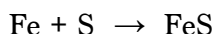


CHM 151 Practice Final Exam

- How many significant figures are there in the result of 5.52 divided by 3.745?
(a) 1 (b) 2 (c) 3 (d) 4 (e) 5
- How many significant figures are there in the answer when 9.021 is added to 0.82?
(a) 1 (b) 2 (c) 3 (d) 4 (e) 5
- The density of bromine liquid is 3.12 g/mL. Since it is a liquid, it is easier to measure in a graduated cylinder than to weigh out on a balance. If we needed 28.1 g of Br₂ for a reaction, what volume would we measure out?
(a) 87.7 mL (b) 9.01 mL (c) 25.0 mL (d) 0.111 mL (e) 0.549 mL
- How many protons, neutrons, and electrons are in the chloride ion isotope ${}^{37}_{17}\text{Cl}^-$?
(a) 17 p, 37 n, 37 e (b) 37 p, 17 n, 18 e (c) 17 p, 20 n, 17 e (d) 17 p, 20 n, 18 e
- What is the formula of aluminum sulfide?
(a) AlSO₄ (b) Al₂(SO₄)₃ (c) AlS (d) Al₂S₃ (e) Al₃S₂
- Name this compound: Pb(CO₃)₂
(a) lead carbonate (b) lead dicarbonate (c) lead(II) carbonate
(d) lead carbontrioxide (e) lead(IV) carbonate
- How many moles are in 12.0 g of P atoms?
(a) 372 mol (b) 2.58 mol (c) 0.387 mol (d) 7.23×10^{24} mol
- How many moles of mercury are in 1.00×10^{19} Hg atoms?
(a) 6.02×10^4 mol (b) 4.99×10^{16} mol (c) 3.33×10^{-3} mol (d) 1.66×10^{-5} mol
- What is the mass of 7.80×10^{18} carbon atoms?
(a) 1.56×10^{-4} g (b) 1.30×10^{-5} g (c) 9.36×10^{19} g (d) 6.50×10^{17} g
- What is the percent by mass of Na in sodium carbonate?
(a) 27.7 % (b) 33.3 % (c) 43.4 % (d) 34.8 % (e) 65.7 %
- 1.52 g of a compound of N and O is 63.2 % oxygen and 36.8 % nitrogen by mass. What is the empirical formula of this compound?
(a) NO (b) NO₂ (c) NO₃ (d) N₂O (e) N₂O₃
- For the reaction $2 \text{KClO}_3 \rightarrow 2 \text{KCl} + 3 \text{O}_2$, how many molecules of oxygen are produced when 0.82 moles of potassium chlorate decompose?
(a) 26 (b) 1.5×10^{24} (c) 7.4×10^{23} (d) 4.9×10^{23} (e) 1.23

13. "Fool's gold" is based on an iron sulfide compound and can be made by:



If 9.42 g Fe and 8.50 g S react, what mass of FeS can be made?

- (a) 14.8 g (b) 23.3 g (c) 0.169 g (d) 17.9 g (e) 38.1 g

14. When 1 mol magnesium chloride dissolves in water and dissociates, how many moles of ions are produced?

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

15. Which one of these ionic compounds is soluble in water?

- (a) BaS (b) AgOH (c) PbCl₂ (d) K₂CO₃ (e) AlPO₄

16. Identify the precipitate that forms when an aqueous solution of barium chloride is mixed with an aqueous solution of sodium sulfate.

- (a) BaSO₄ (b) Na₂SO₄ (c) NaCl (d) BaCl₂
(e) There would be no precipitate

17. Iron(II) nitrate [Fe(NO₃)₂ (aq)] reacts with aqueous potassium hydroxide [KOH (aq)]. Write the net ionic equation for this reaction.

- (a) $\text{K}^+ (\text{aq}) + \text{NO}_3^- (\text{aq}) \rightarrow \text{KNO}_3 (\text{s})$ (b) $\text{Fe}^{2+} (\text{aq}) + \text{OH}^{2-} (\text{aq}) \rightarrow \text{FeOH} (\text{s})$
(c) $2 \text{K}^+ (\text{aq}) + (\text{NO}_3^-)_2 (\text{aq}) \rightarrow \text{K}_2(\text{NO}_3)_2 (\text{s})$ (d) $\text{Fe}^{2+} (\text{aq}) + 2 \text{OH}^- (\text{aq}) \rightarrow \text{Fe}(\text{OH})_2 (\text{s})$

18. What is the molarity of a solution containing 1.77 g of ethanol (CH₃CH₂OH, molar mass: 46.07 g/mol) that has a volume of 85.0 mL?

- (a) 20.0 M (b) 4.52×10^{-4} M (c) 2.21 M (d) 0.452 M (e) 0.0208 M

19. What volume of Br₂ would be needed to make 500. mL of a 2.50 M solution of bromine? Hint: Calculate the mass needed, then use the density in question #3

- (a) 32.0 mL (b) 0.401 mL (c) 128 mL (d) 64.0 mL (e) 16.0 mL

20. What volume of 0.200 M NaOH would it take to react exactly with 25.0 mL of 0.100 M H₂S, according to: $\text{H}_2\text{S} (\text{aq}) + 2 \text{NaOH} (\text{aq}) \rightarrow \text{Na}_2\text{S} (\text{aq}) + 2 \text{H}_2\text{O} (\text{l})$?

- (a) 50.0 mL (b) 25.0 mL (c) 100.0 mL (d) 12.5 mL

21. A 25.0 mL sample of a 0.866 M KNO₃ solution is poured into a 500 mL volumetric flask. Water is added to make the volume of the solution 500.00 mL. What is the molar concentration of the final solution?

- (a) 17.3 M (b) 0.0577 M (c) 0.0433 M (d) 23.1 M

22. Al (s) reacts with water to form aqueous aluminum hydroxide and hydrogen gas. Write a balanced equation using the smallest whole numbers as coefficients. What is the coefficient of H₂O?

- (a) 6 (b) 3 (c) 2 (d) 1

23. Which substance would have a ΔH_f^0 of zero at standard conditions?

- (a) $\text{H}_2\text{O} (l)$ (b) $\text{O} (g)$ (c) $\text{CH}_4 (g)$ (d) $\text{H}_2 (g)$ (e) $\text{C}_2 (g)$

24. Use the enthalpies of formation below to calculate ΔH_{rxn} for the combustion of 1 mol of benzene (C_6H_6) to produce CO_2 and liquid water. Start by writing a balanced equation for the reaction of benzene and oxygen.

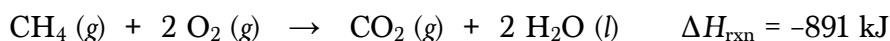
$\Delta H_f [\text{C}_6\text{H}_6] = 49.04 \text{ kJ/mol}$; $\Delta H_f [\text{CO}_2] = -393.5 \text{ kJ/mol}$; $\Delta H_f [\text{H}_2\text{O} (l)] = -285.8 \text{ kJ/mol}$.

- (a) 629.8 kJ (b) -2695.8 kJ (c) -3267.4 kJ
(d) -728.3 kJ (e) not enough information has been given

25. 466 g of water initially at 74.6°C releases 129 kJ of heat as it cools. What would be the final temperature of the water? The specific heat capacity of water is $4.18 \text{ J/g}\cdot^\circ\text{C}$

- (a) 73.4°C (b) 141°C (c) 74.5°C (d) 8.4°C (e) 66.2°C

26. How much heat would be released if 36 g of methane (molar mass: 16.05 g/mol) burned according to this thermochemical equation?



- (a) $4.0 \times 10^2 \text{ kJ}$ (b) $3.2 \times 10^4 \text{ kJ}$ (c) $2.0 \times 10^3 \text{ kJ}$ (d) 25 kJ

27. Calculate the frequency of red light with a wavelength of 650. nm.

- (a) $4.61 \times 10^{14} \text{ Hz}$ (b) $3.05 \times 10^{-19} \text{ Hz}$ (c) $4.32 \times 10^{-31} \text{ Hz}$ (d) $4.61 \times 10^5 \text{ Hz}$

28. What is the energy of 1 mol of photons of red light with a wavelength of 700. nm?

- (a) $2.84 \times 10^{-19} \text{ J}$ (b) $4.29 \times 10^{14} \text{ J}$ (c) $1.71 \times 10^5 \text{ J}$ (d) $4.22 \times 10^{17} \text{ J}$

29. How many electrons in total can be contained in any p subshell?

- (a) 2 (b) 3 (c) 4 (d) 6 (e) 8

30. Which atom corresponds to the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$?

- (a) Cr (b) Fe (c) Br (d) As (e) Mn

31. What is the electron configuration of the Cr^{2+} ion?

- (a) $[\text{Ar}]4s^2 3d^4$ (b) $[\text{Ar}]4s^1 3d^5$ (c) $[\text{Ar}]3d^4$
(d) $[\text{Ar}]4s^2 3d^2$ (e) $[\text{Ar}]4s^1 3d^3$ (f) $[\text{Ar}]4s^2 3d^6$

32. Rank the elements P, Si and N in order of increasing atomic radius.

- (a) $\text{N} < \text{Si} < \text{P}$ (b) $\text{Si} < \text{N} < \text{P}$ (c) $\text{N} < \text{P} < \text{Si}$ (d) $\text{Si} < \text{P} < \text{N}$

33. Which is a correct ranking by ionic radius?

- (a) $\text{Fe}^{2+} > \text{Fe}^{3+}$ (b) $\text{Cl}^- > \text{Br}^-$ (c) $\text{Na}^+ > \text{F}^-$ (d) $\text{O}^- > \text{O}^{2-}$

34. Which of these elements would require the least amount of energy to remove an electron and form a +1 cation (*i.e* which would have the lowest first ionization energy)?

- (a) Be (b) Li (c) Ne (d) O (e) F

35. An ionic bond typically consists of:

- (a) Two metal atoms (b) Two nonmetal atoms
 (c) A metal cation and a nonmetal anion (d) A metal anion and a nonmetal cation

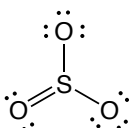
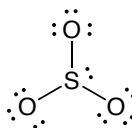
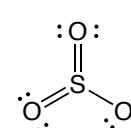
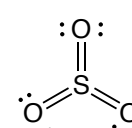
36. Which of these elements is the most electronegative?

- (a) Na (b) Si (c) P (d) S (e) Cl

37. Which of these bonds has been classified incorrectly?

- (a) N-H – polar covalent (b) K-F – ionic
 (c) The CC bond in C₂H₄ – polar covalent (d) Cl-Cl – nonpolar covalent

38. Which of these is not a valid Lewis structure for sulfur trioxide?

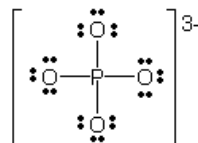
- (a)  (b)  (c)  (d) 

(e) All of the above are possible

39. Draw the Lewis structure of XeF₂. The number of lone pairs on the xenon atom is:

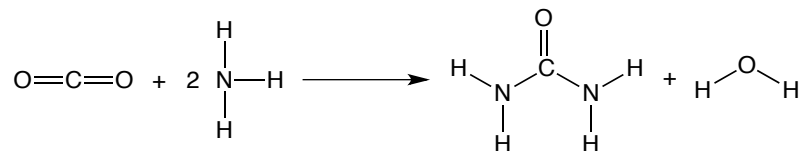
- (a) 0 (b) 1 (c) 2 (d) 3

40. The formal charge on the phosphorus in the Lewis structure shown of the phosphate ion (PO₄³⁻) is:



- (a) 0 (b) +1 (c) -1 (d) +4 (e) -3

41. CO₂ reacts with two moles of NH₃ to produce urea and water. Use the bond energies given to calculate ΔH_{rxn} for this reaction:



Bond energies (kJ/mol): C=O: 799, N-H: 391, C-N: 305, O-H 467

- (a) 37 kJ (b) 418 kJ (c) 809 kJ (d) 836 kJ (e) -418 kJ

42. Which molecule has no net dipole, but has polar bonds?

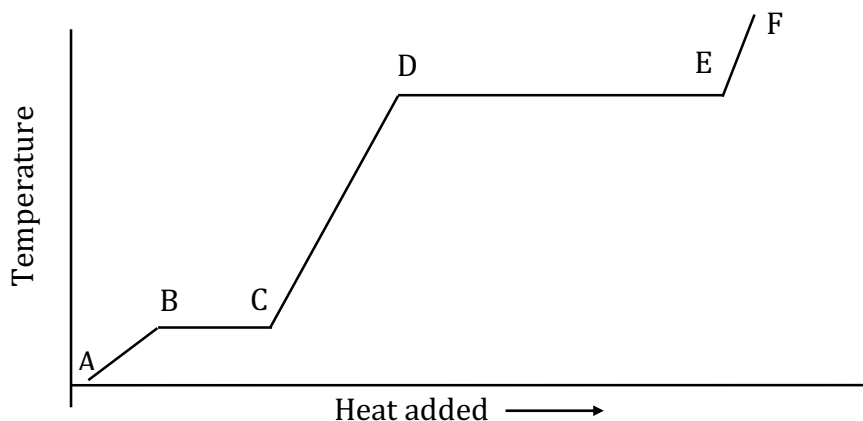
- (a) CO₂ (b) I₂ (c) CH₂Cl₂ (d) NH₃
 (e) Molecules that have no net dipole cannot have polar bonds

43. Which molecule has the correct molecular geometry listed?
- (a) BH_3 – bent (b) CH_4 – square planar (c) SF_4 – tetrahedral
 (d) PF_5 – trigonal bipyramidal (e) H_2S – linear
44. Which approximate bond angles are incorrect for the given molecule?
- (a) BeH_2 – 180° (b) CO_3^{2-} – 120° (c) NH_4^+ – 109.5° (d) XeF_4 – 109.5°
45. How many sigma (σ) bonds, pi (π) bonds, and lone pairs are there in C_2H_4 ?
- (a) 4 σ , 2 π , 0 lone pairs (b) 5 σ , 0 π , 2 lone pairs
 (c) 5 σ , 1 π , 0 lone pairs (d) 6 σ , 0 π , 1 lone pair
46. In the nitrate ion, NO_3^- , what hybrid orbitals are used by nitrogen in bonding?
- (a) sp (b) sp^2 (c) sp^3 (d) sp^3d (e) sp^3d^2
47. What is the volume in liters occupied by 7.40 g of carbon dioxide gas at 25°C and 1.09 atm pressure?
- (a) 0.32 L (b) 166 L (c) 3.77 L (d) 133 L
48. The density of a gaseous compound is 3.38 g/L at 40°C and 1.97 atm. What is the *molar mass* of the gas? (Hint: Assume 1.0 L of gas, and calculate the number of moles.)
- (a) 44.1 g/mol (b) 5.6 g/mol (c) 16.1 g/mol (d) 70.90 g/mol
49. Sodium azide (NaN_3 , molar mass: 65.01 g/mol) is used in air bags for automobile safety. The impact triggers the decomposition of NaN_3 to form nitrogen gas, filling the bag as follows:
- $$2 \text{NaN}_3 \rightarrow 2 \text{Na} (s) + 3 \text{N}_2 (g)$$
- What volume of N_2 would be produced at 21°C and 823 mmHg from the reaction of 60.0 g of sodium azide?
- (a) 20.6 L (b) 30.8 L
 (c) 2010 L (d) 2.90×10^{-3} L (e) 2.20 L
50. In which gas would the molecules be moving at the highest average speed (velocity) at room temperature?
- (a) CH_4 (b) CO_2 (c) Cl_2 (d) C_3H_8
 (e) All gases have the same average velocity at the same temperature
51. If 1.20 g of Cl_2 gas and 4.20 g of O_2 gas were placed into a 2.5 L container at 298 K, what would be the total pressure in the container?
 [molar masses: Cl_2 : 70.90 g/mol; O_2 : 32.00 g/mol]
- (a) 52.8 atm (b) 0.166 atm (c) 1.28 atm
 (d) 1.45 atm (e) 0.690 atm

52. The boiling point of I_2 is higher than that of F_2 because of what type of attraction?

- (a) dispersion forces (b) dipole-dipole forces (c) covalent bonds
(c) ionic bonds (d) ion-dipole forces (e) hydrogen bonds

53. The heating curve below shows how the temperature of a substance changes as heat is added. What represents the heat involved in going from point **D** to point **E**?



- (a) $mC\Delta T$ (b) ΔH_{fus} (c) $\Delta H_{\text{sublimation}}$ (d) ΔH_{vap} (e) ΔH_f^0

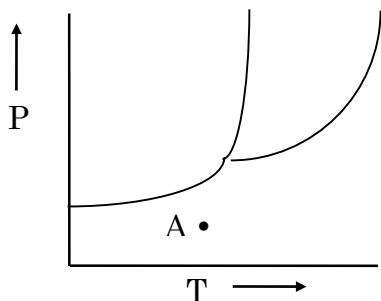
54. Rank these compounds in order of increasing boiling point:

- ethane (CH_3CH_3) formaldehyde (CH_2O) hydrogen peroxide (H_2O_2)
- (a) $CH_3CH_3 < CH_2O < H_2O_2$ (b) $CH_3CH_3 < H_2O_2 < CH_2O$
(c) $CH_2O < H_2O_2 < CH_3CH_3$ (d) $H_2O_2 < CH_2O < CH_3CH_3$

55. What is the main intermolecular attraction in ammonia (NH_3)?

- (a) dispersion forces (b) dipole-dipole forces
(c) ionic bonds (d) hydrogen bonding

56. On the phase diagram below, what phase(s) would be present at the point "A"?



- (a) solid (b) liquid (c) gas
(d) solid and gas (e) solid and liquid

57. Which of the following substances would be the most soluble in CCl_4 ?

- (a) CH_3CH_2OH (b) H_2O (c) NH_3 (d) $C_{10}H_{22}$ (e) $NaCl$

58. A solution is prepared by dissolving 50.0 g of cesium chloride (CsCl) in 50.0 g of water. What is the molality of this solution?

- (a) 1.00 *m* (b) 1000 *m* (c) 2.97 *m*
(d) 1.68 *m* (e) 5.94 *m*

59. Calculate the molarity of the cesium chloride solution in the previous question if the density of the solution is 1.58 g/mL.

- (a) 4.69 *M* (b) 0.0667 *M* (c) 0.188 *M* (d) 9.38 *M*

60. What is the boiling point of a solution of 5.1 g of ethylene glycol (molar mass: 62.06 g/mol) dissolved in 48.3 g of water? Some possibly useful constants for water are $K_f = 1.86 \text{ }^\circ\text{C}/m$ and $K_b = 0.512 \text{ }^\circ\text{C}/m$. Assume pure water boils at 100.00 $^\circ\text{C}$.

- (a) 103.2 $^\circ\text{C}$ (b) 100.87 $^\circ\text{C}$ (c) 96.8 $^\circ\text{C}$
(d) 99.13 $^\circ\text{C}$ (e) 100.04 $^\circ\text{C}$

Answers

- (1) c (2) c (3) b (4) d (5) d (6) e (7) c (8) d (9) a (10) c (11) e (12) c (13) a
(14) d (15) d (16) a (17) d (18) d (19) d (20) b (21) c (22) a (23) d (24) c (25) d
(26) c (27) a (28) c (29) d (30) e (31) c (32) c (33) a (34) b (35) c (36) e (37) c
(38) b (39) d (40) b (41) a (42) a (43) d (44) d (45) c (46) b (47) c (48) a
(49) b (50) a (51) d (52) a (53) d (54) a (55) d (56) c (57) d (58) e (59) a (60) b