CHEMISTRY 211, Lect. Sect. **003** **Fall 2000**
Dr. G. L. Roberts
Exam #2, **Tuesday, October 31, 2000**

CLOSED BOOK EXAM—Notes, books, and periodic tables not allowed. Calculators may be used. Potentially useful information (equations) included on last page**. Circle ANSWER OF CHOICE and darken corresponding oval on ScanTron sheet. Turn in LAST PAGE & ScanTron.**

1. What is the reducing agent in the reaction?

$$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$$

(a) Fe^{2+} (b) H^+ (c) Mn^{2+} (d) MnO_4^-

2. What is the reduction half reaction in the chemical reaction?

$$Cr_2O_7^{2-}(aq) + 6Cl^-(aq) + 14H^+(aq) \rightarrow 2Cr^{3+}(aq) + 3Cl_2(aq) + 7H_2O(l)$$

(a) $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$
(b) $Cr_2O_7^{2-}(aq) + 14H^+(aq) \rightarrow 2Cr^{3+}(aq) + 7H_2O(l) + 6e^-$
(c) $2Cl^-(aq) \rightarrow Cl_2(aq) + 2e^-$
(d) $Cl_2(aq) \rightarrow 2Cl^-(aq)$

3. Pure water is a conductor of electricity.

(a) true (b) false

4. Soluble metal oxides yield bases and some soluble nonmetal oxides yield acids when dissolved in water.

(a) true (b) false

5. Radiation emitted from the human body and warm objects is mostly infrared.

(a) true (b) false

6. In 1922, at the age of ~37, Niels Bohr received the Nobel prize in physics for his model of the hydrogen atom.

(a) true (b) false

7. What is the deBroglie wavelength of a 3.00-g object moving at a velocity of 0.0005 miles per hour?

(a) 9.88×10^{-28} m (b) 2.51×10^{-27} m (c) 3.98×10^{26} m (d) 1.01×10^{27} m

8. According to the Heisenberg uncertainty principle

(a) the position of a particle cannot be measured precisely
(b) the momentum of a particle cannot be measured precisely
(c) neither the position nor the momentum of a particle can be measured precisely
(d) the position and momentum of a particle can be measured precisely, but not at the same time.

9. The work function phi, **Φ**, is defined as:

(a) the minimum amount of energy required to remove an electron from an orbital
(b) the minimum amount of energy required to remove an electron from the surface of a metal
(c) the maximum amount of energy required to remove an electron from an orbital
(d) the maximum amount of energy required to remove an electron from the surface of a metal
(e) none of the above

10. A high-powered laser is pulsed for a period of 100 ns. During that time, it emits a signal with a total energy of 8300 J. If the wavelength of the signal is 351 nm, how many photons have been emitted?

(a) 5.66×10^{-19} photons (b) 1.77×10^{-18} photons (c) 6.06×10^{20} photons
(d) 6.83×10^{-23} photons (e) 1.46×10^{22} photons

11. The laser in an audio compact disc uses light whose wavelength is 780 nm. What is the frequency of this radiation? What is the energy (in joules) of a single photon of this wavelength?

(a) 3.85×10^{14}/s; 2.55×10^{-19} J/photon (b) 3.85×10^{5}/s; 2.55×10^{-28} J/photon
(c) 2.55×10^{14}/s; 3.85×10^{-19} J/photon (d) 3.85×10^{5}/s; 2.55×10^{14} J/photon
(e) none of the above

12. How many values are there for the magnetic quantum number when the value of the angular momentum quantum number is 3?

(a) 1 (b) 3 (c) 5 (d) 7 (e) 9

13. The ground-state electron configuration of a Co^{3+} ion is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$ making it
    (a) diamagnetic.
    (b) paramagnetic with one unpaired electron.
    (c) paramagnetic with two unpaired electrons.
    (d) paramagnetic with three unpaired electrons.
    (e) paramagnetic with four unpaired electrons.

14. Potassium metal must absorb radiation with a minimum frequency of 5.57×10^{14} s^{-1} before it can emit an electron from its surface via the photoelectric effect. Calculate the minimum energy (in units of *joules*) required to produce this effect.

    (a) 1.19×10^{-48} (b) 8.41×10^{47} (c) 3.69×10^{-19} (d) 3.90×10^{-19}

15. Indicate which of the following electron configurations are ruled out by the Pauli exclusion principle:

    (*I*) $1s^2 2s^2 2p^7$ (*II*) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{12}$ (*III*) $1s^2 2s^2 2p^6 3s^3$ (*IV*) $1s^2 2s^2 2p^6 3s^3 3p^6$

    (a) I, III, and IV
    (b) II and III
    (c) II, III, and IV
    (d) I, II, and III
    (e) all of the above

16. All of the following electronic ground-state configurations are correct <u>except</u>?

    (a) $_{20}Ca$ $[Ar]4s^2$
    (b) $_{25}Mn$ $[Ar]4s^2 4d^5$
    (c) $_{29}Cu$ $[Ar]3d^{10}4s^1$
    (d) $_{50}Sn$ $[Kr]4d^{10}5s^2 5p^2$
    (e) $_{54}Xe$ $[Kr]4d^{10}5s^2 5p^6$

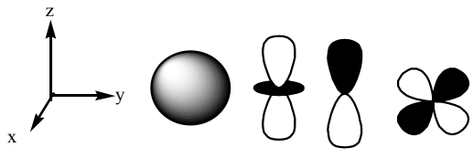
17. A ground-state hydrogen atom absorbs a photon of light having a wavelength of 97.2 nm. It then gives off a photon having a wavelength of 400 nm. Which of the following transitions occurred to give the *final state* of the hydrogen atom?

    (a) $E_{5\rightarrow3}$
    (b) $E_{2\rightarrow1}$
    (c) $E_{4\rightarrow3}$
    (d) $E_{3\rightarrow1}$
    (e) $E_{4\rightarrow2}$

18. The reaction velocity can me monitored spectroscopically when the thioester bond of succinyl-CoA is hydrolyzed. Calculate the energy of absorption (in units of kJ/mol) if $\tilde{\nu} = 43{,}103$ cm^{-1}.

    (a) 8.57×10^{-31} (b) 5.16×10^{-4} (c) 1.17×10^{27} (d) 516 (e) 516,000

19. Which of the following elements is likely to be the most metallic?
    (a) Zn (b) Cd (c) W (d) Zr (e) Li



20. Given the above *x,y,z* coordinates, which most accurately describe the orbital shapes shown?

    (a) s, p_z, p_z^2, d_{xy} (b) s, p_z^2, d_z, d_{yz} (c) s, d_z^2, p_z, d_{yz} (d) s, d_z^2, p_z, $d_{x^2-y^2}$

Key Equations

$\lambda = h/mv$
$\nu = c/\lambda$

$c = 3.00 \times 10^{8}$ m/s
$h = 6.626 \times 10^{-34}$ J•s
$E = n h\nu$
$E = -R_H/n^2$
$\Delta E = |E_i - E_f|$
$\Phi = h\nu_0$
K.E. $= h\nu - \Phi$
$R_H = 2.18 \times 10^{-18}$ J
K.E. $= mv^2/2$
$m_e = 9.11 \times 10^{-31}$ kg
$m_p = 1.673 \times 10^{-27}$ kg
$m_n = 1.675 \times 10^{-27}$ kg
J = N•m
N = m•kg•s^{-2}
$E_n = -(2.18 \times 10^{-18}\text{J})Z^2(1/n^2)$
$Z_{eff} = Z - \sigma$
$N_0 = N_A = 6.02 \times 10^{23}$ units/mol
d(Hg) = 13.6 g/mL
d(H_2O) = 1.00 g/mL
R= 0.0821 L•atm/mol•K
R= 8.314 J/mol•K
1 atm = 760 torr = 760 mmHg
1 Pa = 1 kg/(m•s^2) = 1 N/m^2
1 atm = 1.10×10^5 Pa
g = 9.807 m/s^2
1.00 L•atm = 101 J = 0.101 kJ
M = n/V
M_m= (dRT/P)

5280 ft = 1 mile
2.54cm = 1 inch