

Group Number :	Surname :	Signature
List Number :	Name :	
Student Number :	e-mail :	

1	1 H 1,008	2											13	14	15	16	17	18 He 4,003
2	3 Li 6,94	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
3	11 Na 22,99	12 Mg 24,31	3	4	5	6	7	8	9	10	11	12	13 Al 26,98	14 Si 28,09	15 P 30,97	16 S 32,06	17 Cl 35,45	18 Ar 39,95
4	19 K 39,10	20 Ca 40,08	21 Sc 44,96	22 Ti 47,87	23 V 50,94	24 Cr 52,00	25 Mn 54,94	26 Fe 55,85	27 Co 58,93	28 Ni 58,69	29 Cu 63,55	30 Zn 65,38	31 Ga 69,72	32 Ge 72,63	33 As 74,92	34 Se 78,97	35 Br 79,90	36 Kr 83,80
5	37 Rb 85,47	38 Sr 87,62	39 Y 88,91	40 Zr 91,22	41 Nb 92,91	42 Mo 95,95	43 Tc	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
6	55 Cs 132,9	56 Ba 137,3	57-71	72 Hf 178,5	73 Ta 180,9	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	85 At	86 Rn
7	87 Fr	88 Ra	89-103	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
				57 La 138,9	58 Ce 140,1	59 Pr 140,9	60 Nd 144,2	61 Pm	62 Sm 150,4	63 Eu 152,0	64 Gd 157,3	65 Tb 158,9	66 Dy 162,5	67 Ho 164,9	68 Er 167,3	69 Tm 168,9	70 Yb 173,0	71 Lu 175,0
				89 Ac	90 Th 232,0	91 Pa 231,0	92 U 238,0	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

$$c = 2.998 \times 10^8 \text{ m s}^{-1} \quad g = 9.8 \text{ m s}^{-2} \quad h = 6.626 \times 10^{-34} \text{ J s} \quad R_H = 2.179 \times 10^{-18} \text{ J} \quad 0^\circ\text{C} = 273 \text{ K}$$

$$N_A = 6.02 \times 10^{23} \quad 1 \text{ cal} = 4.184 \text{ J} \quad 1 \text{ m} = 10^9 \text{ nm} = 10^{10} \text{ \AA} = 10^{12} \text{ pm} \quad 1 \text{ g} = 10^3 \text{ mg} = 10^6 \text{ \mu g}$$

$$1 \text{ atm} = 760 \text{ mmHg} = 760 \text{ torr} = 101325 \text{ Pa} = 101.325 \text{ kPa} = 1.01325 \text{ bar}$$

$$R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1} = 0.08314 \text{ L bar mol}^{-1} \text{ K}^{-1} = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 8.314 \text{ L kPa mol}^{-1} \text{ K}^{-1}$$

$$\text{For water: } c = 4.184 \text{ J g}^{-1} \text{ K}^{-1} \quad K_f = 1.86 \text{ K kg mol}^{-1} \quad K_b = 0.512 \text{ K kg mol}^{-1}$$

$$1 \text{ Newton (N)} = 1 \text{ kg m s}^{-2} \quad 1 \text{ Joule (J)} = 1 \text{ N m} = 1 \text{ kg m}^2 \text{ s}^{-2} \quad 1 \text{ Watt (W)} = 1 \text{ J s}^{-1}$$

1) A gas, contained in a cylinder with a frictionless piston, expands from a volume of 4 L to a volume of 14 L under a constant pressure 1 atmosphere and absorbs 800 J of thermal energy from its surroundings. Determine the change in the internal energy of the gas. (1L.atm=101.325 J)

- A) -213.25 J B) 150.32 J C) -417.30 J D) 320.75 J E) -320.75 J

2) A 1.072 g sample of helium gas is found to occupy a volume of 8.446 L when collected over hexane at 25°C and 738.6 mmHg barometric pressure. Use these data to determine the vapor pressure of hexane at 25°C.

- A) 149.0 mmHg B) 254.2 mmHg C) 76.4 mmHg D) 737.8 mmHg E) 590 mmHg

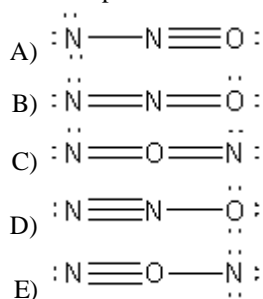
3) Which of the following molecules has the sp^2 hybridization on its central atom?

- I) CO_2 II) SO_2 III) NO_2^- IV) SO_3^{2-} V) SO_3

- A) III, V B) II, IV, V C) II, III D) II, III, V E) I, II, IV

Booklet A

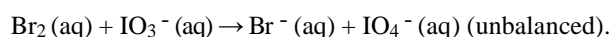
4) Nitrous oxide is a gas used in anesthesia with the formula N_2O . It is also known as laughing gas. Which of the following is the most plausible Lewis structure of nitrous oxide?



5) Which of the following molecule(s) has zero dipole moment?

- I) BF_3 II) H_2O III) SO_4^{2-} IV) ICl_2^- V) SO_2
 A) I, III, and IV B) I, II, and V C) I and III D) Only I E) II and IV

6) The unbalanced reaction between $Br_2(aq)$ and $IO_3^-(aq)$ in an acidic solution is given below.



What volume of 0.788 M KIO_3 will react with 4 g Br_2 ?

- A) 31.76 mL B) 26.01 mL C) 34.90 mL D) 0.02601 mL E) 0.03176 mL

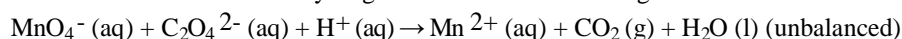
7) A tank contains 13.0 L of oxygen gas at $25^\circ C$ and 35.0 atm. Helium gas is added into the tank until the mole fraction of oxygen becomes 0.210. Calculate the density of the gas mixture in g/L.

- A) 56.6 g/L B) 76.2 g/L C) 44.4 g/L D) 33.7 g/L E) 67.3 g/L

8) Which of the following is a characteristic of an ideal gas?

- A) Collisions between gas particles are perfectly elastic.
 B) Individual gas particles occupy fixed volume.
 C) The gas cannot be compressed infinitely.
 D) There exist attractive and repulsive inter-particle forces.
 E) Collisions between gas particles and container walls are not elastic.

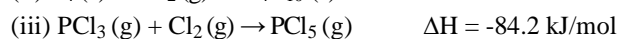
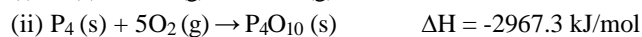
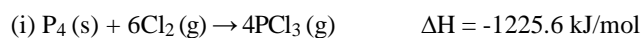
9) What is the coefficient of a hydrogen ion when the following redox reaction is balanced?



- A) 10 B) 8 C) 16 D) 2 E) 5



Calculate the enthalpy of the reaction above by using the information given below.



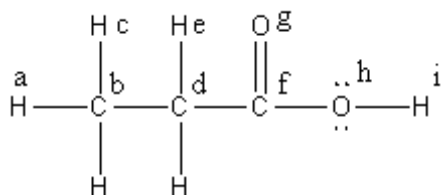
- A) -110.5 kJ/mol
 B) -2682.2 kJ/mol
 C) -1230.6 kJ/mol
 D) -610.1 kJ/mol
 E) -7555.0 kJ/mol

11) Which of the following molecules has a trigonal pyramidal molecular geometry?

- A) O_3 B) BF_3 C) $AlCl_3$ D) ClF_3 E) ClO_3^-

Booklet A

- 12) A chemist combines 300 mL of a 0.3 M Na_2SO_4 solution with 200 mL of 0.4 M BaCl_2 solution. How much precipitate is formed?
 A) 233.4 g
 B) 21.0 g
 C) No precipitation
 D) 18.7 g
 E) 58.5 g
- 13) In an acid-base neutralization reaction, 38.74 mL of 0.500 M potassium hydroxide reacts with 50.00 mL of sulfuric acid solution. What is the concentration of the H_2SO_4 solution?
 A) 5.163 M B) 0.775 M C) 0.387 M D) 1.290 M E) 0.194 M
- 14) A 40.2 g sample of metal is heated to 99.3°C and then placed in a calorimeter containing 120.0 g of water ($c = 4.18 \text{ J/g}^\circ\text{C}$) at 21.8°C . The final temperature of the water is 24.5°C . Which metal was used? Assume no loss or gain of heat from the surroundings.
 A) Iron ($c = 0.45 \text{ J/g}^\circ\text{C}$)
 B) Aluminum ($c = 0.89 \text{ J/g}^\circ\text{C}$)
 C) Lead ($c = 0.14 \text{ J/g}^\circ\text{C}$)
 D) None of these
 E) Copper ($c = 0.20 \text{ J/g}^\circ\text{C}$)
- 15) When 1.89 g of benzoic acid ($\text{C}_7\text{H}_6\text{O}_2$) undergoes combustion in a bomb calorimeter at 25°C , the released heat causes a rise in the temperature of 18.94 kg water by 0.6320°C . Given that the specific heat capacity of water at 25°C is $0.998 \text{ cal/g}^\circ\text{C}$, what is the molar heat of combustion of benzoic acid?
 A) -771.1 kcal B) -981.1 kcal C) -881.1 kcal D) -251.1 kcal E) -11.946 kcal
- 16) Which of the following molecules has a different electron group geometry than the others?
 A) XeF_4 B) BrF_5 C) SF_6 D) XeO_3 E) ICl_4^-
- 17) 20.00 moles of helium gas are mixed with 5.00 moles of oxygen gas in a 15.00 L container at 22°C . Calculate the partial pressure of helium gas in the container after the temperature drops to 8°C .
 A) 30.8 atm B) 1.52 atm C) 40.4 atm D) 32.3 atm E) 38.5 atm
- 18) According to Molecular Orbital theory, which of the following species has the shortest bond length?
 A) C_2 B) N_2 C) F_2 D) O_2 E) Li_2
- 19) The Lewis structure of the propionic acid compound is as follows.



Accordingly, between which atoms does the largest bond angle occur?

- A) g-f-h B) b-d-f C) f-h-i D) e-d-f E) a-b-c
- 20) While CO_2 gas diffuses at 6 cm per second in a glass pipe, how many cm does CO gas diffuse within the same duration in the same pipe?
 A) 9.8 cm B) 6.0 cm C) 3.2 cm D) 7.5 cm E) 4.8 cm

Answer Key

Testname: MIDTERM-2-EN-A

- 1) A
- 2) A
- 3) D
- 4) D
- 5) A
- 6) A
- 7) E
- 8) A
- 9) C
- 10) D
- 11) E
- 12) D
- 13) E
- 14) A
- 15) A
- 16) D
- 17) A
- 18) B
- 19) A
- 20) D