STUDENT NUMBER:

NAME:

SECTION NUMBER:

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KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

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COURSE: CH101

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EXAM: THE FINAL EXAM OF CHEM101 – 042
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TEST CODE NUMBER: XXX

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INSTRUCTIONS:
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1. PRINT YOUR STUDENT NUMBER, NAME, AND SECTION NUMBER ON THE EXAM.

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COURSE: CH101

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****
QUESTION NO: 1
****

All the numbers in

$$\frac{123.4 + 1.42}{17.0000 - 16.950}$$

are measured quantities. The number of significant
figures to which the answer must be given is:

A.   2

B.   1

C.   3

D.   4

E.   5

****
QUESTION NO: 2
****

Four samples from a solution known to contain 12.40% $CaCl_2$ were

analyzed by a student. The following results were obtained:

12.81%   12.84%   12.80%   12.87%

These results

A.   are precise but not accurate

B.   are not precise and not accurate

C.   are accurate but not precise

D.   prove that there are no systematic errors

E.   prove that random errors are absent

****

QUESTION NO: 3
****

Which statement is false?

A.   By directing an alpha-particle beam onto a thin gold foil,
     Rutherford concluded that the atom has a plum pudding
     structure.

B.   Using a cathode ray tube, Thomson discovered that atoms
     contain electrons.

C.   The cathode ray tube experiment was the one in which
     electrons were discovered.

D.   Using charged oil droplets, Millikan determined the charge
     of an electron.

E.   Most alpha particles are not deflected by a thin
     metal foil.

****

QUESTION NO: 4
****

The correct name of $CrCl_3$ is:

A.   Chromium (III) chloride

B.   Chromium chloride

C.   Chromium trichloride

D.   Chromium (III) chlorite

E.   Chromium perchlorate

****
QUESTION NO: 5
****

Which pair of the following compounds illustrates the law
of multiple proportions?

A. $CrCl_2$, $CrCl_3$

B. NO_2 , KNO_3

C. Na_2CO_3 , $NaHCO_3$

D. $FeCl_2$, $Fe(ClO)_2$

E. PCl_3 , $AlCl_3$

****
QUESTION NO: 6
****

Chlorine has two isotopes, ^{35}Cl (35.0 amu) and
^{37}Cl (37.0 amu).   Which is the more abundant one and
what is its percent abundance?

A. ^{35}Cl, abundance 77.5%

B. ^{35}Cl, abundance 22.5%

C. ^{37}Cl, abundance 77.5%

D. ^{37}Cl, abundance 22.5%

E. ^{35}Cl, abundance 55.5%

****
QUESTION NO: 7
****

When octane (C_8H_{18}) is burned in oxygen in a particular combustion engine, the actual yield of products (carbon dioxide and water) is 93%. Considering this yield, what mass of carbon dioxide will be produced in this engine, when 15.0 g of octane are burned with 15.0 g of oxygen gas?

A.   12 g

B.   13 g

C.   21 g

D.   54 g

E.   43 g

****
QUESTION NO: 8
****

The percent composition by mass of a compound is 76.0 % C, 12.8% H and 11.2 % O. The molar mass of this compound is 284.5 g/mol. What is the molecular formula of the compound?

A. $C_{18}H_{36}O_2$

B. $C_{20}H_{12}O_2$

C. $C_{16}H_{28}O_4$

D. $C_9H_{18}O$

E. $C_{10}H_6O$

****

QUESTION NO: 9
****

What mass of Na_2CrO_4 is required to precipitate all of the

silver ions from 75.0 mL of a 0.100 M solution of $AgNO_3$?

A.   0.607 g

B.   1.21 g

C.   6.07 g

D.   12.1 g

E.   60.7 g

****

QUESTION NO: 10
****
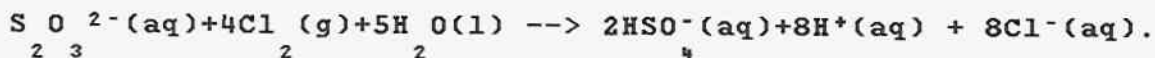
A drug contains aspirin, $HC_9H_7O_4$, which has one

acidic hydrogen. A 0.500 g sample of the drug required 21.5 mL
of a 0.100 M NaOH solution to neutralize it. Calculate the
percentage by mass of aspirin in the drug.

A.   77.5%

B.   7.75%

C.   38.7%

D.   3.87%

E.   50.0%

****
QUESTION NO: 11
****

   Identify the reducing agent in the following redox reaction:

   $S_2O_3^{2-}(aq) + 4Cl_2(g) + 5H_2O(l) \longrightarrow 2HSO_4^-(aq) + 8H^+(aq) + 8Cl^-(aq)$.

   A. $S_2O_3^{2-}$

   B. Cl_2

   C. H_2O

   D. HSO_4^-

   E. H^+

****
QUESTION NO: 12
****

   Oxygen generated in the decomposition by heat of potassium
   chlorate by the following reaction:

   $2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$

   is collected over water. At a total atmospheric pressure of
   765 torr a volume of 128 mL of oxygen gas was collected by
   displacement of water at 24.0°C. Calculate the mass of $KClO_3$
   in the sample that has decomposed. The pressure of water
   vapor at 24.0°C is 22.4 torr (1 atm = 760 torr).

   A.   0.419 g

   B.   0.127 g

   C.   0.170 g

   D.   0.164 g

   E.   0.629 g

****
UESTION NO: 13
****

A gas consisting of only carbon and hydrogen has an empirical
formula of CH_2. The gas has a density of 1.65 g/L at 27.0°C

and 734 torr. What is its molar mass?

A.   42.1 g/mol

B.   112 g/mol

C.   70.2 g/mol

D.   224 g/mol

E.   154 g/mol

****
UESTION NO: 14
****

The rate of effusion of an unknown gas is 31.50 mL/min.
Under identical conditions, the effusion rate of
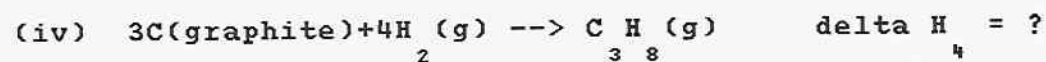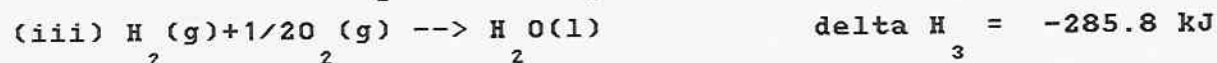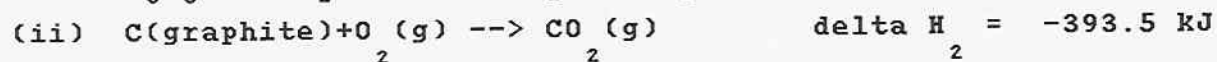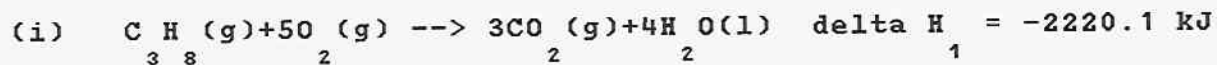O_2 is 22.31 mL/min. The unknown gas is:

A. CH_4

B.   CO

C.   NO

D. CO_2

E. NO_2

****
QUESTION NO: 15
****

Using the following heats of combustion, determine
delta H_4 for the overall reaction (iv) and round up to the

next whole number:

(i) $C_3H_8(g)+5O_2(g) \longrightarrow 3CO_2(g)+4H_2O(l)$ delta H_1 = -2220.1 kJ

(ii) $C(graphite)+O_2(g) \longrightarrow CO_2(g)$ delta H_2 = -393.5 kJ

(iii) $H_2(g)+1/2O_2(g) \longrightarrow H_2O(l)$ delta H_3 = -285.8 kJ

(iv) $3C(graphite)+4H_2(g) \longrightarrow C_3H_8(g)$ delta H_4 = ?

A.   -104 kJ

B.   +104 kJ

C.   -2258 kJ

D.   +2258 kJ

E.   -2154 kJ

****
QUESTION NO: 16
****

The standard enthalpy of combustion of ethene gas, C_2H_4 (g), is $\Delta H_c^\circ[C_2H_4(g)] = -1411.1$ kJ/mol at 298 K.   Given the enthalpies of formation, $\Delta H_f^\circ[CO_2(g)] = -393.5$ kJ/mol and $\Delta H_f^\circ[H_2O(l)] = -285.8$ kJ/mol, calculate

$\Delta H_f^\circ[C_2H_4(g)]$ for ethene.

A.   +52.5 kJ/mol

B.   -52.5 kJ/mol

C.   -731.8 kJ/mol

D.   +731.8 kJ/mol

E.   -338.3 kJ/mol

****
QUESTION NO: 17
****

Which of the following orbitals is occupied by the outer electrons in Sr^{2+}?

A.   4p

B.   4s

C.   5p

D.   5s

E.   3d

****

QUESTION NO: 18
****

What is the wavelength in nm (1 nm = 10^{-9}m) of the electromagnetic radiation needed to remove an electron from the n = 3 level of an excited hydrogen atom?

A.   820.5 nm

B.   547.0 nm

C.   273.5 nm

D.   136.7 nm

E.   102.6 nm

****

QUESTION NO: 19
****

Which of the following has the highest first ionization energy?

A.   Cl

B.   P

C.   Se

D.   S

E.   As

****

QUESTION NO: 20
****

The electronic configuration of titanium (Ti) is:

A. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2$

B. $[Ar]3d^4$

C. $[Ar]4s^2 4p^2$

D. $[Kr]5s^2 4d^{10} 5p^2$

E. $1s^2 2s^2 2p^6 3s^2 3p^6$

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QUESTION NO: 21
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Which one of the following molecules has a dipole moment?

A.   HCl

B. SF_6

C. CH_4

D. CO_2

E. N_2

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QUESTION NO: 22
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Calculate the lattice energy of CsCl (in kJ/mol) using the following data:

Standard enthalpy of formation of CsCl: −443 kJ/mol
Enthalpy of sublimation of Cs: 79 kJ/mol
First ionization energy of Cs: 376 kJ/mol
Electron affinity of Cl: −349 kJ/mol
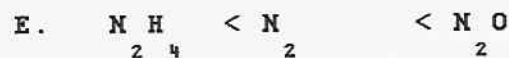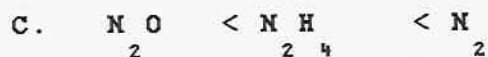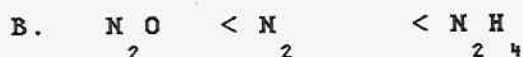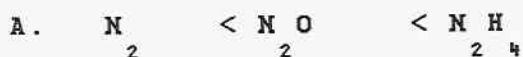Bond energy of Cl_2:   244 kJ/mol

A.   −671 kJ/mol

B.   −523 kJ/mol

C.   −1235 kJ/mol

D.   −793 kJ/mol

E.   754 kJ/mol

****
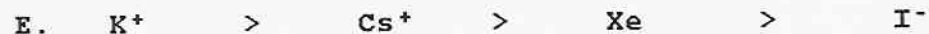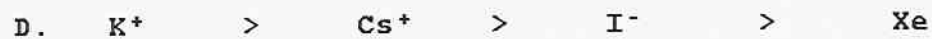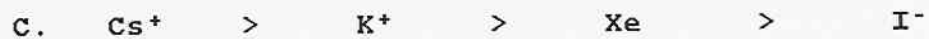QUESTION NO: 23
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Arrange the following molecules in the order of increase in their nitrogen-nitrogen bond length

N_2O (skeleton structure NNO), N_2, N_2H_4 (skeleton structure H_2NNH_2 ; 2 N-H bonds to each N)

A. N_2 < N_2O < N_2H_4

B. N_2O < N_2 < N_2H_4

C. N_2O < N_2H_4 < N_2

D. N_2 < N_2H_4 < N_2O

E. N_2H_4 < N_2 < N_2O

****
QUESTION NO: 24
****

Arrange Cs^+, K^+, I^-, Xe in the order of decreasing size.

A. I^- >   Xe   > Cs^+ > K^+

B.   Xe   > Cs^+ > K^+ > I^-

C. Cs^+ > K^+ >   Xe   > I^-

D. K^+ > Cs^+ > I^- >   Xe

E. K^+ > Cs^+ >   Xe   > I^-
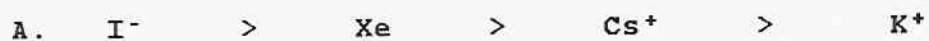
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QUESTION NO: 25
****

Give the number of sigma and pi bonds in a carbon
dioxide molecule.

A.   2 sigma bonds and 2 pi bonds

B.   1 sigma bonds and 2 pi bonds

C.   2 sigma bonds and 1 pi bonds

D.   3 sigma bonds and 1 pi bonds

E.   3 sigma bonds and 2 pi bonds

****
QUESTION NO: 26
****

Given the following compounds with the hybridization on
the central atom, X, identify the compound that is polar.

A. XY_5 , d^2sp^3

B. XY_2 , sp

C. XY_3 , sp^2

D. XY_5 , dsp^3

E. XY_4 , d^2sp^3

****
QUESTION NO: 27
****

Which of the following has a linear molecular shape?

A.   2 sigma bonds plus 3 lone pairs

B. sp^2 hybridization and no lone pair

C.   2 sigma bonds plus 2 lone pairs

D. dsp^3 hybridization and no lone pair

E. sp^3 hybridization and no lone pair

****
QUESTION NO: 28
****

What is the bond order in O_2^+?

A.   2.5

B.   0.5

C.   1.0

D.   1.5

E.   2.0

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QUESTION NO:   29
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The molecular orbital electron configuration

$(\text{sigma } 2s)^2(\text{sigma}*2s)^2(\text{pi } 2p)^4(\text{sigma } 2p)^2$
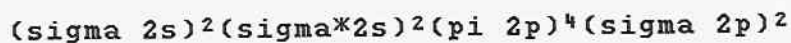
can describe which one of the following diatomic molecules?

A. CN^-

B. O_2

C. F_2

D. C_2

E.   BC

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QUESTION NO:   30
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There are 250 mL of water stored in a 500 mL sealed container.
As the temperature increases from 298 K to 308 K, the number
of water molecules

A.   in the liquid phase decreases.

B.   in the liquid phase increases.

C.   in the vapor phase increases indefinitely.

D.   in the vapor phase decreases.

E.   in the vapor phase remains constant.

****
QUESTION NO: 31
****

The vapor pressures of aluminum at 1760.°C and 1908°C
are 10.00 torr and 40.00 torr, respectively. The enthalpy
of vaporization of aluminum is:

A.   345.4 kJ/mol

B.   3.452 kJ/mol

C.   5217 kJ/mol

D.   3649 kJ/mol

E.   4340 kJ/mol

****
QUESTION NO: 32
****

How much energy is required to convert 10.0 g of ice at -118°C
to ice at -10.0°C at normal atmospherica pressure.
The specific heat of ice is 2.09 J/(g K).

A.   2.26 kJ

B.   3.35 kJ

C.   4.18 kJ

D.   2.30 kJ

E.   2.07 kJ

****
QUESTION NO: 33
****

A phase diagram is

A.   a graphical summary of the conditions under which different
     states of a substance are stable.

B.   a graphical summary of the energy needed to convert a solid
     at a given temperature to a gas at a given temperature.

C.   a graphical summary of crystal formation.

D.   a graphical summary of the energy changes that occur as a
     substance changes from solid to liquid to gas.

E.   a graphical representation of the logarithm of the vapor
     pressure as a function of the inverse of the temperature.

****
QUESTION NO: 34
****

The edge of a body-centered cubic unit cell of the rare
earth metal europium (Eu) is 476 pm. What is the density
of europium?

A.   4.68 g/cm^3

B.   5.25 g/cm^3

C.   10.5 g/cm^3

D.   14.0 g/cm^3

E.   7.77 g/cm^3

****

QUESTION NO: 35
****

The distance between two planes of a crystal is 0.348 nm.
At what angle will the first order reflections occur for
X-rays of 0.135 nm wavelength?

A.   11.2°

B.   40.3°

C.   5.0°

D.   2.0°

E.   22.8°

****

QUESTION NO: 36
****

Which one of the following in their liquid states would be a
good solvent for iodine, I_2 ?

A. CS_2

B. NH_3

C. CH_3OH

D. H_2O

E.   HCl

****
QUESTION NO: 37
****

What is the percentage by mass of $CdSO_4$ in a 1.00 molal
aqueous $CdSO_4$ solution?

A.   17.3%

B.   24.4%

C.   20.8%

D.   0.100%

E.   0.001%

****
QUESTION NO: 38
****

According to Raoult's law, which statement is FALSE?

A.   The vapor pressure of a solvent over a solution decreases
      as its mole fraction increases.

B.   The solubility of a gas increases as the temperature decreases.

C.   The vapor pressure of a solvent over a solution is less than
      that over pure solvent.

D.   The greater the pressure of a gas over a solution the
      greater is its solubility.

E.   Ionic solutes dissociate in solution causing an enhancement
      of all colligative properties.

****
QUESTION NO: 39
****

A solution that contains 55.0 g of a nonelectrolyte solute
in 250.0 g of water freezes at -2.32°C.   What is the molecular
formula of the solute (K$_f$ of water is 1.86°C/m)?

A.   C$_6$H$_8$O$_6$

B.   C$_{10}$H$_{22}$O$_4$

C.   C$_3$H$_4$O

D.   C$_{12}$H$_{24}$

E.   C$_8$H$_{10}$O$_6$

****
QUESTION NO: 40
****

Arrange the following aqueous solutions in the order of their
increasing boiling points:
0.050 m Mg(NO$_3$)$_2$; 0.100 m ethanol; 0.090 m NaCl.

A.   ethanol   <   Mg(NO$_3$)$_2$ <   NaCl

B.   Mg(NO$_3$)$_2$ <   NaCl   <   ethanol

C.   ethanol   <   NaCl   <   Mg(NO$_3$)$_2$

D.   NaCl   <   ethanol   <   Mg(NO$_3$)$_2$

E.   Mg(NO$_3$)$_2$ <   ethanol   <   NaCl