?
- NaI
 - MgO
 - NaCl
 - LiBr
 - CaS
16. The intermolecular forces active in $\text{CH}_3\text{-O-CH}_2\text{-CH}_3$ are:
- hydrogen bonding
 - dipolar interactions
 - london dispersion forces
- 1 only
 - 2 only
 - 3 only
 - 2 and 3
 - 1, 2 and 3
17. The boiling point of H_2O is much higher than that of the analogous molecule H_2S . This result is attributable to:
- dispersion forces being much stronger in H_2S than H_2O .
 - hydrogen bonding being much stronger in H_2S than H_2O .
 - ionic forces being much stronger in H_2S than H_2O .
 - all of these
 - none of these
18. Which one of the following statements concerning dispersion forces is correct?
- Dispersion forces are the only ones that hold atoms together in a molecule.
 - Dispersion forces result from temporary dipoles induced in atoms and molecules.
 - Dispersion forces result from the presence of hydrogen atoms bonded to O, N or F.
 - For similar species dispersion forces tend to decrease with increasing molar mass.
 - Atoms and molecules for which the electron cloud cannot easily be distorted give rise to high dispersion forces.
19. Calculate the frequency of visible light having a wavelength of 486.1 nm.
- $2.06 \times 10^{14}/\text{s}$
 - $2.06 \times 10^6/\text{s}$
 - $6.17 \times 10^{14}/\text{s}$
 - $1.20 \times 10^{-15}/\text{s}$
 - $4.86 \times 10^{-7}/\text{s}$

20. Davisson and Germer (as well as G. P. Thompson) conducted a famous and important experiment. Which of the following statements is TRUE concerning their experiment?
- A. They observed diffraction patterns from photons confirming that light had wave properties
 - B. They observed diffraction patterns of electrons confirming that matter had wave properties
 - C. Their experiment contradicted DeBroglie's equation
 - D. They observed standing wave patterns from electrons confirming the existence of orbitals
 - E. None of the other four statements is true
21. If the wavelength of an electron is equal to the radius of the $n=2$ orbit in He^+ , what must the velocity of the electron be?
- A. 6.88×10^6 m/s
 - B. 1.38×10^7 m/s
 - C. 3.44×10^6 m/s
 - D. 5.47×10^5 m/s
 - E. The velocity cannot have an exact value
22. Which of the following statements is/are TRUE ?
- A. The wavefunction, ψ , is a solution to the Schrodinger equation
 - B. The square of the wavefunction, ψ^2 , is the total probability of finding the electron in a **spherical shell** at distance r from the nucleus
 - C. Orbitals with the same n cannot overlap in space
 - D. For the same orbital type (i.e. same l quantum number), orbitals with the higher n value will have a more negative energy
 - E. two of the other four statements are true
23. If the wavelength of an electron is equal to the radius of the $n=2$ orbit in He^+ , what must the velocity of the electron be?
- A. 6.88×10^6 m/s
 - B. 1.38×10^7 m/s
 - C. 3.44×10^6 m/s
 - D. 5.47×10^5 m/s
 - E. The velocity cannot have an exact value
24. When light of a wavelength of 125 nm strikes a certain metal, electrons having a velocity of 8.2×10^5 m/s are emitted from the surface of the metal. What is the threshold frequency of the metal?
- A. 1.9×10^{15} s⁻¹
 - B. 3.1×10^{-19} s⁻¹
 - C. 2.4×10^{15} s⁻¹
 - D. 1.3×10^{18} s⁻¹
 - E. None of the listed answers.

25. If the wavelength of an electron is equal to the radius of the $n=2$ orbit in He^+ , what must the velocity of the electron be?
- $6.88 \times 10^6 \text{ m/s}$
 - $1.38 \times 10^7 \text{ m/s}$
 - $3.44 \times 10^6 \text{ m/s}$
 - $5.47 \times 10^5 \text{ m/s}$
 - The velocity cannot have an exact value
26. Which is not a valid set of quantum numbers for an electron?
- $n = 6, l = 2, m_l = 0, m_s = 1/2$
 - $n = 3, l = 2, m_l = -2, m_s = 1/2$
 - $n = 7, l = 0, m_l = 0, m_s = 1/2$
 - $n = 17, l = 16, m_l = 16, m_s = -1/2$
 - $n = 4, l = -2, m_l = 2, m_s = -1/2$
27. A beam of neutrons ($m_{\text{neutron}} = 1.6749 \times 10^{-24} \text{ g}$) has a velocity of 1.44 km/hour. What is the wavelength of the neutron wave?
- 993 nm
 - $2.76 \times 10^{-10} \text{ m}$
 - $2.76 \times 10^{-13} \text{ m}$
 - $9.93 \times 10^{-10} \text{ m}$
 - 276 nm
28. What are the possible values for the orbital angular momentum quantum number l given the following values for the other three quantum numbers: $n = 4, l = ?, m_l = 0, m_s = +1/2$
- 0
 - 1, 2, 3, or 4
 - 3
 - 0, 1, 2, or 3
 - none of these answers
29. Which of the following pairs of quantum numbers would describe electrons in degenerate orbitals?
- $n=4 \quad l=3 \quad m_l=-2 \quad m_s = +1/2$
 - $n=3 \quad l=1 \quad m_l=0 \quad m_s = +1/2$
 - $n=3 \quad l=2 \quad m_l=-2 \quad m_s = +1/2$
 - $n=4 \quad l=3 \quad m_l=3 \quad m_s = -1/2$
 - $n=3 \quad l=0 \quad m_l=0 \quad m_s = +1/2$
- 3 and 5
 - 2 and 5
 - 1 and 3
 - 2 and 3
 - 1 and 4

30. List the following species in predicted order of increasing radius: Ti^{4+} , Ar, P^{3-} , Ca^{2+} , K^{+}
- P^{3-} , Ar, K^{+} , Ca^{2+} , Ti^{4+}
 - Ar, K^{+} , Ca^{2+} , P^{3-} , Ti^{4+}
 - Ti^{4+} , P^{3-} , Ca^{2+} , K^{+} , Ar
 - Ti^{4+} , Ca^{2+} , K^{+} , Ar, P^{3-}
 - They are isoelectronic species so they have the same radius
31. When the following species: As, Sb, Sr, Rb, Br are listed in order of increasing first ionization energy the element in the middle is?
- Sr
 - Br
 - As
 - Sb
 - Rb
32. The successive ionization energies for an unknown element are $I_1=896$ kJ/mol, $I_2=1752$ kJ/mol, $I_3=14,807$ kJ/mol, $I_4=17,948$ kJ/mol. To which group of the periodic table would you predict the element to belong?
- Group 1
 - Group 2
 - Group 4
 - Group 17
 - None of these groups
33. According to the VSEPR theory, which of the following should NOT be linear?
- BeH_2
 - SO_2
 - CS_2
 - NNO
 - ICI
34. Which of the following should NOT have a dipole moment?
- O_3
 - PF_5
 - IBr
 - IF_5
 - PH_3
35. What is the formal charge on the nitrogen atom in the most plausible Lewis structure of $[\text{CNO}]^-$?
- 2
 - 1
 - +1
 - +2
 - none of these
36. In which of the following molecules would you expect the nitrogen to nitrogen bond to be the shortest?
- N_2H_4
 - N_2
 - N_2O_4
 - N_2O
 - NH_3
37. What is the bond order of CO according to the MO theory?
- 1
 - 1/2
 - 3
 - 0
 - 2

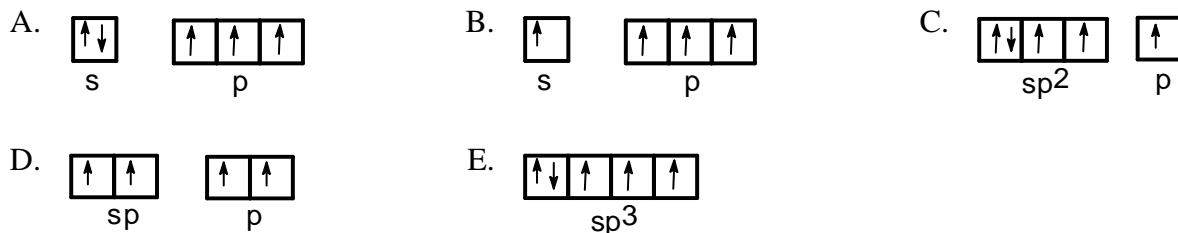
38. One resonance structure of N_2O is shown in the diagram .



The hybridized atomic orbitals of the central nitrogen atom which are consistent with this structure are:

- A. four sp^3 orbitals
 - B. three sp^2 orbitals and a p orbital
 - C. two sp^2 orbitals and two sp orbitals
 - D. two sp orbitals and two p orbitals
 - E. none of these are consistent because the molecule is a resonance hybrid
39. According to the M.O. theory the removal of an electron from the N_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.
40. The hybridization that agrees with the molecular geometry around the central atom in IF_5 is
- A. sp
 - B. sp^2
 - C. sp^3
 - D. sp^3d
 - E. sp^3d^2
41. According to molecular orbital theory, which of the following species is paramagnetic?
- A. B_2
 - B. CN
 - C. O_2^-
 - D. all of these
 - E. none of these
42. Which of the following has the highest bond order according to the MO Theory?
- A. B_2
 - B. C_2
 - C. N_2
 - D. O_2
 - E. F_2
43. The molecule H_2CNH ($\text{H}_2\text{C}-\text{N}-\text{H}$ connectivity) contains in its structure
- A. 4 sigma bonds and 2 lone pairs
 - B. 3 sigma bonds and 2 pi bonds
 - C. 3 sigma bonds and 1 pi bond
 - D. 4 sigma bonds and 2 pi bonds
 - E. 4 sigma bonds, 1 pi bond and 1 lone pair

44. Which represents the best distribution of electrons among orbitals for the central nitrogen atom in nitrosomethane CH_3NO



45. Co-60 is a beta emitter with a half-life of 5.3 years. Approximately what fraction of Co-60 atoms will remain in a particular sample after 26.5 years?

- A. 1/5 B. 1/16 C. 1/26 D. 1/32 E. 1/64

46. Which one of the following statements concerning nuclear power safety is correct?

- A. The ultimate danger in a nuclear reactor is the formation of a supercritical mass leading to a nuclear explosion.
 B. Calculations have shown that in the case of a core meltdown, the latter would reemerge in China.
 C. Heat continues to be released even after a reactor is shut down.
 D. Pressurized water reactors of the type used in North America are especially susceptible to graphite fires.
 E. The accident at Chernobyl produced, in effect, a small atomic bomb.

47. Which of the following types of nuclear decay result in a decrease in nuclear charge (Atomic number Z)?

- 1) alpha emission
 2) beta emission
 3) positron emission
 4) electron-capture

- A. 1 and 2
 B. 2 and 4
 C. 1 and 3
 D. 3 and 4
 E. 4 only

48. When nitrogen is present in diamond it creates a(n) _____ band and the diamond will absorb _____ light.

- A. acceptor; blue
 B. donor; yellow
 C. acceptor; yellow
 D. donor; blue
 E. acceptor; green and red

49. Which of the following IS NOT a feature of halogens?

- A. They are a component of nerve gas
 B. They are a component of plaster of paris
 C. They form stable diatomic gases
 D. They are used in treatment for swimming pools
 E. They have high electronegativities

50. The strength of fully hardened portland cement depends mainly on the strength of its network of:
- A. -Si-Al-O- bonds
 - B. -Ca-O-Si- bonds
 - C. -Si-Si- bonds
 - D. -C-O- bonds
 - E. -Si-O- bonds
51. Doping silicon with indium increases its conductivity by creating
- A. an *n*-type semiconductor.
 - B. a *p*-type semiconductor.
 - C. an *np*-type semiconductor.
 - D. a metallic conductor.
 - E. none of these.
52. Which of the following reactions represents the removal of silica from iron ore in a blast furnace?
- A. $\text{SiO}_2(\text{s}) \rightarrow \text{SiO}_2(\text{g})$
 - B. $\text{SiO}_2(\text{s}) + \text{CaO}(\text{s}) \rightarrow \text{CaSiO}_3(\text{l})$
 - C. $\text{SiO}_2(\text{s}) + 4\text{HF}(\text{g}) \rightarrow \text{SiF}_4(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
 - D. $\text{SiO}_2(\text{s}) + \text{C}(\text{s}) \rightarrow \text{Si}(\text{l}) + \text{CO}_2(\text{g})$
 - E. $\text{SiO}_2(\text{s}) + \text{CO}(\text{g}) \rightarrow \text{SiCO}_3(\text{l})$
53. Based on the electron-sea model for metals which of the following would be the correct order of increasing melting points.
- A. $\text{Na} < \text{Mg} < \text{Al}$
 - B. $\text{Mg} < \text{Na} < \text{Al}$
 - C. $\text{Al} < \text{Mg} < \text{Na}$
 - D. $\text{Al} < \text{Na} < \text{Mg}$
 - E. $\text{Na} < \text{Al} < \text{Mg}$
54. 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
55. $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$ absorbs light in the yellow part of the visible spectrum, thereby appearing to have the colour:
- A. blue/violet
 - B. red
 - C. green
 - D. purple
 - E. yellow
56. The best name for $\text{K}_4[\text{FeCl}_2(\text{CN})_4]$ is
- A. tetrapotassium dichlorodicyanoiron(II).
 - B. potassium dichlorodicyanoiron(II).
 - C. potassium dichlorodicyanoferrate(III).
 - D. potassium dichlorotetracyanoferrate(II).
 - E. tetrapotassium dichlorobis(cyano)iron(III).

57. Which of the following is accurate for London dispersion forces?
- A. they are primarily responsible for the melting point of SiH_4
 - B. they only occur in polar molecules
 - C. they are only observed in molecules with more than one atom
 - D. they require the presence of hydrogen atoms
 - E. none of the above
58. Which statements are true about the photoelectric effect
- A. If the frequency of the incident light is decreased, then the velocity of the ejected electrons increases.
 - B. If the light directed on the metal has a λ greater than a threshold wavelength, λ_0 , then electrons are ejected
 - C. The photoelectric effect was explained by Bohr
 - D. Increasing the intensity of the incident light always results in more electrons being ejected
 - E. none of these
59. If ^{11}C decays by positron emission, what is the resulting nuclide?
- A. ^{10}B
 - B. ^{10}C
 - C. ^{11}N
 - D. ^{14}C
 - E. none of these
60. Which element group includes the most reactive of all the metallic elements?
- A. alkali metals
 - B. alkaline earth metals
 - C. coinage metals
 - D. transition metals
 - E. Group 2B metals

Answer Key for Test "Chemistry 110 Past Final Exam (Practice) Fall 04.tst", 11/30/2008

No. in Q-Bank	No. on Test	Correct Answer
22 114	1	D
22 72	2	B
22 101	3	A
22 106	4	E
22 20	5	D
22 112	6	A
22 7	7	E
22 44	8	C
22 105	9	A
22 104	10	C
22 109	11	C
11 27	12	A
11 101	13	C
11 97	14	A
11 103	15	B
11 107	16	D
11 105	17	E
11 91	18	B
7 3	19	C
7 124	20	B
7 121	21	A
7 126	22	A
7 123	23	A
7 91	24	A
7 122	25	A
7 127	26	E
7 84	27	A
7 120	28	D
7 90	29	E
8 94	30	D
8 96	31	D
8 93	32	B
9 134	33	B
9 137	34	B
9 125	35	C
9 111	36	B
10 99	37	C
10 77	38	D
10 100	39	D
10 65	40	E
10 88	41	D
10 84	42	C
10 73	43	E
10 104	44	C
23 26	45	D

Answer Key for Test "Chemistry 110 Past Final Exam (Practice) Fall 04.tst", 11/30/2008

No. in Q-Bank	No. on Test	Correct Answer
------------------	----------------	----------------

23	92	46	C
23	107	47	D
20	55	48	D
20	64	49	B
20	66	50	E
20	53	51	B
20	6	52	B
20	57	53	A
20	50	54	C
22	111	55	A
22	28	56	D
11	99	57	A
7	110	58	E
23	115	59	E
20	19	60	A