Chem 111 Final Exam

Name: _____Answer Key – Exam Version a

* Enter your answers on the bubble sheet. Turn in all sheets. *

This exam is composed of **50 questions** on 11 pages total.

Go initially through the exam and answer the questions you can answer *quickly*. Then go back and try the ones that are more challenging to you and/or that require calculations.

As discussed in the course syllabus, honesty and integrity are absolute essentials for this class. In fairness to others, dishonest behavior will be dealt with to the full extent of University regulations.

I hereby state that all answers on this exam are my own and that I have neither gained unfairly from others nor have I assisted others in obtaining an unfair advantage on this exam.

_____
Signature

	Some common ions:	
$E = h\nu = \dfrac{hc}{\lambda}$	PO_4^{3-} CN^- $CH_3CO_2^-$	$h = 6.626 \times 10^{-34}\ J\ s$
$E_n^{H-atom} = -\dfrac{R_H hc}{n^2}$	NO_2^- NO_3^- CO_3^{2-}	$c = 2.9998 \times 10^8\ m\ s^{-1}$
$1\ mL = 1\ cm^3$	SO_3^{2-} SO_4^{2-}	$N = 6.022 \times 10^{23}\ mol^{-1}$
		$R_H = 1.097 \times 10^7\ m^{-1}$

b

PERIODIC TABLE OF THE ELEMENTS

1A	2A	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3A	4A	5A	6A	7A	8A
1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.939	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.71	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (99)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 181.0	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.0	89 **Ac** 227.0	104 **Unq** (261)	105 **Unp** (262)	106 **Unh** (263)	107 **Uns** (262)	108 **Uno** (265)	109 **Une** (266)									

a

Solubility Rules for some ionic compounds in water

Soluble Ionic Compounds

1. All sodium (Na^+), potassium (K^+), and ammonium (NH_4^+) salts are SOLUBLE.
2. All nitrate (NO_3^-), acetate ($CH_3CO_2^-$), chlorate (ClO_3^-), and perchlorate (ClO_4^-) salts are SOLUBLE.
3. All chloride (Cl^-), bromide (Br^-), and iodide (I^-) salts are SOLUBLE -- EXCEPT those also containing: lead, silver, or mercury (I) (Pb^{2+}, Ag^+, Hg^{2+}) which are NOT soluble.
4. All sulfate (SO_4^{2-}) salts are SOLUBLE - - EXCEPT those also containing: calcium, silver, mercury (I), strontium, barium, or lead (Ca^{2+}, Ag^+, Hg_2^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}) which are NOT soluble.

Not Soluble Ionic Compounds

5. Hydroxide (OH^-) and oxide (O^{2-}) compounds are NOT SOLUBLE -- EXCEPT those also containing: sodium, potassium, or barium (Na^+, K^+, Ba^{2+}) which are soluble.
6. Sulfide (S^{2-}) salts are NOT SOLUBLE -- EXCEPT those also containing: sodium, potassium, ammonium, or barium (Na^+, K^+, NH_4^+, Ba^{2+}) which are soluble.
7. Carbonate (CO_3^{2-}) and phosphate (PO_4^{3-}) salts are NOT SOLUBLE -- EXCEPT those also containing: sodium, potassium, or ammonium (Na^+, K^+, NH_4^+), which are soluble.

Identify the choice that best completes the statement or answers the question.

1. A magnesium ion has _____ electrons.
   a) 10   b) 11   c) 12   d) 13   e) 14

2. What is the correct formula for cobalt(III) carbonate?
   a) $CoCO_3$ b) $Co_3(CO_3)_2$ c) $Co_2(CO_3)_3$ d) $Co(CO_3)_3$ e) Co_3CO_3

3. Predict which ionic compound has the highest melting point.
   a) KBr   b) MgO   c) RbI   d) $CaBr_2$ e) CsCl

4. Calculate the number of moles in 0.197 g As_2O_3.
   a) 9.96×10^{-4} mol   d) 198 mol
   b) 5.05×10^{-3} mol   e) 1.00×10^3 mol
   c) 39.0 mol

5. An argon ion laser emits light at 457.9 nm. What is the frequency of this radiation?
   a) $4.338 \times 10^{-19}\ s^{-1}$
   b) $1.527 \times 10^{-15}\ s^{-1}$
   c) $1.373 \times 10^{11}\ s^{-1}$
   d) $6.547 \times 10^{14}\ s^{-1}$
   e) $2.305 \times 10^{18}\ s^{-1}$

6. The _____ of a photon of light is _____ proportional to its frequency and _____ proportional to its wavelength.
   a) energy, directly, inversely
   b) energy, inversely, directly
   c) velocity, directly, inversely
   d) intensity, inversely, directly
   e) amplitude, directly, inversely

7. Which of the following transitions in a hydrogen atom would **emit** the highest energy photon?
   a) $n = 1$ to $n = 2$
   b) $n = 3$ to $n = 2$
   c) $n = 5$ to $n = 1$
   d) $n = 2$ to $n = 8$
   e) $n = 6$ to $n = 5$

8. All of the following sets of quantum numbers are allowed EXCEPT
   a) $n = 1$, $\ell = 0$, $m_\ell = 0$
   b) $n = 3$, $\ell = 2$, $m_\ell = +2$
   c) $n = 4$, $\ell = 3$, $m_\ell = -1$
   d) $n = 5$, $\ell = 1$, $m_\ell = 0$
   e) $n = 6$, $\ell = 2$, $m_\ell = +3$

9. Which of the following diagrams represents a *p*-orbital?

   1   2   3   4

   a) 1 only   b) 2 only   c) 3 only   d) 4 only   e) 1 and 2

10. What is the electron configuration for a gallium (Ga) atom?
    a) $[Ar]3d^{10}3s^23p^1$
    b) $[Ar]4d^{10}4s^24p^1$
    c) $[Ar]3d^{10}4s^24p^1$
    d) $[Ar]5d^{10}4s^24p^1$
    e) $[Ne]3s^23p^1$

11. Which 1+ ion has the ground state electron configuration $[Kr]4d^{10}$?
    a) Ru   b) Au   c) Ag   d) Tc   e) Cd

12. How many valence electrons are in the O atom?
    a) 4   b) 6   c) 8   d) 16   e) 0

13. Place the following atoms in order of increasing atomic radii: K, Mg, Ca, and Rb?
    a) K < Mg < Ca < Rb
    b) K < Mg < Rb < Ca
    c) Mg < Ca < K < Rb
    d) K < Rb < Mg < Ca
    e) Mg < K < Ca < Rb

14. Electronegativity is a measure of
    a) the ability of a substance to conduct electricity.
    b) the ability of an atom in a molecule to attract electrons to itself.
    c) the charge on an polyatomic anion.
    d) the charge on a polyatomic cation.
    e) the oxidation number of an atom in a molecule or polyatomic anion.

15. Which of the following molecules or ions are isoelectronic: SO_2, CO_2, NO_2^+, ClO_2^-?
    a) SO_2 and CO_2
    b) SO_2 and NO_2^+
    c) CO_2 and ClO_2^-
    d) CO_2 and NO_2^+
    e) SO_2, NO_2^+, and ClO_2^-

16. One resonance structure for OCN^- ion is drawn below. What is the formal charge on each atom?

$$\left[:\ddot{O}-C\equiv N: \right]^-$$

    a) O atom = 0, C atom = 0, and N atom = 0
    b) O atom = 0, C atom = 0, and N atom = –1
    c) O atom = –1, C atom = 0, and N atom = 0
    d) O atom = –1, C atom = –1, and N atom = +1
    e) O atom = +1, C atom = 0, and N atom = –2

17. Use VSEPR to predict the electron-pair geometry and the molecular geometry of sulfur dioxide, SO_2.
    a) The electron-pair geometry is trigonal-planar, the molecular geometry is trigonal-planar.
    b) The electron-pair geometry is trigonal-planar, the molecular geometry is bent.
    c) The electron-pair geometry is tetrahedral, the molecular geometry is bent.
    d) The electron-pair geometry is tetrahedral, the molecular geometry is linear.
    e) The electron-pair geometry is trigonal-bipyramidal, the molecular geometry is linear.

18. What is the O–C–N bond angle in OCN^-?
    a) 90°   b) 107°   c) 109.5°   d) 120°   e) 180°

19. The NO bond in HNO is a:
    a) triple bond   d) ionic bond
    b) single bond   e) the molecule doesn't exist
    c) double bond

20. Consider the molecule ClF_5 What is the **molecular geometry**?
    a) trigonal bipyramidal   c) ~~trigonal bipyramidal~~   e) tetrahedral
    b) square pyramidal   d) trigonal planar

21. To form a molecule with a trigonal bipyramidal electron geometry, what set of pure atomic orbitals must be mixed?
    a) one s and three p d) two s, six p, and two d
    b) one s, three p, and one d e) two s, six p, and four d
    c) one s, three p, and two d

22. What is the molecular geometry around a central atom that is sp^2 hybridized, has three sigma bonds, and one pi bond?
    a) trigonal-planar   c) bent   e) tetrahedral
    b) trigonal-pyramidal   d) T-shaped

23. Which of the following characteristics apply to SO_2?
    1. polar bonds
    2. nonpolar molecule
    3. linear molecular shape
    4. sp hybridized

    a) 1 only   c) 3 and 4   e) 1, 2, 3, and 4
    b) 1 and 2   d) 1, 2, and 3

24. A molecular orbital that decreases the electron density between two nuclei is said to be _____.
    a) hybridized   b) bonding   c) antibonding   d) pi-bonding   e) nonpolar

25. The following valence molecular orbital energy level diagram is appropriate for which one of the listed species?

    σ^*_{2p}
    π^*_{2p} ↑   ↑
    σ_{2p} ↑↓
    π_{2p} ↑↓   ↑↓
    σ^*_{2s} ↑↓
    σ_{2s} ↑↓

    a) B_2^{2-} b) C_2^{2-} c) N_2^{2-} d) O_2^{2-} e) F_2^{2-}

26. In the molecule 1-pentene, the carbon labeled 1 has what hybridization?

    a) sp   b) sp^2 c) sp^3 d) sp^4 e) sp^3d

27. Referring to the molecules at right, which of the atom centers below is most electron-deficient?
   a) 1   b) 2   c) 3   d) 6   e) 7
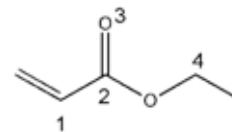
28. Referring to the molecules at right, which of the atom centers below is most electron-rich?
   a) 1   b) 2   c) 4   d) 6   e) 7
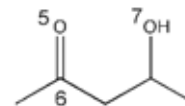
29. When ethanol undergoes complete combustion, the products are carbon dioxide and water.
   $\_\_ C_2H_5OH(\;) + \_\_ O_2(g) \rightarrow \_\_ CO_2(g) + \_\_ H_2O(g)$
   What are the respective coefficients when the equation is balanced with the smallest whole numbers?
   a) 1, 1, 1, 1   d) 1, 3, 2, 3
   b) 1, 2, 1, 3   e) 2, 7, 4, 6
   c) 2, 3, 4, 6
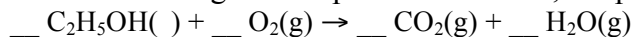
30. Which of the following statements is/are correct?
   1.   All ionic compounds that are soluble in water are electrolytes.
   2.   All ionic compounds dissolve in water.
   3.   Molecular compounds are never soluble in water.

   a) 1 only   c) 3 only   e) 2 and 3
   b) 2 only   d) 1 and 2

31. All of the following compounds are insoluble in water except ____.
   a) $BaSO_4$ b) AgI c) CuS d) $Ca(ClO_4)_2$ e) MgO

32. What is the net ionic equation for the reaction of aqueous calcium acetate and aqueous sodium carbonate?
   a) $Ca^{2+}(aq) + 2\ CH_3CO_2^{-}(aq) \rightarrow Ca(CH_3CO_2)_2(s)$
   b) $Na^{+}(aq) + CH_3CO_2^{-}(aq) \rightarrow NaCH_3CO_2(aq)$
   c) $Na^{+}(aq) + CH_3CO_2^{-}(aq) \rightarrow NaCH_3CO_2(s)$
   d) $Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$
   e) $Ca^{2+}(aq) + 2\ Na^{+}(aq) \rightarrow CaNa_2(s)$

33. Which of the following compounds is a weak base?
    a) KOH   b) H_2CO_3 c) LiCl   d) NH_3 e) HNO_3

34. Which species is oxidized in the reaction below?
    $I^-(aq) + ClO^-(aq) \rightarrow IO^-(aq) + Cl^-(aq)$
    a) I^- b) H_2O c) Cl^- d) IO^- e) ClO^-

35. What is the oxidation number of each atom in sodium phosphate, Na_3PO_4?
    a) Na = +1, P = –3, O = –2   d) Na = –1, P = +5, O = –2
    b) Na = +1, P = +5, O = –2   e) Na = 0, P = 0, O = 0
    c) Na = +1, P = –3, O = +2

36. A battery-operated power tool, such as a cordless drill, converts
    a) electrostatic energy to chemical potential energy.
    b) mechanical energy to electrostatic energy.
    c) thermal energy to mechanical energy.
    d) thermal energy to gravitational energy.
    e) chemical potential energy to mechanical energy.

37. If the same amount of energy in the form of heat is added to 5.00 g samples of each of the metals below, which metal will undergo the largest temperature change?

Metal	Specific Heat Capacity (J/g·K)
Ag	0.235
Al	0.897
Cu	0.385
Fe	0.449
Mg	1.017

    a) Ag   b) Al   c) Cu   d) Fe   e) Mg

38. When 27.0 g of an unknown metal at 18.4 °C is placed in 70.0 g H_2O at 79.5 °C, the water temperature decreases to 76.8 °C. What is the specific heat capacity of the metal? The specific heat capacity of water is 4.184 J/g·K.

   a)   0.34 J/g·K   b)   0.50 J/g·K   c)   0.74 J/g·K   d)   0.94 J/g·K   e)   1.4 J/g·K

39. The thermochemical equation for the combustion of benzene is shown below.

     $2\ C_6H_6(\ ) + 15\ O_2(g) \rightarrow 12\ CO_2(g) + 6\ H_2O(g)$ $\Delta_r H° = -3909.9$ kJ/mol-rxn
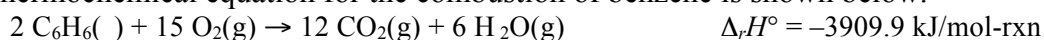
     What is the enthalpy change for the combustion of 12.5 g C_6H_6?

     a)   −313 kJ   c) -1.22×10^4 kJ   e) -4.89×10^4 kJ

     b)   −626 kJ   d) -2.44×10^4 kJ

40. Hydrazine, N_2H_4, is a liquid used as a rocket fuel. It reacts with oxygen to yield nitrogen gas and water.

     $N_2H_4(\ ) + O_2(g) \rightarrow N_2(g) + 2\ H_2O(\ )$
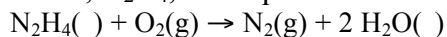
     The reaction of 6.50 g N_2H_4 evolves 126.2 kJ of heat. Calculate the enthalpy change per mole of hydrazine combusted.

     a)   −19.4 kJ/mol   c)   −126 kJ/mol   e)   −820. kJ/mol
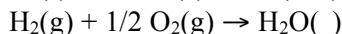
     b)   −25.6 kJ/mol   d)   −622 kJ/mol

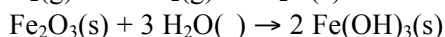41. Determine the enthalpy change for the oxidation of iron,
       4 Fe(s) + 3 O$_2$(g) → 2 Fe$_2$O$_3$(s)
    given the thermochemical equations below.
       Fe(s) + 3 H$_2$O( ) → Fe(OH)$_3$(s) + 3/2 H$_2$(g) $\Delta_rH° = +160.9$ kJ
       H$_2$(g) + 1/2 O$_2$(g) → H$_2$O( ) $\Delta_rH° = -285.8$ kJ
       Fe$_2$O$_3$(s) + 3 H$_2$O( ) → 2 Fe(OH)$_3$(s) $\Delta_rH° = +288.6$ kJ
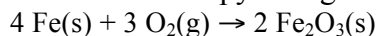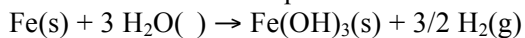
    a) −1648.4 kJ   c) −219.4 kJ   e) +1447.1 kJ
    b) −1182.1 kJ   d) +162.8 kJ

42. The standard molar enthalpy of formation of NH$_3$(g) is −45.9 kJ/mol. What is the enthalpy change if 6.31 g N$_2$(s) and 1.96 g H$_2$(g) react to produce NH$_3$(g)?
    a) −10.3 kJ   c) −29.8 kJ   e) −65.6 kJ
    b) −20.7 kJ   d) −43.7 kJ

43. If the volume of a confined gas is reduced to 1/2 the original volume while its temperature remains constant, what change will be observed?
    a) The pressure of the gas will increase to twice its original value.
    b) The pressure of the gas will remain unchanged.
    c) The density of the gas will decrease to 1/2 its original value.
    d) The pressure of the gas will decrease to 1/2 its original value.
    e) The average velocity of the molecules will double.

44. The lid is tightly sealed on a rigid flask containing 4.20 L O$_2$ at 27 °C and 0.969 atm. If the flask is heated to 81 °C, what is the pressure in the flask?
    a) 0.821 atm   b) 1.14 atm   c) 1.18 atm   d) 2.91 atm   e) 3.45 atm

45. A mass of 0.645 g of an unknown gas is introduced into an evacuated 1.50 L flask. If the pressure in the flask is 0.764 atm at 96 °C, which of the following gases might be in the flask? ($R = 0.08206$ L·atm/mol·K)

    a) N_2O b) C_2H_2 c) O_2 d) HCl   e) NH_3

46. Water can be decomposed by electrolysis into hydrogen gas and oxygen gas. What mass of water must decompose to fill a 5.00 L flask to a total pressure of 2.50 atm at 298 K with a mixture hydrogen and oxygen? ($R = 0.08206$ L·atm/mol·K)

    $$2 H_2O( ) \rightarrow 2 H_2(g) + O_2(g)$$

    a) 6.14 g   b) 9.21 g   c) 13.8 g   d) 23.5 g   e) 35.3 g

47. Which of the following statements are postulates of the kinetic-molecular theory of gases?
    1. Gas particles are in constant, random motion.
    2. The distance between gas particles is large in comparison to their size.
    3. The kinetic energy of gas particles is inversely proportional to the kelvin temperature.

    a) 1 only   b) 2 only   c) 3 only   d) 1 and 2   e) 1, 2, and 3

48. Place the following gases in order of increasing average velocity at 300 K: CO, Ne, O_2, and N_2O.
    a) $CO = Ne = O_2 = N_2O$ d) $O_2 < N_2O < Ne < CO$
    b) $Ne < CO < O_2 < N_2O$ e) $N_2O < O_2 < CO < Ne$
    c) $CO < O_2 < N_2O < Ne$

49. Which of the following statements concerning real gases is/are CORRECT?
    1. Real gases are always liquids or solids at temperatures below 273.15 K.
    2. The pressure of a real gas is higher than predicted by the ideal gas law.
    3. The molecules in a real gas are attracted to each other.

    a) 1 only   c) 3 only   e) 1, 2 and 3
    b) 2 only   d) 2 and 3

50. What is the course number for this class?
    a) 202   c) 111   e) 899
    b) 91   d) 3.14159

Answers

1. ANS: A   TOP: 2.7 Ionic Compounds: Formulas, Names, and Properties
2. ANS: C   TOP: 2.7 Ionic Compounds: Formulas, Names, and Properties
3. ANS: B   TOP: 2.7 Ionic Compounds: Formulas, Names, and Properties
4. ANS: A   TOP: 2.9 Atoms, Molecules, and the Mole
5. ANS: D   TOP: 6.1 Electromagnetic Radiation
6. ANS: A   TOP: 6.2 Planck, Einstein, Energy, and Photons
7. ANS: C   TOP: 6.3 Atomic Line Spectra and Niels Bohr
8. ANS: E   TOP: 6.5 Modern Electronic Struct: Wave or Quantum Mech
9. ANS: B   TOP: 6.6 The Shapes of Atomic Orbitals
10. ANS: C   TOP: 7.3 Electron Configurations of Atoms
11. ANS: C   TOP: 7.4 Electron Configurations of Ions
12. ANS: B   TOP: 7.x 1s22s22p4 n=2 is valence level. Has 6 valence e's
13. ANS: C   TOP: 7.5 Atomic Properties and Periodic Trends
14. ANS: B   TOP: 8.2 Covalent Bonding and Lewis Structures
15. ANS: D   TOP: 8.2 Covalent Bonding and Lewis Structures
16. ANS: C   TOP: 8.3 Formal Charges in Molecules and Ions
17. ANS: B   TOP: 8.6 Molecular Shapes
18. ANS: E   TOP: 8.6 Molecular Shapes
19. ANS: C   TOP: 9.x OWL 9-1d & 9-2b. Study Qs 13-14, Ch
20. ANS: B   TOP: 9.x Molecular Geometry
21. ANS: B   TOP: 9.2 Valence Bond Theory
22. ANS: A   TOP: 9.2 Valence Bond Theory
23. ANS: A   TOP: 9.2 Valence Bond Theory
24. ANS: C   TOP: 9.3 Molecular Orbital Theory
25. ANS: C   TOP: 9.3 Molecular Orbital Theory
26. ANS: B   TOP: 9.x Valence Bonding - Hybridization
27. ANS: B   TOP: 10 Organic
28. ANS: E   TOP: 10 Organic
29. ANS: D   TOP: 3.2 Balancing Chemical Equations
30. ANS: A   TOP: 3.5 Ions and Molecules in Aqueous Solutions
31. ANS: D   TOP: 3.5 Ions and Molecules in Aqueous Solutions
32. ANS: D   TOP: 3.6 Precipitation Reactions
33. ANS: D   TOP: 3.7 Acids and Bases
34. ANS: A   TOP: 3.9 Oxidation-Reduction Reactions
35. ANS: B   TOP: 3.9 Oxidation-Reduction Reactions
36. ANS: E   TOP: 5.1 Energy: Some Basic Principles
37. ANS: A   TOP: 5.2 Specific Heat Capacity: Heating and Cooling
38. ANS: B   TOP: 5.2 Specific Heat Capacity: Heating and Cooling
39. ANS: A   TOP: 5.5 Enthalpy Changes for Chemical Reactions
40. ANS: D   TOP: 5.5 Enthalpy Changes for Chemical Reactions
41. ANS: A   TOP: 5.7 Enthalpy Calculations
42. ANS: B   TOP: 5.7 Enthalpy Calculations
43. ANS: A   TOP: 11.2 Gas Laws: The Experimental Basis
44. ANS: B   TOP: 11.2 Gas Laws: The Experimental Basis
45. ANS: E   TOP: 11.3 The Ideal Gas Law
46. ANS: A   TOP: 11.5 Gas Mixtures and Partial Pressures
47. ANS: D   TOP: 11.6 The Kinetic-Molecular Theory of Gases
48. ANS: B   TOP: 11.6 The Kinetic-Molecular Theory of Gases
49. ANS: C   TOP: 11.9 Nonideal Behavior: Real Gases
50. ANS: C   TOP: Bonus Question
51. An excellent answer from one of you:

"Using HHO as a fuel wouldn't work because it uses water and produces water, which means it's really not using anything. You can't get something from nothing, which is basically what Klein is trying to say he has done."

A bit more chemically: Energy is a state function, so as noted above, a reaction which proceeds water -> x -> water has the same energetics as water -> water. Using heats of formation, $\Delta H_{rxn} = \Delta H_f(water) - \Delta H_f(water) = 0$. You can't run a car two feet on zero energy. It's a scam.