KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

CHEMISTRY DEPARTMENT

EXAM

THE SECOND MAJOR EXAM

TEST CODE

000

COURSE

CHEM101 - 051

STUDENT NUMBER: _____

NAME : _____

SECTION NUMBER: _____

INSTRUCTIONS

1. Type your student number, name, and section number on the *EXAM COVER* page.
2. Type your student number, section number, your name, and your test code number on your *EXAM ANSWER* form.
3. With your pencil, bubble your student number, your section number, and test code number on the *EXAM ANSWER* form.
4. With your pencil, bubble your answer's selections on the *EXAM ANSWER* form. You must not give more than *ONE* answer per question.
5. Return the *EXAM* booklet and *ANSWER* form to the proctor of the exam when you have finished.

Important constants

Gas Constant (R)	= 0.0821	L.atm/(mol.K)
	= 8.31	J/(mol.K)
	= 8.31×10^{7}	$g.cm^2/(sec^2.mol.K)$
Planck's Constant (h)	= 6.626×10^{-34}	J.sec/particle
	= 6.626×10^{-34}	$kg.m^2/(sec.particle)$
Velocity of light (c)	= 2.998×10^{8}	m/sec
Avogadro's number (N)	= 6.022×10^{23}	particles/mol
Bohr's Constant (R_H)	= 2.179×10^{-18}	J/particle
Faraday (F)	= 96485	Coulombs
Specific heat of H_2O	= 4.18	$I/(g.^oC)$

PERIODIC TABLE OF THE ELEMENTS

	IA							VIII B			I B	II B	III A	IV A	V A	VI A	VIII A
1	1 H 1.0079	IIA															1 H VIIA 2 He 4.0026
2	3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
3	11 Na 22.990	12 Mg 24.305	III B	IV B	V B	VI B	VIIB						13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
4	19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80
5	37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
6	55 Cs 132.91	56 Ba 137.33	57 La* 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	89 Ac** (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (264)	108 Hs 265)	109 Mt (268)	110 Uun (269)	111 Uuu (272)	112 Uub (277)	113	114	115	116	117	118

58 *Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 165.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 **Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

1. If the volume of a gas is doubled at constant temperature, which of the following changes is observed?
   A) The pressure of the gas is decreased to ½ of its original value.
   B) The pressure of the gas is decreased to ¼ of its original value.
   C) The pressure of the gas is increased to twice its original value.
   D) The density of the gas is doubled.
   E) The velocities of the molecules are doubled.

2. Which of the following gases has the greatest density at 1.0 atm and 305 K?
   A) CF_4
   B) CO
   C) N_2
   D) CO_2
   E) He

3. A 10.0 L flask contains 2.5 atm of ethane gas and 8.0 atm of oxygen gas at 28ºC. What is the partial pressure of the water gas in the flask at 28ºC after the completion of the reaction?

$$2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(g)$$

   A) 6.85 atm
   B) 1.85 atm
   C) 11.1 atm
   D) 1.01 atm
   E) 3.24 atm

4. In an experiment, argon is allowed to effuse through a tiny opening into an evacuated 5.00×10^2 mL flask for 30.0 seconds, where the pressure in the flask is found to be 15.0 mm Hg. The experiment is repeated using an unknown gas at the same temperature and pressure. After 30.0 seconds, the pressure is found to be 47.4 mm Hg. What is the molar mass of the gas?
   A) 4.00 g/mol
   B) 16.0 g/mol
   C) 28.0 g/mol
   D) 32.0 g/mol
   E) 83.8 g/mol

5. One way in which real gases differ from ideal gases is that the molecules of a real gas
   A) are attracted to each other.
   B) move in curved paths.
   C) have no mass.
   D) occupy no volume.
   E) have no kinetic energy.

6. Two metals of equal mass with different heat capacities are subjected to the same amount of heat. Which undergoes the smallest change in temperature?
   A) The metal with higher heat capacities.
   B) The metal with lower heat capacities.
   C) Both undergo the same change in temperature.
   D) You need to know the initial temperatures of the metal
   E) You need to know which metal you have.

7. Which of the following processes is (are) endothermic?

I. $CO_{2(s)} \rightarrow CO_{2(g)}$

II. When solid KBr is dissolved in water, the solution gets colder.

III. The combustion of gas in a car engine.

A) I and II
B) II only
C) III only
D) II and III
E) I only

8. Given the standard heat of reactions:

$P_4 + 6Cl_2 \rightarrow 4PCl_3$ $\Delta H^o = -1225.6$ kJ

$P_4 + 5O_2 \rightarrow P_4O_{10}$ $\Delta H^o = -2967.3$ kJ

$PCl_3 + Cl_2 \rightarrow PCl_5$ $\Delta H^o = -84.2$ kJ

$PCl_3 + (1/2)O_2 \rightarrow Cl_3PO$ $\Delta H^o = -285.7$ kJ

Calculate the value of ΔH^o for the reaction below:

$P_4O_{10} + 6PCl_5 \rightarrow 10\ Cl_3PO$

A) -610.1 kJ
B) -110.5 kJ
C) -2682.2 kJ
D) -7555.0 kJ
E) 154.1 kJ

9. It takes 75.0 J to raise the temperature of 35.0 g of lead 12.0 ˚C.

Calculate the molar heat capacity of lead.

A) 37.1 J/mol ˚C
B) 0.179 J/mol ˚C
C) 0.124 J/mol ˚C
D) 8.05 J/mol ˚C
E) 8.63×10^{-4} J/mol ˚C

10. Calculate the standard of enthalpy of combustion per gram of liquid ethanol.

$$C_2H_5OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$$

ΔH_f^o of C_2H_5OH = -278.0 kJ/mol

ΔH_f^o of CO_2 = -393.5 kJ/mol

ΔH_f^o of H_2O = -286.0 kJ/mol

A) -29.67 kJ/g
B) -13.67 kJ/g
C) -8.72 kJ/g
D) 8.72 kJ/g
E) -8.35 kJ/g

11. A single pulse of a laser yields an average of 5.00×10^{18} photons with λ = 633 nm. If melting ice to water at 0°C requires 6.01 kJ/mol, what is the least number of laser pulses needed to melt 10.0 g of ice?
A) 2120
B) 3340
C) 38300
D) 3830
E) 212

12. "No two electrons in an atom can have the same four quantum numbers" is a statement of
A) the Pauli exclusion principle.
B) Bohr's equation.
C) Hund's rule.
D) de Broglie's relation.
E) Dalton's atomic theory.

13. An electron in the hydrogen atom makes a transition from an energy state of principal quantum numbers n_i to the n = 2 state. If the photon emitted has a wavelength of 434 nm, what is the value of n_i?
    A) 5
    B) 4
    C) 3
    D) 6
    E) 7

14. An electron in an atom is in the n = 3 quantum level. List all the possible values of l and m_l, that it can have.
    A) $l = 0$, $m_l = 0$; $l = 1$, $m_l = -1, 0, 1$; $l = 2$, $m_l = -2, -1, 0, 1, 2$
    B) $l = 0$, $m_l = 0$; $l = 1$, $m_l = 0, 1$; $l = 2$, $m_l = 0, 1, 2$
    C) $l = 1$, $m_l = -1, 0, 1$; $l = 2$, $m_l = -2, -1, 0, 1, 2$
    D) $l = 0$, $m_l = 0$; $l = 1$, $m_l = -1, 0, 1$; $l = 2$, $m_l = -2, -1, 0, 1, 2$; $l = 3$, $m_l = -3, -2, -1, 0, 1, 2, 3$
    E) $l = 2$, $m_l = -2, -1, 0, 1, 2$

15. Photodissociation of water

$$H_2O\ (l) + h\nu \rightarrow H_2\ (g) + 1/2O_2\ (g)$$

has been suggested as a source of hydrogen. The ΔH_{rxn} for the reaction, calculated from thermochemical data, is 285.8 kJ per mole of water decomposed. Calculate the maximum wavelength (in nm) that would provide the necessary energy.
    A) 419 nm
    B) 2.95×10^5 nm
    C) 4.19×10^5 nm
    D) 295 nm
    E) 630 nm

16. Estimate the enthalpy change for the reaction

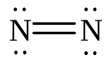
$$2CO + O_2 \rightarrow 2CO_2$$

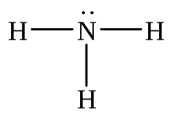
given the following bond energies (BE).

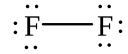
BE(C≡O) = 1074 kJ/mol, BE(O=O) = 499 kJ/mol, and BE(C=O) = 802 kJ/mol

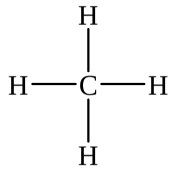
A) –561 kJ/mol
B) +744 kJ/mol
C) +1949 kJ/mol
D) +2380 kJ/mol
E) –744 kJ/mol

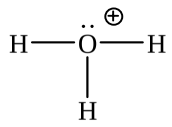
17. Which of the following Lewis structures is incorrect?

A) 

B) 

C) 

D) 

E) 

18. Which of the following electron configurations represent elements that would have similar chemical properties?

I. $1s^2 2s^2 2p^4$ II. $1s^2 2s^2 2p^5$ III. $[Ar]4s^2 3d^{10} 4p^3$ IV. $[Ar]4s^2 3d^{10} 4p^4$

A) I and IV
B) I and II
C) I and III
D) II and IV
E) II and III

19. Arrange the following 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. The molecular geometry for the chlorate anion, ClO_3^-, is

A) trigonal pyramid
B) linear
C) bent
D) triangular-planar
E) tetrahedral

Answer Key

1. A
2. A
3. A
4. A
5. A
6. A
7. A
8. A
9. A
10. A
11. A
12. A
13. A
14. A
15. A
16. A
17. A
18. A
19. A
20. A