Monday Night Final Review
Fall 2004

1. Which of the following boils at the highest temperature?
   (a) CH₄  (b) C₂H₆  (c) C₃H₈  (d) C₄H₁₀  (e) C₅H₁₂

2. What is the **total ionic** equation for the following formula unit equation?

   \[ \text{BaCl}_2(aq) + \text{Na}_2\text{SO}_4(aq) \rightarrow \text{BaSO}_4(s) + 2\text{NaCl}(aq) \]

   (a) \[\text{[Ba}^{2+}(aq)+\text{Cl}^-(aq)] + [\text{Na}^+(aq)+\text{SO}_4^{2-}(aq)] \rightarrow \text{BaSO}_4(s) + [\text{Na}^+(aq)+\text{Cl}^-(aq)]\]
   (b) \[\text{[Ba}^{2+}(aq)+2\text{Cl}^-(aq)] + [2\text{Na}^+(aq)+\text{SO}_4^{2-}(aq)] \rightarrow \text{BaSO}_4(s) + 2[\text{Na}^+(aq)+\text{Cl}^-(aq)]\]
   (c) \[\text{[Ba}^{2+}(aq)+2\text{Cl}^-(aq)] + 2[\text{Na}^+(aq)+\text{SO}_4^{2-}(aq)] \rightarrow \text{BaSO}_4(s) + 2[\text{Na}^+(aq)+\text{Cl}^-(aq)]\]
   (d) \[\text{[Ba}^{2+}(aq)+2\text{Cl}^-(aq)] + [\text{Na}^+(aq)+\text{SO}_4^{2-}(aq)] \rightarrow \text{BaSO}_4(s) + [\text{Na}^+(aq)+\text{Cl}^-(aq)]\]
   (e) \text{Ba}^{2+}(aq) + \text{SO}_4^{2-}(aq) \rightarrow \text{BaSO}_4(s)

3. Argon has a higher melting point (84K) than neon (24K) because of
   (a) permanent dipole forces   (b) hydrogen bonding
   (c) stronger dispersion (London) forces   (d) ionic bonding
   (e) covalent bonding

4. Elemental silicon exists as a solid with a crystal structure like that of diamond, but silicon is less dense than diamond. Which response contains all the correct conclusions that can be drawn?
   (1) The carbon atoms in diamond are more closely spaced than silicon atoms in solid silicon.
   (2) Silicon and diamond are allotropes.
   (3) Silicon is a molecular solid.
   (4) Silicon is amorphous in the solid state.
   (5) One would expect silicon to have a very high melting point.

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

5. Which element has the **largest** atomic radius?
   (a) Cs   (b) Ba   (c) Tl   (d) Pb   (e) Bi

6. Which one of the following pairs contains isoelectronic species?
   (a) Na, Na⁺   (b) S, Se   (c) S²⁻, Se²⁻   (d) F₂, Cl₂   (e) Na⁺, O²⁻

7. A 1.0 g sample of a molecular compound having a molecular weight of 100,000 g/mol is dissolved in 100 mL of water. Calculate the osmotic pressure of the solution in torr at a temperature of 27°C.

   (a) 1.9 torr   (b) 2.9 torr   (c) 3.9 torr   (d) 4.9 torr   (e) 5.9 torr
8. Given: Water: m.p. 0°C, b.p. 100°C
   Heat of fusion = 333 J/g at 0°C
   Heat of vap. = 2260 J/g at 100°C
   Specific Heat (gas) = 2.03 J/g°C
   Specific Heat (liq.) = 4.18 J/g°C
   Specific Heat (sol.) = 2.09 J/g°C

   Calculate the amount of heat that must be absorbed to convert 144 g water at 50°C to steam at 110°C (in kJ).

   (a) 358   (b) 354   (c) 81   (d) 89   (e) 64

9. What final temperature results upon mixing 400 g of water at 20°C with 100 g of water at 70°C? (a) 60°C   (b) 20°C   (c) 70°C   (d) 30°C   (e) 90°C

10. Which one of the following compounds is not a salt?
   (a) Ag₂SO₄   (b) Ca(OH)₂   (c) KCl   (d) Ca(NO₃)₂   (e) NaCH₃COO

11. What type of intermolecular forces are responsible for the high boiling point of water, compared to H₂S and H₂Se?
   (a) London dispersion   (b) metallic bond
   (c) ionic bond   (d) covalent bond   (e) hydrogen bond

12. A 250 mL solution contains 12.5 g of a polymer in toluene and has an osmotic pressure of 0.029 atm at 27°C. What is the apparent formula weight of the polymer? (a) 30,000   (b) 42,000   (c) 52,000   (d) 56,000   (e) 80,000

13. What quantity of heat is required to convert 250 g of solid benzene at -5.0°C to vapor at 100°C at 1.00 atm pressure? (benzene C₆H₆)
   Specific Heat (gas) = 1.04 J/g°C,   bp = 80.1 °C
   Specific Heat (liq.) = 1.74 J/g°C,   mp = 5.48 °C
   Specific Heat (sol.) = 0.89 J/g°C,
   Heat of fusion = 127 J/g at 5.48°C (m.p.)
   Heat of vap. = 395 J/g at 80°C (b.p.)

   (a) 350 kJ  (b) 186 kJ  (c) 170 kJ  (d) 53 kJ  (e) 87 kJ

14. Estimate the freezing point (°C) of a solution prepared by dissolving 0.100 mol of Al(NO₃)₃ in 0.500 kg of water. Kₑ(water) = 1.86°C/m
   (Assume complete dissociation of the salt.)

   (a) 0.00  (b) −0.37  (c) −0.74  (d) −1.1  (e) −1.5
15. How many equivalents weights are there in 150. g of CH₃COOH?
   (a) 3.41 eq  (b) 1.25 eq  (c) 0.83 eq  (d) 2.50 eq  (e) 0.62 eq

16. The vapor pressure of pure water at 65°C is 188 torr. What is the vapor pressure at 65°C of a solution prepared from 100 mL of water (density = 1.00 g mL⁻¹) and 120 g of diglyme, C₆H₁₄O₃, a nonvolatile substance?
   (a) 237 torr  (b) 185 torr  (c) 173 torr  (d) 146 torr  (e) 162 torr

17. Balance the reduction half reaction for the following redox reaction. What is the coefficient of the electrons in the reduction half reaction?
   \[ \text{Br}_2 + \text{NaOH} \rightarrow \text{NaBrO}_3 + \text{NaBr} + \text{H}_2\text{O} \]
   (a) 2  (b) 4  (c) 5  (d) 6  (e) 7

18. The ground state electron configuration for tin is:
   (a) [Ar] 4s²4p⁶4d¹⁰5s²5p⁶4d¹⁰  (b) [Kr] 5s²5p⁶5d²06s²6p⁴
   (c) [Rn] 6s²5d¹⁰5f¹⁴6p⁸  (d) [Kr] 5s²4d¹⁰5p²
   (e) [Kr] 5s²4d⁸5p⁴

19. Consider the ³⁵¹⁷Cl isotope. An atom of this isotope contains ____ neutrons. (a) 17  (b) 18  (c) 30  (d) 35  (e) none of these

20. What is the oxidation number of P in H₃PO₂? (a) -3  (b) 0  (c) +1  (d) +3  (e) +7

21. Which term best describes the bonding between hydrogen and bromine in a molecule of HBr(g)? (a) nonpolar covalent  (b) polar covalent  (c) ionic  (d) metallic  (e) none of these

22. Which of these compounds violates the octet rule for electron distribution around the central atom?  (a) CO₂  (b) NF₃  (c) OF₂  (d) PF₅  (e) N₂

23. Which indication of relative acid strength is wrong?
   (a) HNO₃ > HNO₂  (b) H₂SO₄ > H₂SO₃  (c) HClO > HCl  (d) HCl > HF  (e) H₂SO₃ > HSO₃⁻

24. Which of the following molecules would be trigonal planar?
   (a) H₂O  (b) PCl₅  (c) SiH₄  (d) BCl₃  (e) NH₃

25. In the reaction occurring during discharge of a lead storage battery, which species would be referred to as “being oxidized”?
   \[ \text{Pb} + \text{PbO}_2 + 4\text{H}^+ + 2\text{SO}_4^{2-} \rightarrow 2\text{PbSO}_4 + 2\text{H}_2\text{O} \]
   (a) only PbO₂   (b) PbO₂ and H₂O   (c) only H⁺   (d) H⁺ and SO₄²⁻   (e) only Pb
26. The volume (in mL) of 15 $M$ ammonia required for preparation of 250 mL of 0.20 $M$ solution is:

(a) 2.2  (b) 3.3  (c) 4.5  (d) 5.0  (e) 6.6

27. An unknown organic compound composed of carbon, hydrogen and oxygen was analyzed and found to be 60.02% C, 8.00% H, and 31.98% O by weight. Which of the following represents the correct empirical formula for the compound?

(a) $C_5H_7O$  (b) $C_5H_8O_2$  (c) $C_5H_6O$  (d) $C_4H_6O_2$  (e) $C_4H_5O$

28. In a particular process 3.08 g of carbon tetrachloride (CCl₄) was treated with excess oxidizing agent and 1.54 g of phosgene (COCl₂) was obtained.

\[ \text{CCl}_4 + \ldots \rightarrow \text{COCl}_2 + \ldots \]

The yield for this process was approximately:

(a) 92%  (b) 84%  (c) 78%  (d) 50%  (e) 39%

29. What mass of propane is represented by a volume of 43 liters collected over water at 25°C and 275 torr? (Vap. press. of water at 25°C is 24 torr.)

(a) 43 g  (b) 30 g  (c) 26 g  (d) 130 g  (e) 280 g

30. How many grams of NaOH (M.W. = 40.0) would be required to neutralize all the acid in 50.0 mL of 0.120 N H₂SO₄ (M.W. = 98.1)? The H₂SO₄ was standardized for use as an acid.

(a) 0.240  (b) 0.120  (c) 0.588  (d) 0.294  (e) none of these

31. Write the net ionic equation for the reaction of iron(II) hydroxide with hydrochloric acid. What is the sum of the coefficients? (Assume complete neutralization. Use H⁺ rather than H₃O⁺. Use the smallest possible whole number coefficients. Do not forget coefficients of one.)

(a) 6  (b) 7  (c) 3  (d) 4  (e) 5

32. Which response includes all of the following that involve chemical changes, and none that involve physical changes?

I. souring of milk  II. melting of silver
III. digestion of food  IV. burning of coal
V. condensation of steam

(a) II and V  (b) I, III, and IV  (c) I, II, and III  (d) IV and V  (e) III, IV, and V
33. Which of the following is **not** a correct description of 16.0 grams of methane, CH₄?
(a) It is one mole of methane.
(b) It is the amount of methane that contains 12.0 g of carbon.
(c) It is 16.0 x 6.02 x 10²³ molecules of methane.
(d) It is the amount of methane that contains 4.0 grams of hydrogen.
(e) It is the amount of methane that contains 4 x 6.02 x 10²³ hydrogen atoms.

34. How many atoms are there in 60g of Ar?
(a) 1.4 x 10²⁷  (b) 3.6 x 10²⁵  (c) 6.0 x 10²³  (d) 9.0 x 10²³  (e) 1.5

35. Arrange the following elements in order of **increasing** first ionization energy.
Mg, Al, Si, P, S
(a) Al < Mg < Si < S < P  (b) Mg < Al < Si < P < S  (c) Al < Mg < Si < P < S  
(d) Mg < Al < Si < S < P  (e) Al < Mg < P < Si < S

36. Which of the following oxides is(are) basic anhydrides?
(a) N₂O  (b) P₄O₆  (c) MgO  (d) OCl₂

37. What is the normality of 150. mL of a solution that contains 5.00 grams of H₃PO₄?  (Assume the acid is to be completely neutralized.)

Answers: 1 (e), 2 (b), 3 (c), 4 (d), 5 (a), 6 (e), 7 (a), 8 (a), 9 (d), 10 (b), 11 (e), 12 (b), 13 (c), 14 (e), 15 (d), 16 (e), 17 (a), 18 (d), 19 (b), 20 (c), 21 (b), 22 (d), 23 (c), 24 (d), 25 (e), 26 (b), 27 (b), 28 (c), 29 (c), 30 (a), 31 (a), 32 (b), 33 (c), 34 (d), 35 (a), 36 (c), 37 (1.02 N).