



**KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS**  
**CHEMISTRY DEPARTMENT**  
**CHEM 102-102**  
**FINAL EXAM (JULY 07, 2011)**  
**TEST CODE NUMBER 000**

STUDENT NUMBER: \_\_\_\_\_

NAME : \_\_\_\_\_

SECTION NUMBER: \_\_\_\_\_

**INSTRUCTIONS**

1. Write your student number, name, and section number on the *EXAM COVER* page.
2. Write your student number, section number, and your name on your *EXAM ANSWER FORM*.
3. **Bubble in pencil** your student number and your section number on the *EXAM ANSWER FORM*.
4. **Bubble in pencil** on your *EXAM ANSWER FORM* the correct answer to each of the questions. .  
You must not give more than *ONE* answer per question.
5. At the end of the exam return the *EXAM ANSWER FORM* to the proctor.
6. The exam contains **40 multiple choice questions** and the time allowed is **160 min (2 hrs and 40 min)**. Time will be announced after **80** minutes and again **10** minutes before the end of the exam.

**Important constants**

Gas Constant (R)	= 0.0821	L.atm/(mol.K)
	= 8.314	J/(mol.K)
	= 8.314 x 10 <sup>7</sup>	g.cm <sup>2</sup> /(sec <sup>2</sup> .mol.K)
Planck's Constant (h)	= 6.626 x 10 <sup>-34</sup>	J.sec/particle
	= 6.626 x 10 <sup>-34</sup>	kg.m <sup>2</sup> /(sec.particle)
Speed of light (c)	= 2.998 x 10 <sup>8</sup>	m/sec
Avogadro's number (N)	= 6.022 x 10 <sup>23</sup>	particles/mole
Bohr's Constant (R <sub>H</sub> )	= 2.179 x 10 <sup>-18</sup>	J/particle
Faraday (F)	= 96500	Coulombs/mol e <sup>-</sup>
Specific heat of H <sub>2</sub> O	= 4.18	J/(g.°C)

## IDENTIFYING SECTIONS USING RECITATION TIMES

### ALHOOSHANI

Section	Day	Time
01	T	10 a.m.
02	U	10 a.m.
03	T	11 a.m.

### AL-SAAD

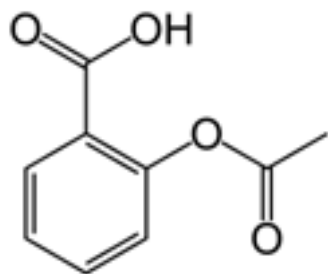
Section	Day	Time
04	T	8 a.m.
05	T	9 a.m.
06	U	9 a.m.

### OWEIMREEN

Section	Day	Time
07	U	8 a.m.
09	U	9 a.m.
08	T	8 a.m.



1. Which of the following choices is correct for an Aspirin molecule?



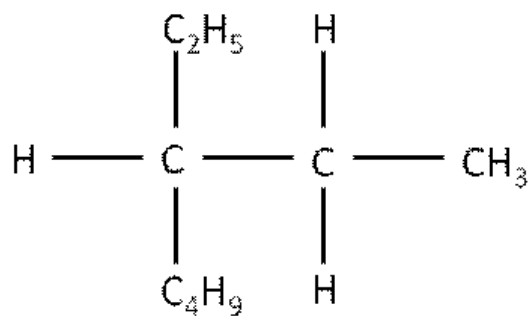
Aspirin

	Number of C atoms	Number of H atoms
A)	9	8
B)	9	10
C)	8	6
D)	8	12

2. Which of the following statements about isomerism in organic molecules is **NOT** correct?

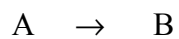
- A) Optical isomers result from rotating the molecules about a double or a triple bond.
- B) Optical isomers have structures that are mirror images of each other but are not superimposable.
- C) Optical isomers have almost identical physical properties but differ in their chemical reactions.
- D) An optical isomer rotates plane polarized light.

3. What is the correct name for the following molecule?



- A) 3-ethyl heptane.
- B) 1-butyl-1-ethyl-2-methyl ethane.
- C) 1-butyl-1-ethyl propane.
- D) 3-butyl pentane.

4. What is the half-life (in minutes) of the first order reaction,



if 25 % of A decompose after 42 minutes?

- A) 101
- B) 21
- C) 84
- D) 120

5. A study of the decomposition reaction,



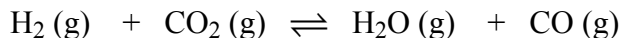
gave the following data::

Initial $[\text{RS}_2]$ ( $\text{mol L}^{-1}$ )	Initial Rate ( $\text{mol L}^{-1} \text{s}^{-1}$ )
0.150	0.0394
0.250	0.109
0.350	0.214
0.500	0.438

The rate constant for this reaction is:

- A) 1.74  $\text{L mol}^{-1} \text{s}^{-1}$
- B) 0.263  $\text{L mol}^{-1} \text{s}^{-1}$
- C) 0.571  $\text{L mol}^{-1} \text{s}^{-1}$
- D) 1.17  $\text{L mol}^{-1} \text{s}^{-1}$

6. The equilibrium constant for the reaction,



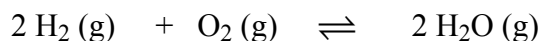
is 4.2 at 1650 °C. If initially 0.80 mol of  $\text{H}_2$  and 0.80 mol of  $\text{CO}_2$  gases were in a 5.0-L vessel at 1650 °C, what is the concentration of  $\text{CO}_2$  when the system reaches equilibrium at 1650 °C?

- A) 0.052  $\text{mol L}^{-1}$
- B) 0.16  $\text{mol L}^{-1}$
- C) 0.11  $\text{mol L}^{-1}$
- D) 0.27  $\text{mol L}^{-1}$

7. Equilibrium is reached in a chemical reaction when,

- A) the rates of the forward and backward reactions become equal.
- B) the concentrations of reactants and products become equal.
- C) the numbers of moles of reactants and products become equal.
- D) the forward and backward reactions stop.

8. Consider the equilibrium,



An increase in pressure would produce **more**,

- A)  $\text{H}_2\text{O}$ .
- B)  $\text{H}_2$  and  $\text{O}_2$ .
- C)  $\text{H}_2$  only.
- D)  $\text{O}_2$  only.

9. What is the pH of a 0.050 M solution of triethylamine ( $\text{C}_2\text{H}_5)_3\text{N}$ ?

$K_b$  for triethylamine is  $5.3 \times 10^{-4}$ .

- A) 11.71
- B) 8.68
- C) 5.32
- D) 2.29

10. What is the pH of a 0.20 M solution of  $\text{NH}_4\text{Cl}$ ?

$K_b (\text{NH}_3) = 1.8 \times 10^{-5}$ .

- A) 4.98
- B) 3.74
- C) 6.53
- D) 9.02

11. A 10.0 mL sample of 0.75 M  $\text{CH}_3\text{CH}_2\text{COOH}$  ( $K_a = 1.3 \times 10^{-5}$ ) is titrated with 0.30 M NaOH. What is the pH of the solution after 22.0 mL of NaOH have been added to the acid?

- A) 5.75
- B) 4.94
- C) 4.83
- D) 4.02

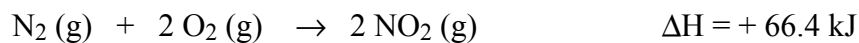
12. When a weak acid is titrated with a strong base, the pH at the equivalence point is :

- A) greater than 7
- B) less than 7
- C) is equal to 7
- D) equal to  $pK_a$  of the acid

13. The solubility of  $PbCl_2$  in water is 0.45 g in 100 mL of solution.  $K_{sp}$  for  $PbCl_2$  is :

- A)  $1.7 \times 10^{-5}$
- B)  $8.5 \times 10^{-6}$
- C)  $4.2 \times 10^{-6}$
- D)  $4.9 \times 10^{-2}$

14. Which of the following choices is correct for the reaction,



at constant pressure and 25 °C?

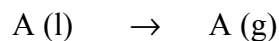
$\Delta S_{surr}$  is

The reaction is

- |                               |                 |
|-------------------------------|-----------------|
| A) $- 223 \text{ J K}^{-1}$   | Non-spontaneous |
| B) $+ 223 \text{ J K}^{-1}$   | Spontaneous     |
| C) $- 2.66 \text{ kJ K}^{-1}$ | Spontaneous     |
| D) $+ 2.66 \text{ kJ K}^{-1}$ | Non-spontaneous |



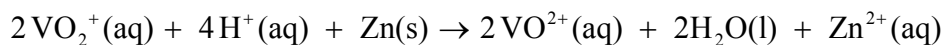
15. For the vaporization process,



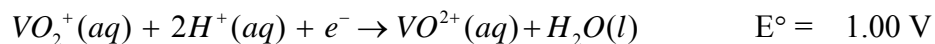
at the normal boiling point of 90 °C,  $\Delta H^\circ$  is 68.6 kJ mol<sup>-1</sup>. If at 90 °C,  $S^\circ$  for A(g) is 310 J mol<sup>-1</sup>K<sup>-1</sup>, calculate  $S^\circ$ , in J mol<sup>-1</sup> K<sup>-1</sup>, for A (l) at 90 °C.

- A) 121
- B) 452
- C) 189
- D) 85.4

16. Calculate  $E_{\text{cell}}$  for the cell in which the reaction,



occurs at 25 °C when  $[\text{VO}_2^+] = 2.0 \text{ M}$ ,  $[\text{H}^+] = 0.50 \text{ M}$ ,  $[\text{VO}^{2+}] = 0.010 \text{ M}$  and  $[\text{Zn}^{2+}] = 0.10 \text{ M}$ . Given the following standard reduction potentials at 25 °C.



- A) 1.89 V
- B) 1.31 V
- C) 1.63 V
- D) 2.06 V

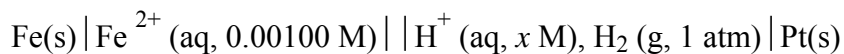
17. Given the following data at 25 °C,

Species	Pb <sup>2+</sup> (aq)	Br <sup>-</sup> (aq)	PbBr <sub>2</sub> (s)
$\Delta G_f^\circ$ (kJ mol <sup>-1</sup> )	- 24.4	- 104.0	- 261.9

Calculate the solubility, in mol L<sup>-1</sup>, of PbBr<sub>2</sub> in water, at 25 °C.

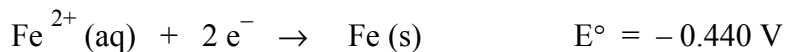
- A)  $1.19 \times 10^{-2}$
- B)  $9.89 \times 10^{-9}$
- C)  $1.29 \times 10^{-4}$
- D)  $7.87 \times 10^{-17}$

18. In the galvanic cell,



the H<sup>+</sup> ions are provided by a 1.00 M weak monoprotic acid HA.

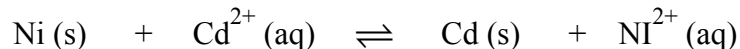
At 25 °C the cell has a potential of 0.333 V. Given the following standard reduction potential at 25 °C



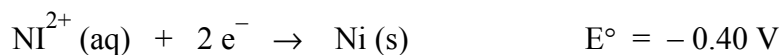
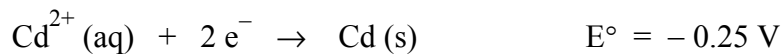
calculate K<sub>a</sub> for the acid at 25 °C.

- A)  $2.4 \times 10^{-7}$
- B)  $5.7 \times 10^{-11}$
- C)  $2.4 \times 10^{-10}$
- D)  $1.6 \times 10^{-5}$

19. Calculate the equilibrium constant at 25 °C for the reaction,

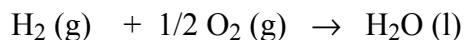


given the following standard reduction potentials at 25 °C.



- A)  $1.2 \times 10^5$
- B)  $1.0 \times 10^{-5}$
- C)  $3.4 \times 10^2$
- D)  $8.6 \times 10^{-6}$

20. What would the voltage of the fuel cell based on the reaction,



be assuming it is working reversibly at 25 °C and 1 atm?

( $\Delta G_f^{\circ}$  for  $\text{H}_2\text{O} (\text{l}) = -237 \text{ kJ mol}^{-1}$ )

- A) 1.23 V
- B) 0.246 V
- C) 0.0614 V
- D) 2.37 V

21. Which of the following occurs when a nuclide captures an electron?

Mass Number (A)    Atomic Number (Z)

- A) Unchanged            Decreases
- B) Decreases            Decreases
- C) Increases            Increases
- D) Unchanged            Increases

22. How many neutrons are produced when an  $^{244}_{95}\text{Am}$  nuclide undergoes spontaneous fission to  $^{134}\text{I}$  and  $^{107}\text{Mo}$ ?

- A) 3
- B) 4
- C) 1
- D) 2

23. Which of the following processes is nuclear fusion?

- A)  $^2_1\text{H} + ^3_1\text{H} \rightarrow ^4_2\text{He} + ^1_0\text{n}$
- B)  $^{241}_{95}\text{Am} \rightarrow ^4_2\text{He} + ^{237}_{93}\text{Np}$
- C)  $^{214}_{82}\text{Pb} \rightarrow ^0_{-1}\text{e} + ^{214}_{83}\text{Bi}$
- D)  $^{235}_{92}\text{U} + ^1_0\text{n} \rightarrow ^{139}_{56}\text{Ba} + ^{94}_{36}\text{K} + 3 ^1_0\text{n}$

24. How old is a geological sample containing 4.2017 mmoles  $^{238}\text{U}$  and 1.6359 mmoles  $^{206}\text{Pb}$ .

Assume that all the  $^{206}\text{Pb}$  in the sample was originally  $^{238}\text{U}$  and a half-life of  $4.5 \times 10^9$  years for the overall decay steps from  $^{238}\text{U}$  to  $^{206}\text{Pb}$ .

- A)  $2.1 \times 10^9$  years
- B)  $2.4 \times 10^{10}$  years
- C)  $7.1 \times 10^9$  years
- D)  $7.3 \times 10^{10}$  years

25. The mass of a  $^{107}\text{Ag}$  nucleus is 106.879289 amu. Determine its binding energy in units of MeV nucleon<sup>-1</sup> given the following information.

Mass of a proton = 1.007280 amu

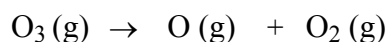
Mass of a neutron = 1.008665 amu

1 MeV =  $1.6022 \times 10^{-13}$  J

1 g =  $6.022 \times 10^{23}$  amu

- A) 8.56
- B) 9.16
- C) 922
- D) 8.99

26. What is the wavelength in nm ( $1 \text{ m} = 10^9 \text{ nm}$ ) of the photon needed for the dissociation reaction,



given that the energy of an O–O bond in  $\text{O}_3$  is  $107.2 \text{ kJ mol}^{-1}$ .

- A)  $1.116 \times 10^3$   
B) 8944  
C)  $1.116 \times 10^6$   
D)  $9.003 \times 10^5$
27. Which of the following reactions is an example of nitrogen fixation?
- A)  $\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}$   
B)  $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4^+ + \text{OH}^-$   
C)  $2 \text{N}_2\text{O} \rightarrow 2 \text{N}_2 + \text{O}_2$   
D)  $2 \text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_2 + \text{HNO}_3$
28. The presence of ozone ( $\text{O}_3$ ) in the upper atmosphere is important because it,
- A) absorbs harmful solar UV radiation.  
B) absorbs radiation from earth thus helping to keep the earth warm.  
C) dissolves in water droplets and is very essential for plants.  
D) is a major reactant in the photosynthesis process.
29. Which of the following gases is NOT a greenhouse gas?
- A)  $\text{Cl}_2$   
B)  $\text{CO}$   
C)  $\text{CO}_2$   
D)  $\text{H}_2\text{O}$

30. Which of the following statements is NOT correct?
- A) CO is poisonous and can lead to death because it binds very strongly to Fe(II) in hemoglobin.
  - B) Both CO and CO<sub>2</sub> bind to Fe(II) in hemoglobin which is present in blood.
  - C) Formaldehyde released from industrial products used in homes causes respiratory illnesses.
  - D) Good ventilation of houses minimizes the risk from products of <sup>222</sup>Ra decay.

31. Which one of the following choices is **completely** correct for the compound  $K [ Co (C_2O_4)_2 (H_2O)_2 ]$ , where  $C_2O_4^{2-}$  is the oxalate ion?

Oxidation number    Coordination number

- |    |   |   |
|----|---|---|
| A) | 3 | 6 |
| B) | 2 | 4 |
| C) | 4 | 6 |
| D) | 3 | 4 |

32. The systematic name for  $[ Co Cl_3 (H_2O) ]^-$

- A) aquotrichlorocobaltate(II)
- B) cobalt(II) chloride monohydrate
- C) aquotrichlorocobalt(II)
- D) aquotrichlorocobaltite(II)

33. Given that  $F^-$  is a weak-field ligand find the number of unpaired electrons in  $[ Co F_6 ]^{3-}$ .

- A) 4
- B) 0
- C) 1
- D) 2

34. Which of the following complexes shows geometric isomerism?

- A)  $K [ Co (NH_3)_2 Cl_4 ]$
- B)  $[ Co (NH_3)_5 Cl ] Cl_2$
- C)  $[ Co (NH_3)_6 ] Cl_3$
- D)  $[ Co (NH_3)_5 Cl ] SO_4$

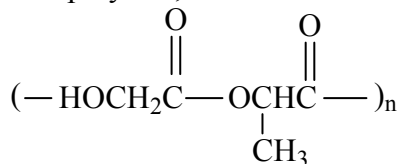
35. Which one of the following transition metals does **NOT** form colored compounds?

- A) Zn
- B) Cu
- C) Ni
- D) Cr

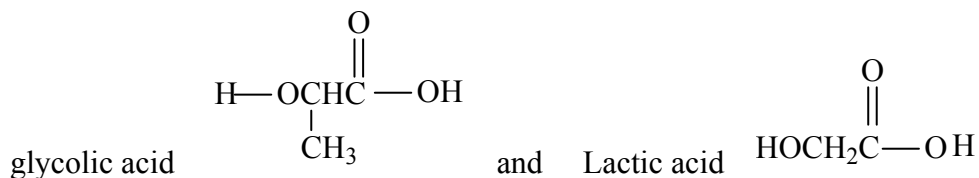
36. Which of the following is not a semiconductor?

- A) Sn
- B) Si
- C) Ge
- D) C (graphite)

37. The polymer,



used in degradable stitches and prepared from reacting



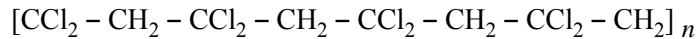
is :

- A) a condensation copolymer.
- B) an addition block copolymer.
- C) a substitution graft copolymer.
- D) a dehydrogenation random copolymer.

38. Which of the following statements is NOT correct?

- A) The hybridization of C atoms in a nanotube is  $sp^3$ .
- B) The smectic phase in a liquid crystal consists of ordered molecules in layers..
- C) Doping Si with Sb produces a semiconductor of the n-type.
- D) Combining Zn and Sb is not expected to produce a semiconductor.

39. The monomer from which the polymer,



is produced, is :

- A)  $\text{CCl}_2 = \text{CH}_2$
- B)  $\text{Cl}_2\text{C} - \text{CH}_2$
- C)  $n \text{Cl}_2\text{C} = \text{CH}_2 = \text{CCl}_2$
- D)  $n \text{CHCl}_2$

40. Which of the following statements is NOT correct?

- A) Ceramic materials can be produced by sintering which produces particles of a uniform size.
- B) Electrical and heat insulation are very important properties of ceramic materials.
- C) Ceramic materials are composed of polymeric inorganic materials that can stand very high temperatures.
- D) The sol-gel process produces ceramics through condensation polymerization.



## 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
21. A
22. A
23. A
24. A
25. A
26. A
27. A
28. A
29. A
30. A
31. A
32. A
33. A
34. A
35. A
36. A
37. A
38. A
39. A
40. A