CHEMISTRY 101, 1st Semester, 08/09
Examination 2, Dec. 27, 2008
Time: 75 minutes

15

NAME: _____ REGISTRATION #: _____

INSTRUCTOR'S NAME: الدكتور : ايهاب السماك SECTION: _____

$PV = nRT$, $\Delta E = q + w$, $R = 0.0821$ atm L/mol. K , $h = 6.63 \times 10^{-34}$ J.s

$1m = 10^9$ nm, $N_A = 6.022 \times 10^{23}$, $R = 8.314$ J/mol.K, $1atm.L = 101.3$ J

$u_{rms} = \sqrt{\frac{3RT}{M}}$, $E = h\nu$, $\Delta E = -2.18 \times 10^{-18}$ J $\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$, $c = 3.0 \times 10^8$ m/s

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ANSWER SHEET

1.	a	b	c	**d**	e	11.	a	b	**c**	d	e
2.	a	**b**	c	d	e	12.	**a**	b	**c**	d	e
3.	**a**	b	c	d	e	13.	a	b	**c**	d	e
4.	a	b	c	d	**e**	14.	a	b	c	d	**e**
5.	a	b	**c**	d	e	15.	**a**	b	c	d	e
6.	a	b	c	**d**	e	16.	a	**b**	c	d	e
7.	a	b	**c**	d	**e**	17.	a	b	c	**d**	e
8.	**a**	**b**	c	d	e	18.	a	b	c	**d**	e
9.	a	b	**c**	d	e	19.	**a**	b	c	d	e
10.	a	**b**	c	d	**e**	20.	a	b	**c**	d	**e**

C

1. A sample of nitrogen gas has a volume of 32.4 L at 20°C. The gas is heated to 220°C at constant pressure. What is the final volume of nitrogen (in liters)?

a) 2.93 b) 19.3 c) 31.5 d) 54.5 e) 356

$\frac{32.4}{293} = \frac{V_2}{493}$ = $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_1 = 32.4$
$T_1 = 20 + 273$
$T_2 = 220 + 273$
493

2. Which of the following gases will have the greatest density at the same specified temperature and pressure?

a) H_2O b) $CClF_3$ c) CO_2 d) C_2H_6 e) CF_4

18 104.5 44 30 88

$PV = nRT$
$PV = \frac{mRT}{M}$
$P = \frac{dRT}{M}$
$d = \frac{PM}{RT}$

3. How many liters of chlorine gas at 200°C and 0.500 atm can be produced by the reaction of 12.0 grams of MnO_2 in excess HCl as follows?

$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$

a) 10.7 b) 3.09 c) 4.53 d) 0.138 e) 0.093

$V = \frac{nRT}{P}$

4. Oxygen gas, generated by the reaction $2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$, is collected over water at 27°C in a 2.00-L vessel at a total pressure of 760. torr. (The vapor pressure of H_2O at 27°C is 26.0 torr). How many moles of $KClO_3$ were consumed in the reaction? [1 atm. = 760 torr]

a) 0.079 b) 0.052 c) 0.12 d) 0.081 e) 0.22

$P = 1\ atm$
$T = 27 + 273$
$V = 2$

5. What is the root-mean-square speed (u_{rms}) in m/s for ethanol, C_2H_5OH at 298K? (Molar mass of ethanol = 46.07 g/mol)

a) 12.7 b) 451 c) 402 d) 254 e) 476

$\sqrt{\frac{3RT}{M}}$

6. Which of the following statements is *false*?

a) The change in internal energy, ΔE, is equal to the amount of heat absorbed/released at constant volume, q_v.
b) The change in enthalpy, ΔH, is equal to the amount of heat absorbed/released at constant pressure, q_p.
c) If ΔH for a process is negative, the process is exothermic.
d) For the reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, ΔH & ΔE are equal.
e) The boiling of water is an example of an endothermic process.

C = 2.47

7. A bomb calorimeter has a heat capacity of 2.47 kJ/°C. When a 0.105g of ethylene (C_2H_4) is burned in this calorimeter, temperature rose by 2.14°C. Find the heat of combustion (in kJ) per mole of C_2H_4 (MW = 28.05 g/mol).

a) −5.29 b) −50.5 c) −572 d) −661 e) -1.41×10^3

8. Given: $Cu_2O(s) + \frac{1}{2} O_2(g) \rightarrow 2CuO(s)$ ΔH° = −144 kJ
$Cu_2O(s) \rightarrow Cu(s) + CuO(s)$ ΔH° = + 11 kJ

Calculate the standard enthalpy of formation (ΔH°_f) of $CuO(s)$.

a) −155 kJ/mol b) 155 kJ/mol c) 166 kJ/mol
d) −299 kJ/mol e) −166 kJ/mol

$2CuO \rightarrow Cu_2O + \frac{1}{2}O_2$

9. Given the following thermochemical equation:

$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(l)$ ΔH° = −11020 kJ/mol

If $\Delta H^\circ_f [CO_2(g)] = -393.5$ kJ/mol and $\Delta H^\circ_f [H_2O(l)] = -285.8$ kJ/mol, calculate the standard enthalpy of formation of octane, C_8H_{18} (in kJ/mol).

a) −11020 b) −390 c) −210 d) 420 e) −420

$-11020 = \Sigma(16 \times (-393.5) + 18 \times -285.8) - \Sigma$ of ??

10. For the reaction $C(graphite) + O_2(g) \rightarrow CO_2(g)$, ΔH° = −393 kJ/mol. How many grams of C(*graphite*) must be burned to release 275 kJ of heat?

a) 22.3 g b) 8.40 g c) 12.0 g d) 17.1 g e) 7.24 g

$\Delta V = 3.45 -$

11. A system absorbs 1.39 kJ of heat while expanding against a constant external pressure of 1.20 atm from an initial volume of 0.75L to a final volume of 3.45L. Find ΔE, the change in internal energy of the system?

$\Delta E = q$
$= 1.39$

a) −1.06 kJ b) −1.72 kJ c) 1.72 kJ d) 1.06 kJ e) 1.39 kJ

12. A 100. mL of 0.200 M aqueous hydrochloric acid is added to 100. mL of 0.200 M aqueous ammonia in a calorimeter with heat capacity of 480. J/°C. The following reaction occurs when the two solutions are mixed.

$$HCl(aq) + NH_3(aq) \rightarrow NH_4Cl(aq)$$

Temperature rose by 2.34°C. Find ΔH per mole of HCl and NH_3 reacted. (Specific heat of solution = 4.184 J/°C.g, density of solution = 1.00 g/mL)

a) −154 kJ/mol b) −308 kJ/mol c) 485 kJ/mol
d) 308 kJ/mol e) 154 kJ/mol

13. What is the energy in joules of one photon of microwave radiation with a wavelength of 0.122 m?

a) 2.70×10^{-43} b) 5.43×10^{-33} c) 1.63×10^{-24}
d) 3.06×10^{-19} e) 2.46×10^{9}

nm

14. Calculate the wavelength, in nanometers, of the light emitted by hydrogen when its electron falls from the $n = 7$ to the $n = 4$ principal energy level.

$\Delta E = RH\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

a) 4.87×10^{2} nm b) 2.16×10^{-6} nm c) 4.87×10^{-7} nm
d) 1.38×10^{14} nm e) 2.16×10^{3} nm

15. Which ground-state atom has the following *orbital diagram*?

[Ar] ↑↓ (4s) ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ (3d) ↑↓ ↑ ↑ (4p)

a) selenium b) germanium c) sulfur
d) tellurium e) polonium

16. Which one of the following sets of quantum numbers is not possible?

	n	l	m_l	m_s
a)	4	3	−2	+1/2
b)	3	2	−3	−1/2
c)	3	0	0	+1/2
d)	4	1	1	−1/2
e)	2	0	0	+1/2

17. A ground-state atom of manganese has ___ unpaired electrons and is _____.

$Mn^{25} = 1s^2 2s^2 p^6 3s^2 p^6 4s^2 3d^5$

a) 0, diamagnetic
b) 5, diamagnetic
c) 2, paramagnetic
d) 5, paramagnetic
e) 3, paramagnetic

18. The successive ionization energies of some element are I_1 = 589.5 kJ/mol, I_2 =1145 kJ/mol, I_3= 4900 kJ/mol, I_4 = 6500 kJ/mol, and I_5 = 8100 kJ/mol. This pattern of ionization energies suggests that the unknown element is

a) K b) Si c) As d) Ca e) S

19. Arrange these ions in order of increasing ionic radius: K^+, P^{3-}, S^{2-}, Cl^-.

a) $K^+ < Cl^- < S^{2-} < P^{3-}$
b) $K^+ < P^{3-} < S^{2-} < Cl^-$
c) $P^{3-} < S^{2-} < Cl^- < K^+$
d) $Cl^- < S^{2-} < P^{3-} < K^+$
e) $Cl^- < S^{2-} < K^+ < P^{3-}$

20. Which of these elements has the greatest affinity for electrons?

a) K b) As c) Br d) Ar e) I

Chemistry Department Chem 101 Final Exam

2 Hours 26/1/2005

Name(in Arabic): Reg. No.:

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N(Avogadro's Number = 6.02×10^{23}; atm=760 mm Hg ; atm = 101.325 kPa

h = 6.63×10^{-34} J.s ; nm = 10^{-9} m ; E_n(for H atom) = $-2.18 \times 10^{-18}/n^2$ J.

Answer sheet

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4-	a	b	c	d	e	18-	a	b	c	d	e
5-	a	b	c	d	e	19-	a	b	c	d	e
6-	a	b	c	d	e	20-	a	b	c	d	e
7-	a	b	c	d	e	21-	a	b	c	d	e
8-	a	b	c	d	e	22-	a	b	c	d	e
9-	a	b	c	d	e	23-	a	b	c	d	e
10-	a	b	c	d	e	24-	a	b	c	d	e
11-	a	b	c	d	e	25-	a	b	c	d	e
12-	a	b	c	d	e	26-	a	b	c	d	e
13-	a	b	c	d	e	27-	a	b	c	d	e
14-	a	b	c	d	e						

Answer each of the following questions and put "x" on the correct choice on the answer sheet on the front page.

1. Perform the following calculation and give the answer rounded to the correct number of significant figures:

$$(29.3 - 23.1) \div 2.201$$

a) 3 b) 2.82 c) 2.817 d) 2.8 e) 2.816

2. Calculate the kinetic energy (in kJ) of a 4555 g object moving at a speed of 144 km/hour.($J = kg.m^2/s^2$)

a) 2.04 b) 324 c) 1.24 d) 2.84 e) 3.64

3. Which of the following formula-name pairs is correct ?

a) N_2O_4 : dinitrogen tetroxide. b) H_2SO_3 : sulfuric acid.
c) $KClO_4$: potassium chlorate. d) Fe_2O_3 : iron oxide.
e) PCl_3 : phosphorous chloride.

4. Calculate the total number of ions in 600. mL of 0.300 M KNO_3 solution.

a) 1.81×10^{23} b) 1.44×10^{21} c) 2.17×10^{23} d) 4.23×10^{24} e) 1.08×10^{23}

5. A sample of a compound containing only carbon , chlorine and fluorine was analyzed and found to contain 0.323 g C , 2.38 g Cl and 0.255 g F. What is the empirical formula of the compound ? molar masses (g/mol): C = 12.01 ; Cl = 35.45 and F = 19.00 .

a) C_2ClF_5 b) CCl_2F c) $C_2Cl_3F_3$ d) C_2Cl_3F e) $CClF_2$

6. Al reacts with Fe_3O_4 according to the unbalanced equation:

$$Al + Fe_3O_4 \rightarrow Al_2O_3 + Fe$$

Calculate the mass of iron, Fe, produced from the reaction of 160. g Fe_3O_4 with excess Al.(molar masses , in g/mol. Fe = 55.85 ; Fe_3O_4 = 231.55).

a) 101 g b) 116 g c) 34.7 g d) 72.4 g e) 86.8 g

7. A volume of 55.0 mL of aqueous H_2SO_4 solution was required to react completely with 0.940 g of solid $Fe(OH)_3$ (molar mass = 106.8 g/mol) to produce $Fe_2(SO_4)_3$. The molar concentration of H_2SO_4 is:
(Unbalanced equation: $H_2SO_4 + Fe(OH)_3 \rightarrow Fe_2(SO_4)_3 + H_2O$)

a) 0.240 b) 0.218 c) 0.289 d) 0.226 e) 0.266

8. Which of the following pairs of aqueous solutions would not produce a reaction when mixed ?

a) $AgNO_3$ and HCl
b) Na_2SO_4 and $Ba(OH)_2$
c) $Ba(OH)_2$ and HNO_3
d) $CaCl_2$ and Na_3PO_4
e) $NaNO_3$ and $CuCl_2$

9. Balance the following redox reaction in basic medium.

$$CN^- + MnO_4^- \rightarrow MnO_2 + CNO^-$$

The ratio of moles of MnO_4^- / H_2O in the balanced equation is:

a) 3/2 b) 3/1 c) 2/1 d) 1/1 e) 4/3

10. Calculate the volume (in L) occupied by 8.00 g O_2 at 0.0 °C and 1.00 atm . (molar mass for O_2 = 32.0 g/mol).

a) 4.20 b) 2.80 c) 4.20 d) 5.60 e) 9.80

11. A mixture of 5.65 g N_2 and 5.00 g O_2 has a total pressure of 0.621 atm. Calculate the partial pressure of O_2 (in atm).

a) 0.350 b) 0.271 c) 0.421 d) 0.184 e) 0.237

12. The time required for the effusion of 1.00 L of O_2 from a vessel was 55.0 min., and under same conditions the time required for the effusion of 1.00 L of an unknown gas is 100.0 min. Calculate the molar mass of the unknown gas (in g/mol). Molar mass of O_2 is 32.0 g/mol.

a) 20.0 b) 60.0 c) 76.4 d) 40.0 e) 106

13. A solution of 100.0 ml of 1.00 M HCl at 20.0 °C is added to 200.0 ml of 1.00 M NH_3 solution at 20.0 °C in a styrofoam cup(heat capacity = 0). Given that final temperature of solution is 23.2 °C , mass of solution is 302.0 g and specific heat of solution is 4.10 J/g.°C, calculate ΔH for the reaction (in kJ/mol NH_4Cl produced) .

a) - 44.6 b) - 54.8 c) - 42.1 d) - 39.6 e) - 47.1

14. Consider the following thermochemical equations:

$C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O\ (g)$, $\Delta H^\circ = -1900.$ kJ

$C_3H_8(g) + 10\ N_2O(g) \rightarrow 10\ N_2(g) + 3\ CO_2(g) + 4\ H_2O(g)$, $\Delta H^\circ = -2600.$ kJ

Calculate ΔH°_f for $N_2O(g)$, in kJ/mol.

a) +200. b) + 100. c) +70. d) +80. e) +90

15. Consider the following combustion reaction at 25 °C :

$C_2H_2(g) + 5/2\ O_2(g) \rightarrow 2\ CO_2(g) + H_2O(l)$, $\Delta H^\circ = -1305$ kJ.

At the same temperature $\Delta H^\circ_f (CO_{2(g)}) = -393$ kJ/mol, and $\Delta H^\circ_f (H_2O_{(g)}) = -286$ kJ /mol. Calculate $\Delta H^\circ_f (C_2H_{2(g)})$ in kJ/mol.

a) + 227 b) + 77 c) + 129 d) + 273 e) + 233

16. Calculate the frequency(in Hz) of the light emitted when an excited electron goes back from 6th to 4th energy level in H atom.

a) 7.40×10^{13} b) 2.34×10^{14} c) 2.80×10^{15}

d) 1.14×10^{14} e) 1.60×10^{34}

17. Which of the following sets of quantum numbers is correct for an electron in an atom ?

a) $n = 4$, $l = 3$, $m_l = 2$, $m_s = 1/2$.
b) $n = 4$, $l = 2$, $m_l = 3$, $m_s = 1/2$.
c) $n = 5$, $l = 4$, $m_l = 5$, $m_s = 1/2$.
d) $n = 4$, $l = 5$, $m_l = 0$, $m_s = 1/2$.
e) $n = 4$, $l = 4$, $m_l = 3$, $m_s = 1/2$.

18. The electronic configuration of Ag is:(atomic number for Ag = 47)

a) $[Ar]\ 5s^1\ 4d^{10}$ b) $[Kr]\ 5s^2\ 4d^9$ c) $[Kr]\ 4s^2\ 3d^5 4p^4$

d) $[Kr]\ 5s^1\ 4d^{10}$ e) $[Kr]\ 5s^1\ 3p^5$

19. Among the following, the element with highest first ionization energy is :

a) Ga b) As c) Se d) Ge e) Ca

20. Which of the following atoms or ions has the smallest radius ?

a) Na^+ b) F^- c) Mg^{2+} d) O^{2-} e) Ne

21. Given the following data:

Sublimation energy of K = 90 kJ/mol.
First ionization energy of K = 419 kJ/mol.
Bond energy for F_2 = 154 kJ/mol.
Electron affinity for F = -328 kJ/mol.
$\Delta H_f (KF_{(s)}) = -554$kJ/mol.
Calculate the lattice energy for $KF_{(s)}$ (kJ/mol).

a) -812 b) - 1034 c) – 914 d) - 673 e) - 840.

22. The number of bonding pairs (shared pairs) of electrons in the Lewis structure of O_2 is:

a) 5 b) 2 c) 1 d) 5 e) 3

23. According to VSEPR theory the shape of the ion BH_4^- is:

a) tetrahedral b) trigonal bipyramidal c) octahedral

d) square planar e) distorted tetrahedral

24. Which of the following molecules has no dipole moment ?

a) SO_2 b) XeF_2 c) CH_2Cl_2 d) NH_3 e) SF_4

25. The hybridization of Xe in XeF_4 is :

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

26. The number of π bonds and formal charge on nitrogen in the Lewis structure of NO^- are:

a) 1 , 0 b) 2 , -1 c) 1 , -1 d) 2 , 0 e) 2 , +1

27. Given the following bond energies :

bond	bond energy(kJ/mol)
C=C	614
O=O	745
C=O	789
O–H	467
C-H	413

Calculate ΔH for the reaction:

$$C_2H_4 + 3\,O_2 \rightarrow 2\,CO_2 + 2H_2O$$

a) – 547 kJ b) – 531 kJ c) – 463 kJ d) – 523 kJ e) – 486 kJ

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$$CN^- + MnO_4^- \rightarrow MnO_2 + CNO^-$$

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10. Calculate the volume (in L) occupied by 8.00 g O_2 at 0.0 °C and 1.00 atm . (molar mass for O_2 = 32.0 g/mol).

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11. A mixture of 5.65 g N_2 and 5.00 g O_2 has a total pressure of 0.621 atm. Calculate the partial pressure of O_2 (in atm).

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$C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O\ (g)$, $\Delta H^\circ = -1900.$ kJ

$C_3H_8(g) + 10\ N_2O(g) \rightarrow 10\ N_2(g) + 3\ CO_2(g) + 4\ H_2O(g)$, $\Delta H^\circ = -2600.$ kJ

Calculate ΔH°_f for $N_2O(g)$, in kJ/mol.

a) +200. b) + 100. c) +70. d) +80. e) +90

15. Consider the following combustion reaction at 25 °C :

$C_2H_2(g) + 5/2\ O_2(g) \rightarrow 2\ CO_2(g) + H_2O(l)$, $\Delta H^\circ = -1305$ kJ.

At the same temperature $\Delta H^\circ_f\ (CO_{2(g)}) = -393$ kJ/mol, and $\Delta H^\circ_f\ (H_2O_{(l)}) = -286$ kJ /mol. Calculate $\Delta H^\circ_f(C_2H_{2(g)})$ in kJ/mol.

a) + 227 b) + 77 c) + 129 d) + 273 e) + 233

16. Calculate the frequency(in Hz) of the light emitted when an excited electron goes back from 6^{th} to 4^{th} energy level in H atom.

a) 7.40×10^{13} b) 2.34×10^{14} c) 2.80×10^{15}

d) 1.14×10^{14} e) 1.60×10^{14}

17. Which of the following sets of quantum numbers is correct for an electron in an atom ?

a) $n = 4$, $l = 3$, $m_l = 2$, $m_s = 1/2$.
b) $n = 4$, $l = 2$, $m_l = 3$, $m_s = 1/2$.
c) $n = 5$, $l = 4$, $m_l = 5$, $m_s = 1/2$.
d) $n = 4$, $l = 5$, $m_l = 0$, $m_s = 1/2$.
e) $n = 4$, $l = 4$, $m_l = 3$, $m_s = 1/2$.

18. The electronic configuration of Ag is:(atomic number for Ag = 47)

a) $[Ar]\ 5s^1\ 4d^{10}$ b) $[Kr]\ 5s^2\ 4d^9$ c) $[Kr]\ 4s^2\ 3d^5 4p^4$

d) $[Kr]\ 5s^1\ 4d^{10}$ e) $[Kr]\ 5s^1\ 3p^5$

1. A sample of nitrogen gas has a volume of 32.4 L at 20°C. The gas is heated to 220°C at constant pressure. What is the final volume of nitrogen (in liters)?

a) 2.93 b) 19.3 c) 31.5 d) 54.5 e) 356

$\frac{32.4}{293} = \frac{V_2}{493}$ = $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_1 = 32.4$
$T_1 = 20 + 273$
$T_2 = 220 + 273$
493

2. Which of the following gases will have the greatest density at the same specified temperature and pressure?

a) H_2O b) $CClF_3$ c) CO_2 d) C_2H_6 e) CF_4

18 104.5 44 30 88

$PV = nRT$
$PV = \frac{mRT}{M}$
$P = \frac{dRT}{M}$
$d = \frac{PM}{RT}$

3. How many liters of chlorine gas at 200°C and 0.500 atm can be produced by the reaction of 12.0 grams of MnO_2 in excess HCl as follows?

$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$

a) 10.7 b) 3.09 c) 4.53 d) 0.138 e) 0.093

$V = \frac{nRT}{P}$

4. Oxygen gas, generated by the reaction $2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$, is collected over water at 27°C in a 2.00-L vessel at a total pressure of 760. torr. (The vapor pressure of H_2O at 27°C is 26.0 torr). How many moles of $KClO_3$ were consumed in the reaction? [1 atm. = 760 torr]

$P = 1\ atm$
$T = 27 + 273$
$V = 2$

a) 0.079 b) 0.052 c) 0.12 d) 0.081 e) 0.22

5. What is the root-mean-square speed (u_{rms}) in m/s for ethanol, C_2H_5OH at 298K? (Molar mass of ethanol = 46.07 g/mol)

a) 12.7 b) 451 c) 402 d) 254 e) 476

$\sqrt{\frac{3RT}{M}}$

6. Which of the following statements is *false*?

a) The change in internal energy, ΔE, is equal to the amount of heat absorbed/released at constant volume, q_v.
b) The change in enthalpy, ΔH, is equal to the amount of heat absorbed/released at constant pressure, q_p.
c) If ΔH for a process is negative, the process is exothermic.
d) For the reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, ΔH & ΔE are equal.
e) The boiling of water is an example of an endothermic process.

C = 2.47

7. A bomb calorimeter has a heat capacity of 2.47 kJ/°C. When a 0.105g of ethylene (C_2H_4) is burned in this calorimeter, temperature rose by 2.14°C. Find the heat of combustion (in kJ) per mole of C_2H_4 (MW = 28.05 g/mol).

a) −5.29 b) −50.5 c) −572 d) −661 e) -1.41×10^3

$\frac{1}{2}O_2$

8. Given: $Cu_2O(s) + \frac{1}{2} O_2(g) \rightarrow 2CuO(s)$ ΔH° = −144 kJ
$Cu_2O(s) \rightarrow Cu(s) + CuO(s)$ ΔH° = + 11 kJ

Calculate the standard enthalpy of formation (ΔH°_f) of CuO(s).

a) −155 kJ/mol b) 155 kJ/mol c) 166 kJ/mol
d) −299 kJ/mol e) −166 kJ/mol

$2CuO \rightarrow Cu_2O + \frac{1}{2}O_2$

9. Given the following thermochemical equation:

$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(l)$ ΔH° = −11020 kJ/mol

If $\Delta H^\circ_f [CO_2(g)] = -393.5$ kJ/mol and $\Delta H^\circ_f [H_2O(l)] = -285.8$ kJ/mol, calculate the standard enthalpy of formation of octane, C_8H_{18} (in kJ/mol).

a) −11020 b) −390 c) −210 d) 420 e) −420

$-11020 = \Sigma(16 \times (-393.5) + 18 \times -285.8) - \Sigma$ of ??

10. For the reaction $C(graphite) + O_2(g) \rightarrow CO_2(g)$, ΔH° = −393 kJ/mol. How many grams of C(*graphite*) must be burned to release 275 kJ of heat?

a) 22.3 g b) 8.40 g c) 12.0 g d) 17.1 g e) 7.24 g

$\Delta V = 3.45 -$

11. A system absorbs 1.39 kJ of heat while expanding against a constant external pressure of 1.20 atm from an initial volume of 0.75L to a final volume of 3.45L. Find ΔE, the change in internal energy of the system?

$\Delta E = q$
$= 1.39$

a) −1.06 kJ b) −1.72 kJ c) 1.72 kJ d) 1.06 kJ e) 1.39 kJ

12. A 100. mL of 0.200 M aqueous hydrochloric acid is added to 100. mL of 0.200 M aqueous ammonia in a calorimeter with heat capacity of 480. J/°C. The following reaction occurs when the two solutions are mixed.

$$HCl(aq) + NH_3(aq) \rightarrow NH_4Cl(aq)$$

Temperature rose by 2.34°C. Find ΔH per mole of HCl and NH_3 reacted. (Specific heat of solution = 4.184 J/°C.g, density of solution = 1.00 g/mL)

a) −154 kJ/mol b) −308 kJ/mol c) 485 kJ/mol
d) 308 kJ/mol e) 154 kJ/mol

13. What is the energy in joules of one photon of microwave radiation with a wavelength of 0.122 m?

a) 2.70×10^{-43} b) 5.43×10^{-33} c) 1.63×10^{-24}
d) 3.06×10^{-19} e) 2.46×10^{9}

nm

14. Calculate the wavelength, in nanometers, of the light emitted by hydrogen when its electron falls from the $n = 7$ to the $n = 4$ principal energy level.

$\Delta E = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

a) 4.87×10^{2} nm b) 2.16×10^{-6} nm c) 4.87×10^{-7} nm
d) 1.38×10^{14} nm e) 2.16×10^{3} nm

15. Which ground-state atom has the following *orbital diagram*?

[Ar] ↑↓ (4s) ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ (3d) ↑↓ ↑ ↑ (4p)

a) selenium b) germanium c) sulfur
d) tellurium e) polonium

16. Which one of the following sets of quantum numbers is not possible?

	n	l	m_l	m_s
a)	4	3	−2	+1/2
b)	3	2	−3	−1/2
c)	3	0	0	+1/2
d)	4	1	1	−1/2
e)	2	0	0	+1/2

17. A ground-state atom of manganese has ___ unpaired electrons and is ___.

$Mn^{25} = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

a) 0, diamagnetic
b) 5, diamagnetic
c) 2, paramagnetic
d) 5, paramagnetic
e) 3, paramagnetic

18. The successive ionization energies of some element are I_1 = 589.5 kJ/mol, I_2 =1145 kJ/mol, I_3= 4900 kJ/mol, I_4 = 6500 kJ/mol, and I_5 = 8100 kJ/mol. This pattern of ionization energies suggests that the unknown element is

a) K b) Si c) As d) Ca e) S

19. Arrange these ions in order of increasing ionic radius: K^+, P^{3-}, S^{2-}, Cl^-.

a) $K^+ < Cl^- < S^{2-} < P^{3-}$
b) $K^+ < P^{3-} < S^{2-} < Cl^-$
c) $P^{3-} < S^{2-} < Cl^- < K^+$
d) $Cl^- < S^{2-} < P^{3-} < K^+$
e) $Cl^- < S^{2-} < K^+ < P^{3-}$

20. Which of these elements has the greatest affinity for electrons?

a) K b) As c) Br d) Ar e) I