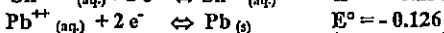
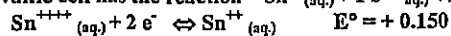


The boiling point elevation is  $0.4^{\circ}\text{C}$  for a solution containing 1 g of unknown solute in 160 g of carbon tetrachloride. The density of solution is  $1.61\text{ g/cm}^3$ . for carbon tetrachloride at  $27^{\circ}\text{C}$  you have:-  $M_{\text{wt}}=154\text{ g/mole}$ ,  $T_b^{\circ}=76.72^{\circ}\text{C}$ ,  $K_b=5.21\text{ deg. kg/mole}$ , and  $P^{\circ}=105\text{ mmHg}$ .

16. The Molality .....  
a)  $\mu=0.066\text{ mole/kg}$     b)  $\mu=0.077\text{ mole/kg}$     c)  $\mu=0.023\text{ mole/kg}$     d)  $\mu=0.256\text{ mole/kg}$
17. The molecular weight of the solute.....  
a)  $M_{\text{wt}}=80\text{ g / mole}$     b)  $M_{\text{wt}}=76.4\text{ g / mole}$     c)  $M_{\text{wt}}=81.4\text{ g / mole}$     d)  $M_{\text{wt}}=85.4\text{ g / mole}$
18. The Molarity .....  
a)  $M=0.123\text{ mole/liter}$     b)  $M=0.222\text{ mole/liter}$     c)  $M=0.231\text{ mole/liter}$     d)  $M=0.256\text{ mole/liter}$
19. The vapor pressure lowering of solution is .....  
a)  $\Delta P=2\text{ mmHg}$ .    b)  $\Delta P=0.855\text{ mmHg}$ .    c)  $\Delta P=1.2\text{ mmHg}$ .    d)  $\Delta P=3.6\text{ mmHg}$ .
20. The osmotic pressure of the resulting solution at  $27^{\circ}\text{C}$  is .....  
a)  $\pi=2\text{ atm}$ .    b)  $\pi=3\text{ atm}$ .    c)  $\pi=3.5\text{ atm}$ .    d)  $\pi=2.5\text{ atm}$ .

A galvanic cell has the reaction  $\text{Sn}^{2+}_{(\text{aq})} + \text{Pb}^{2+}_{(\text{aq})} \rightleftharpoons \text{Sn}^{4+}_{(\text{aq})} + \text{Pb}$ , where:-



$T=298\text{ K}$ ,  $[\text{Sn}^{4+}]=0.1\text{ molar}$ ,  $[\text{Pb}^{2+}]=10^{-4}\text{ molar}$ ,  $[\text{Sn}^{2+}]=10^{-5}\text{ molr}$ , and  $F=96500\text{ coulombs/mole electron}$ .

21. The standard potential is .....  
a)  $E^{\circ}_{\text{cell}}=-0.276\text{ V}$     b)  $E^{\circ}_{\text{cell}}=0.024\text{ V}$     c)  $E^{\circ}_{\text{cell}}=0.276\text{ V}$     d)  $E^{\circ}_{\text{cell}}=-0.024\text{ V}$
22. The potential is .....  
a)  $E_{\text{cell}}=-0.512\text{ V}$     b)  $E_{\text{cell}}=0.431\text{ V}$     c)  $E_{\text{cell}}=0.512\text{ V}$     d)  $E_{\text{cell}}=-0.431\text{ V}$
23. The change in free energy is .....  
a)  $\Delta G_r = -80.3\text{ kJ}$     b)  $\Delta G_r = 99.4\text{ kJ}$     c)  $\Delta G_r = -99.4\text{ kJ}$     d)  $\Delta G_r = 80.3\text{ kJ}$
24. The change in standard free energy is .....  
a)  $\Delta G^{\circ}_r = -60\text{ kJ}$     b)  $\Delta G^{\circ}_r = -53.3\text{ kJ}$     c)  $\Delta G^{\circ}_r = 53.3\text{ kJ}$     d)  $\Delta G^{\circ}_r = 60\text{ kJ}$
25. The equilibrium constant is .....  
a)  $K_{\text{eq}}=5.6 \times 10^{-9}$     b)  $K_{\text{eq}}=7.6 \times 10^{-10}$     c)  $K_{\text{eq}}=4.6 \times 10^{-10}$     d)  $K_{\text{eq}}=2 \times 10^{-20}$

*With our Best Regards and Good Luck*

Examiner:

Prof. Dr. Ahmed Alsarawy,  
Prof. Dr. Mohamed Elhalwany, and  
Dr. Mahmoud Hanafy

(Given that  $N=14\text{ g/atom}$ ,  $C=12\text{ g/atom}$ ,  $H=1\text{ g/atom}$ , and  $O=16\text{ g/atom}$ )



### Model (1)

(15 Marks)

#### Question (1)

Which of the following statements are True (T) and which are false (F)?

1. One method divides corrosion into low-temperature and high temperature corrosion.
2. Isolated system means that  $Q=0$ ,  $W=0$  and at the same time the mass of the system is constant
3. The attractive and repulsive forces differ from one substance to another.
4. In calculating the quantity of gas collected over water, correction must be made for the partial pressure of water in the container.
5. The relationship between free energy and cell potential,  $\Delta G_r = -n F E_{\text{cell}}$ .
6. The reaction between  $\text{CO}_{2(\text{g})}$  and  $\text{C}_{(\text{s})}$  to form  $\text{CO}_{(\text{g})}$  is an example of decreasing randomness (entropy).
7. The molality of a solution is the number of moles of the solute per kilogram of solvent contained in solution.
8. If one solution is of lower osmotic pressure, it is described as being hypotonic with respect to the more concentrated solution.
9. In dilute solutions of nonvolatile nonelectrolytes, the relative lowering in vapor pressure of solvent equals to the mole fraction of the solute.
10. Isochoric or isometric process is the process takes place at constant Volume where,  $W \neq 0$ .
11. When an electrical field is applied to electrolyte solution, the positive ions will migrate toward the electrode with the positive charge.
12. We can deduce from Avogadro's hypothesis that the volume fraction of any component in the gas mixture is the same as the mole fraction.
13. The galvanic cell is an electrochemical cell where the spontaneous occurrence of electrode reactions produces electrical energy.
14. The electrolytic cell is an electrochemical cell where non spontaneous electrode reactions.
15. The boiling point of the solution is higher than that of the pure solvent.
16. The average kinetic energy of the gas molecules is proportional to absolute temperature.
17. Raoult's law govern the "fizz" in soda pop.
18. If the solute concentration are increased, the raise of a solution osmotic pressure occur.
19. Passivity refers to the loss of chemical activity experienced by certain metals and alloys under particular environmental condition.
20. Electrochemistry focuses on reactions in which electrons are transferred from substance to another.
21. Dry corrosion occurs when a liquid is present.
22. Deviation from ideal behavior increase in magnitude as pressure decreases and as temperature decrease.
23. Corrosion is defined as the destruction of metals by interaction with the environment.
24. At constant volume the pressure of a gas is inversely proportional to its temperature.
25. A property is a state function, if its value depends only on the path of the system.
26. If a metal is placed in the proper environment, it will corrode and return to its more stable oxidized state.
27. Anergetic process means that no work is performed, (i.e.  $W=0$ ).
28. Activation polarization refers to electro-chemical reaction, which are controlled by the diffusion in the electrolyte.
29. A spontaneous process at any temperature are these that are exothermic and that lead to a lower degree of order in the system.
30. A solute that can be dissolved in water to become a solution which conducts electricity is called electrolyte.

### Question (2)

Choose the correct answer

(10 Marks)

- ..... is the process that takes place at constant Enthalpy.  
a- isentropic b- Anergic c- Isochoric d- Non of these
- Aggregate state of matter may be found, in .....states according to external conditions such as pressure and temperature.  
a- Gaseous b- Liquid c- Solid d- All of them
- The assumptions of the kinetic theory of gases include: A molecule has a.....  
a- large size b- Small size c- Negligible size d- Definite size
- The entropy of a system depends on a number of factors which are .....  
a- Phase changes b- Temperature c- Processes mixing d- All of them
- For a certain chemical reaction,  $\Delta H^\circ_r = +35.4 \text{ kJ}$  and  $\Delta S^\circ_r = -85.5 \text{ J/K}$ . The reaction .....  
a- Spontaneous at all temperature. b- Spontaneous at Height temperature.  
c- Spontaneous at low temperature. d- Non spontaneous at all temperature.
- Heat is not a property of the state of a system but, ..... the path taken by the process.  
a- Independent on b- Depends on c- a and b d- Non of these
- A decrease in .....charge or the consumption of .....signifies a reduction or cathodic reaction.  
a) valence, neutron b) valence, proton c) valence, electrons d- Non of them
- The second law of thermodynamics tells us that in any spontaneous process the entropy of the universe.....  
a-  $\Delta S < 0$  b-  $\Delta S > 0$  c-  $\Delta S = 0$  d- non of them
- The work, (W), heat, (Q) and the change in internal energy, ( $\Delta E$ ) are related through the following relation; .....which is one of the forms of the first law of thermodynamics.  
a-  $Q = \Delta E + W$  b-  $Q = \Delta E - W$  c-  $\Delta E = W - Q$  d- non of them.
- Molecules in a real gas posses .....volume and thus undergo frequent collisions with one another.  
a- Large volume b- Small volume c- Negligible volume d- Finite volume
- The value of the Universal gas constant R=.....  
a)  $R = 1.98 \text{ cal/mole-k}$  b-  $R = 8.314 \times 10^7 \text{ erg/K-mole}$  c-  $R = 0.082 \text{ atm. liter/k-mole}$  d) all of them
- During metallic corrosion, the rate of oxidation ..... the rate of reduction.  
a- lower than b- higher than c- Equal d- all of them
- During corrosion, .....one oxidation and one reduction reaction may occur  
a- More than b- Less than c- a and b d- Equal
- ..... refers to an electrochemical process, which is controlled by the reaction sequence at the metal electrolyte interface.  
a- Activation polarization b- Concentration polarization c- Polarization d- a and b
- For some metals and it's alloys, at very high concentrations of oxidizers, or in the presence of very powerful oxidizers, the corrosion rate again increases with increasing oxidizer power. This region is termed the.....  
a- Transpassive region b- Passive region c- Active region. d- All of them
- When an electrical field is applied to electrolyte solution, the positive ions will migrate toward the electrode with the .....  
a- Cathode. b- Anode c- a and b d- Non of them
- Thermodynamic and electrochemistry are of great importance for understanding and controlling.....  
a- Corrosion b- Destruction of metals c- Deterioration of a material d- all of them
- The relationship between the equilibrium constant and the standard cell potential is .....  
a-  $\ln(K_{eq}) = -n FE^\circ / RT$  b-  $\ln(K_{eq}) = n FE^\circ / RT$  c-  $\ln(K_{eq}) = -n RT / FE^\circ$  d-  $\ln(K_{eq}) = FE^\circ / RT$
- Acid solutions containing .....will be more corrosive than air free acids.  
a- dissolved nitrogen b- dissolved carbon dioxide c- dissolved oxygen d- Non of them
- The electrolytic cell is an electrochemical cell where .....electrode reactions.....  
a- Spontaneous b- Non- spontaneous c- Equilibrium d- Non of them

### Question (3)

Choose the correct answer

(25 Marks)

The blower delivers dry air with ammonia at STP. 100 g/min of sample of the gaseous mixture indicates 67%  $N_2$ , 16%  $O_2$ , and 17%  $NH_3$  by weight. Your are given that:- dry air composition is  $O_2 = 21\%$  and  $N_2 = 79\%$  by volume and  $M_{wt}$  of air = 28.7 g/mole.

- The mole fraction of  $NH_3$  out of the blower is .....  
a)  $Y = 0.14$  b)  $Y = 0.26$  c)  $Y = 0.13$  d)  $Y = 0.10$
- The number of moles of dry air delivery by blower are .....  
a)  $n = 2.89 \text{ mol/min}$  b)  $n = 2.63 \text{ mole/min}$  c)  $n = 2.5 \text{ mole/min}$  d)  $n = 3.4 \text{ mole/min}$
- The volumetric flow rate of dry air delivery by blower in L/min is .....  
a) 64.73 b) 50.17 c) 61.15 d) 30.15
- The average  $M_{wt}$  of the gaseous mixture out of the blower is .....  
a)  $M_{wt} = 30.17 \text{ g/mol}$  b)  $M_{wt} = 28.53 \text{ g/mol}$  c)  $M_{wt} = 21.52 \text{ g/mol}$  d)  $M_{wt} = 25.69 \text{ g/mol}$
- The density of dry air delivery by blower at in g/L .....  
a)  $\rho = 2.34 \text{ g/l}$  b)  $\rho = 2.46 \text{ g/l}$  c)  $\rho = 1.28 \text{ g/l}$  d)  $\rho = 1.81 \text{ g/l}$

When 32 g of methane gas, ( $CH_4$ ), are compressed isobarically at 2492.8 torr., from  $0.015 \text{ m}^3$  to 5 liters by cooling the gas. Consider methane behaves as an ideal gas during this process and the specific heat of methane gas at constant pressure ( $C_p$ ) varies with temperature  $c_p = (5.34 + 0.0115 T) \text{ cal / mole-k}$ .

- The number of moles of  $CH_4$  is .....  
a)  $n = 1 \text{ mole}$  b)  $n = 2 \text{ mole}$  c)  $n = 3.5 \text{ mole}$  d)  $n = 1.75 \text{ mole}$
- The Temperature changed between state 1 and state 2 is .....  
a)  $\Delta T = 514 \text{ K}$  b)  $\Delta T = 400 \text{ K}$  c)  $\Delta T = 200 \text{ K}$  d)  $\Delta T = 230 \text{ K}$
- The work done on the system is .....  
a)  $W = 791 \text{ cal}$  b)  $W = 408 \text{ cal}$  c)  $W = -791 \text{ cal}$  d)  $W = -408 \text{ k cal}$
- The heat changed from state 1 to state 2 is .....  
a)  $\Delta Q = -3056 \text{ cal.}$  b)  $\Delta Q = 3056 \text{ cal.}$  c)  $\Delta Q = -5274 \text{ cal.}$  d)  $\Delta Q = 5274 \text{ cal.}$
- The internal energy changed, is .....  
a)  $\Delta E = 2275 \text{ cal.}$  b)  $\Delta E = -2265 \text{ cal.}$  c)  $\Delta E = 5274 \text{ cal.}$  d)  $\Delta E = -5274 \text{ cal.}$

Glucose is oxidized to produce  $CO_2$ , according to reaction:  $C_6H_{12}O_6(aq) + 6 O_{2(g)} \rightarrow 6 CO_{2(g)} + 6 H_2O(l)$ . Referring to given data in the attached table at  $25^\circ C$ :-

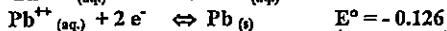
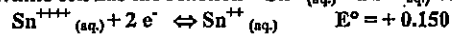
- The change in standard enthalpy of the reaction is .....  
a)  $\Delta H^\circ_r = -2795 \text{ kJ}$  b)  $\Delta H^\circ_r = +2795 \text{ kJ}$  c)  $\Delta H^\circ_r = -2000 \text{ kJ}$  d)  $\Delta H^\circ_r = +2000 \text{ kJ}$
- The change in standard entropy of the reaction is .....  
a)  $\Delta S^\circ_r = -0.256 \text{ kJ/K}$  b)  $\Delta S^\circ_r = 0.256 \text{ kJ/K}$  c)  $\Delta S^\circ_r = -0.2 \text{ kJ/K}$  d)  $\Delta S^\circ_r = +0.2 \text{ kJ/K}$
- The change in standard free energy of the reaction is .....  
a)  $\Delta G^\circ_r = -200.3 \text{ kJ}$  b)  $\Delta G^\circ_r = -2871.3 \text{ kJ}$  c)  $\Delta G^\circ_r = +200.3 \text{ kJ}$  d)  $\Delta G^\circ_r = -2871.3 \text{ kJ}$
- The standard free energy of formation of  $CO_2$  is .....  
a)  $\Delta G^\circ_f = -357.21 \text{ kJ}$  b)  $\Delta G^\circ_f = +357.21 \text{ kJ}$  c)  $\Delta G^\circ_f = -300.21 \text{ kJ}$  d)  $\Delta G^\circ_f = +300.21 \text{ kJ}$
- The effect of temperature on the spontaneity is .....  
a) Spontaneous at all temperature b) non-Spontaneous at all temperature  
c) Spontaneous at low temperature d) Spontaneous at high temperature

Compound	State	$\Delta H^\circ_f$ (KJ/mol)	$\Delta G^\circ_f$ (KJ/mol)	$S^\circ$ (J/mol.k)
$C_6H_{12}O_6$	S	-1273	-910	212
$O_2$	G	0.0	0.0	205
$CO_2$	G	-393	.....	213
$H_2O$	L	-285	-273	70

The boiling point elevation is  $0.4^{\circ}\text{C}$  for a solution containing 1 g of unknown solute in 160 g of carbon tetrachloride. The density of solution is  $1.61\text{ g/cm}^3$  for carbon tetrachloride at  $27^{\circ}\text{C}$  you have:  $M_{\text{wt}} = 154\text{ g/mole}$ ,  $T_b = 76.72^{\circ}\text{C}$ ,  $K_b = 5.21\text{ deg. kg/mole}$ , and  $P^{\circ} = 105\text{ mmHg}$ .

16. The Molality .....  
a)  $\mu = 0.066\text{ mole/kg}$  b)  $\mu = 0.077\text{ mole/kg}$  c)  $\mu = 0.023\text{ mole/kg}$  d)  $\mu = 0.256\text{ mole/kg}$
17. The molecular weight of the solute.....  
a)  $M_{\text{wt}} = 80\text{ g/mole}$  b)  $M_{\text{wt}} = 76.4\text{ g/mole}$  c)  $M_{\text{wt}} = 81.4\text{ g/mole}$  d)  $M_{\text{wt}} = 85.4\text{ g/mole}$
18. The Molarity .....  
a)  $M = 0.123\text{ mole/liter}$  b)  $M = 0.222\text{ mole/liter}$  c)  $M = 0.231\text{ mole/liter}$  d)  $M = 0.256\text{ mole/liter}$
19. The vapor pressure lowering of solution is .....  
a)  $\Delta P = 1.2\text{ mmHg}$  b)  $\Delta P = 0.855\text{ mmHg}$  c)  $\Delta P = 2\text{ mmHg}$  d)  $\Delta P = 3.6\text{ mmHg}$
20. The osmotic pressure of the resulting solution at  $27^{\circ}\text{C}$  is .....  
a)  $\pi = 3\text{ atm}$  b)  $\pi = 2\text{ atm}$  c)  $\pi = 3.5\text{ atm}$  d)  $\pi = 2.5\text{ atm}$

A galvanic cell has the reaction  $\text{Sn}^{++}(\text{aq}) + \text{Pb}^{++}(\text{aq}) \rightleftharpoons \text{Sn}^{++++}(\text{aq}) + \text{Pb}$ , where:-



$T = 298\text{ K}$ ,  $[\text{Sn}^{++++}] = 0.1\text{ molar}$ ,  $[\text{Pb}^{++}] = 10^{-4}\text{ molar}$ ,  $[\text{Sn}^{++}] = 10^{-5}\text{ molar}$ , and  $F = 96500\text{ coulombs/mole electron}$ .

21. The standard potential is .....  
a)  $E^{\circ}_{\text{cell}} = -0.276\text{ V}$  b)  $E^{\circ}_{\text{cell}} = 0.024\text{ V}$  c)  $E^{\circ}_{\text{cell}} = 0.276\text{ V}$  d)  $E^{\circ}_{\text{cell}} = -0.024\text{ V}$
22. The potential is .....  
a)  $E_{\text{cell}} = -0.512\text{ V}$  b)  $E_{\text{cell}} = 0.431\text{ V}$  c)  $E_{\text{cell}} = 0.512\text{ V}$  d)  $E_{\text{cell}} = -0.431\text{ V}$
23. The change in free energy is .....  
a)  $\Delta G_r = -80.3\text{ kJ}$  b)  $\Delta G_r = 99.4\text{ kJ}$  c)  $\Delta G_r = -99.4\text{ kJ}$  d)  $\Delta G_r = 80.3\text{ kJ}$
24. The change in standard free energy is .....  
a)  $\Delta G^{\circ}_r = -60\text{ kJ}$  b)  $\Delta G^{\circ}_r = -53.3\text{ kJ}$  c)  $\Delta G^{\circ}_r = 53.3\text{ kJ}$  d)  $\Delta G^{\circ}_r = 60\text{ kJ}$
25. The equilibrium constant is .....  
a)  $K_{\text{eq}} = 5.6 \times 10^{-9}$  b)  $K_{\text{eq}} = 7.6 \times 10^{-10}$  c)  $K_{\text{eq}} = 4.6 \times 10^{-10}$  d)  $K_{\text{eq}} = 2 \times 10^{-20}$

*With our Best Regards and Good Luck*

Examiner:  
Prof. Dr. Ahmed Alsarawy,  
Prof. Dr. Mohamed Elhalwany, and  
Dr. Mahmoud Hanafy

(Given that  $N = 14\text{ g/atom}$ ,  $C = 12\text{ g/atom}$ ,  $H = 1\text{ g/atom}$ , and  $O = 16\text{ g/atom}$ )



### Model (2)

#### Question (1)

(15 Marks)

Which of the following statements are True (T) and which are false (F)?

1. If one solution is of lower osmotic pressure, it is described as being hypotonic with respect to the more concentrated solution.
2. In dilute solutions of nonvolatile nonelectrolytes, the relative lowering in vapor pressure of solvent equals to the mole fraction of the solute.
3. Isochoric or isometric process is the process takes place at constant Volume where,  $W \neq 0$ .
4. When an electrical field is applied to electrolyte solution, the positive ions will migrate toward the electrode with the positive charge.
5. We can deduce from Avogadro's hypothesis that the volume fraction of any component in the gas mixture is the same as the mole fraction.
6. The galvanic cell is an electrochemical cell where the spontaneous occurrence of electrode reactions produces electrical energy.
7. The electrolytic cell is an electrochemical cell where non spontaneous electrode reactions.
8. The boiling point of the solution is higher than that of the pure solvent.
9. One method divides corrosion into low-temperature and high temperature corrosion.
10. Isolated system means that  $Q = 0$ ,  $W = 0$  and at the same time the mass of the system is constant
11. The attractive and repulsive forces differ from one substance to another.
12. In calculating the quantity of gas collected over water, correction must be made for the partial pressure of water in the container.
13. The relationship between free energy and cell potential,  $\Delta G_r = -nFE_{\text{cell}}$ .
14. The reaction between  $\text{CO}_2(\text{g})$  and  $\text{C}(\text{s})$  to form  $\text{CO}(\text{g})$  is an example of decreasing randomness (entropy).
15. The molality of a solution is the number of moles of the solute per kilogram of solvent contained in solution.
16. The average kinetic energy of the gas molecules is proportional to absolute temperature.
17. Raoult's law govern the "fizz" in soda pop.
18. If the solute concentration are increased, the raise of a solution osmotic pressure occur.
19. Passivity refers to the loss of chemical activity experienced by certain metals and alloys under particular environmental condition.
20. Electrochemistry focuses on reactions in which electrons are transferred from substance to another.
21. Dry corrosion occurs when a liquid is present.
22. Deviation from ideal behavior increase in magnitude as pressure decreases and as temperature decrease.
23. Corrosion is defined as the destruction of metals by interaction with the environment.
24. At constant volume the pressure of a gas is inversely proportional to its temperature.
25. A property is a state function, if its value depends only on the path of the system.
26. If a metal is placed in the proper environment, it will corrode and return to its more stable oxidized state.
27. Anergetic process means that no work is performed, (i.e.  $W = 0$ ).
28. Activation polarization refers to electro-chemical reaction, which are controlled by the diffusion in the electrolyte.
29. A spontaneous process at any temperature are these that are exothermic and that lead to a lower degree of order in the system.
30. A solute that can be dissolved in water to become a solution which conducts electricity is called electrolyte.

### Question (2)

Choose the correct answer

(10 Marks)

- Heat is not a property of the state of a system but, ..... the path taken by the process.  
a- Independent on    b- Depends on    c- a and b    d- Non of these
- A decrease in .....charge or the consumption of .....signifies a reduction or cathodic reaction.  
a) valence, neutron    b) valence, proton    c) valence, electrons    d- Non of them
- The second law of thermodynamics tells us that in any spontaneous process the entropy of the universe.....  
a-  $\Delta S < 0$     b-  $\Delta S > 0$     c-  $\Delta S = 0$     d- Non of them
- The work, (W), heat, (Q) and the change in internal energy, ( $\Delta E$ ) are related through the following relation; .....which is one of the forms of the first law of thermodynamics.  
a-  $Q = \Delta E + W$     b-  $Q = \Delta E - W$     c-  $\Delta E = W - Q$     d- Non of them.
- ..... is the process that takes place at constant Enthalpy.  
a- isentropic    b- Anergic    c- Isochoric    d- Non of these
- Aggregate state of matter may be found, in .....states according to external conditions such as pressure and temperature.  
a- Gaseous    b- Liquid    c- Solid    d- All of them
- The assumptions of the kinetic theory of gases include: A molecule has a.....  
a- large size    b- Small size    c- Negligible size    d- Definite size
- The entropy of a system depends on a number of factors which are .....  
a- Phase changes    b- Temperature    c- Processes mixing    d- All of them
- For a certain chemical reaction,  $\Delta H^\circ_f = +35.4 \text{ kJ}$  and  $\Delta S^\circ_f = -85.5 \text{ J/K}$ . The reaction .....  
a- Spontaneous at all temperature.    b- Spontaneous at Height temperature.  
c- Spontaneous at low temperature.    d- Non spontaneous at all temperature.
- Molecules in a real gas posses .....volume and thus undergo frequent collisions with one another.  
a- Large volume    b- Small volume    c- Negligible volume    d- Finite volume
- The value of the Universal gas constant R =.....  
a)  $R = 1.98 \text{ cal/mole-k}$     b-  $R = 8.314 \times 10^7 \text{ erg/K-mole}$     c-  $R = 0.082 \text{ atm. liter/k-mole}$     d) all of them
- During metallic corrosion, the rate of oxidation ..... the rate of reduction.  
a- lower than    b- higher than    c- Equal    d- all of them
- During corrosion, .....one oxidation and one reduction reaction may occur  
a- More than    b- Less than    c- a and b    d- Equal
- ..... refers to an electrochemical process, which is controlled by the reaction sequence at the metal electrolyte interface.  
a- Activation polarization    b- Concentration polarization    c- Polarization    d- a and b
- For some metals and it's alloys, at very high concentrations of oxidizers, or in the presence of very powerful oxidizers, the corrosion rate again increases with increasing oxidizer power. This region is termed the.....  
a- Transpassive region    b- Passive region    c- Active region.    d- All of them
- When an electrical field is applied to electrolyte solution, the positive ions will migrate toward the electrode with the .....  
a- Cathode.    b- Anode    c- a and b    d- Non of them
- Thermodynamic and electrochemistry are of great importance for understanding and controlling.....  
a- Corrosion    b- Destruction of metals    c- Deterioration of a material    d- all of them
- The relationship between the equilibrium constant and the standard cell potential is .....  
a-  $\ln(K_{eq}) = -nFE^\circ/RT$     b-  $\ln(K_{eq}) = nFE^\circ/RT$     c-  $\ln(K_{eq}) = -nRT/FE^\circ$     d-  $\ln(K_{eq}) = FE^\circ/RT$
- Acid solutions containing .....will be more corrosive than air free acids.  
a- dissolved nitrogen    b- dissolved carbon dioxide    c- dissolved oxygen    d- Non of them
- The electrolytic cell is an electrochemical cell where .....electrode reactions.  
a- Spontaneous    b- Non- spontaneous    c- Equilibrium    d- Non of them

### Question (3)

Choose the correct answer

(25 Marks)

The blower delivers dry air with ammonia at STP. 100 g/min of sample of the gaseous mixture indicates 67%  $N_2$ , 16%  $O_2$ , and 17%  $NH_3$  by weight. Your are given that:- dry air composition is  $O_2 = 21\%$  and  $N_2 = 79\%$  by volume and  $M_{wt}$  of air = 28.7 g/mole.

- The mole fraction of  $NH_3$  out of the blower is .....  
a)  $Y = 0.26$     b)  $Y = 0.14$     c)  $Y = 0.13$     d)  $Y = 0.10$
- The number of moles of dry air delivery by blower are .....  
a)  $n = 2.89 \text{ mol/min}$     b)  $n = 2.63 \text{ mole/min}$     c)  $n = 2.5 \text{ mole/min}$     d)  $n = 3.4 \text{ mole/min}$
- The volumetric flow rate of dry air delivery by blower in L/min is .....  
a) 30.15    b) 50.17    c) 61.15    d) 64.73
- The average  $M_{wt}$  of the gaseous mixture out of the blower is .....  
a)  $M_{wt} = 25.69 \text{ g/mol}$     b)  $M_{wt} = 28.53 \text{ g/mol}$     c)  $M_{wt} = 21.52 \text{ g/mol}$     d)  $M_{wt} = 30.17 \text{ g/mol}$
- The density of dry air delivery by blower at in g/L .....  
a)  $\rho = 1.28 \text{ g/l}$     b)  $\rho = 2.46 \text{ g/l}$     c)  $\rho = 2.34 \text{ g/l}$     d)  $\rho = 1.81 \text{ g/l}$

When 32 g of methane gas, ( $CH_4$ ), are compressed isobarically at 2492.8 torr., from  $0.015 \text{ m}^3$  to 5 liters by cooling the gas. Consider methane behaves as an ideal gas during this process and the specific heat of methane gas at constant pressure ( $C_p$ ) varies with temperature  $c_p = (5.34 + 0.0115 T) \text{ cal/mole-k}$ .

- The number of moles of  $CH_4$  is .....  
a)  $n = 1 \text{ mole}$     b)  $n = 2 \text{ mole}$     c)  $n = 3.5 \text{ mole}$     d)  $n = 1.75 \text{ mole}$
- The Temperature changed between state 1 and state 2 is .....  
a)  $\Delta T = 200 \text{ K}$     b)  $\Delta T = 400 \text{ K}$     c)  $\Delta T = 514 \text{ K}$     d)  $\Delta T = 230 \text{ K}$
- The work done on the system is .....  
a)  $W = 791 \text{ cal}$     b)  $W = 408 \text{ cal}$     c)  $W = -791 \text{ cal}$     d)  $W = -408 \text{ k cal}$
- The heat changed from state 1 to state 2 is .....  
a)  $\Delta Q = -3056 \text{ cal}$     b)  $\Delta Q = 3056 \text{ cal}$     c)  $\Delta Q = -5274 \text{ cal}$     d)  $\Delta Q = 5274 \text{ cal}$
- The internal energy changed, is .....  
a)  $\Delta E = 2275 \text{ cal}$     b)  $\Delta E = -2265 \text{ cal}$     c)  $\Delta E = 5274 \text{ cal}$     d)  $\Delta E = -5274 \text{ cal}$

Glucose is oxidized to produce  $CO_2$ , according to reaction:  $C_6H_{12}O_6(aq) + 6 O_{2(g)} \rightarrow 6 CO_{2(g)} + 6 H_2O(l)$ . Referring to given data in the attached table at  $25^\circ C$ :-

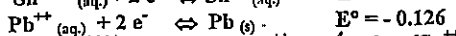
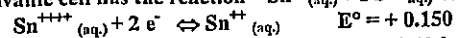
- The change in standard enthalpy of the reaction is .....  
a)  $\Delta H^\circ_f = -2795 \text{ kJ}$     b)  $\Delta H^\circ_f = +2795 \text{ kJ}$     c)  $\Delta H^\circ_f = -2000 \text{ kJ}$     d)  $\Delta H^\circ_f = +2000 \text{ kJ}$
- The change in standard entropy of the reaction is .....  
a)  $\Delta S^\circ_f = -0.256 \text{ kJ/K}$     b)  $\Delta S^\circ_f = +0.2 \text{ kJ/K}$     c)  $\Delta S^\circ_f = -0.2 \text{ kJ/K}$     d)  $\Delta S^\circ_f = 0.256 \text{ kJ/K}$
- The change in standard free energy of the reaction is .....  
a)  $\Delta G^\circ_f = -200.3 \text{ kJ}$     b)  $\Delta G^\circ_f = -2871.3 \text{ kJ}$     c)  $\Delta G^\circ_f = +200.3 \text{ kJ}$     d)  $\Delta G^\circ_f = -2871.3 \text{ kJ}$
- The standard free energy of formation of  $CO_2$  is .....  
a)  $\Delta G^\circ_f = +300.21 \text{ kJ}$     b)  $\Delta G^\circ_f = +357.21 \text{ kJ}$     c)  $\Delta G^\circ_f = -300.21 \text{ kJ}$     d)  $\Delta G^\circ_f = -357.21 \text{ kJ}$
- The effect of temperature on the spontaneity is .....  
a) non-Spontaneous at all temperature    b) Spontaneous at all temperature  
c) Spontaneous at low temperature    d) Spontaneous at high temperature

Compound	State	$\Delta H^\circ_f$ (KJ/mol)	$\Delta G^\circ_f$ (KJ/mol)	$S^\circ$ (J/mol k)
$C_6H_{12}O_6$	S	-1273	-910	212
$O_2$	G	0.0	0.0	205
$CO_2$	G	-393	.....	213
$H_2O$	L	-285	-273	70

The boiling point elevation is  $0.4^{\circ}\text{C}$  for a solution containing 1 g of unknown solute in 160 g of carbon tetrachloride. The density of solution is  $1.61\text{ g/cm}^3$  for carbon tetrachloride at  $27^{\circ}\text{C}$  you have:-  $M_{\text{wt}}=154\text{ g/mole}$ ,  $T_b=76.72^{\circ}\text{C}$ ,  $K_b=5.21\text{ deg. kg/mole}$ , and  $P^{\circ}=105\text{ mmHg}$ .

16. The Molality .....  
a)  $\mu=0.066\text{ mole/kg}$  b)  $\mu=0.077\text{ mole/kg}$  c)  $\mu=0.023\text{ mole/kg}$  d)  $\mu=0.256\text{ mole/kg}$
17. The molecular weight of the solute.....  
a)  $M_{\text{wt}}=80\text{ g / mole}$  b)  $M_{\text{wt}}=76.4\text{ g / mole}$  c)  $M_{\text{wt}}=81.4\text{ g / mole}$  d)  $M_{\text{wt}}=85.4\text{ g / mole}$
18. The Molarity .....  
a)  $M=0.123\text{ mole/liter}$  b)  $M=0.222\text{ mole/liter}$  c)  $M=0.231\text{ mole/liter}$  d)  $M=0.256\text{ mole/liter}$
19. The vapor pressure lowering of solution is .....  
a)  $\Delta P=1.2\text{ mmHg}$  b)  $\Delta P=0.855\text{ mmHg}$  c)  $\Delta P=2\text{ mmHg}$  d)  $\Delta P=3.6\text{ mmHg}$
20. The osmotic pressure of the resulting solution at  $27^{\circ}\text{C}$  is .....  
a)  $\pi=3\text{ atm}$  b)  $\pi=2\text{ atm}$  c)  $\pi=3.5\text{ atm}$  d)  $\pi=2.5\text{ atm}$

A galvanic cell has the reaction  $\text{Sn}^{++}(\text{aq.}) + \text{Pb}^{++}(\text{aq.}) \rightleftharpoons \text{Sn}^{++++}(\text{aq.}) + \text{Pb}$ , where:-



$T=298\text{ K}$ ,  $[\text{Sn}^{++++}]=0.1\text{ molar}$ ,  $[\text{Pb}^{++}]=10^{-4}\text{ molar}$ ,  $[\text{Sn}^{++}]=10^{-5}\text{ molar}$ , and  $F=96500\text{ coulombs/mole electron}$ .

21. The standard potential is .....  
a)  $E^{\circ}_{\text{cell}} = -0.024\text{ V}$  b)  $E^{\circ}_{\text{cell}} = 0.024\text{ V}$  c)  $E^{\circ}_{\text{cell}} = 0.276\text{ V}$  d)  $E^{\circ}_{\text{cell}} = -0.276\text{ V}$
22. The potential is .....  
a)  $E_{\text{cell}} = 0.512\text{ V}$  b)  $E_{\text{cell}} = 0.431\text{ V}$  c)  $E_{\text{cell}} = -0.512\text{ V}$  d)  $E_{\text{cell}} = -0.431\text{ V}$
23. The change in free energy is .....  
a)  $\Delta G_r = -80.3\text{ kJ}$  b)  $\Delta G_r = 99.4\text{ kJ}$  c)  $\Delta G_r = -99.4\text{ kJ}$  d)  $\Delta G_r = 80.3\text{ kJ}$
24. The change in standard free energy is .....  
a)  $\Delta G^{\circ}_r = -60\text{ kJ}$  b)  $\Delta G^{\circ}_r = 53.3\text{ kJ}$  c)  $\Delta G^{\circ}_r = -53.3\text{ kJ}$  d)  $\Delta G^{\circ}_r = 60\text{ kJ}$
25. The equilibrium constant is .....  
a)  $K_{\text{eq}} = 5.6 \times 10^{-9}$  b)  $K_{\text{eq}} = 7.6 \times 10^{-10}$  c)  $K_{\text{eq}} = 4.6 \times 10^{-10}$  d)  $K_{\text{eq}} = 2 \times 10^{-20}$

*With our Best Regards and Good Luck*

Examiner:

Prof. Dr. Ahmed Alsarawy,  
Prof. Dr. Mohamed Elhalwany, and  
Dr. Mahmoud Hanafy

(Given that  $N=14\text{ g/atom}$ ,  $C=12\text{ g/atom}$ ,  $H=1\text{ g/atom}$ , and  $O=16\text{ g/atom}$ )



### Model (3)

(15 Marks)

#### Question (1)

Which of the following statements are True (T) and which are false (F)?

1. The electrolytic cell is an electrochemical cell where non spontaneous electrode reactions.
2. The relationship between free energy and cell potential,  $\Delta G_r = -n F E_{\text{cell}}$ .
3. The reaction between  $\text{CO}_2(\text{g})$  and  $\text{C}(\text{s})$  to form  $\text{CO}(\text{g})$  is an example of decreasing randomness (entropy).
4. The molality of a solution is the number of moles of the solute per kilogram of solvent contained in solution.
5. We can deduce from Avogadro's hypothesis that the volume fraction of any component in the gas mixture is the same as the mole fraction.
6. The galvanic cell is an electrochemical cell where the spontaneous occurrence of electrode reactions produces electrical energy.
7. One method divides corrosion into low-temperature and high temperature corrosion.
8. Isolated system means that  $Q=0$ ,  $W=0$  and at the same time the mass of the system is constant
9. The attractive and repulsive forces differ from one substance to another.
10. In calculating the quantity of gas collected over water, correction must be made for the partial pressure of water in the container.
11. If one solution is of lower osmotic pressure, it is described as being hypotonic with respect to the more concentrated solution.
12. In dilute solutions of nonvolatile nonelectrolytes, the relative lowering in vapor pressure of solvent equals to the mole fraction of the solute.
13. Isochoric or isometric process is the process takes place at constant Volume where,  $W \neq 0$ .
14. When an electrical field is applied to electrolyte solution, the positive ions will migrate toward the electrode with the positive charge.
15. The boiling point of the solution is higher than that of the pure solvent.
16. The average kinetic energy of the gas molecules is proportional to absolute temperature.
17. Raoult's law govern the "fizz" in soda pop.
18. If the solute concentration are increased, the raise of a solution osmotic pressure occur.
19. Passivity refers to the loss of chemical activity experienced by certain metals and alloys under particular environmental condition.
20. Anergic process means that no work is performed, (i.e.  $W=0$ ).
21. Activation polarization refers to electro-chemical reaction, which are controlled by the diffusion in the electrolyte.
22. A spontaneous process at any temperature are these that are exothermic and that lead to a lower degree of order in the system.
23. A solute that can be dissolved in water to become a solution which conducts electricity is called electrolyte.
24. Electrochemistry focuses on reactions in which electrons are transferred from substance to another.
25. Dry corrosion occurs when a liquid is present.
26. Deviation from ideal behavior increase in magnitude as pressure decreases and as temperature decrease.
27. Corrosion is defined as the destruction of metals by interaction with the environment.
28. At constant volume the pressure of a gas is inversely proportional to its temperature.
29. A property is a state function, if its value depends only on the path of the system.
30. If a metal is placed in the proper environment, it will corrode and return to its more stable oxidized state.

### Question (2)

Choose the correct answer

(10 Marks)

- The second law of thermodynamics tells us that in any spontaneous process the entropy of the universe.....  
a-  $\Delta S < 0$       b-  $\Delta S > 0$       c-  $\Delta S = 0$       d- Non of them
- The work, (W), heat, (Q) and the change in internal energy, ( $\Delta E$ ) are related through the following relation; .....which is one of the forms of the first law of thermodynamics.  
a-  $Q = \Delta E + W$       b-  $Q = \Delta E - W$       c-  $\Delta E = W - Q$       d- Non of them.
- Heat is not a property of the state of a system but, ..... the path taken by the process.  
a- Independent on      b- Depends on      c- a and b      d- Non of these
- A decrease in .....charge or the consumption of .....signifies a reduction or cathodic reaction. .  
a) valence, neutron      b) valence, proton      c) valence, electrons      d- Non of them
- The assumptions of the kinetic theory of gases include: A molecule has a.....  
a- large size      b- Small size      c- Negligible size      d- Definite size
- The entropy of a system depends on a number of factors which are .....  
a- Phase changes      b- Temperature      c- Processes mixing      d- All of them
- For a certain chemical reaction,  $\Delta H^\circ_r = +35.4 \text{ kJ}$  and  $\Delta S^\circ_r = -85.5 \text{ J/K}$ . The reaction .....  
a- Spontaneous at all temperature.      b- Spontaneous at High temperature.  
c- Spontaneous at low temperature.      d- Non spontaneous at all temperature.
- ..... is the process that takes place at constant Enthalpy.  
a- isentropic      b- Anergic      c- Isochoric      d- Non of these
- Aggregate state of matter may be found, in .....states according to external conditions such as pressure and temperature.  
a- Gaseous      b- Liquid      c- Solid      d- All of them
- Molecules in a real gas posses .....volume and thus undergo frequent collisions with one another.  
a- Large volume      b- Small volume      c- Negligible volume      d- Finite volume
- When an electrical field is applied to electrolyte solution, the positive ions will migrate toward the electrode with the .....  
a- Cathode.      b- Anode      c- a and b      d- Non of them
- Thermodynamic and electrochemistry are of great importance for understanding and controlling.....  
a- Corrosion      b- Destruction of metals      c- Deterioration of a material      d- all of them
- The relationship between the equilibrium constant and the standard cell potentialis .....  
a-  $\ln(K_{eq}) = -n FE^\circ / RT$       b-  $\ln(K_{eq}) = n FE^\circ / RT$       c-  $\ln(K_{eq}) = -n RT / FE^\circ$       d-  $\ln(K_{eq}) = FE^\circ / RT$
- Acid solutions containing .....will be more corrosive than air free acids.  
a- dissolved nitrogen      b- dissolved carbon dioxide      c- dissolved oxygen      d- Non of them
- The electrolytic cell is an electrochemical cell where .....electrode reactions.  
a- Spontaneous      b- Non- spontaneous      c- Equilibrium      d- Non of them
- The value of the Universal gas constant R =.....  
a)  $R = 1.98 \text{ cal/mole-k}$       b-  $R = 8.314 \times 10^7 \text{ erg/K-mole}$       c-  $R = 0.082 \text{ atm. liter/k-mole}$       d) All of them
- During metallic corrosion, the rate of oxidation ..... the rate of reduction.  
a- lower than      b- higher than      c- Equal      d- All of them
- During corrosion, .....one oxidation and one reduction reaction may occur  
a- More than      b- Less than      c- a and b      d- Equal
- ..... refers to an electrochemical process, which is controlled by the reaction sequence at the metal electrolyte interface.  
a- Activation polarization      b- Concentration polarization      c- Polarization      d- a and b
- For some metals and it's alloys, at very high concentrations of oxidizers, or in the presence of very powerful oxidizers, the corrosion rate again increases with increasing oxidizer power. This region is termed the.....  
a- Transpassive region      b- Passive region      c- Active region.      d- All of them

### Question (3)

Choose the correct answer

(25 Marks)

The blower delivers dry air with ammonia at STP. 100 g/min of sample of the gaseous mixture indicates 67%  $N_2$ , 16%  $O_2$ , and 17%  $NH_3$  by weight. Your are given that:- dry air composition is  $O_2 = 21\%$  and  $N_2 = 79\%$  by volume and  $M_{wt}$  of air = 28.7 g/mole.

- The mole fraction of  $NH_3$  out of the blower is .....  
a)  $Y = 0.13$       b)  $Y = 0.14$       c)  $Y = 0.26$       d)  $Y = 0.10$
- The number of moles of dry air delivery by blower are .....  
a)  $n = 3.4 \text{ mole/min}$       b)  $n = 2.63 \text{ mole/min}$       c)  $n = 2.5 \text{ mole/min}$       d)  $n = 2.89 \text{ mole/min}$
- The volumetric flow rate of dry air delivery by blower in L/min is .....  
a) 30.15      b) 50.17      c) 61.15      d) 64.73
- The average  $M_{wt}$  of the gaseous mixture out of the blower is .....  
a)  $M_{wt} = 21.52 \text{ g/mol}$       b)  $M_{wt} = 28.53 \text{ g/mol}$       c)  $M_{wt} = 25.69 \text{ g/mol}$       d)  $M_{wt} = 30.17 \text{ g/mol}$
- The density of dry air delivery by blower at in g/L .....  
a)  $\rho = 1.28 \text{ g/L}$       b)  $\rho = 2.46 \text{ g/L}$       c)  $\rho = 2.34 \text{ g/L}$       d)  $\rho = 1.81 \text{ g/L}$

When 32 g of methane gas, ( $CH_4$ ), are compressed isobarically at 2492.8 torr., from 0.015  $m^3$  to 5 liters by cooling the gas. Consider methane behaves as an ideal gas during this process and the specific heat of methane gas at constant pressure ( $C_p$ ) varies with temperature  $c_p = (5.34 + 0.0115 T) \text{ cal/mole-k}$ .

- The number of moles of  $CH_4$  is .....  
a)  $n = 1 \text{ mole}$       b)  $n = 2 \text{ mole}$       c)  $n = 3.5 \text{ mole}$       d)  $n = 1.75 \text{ mole}$
- The Temperature changed between state 1 and state 2 is .....  
a)  $\Delta T = 200 \text{ K}$       b)  $\Delta T = 400 \text{ K}$       c)  $\Delta T = 514 \text{ K}$       d)  $\Delta T = 230 \text{ K}$
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- The internal energy changed, is .....  
a)  $\Delta E = 2275 \text{ cal}$       b)  $\Delta E = -5274 \text{ cal}$       c)  $\Delta E = 5274 \text{ cal}$       d)  $\Delta E = -2265 \text{ cal}$

Glucose is oxidized to produce  $CO_2$ , according to reaction:  $C_6H_{12}O_6(aq) + 6 O_{2(g)} \rightarrow 6 CO_{2(g)} + 6 H_2O_{(l)}$ . Referring to given data in the attached table at 25  $^\circ C$ :-

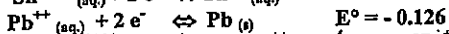
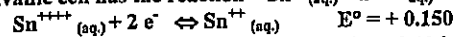
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a)  $\Delta H^\circ_r = -2795 \text{ kJ}$       b)  $\Delta H^\circ_r = +2795 \text{ kJ}$       c)  $\Delta H^\circ_r = -2000 \text{ kJ}$       d)  $\Delta H^\circ_r = +2000 \text{ kJ}$
- The change in standard entropy of the reaction is .....  
a)  $\Delta S^\circ_r = -0.256 \text{ kJ/K}$       b)  $\Delta S^\circ_r = +0.2 \text{ kJ/K}$       c)  $\Delta S^\circ_r = -0.2 \text{ kJ/K}$       d)  $\Delta S^\circ_r = 0.256 \text{ kJ/K}$
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- The standard free energy of formation of  $CO_2$  is .....  
a)  $\Delta G^\circ_f = +300.21 \text{ kJ}$       b)  $\Delta G^\circ_f = +357.21 \text{ kJ}$       c)  $\Delta G^\circ_f = -300.21 \text{ kJ}$       d)  $\Delta G^\circ_f = -357.21 \text{ kJ}$
- The effect of temperature on the spontaneity is .....  
a) non-Spontaneous at all temperature      b) Spontaneous at all temperature  
c) Spontaneous at low temperature      d) Spontaneous at high temperature

Compound	State	$\Delta H^\circ_f$ (KJ/mol)	$\Delta G^\circ_f$ (KJ/mol)	$S^\circ$ (J/mol.k)
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16. The Molality .....  
a)  $\mu = 0.066\text{ mole/kg}$  b)  $\mu = 0.077\text{ mole/kg}$  c)  $\mu = 0.023\text{ mole/kg}$  d)  $\mu = 0.256\text{ mole/kg}$
17. The molecular weight of the solute.....  
a)  $M_{\text{wt}} = 80\text{ g/mole}$  b)  $M_{\text{wt}} = 76.4\text{ g/mole}$  c)  $M_{\text{wt}} = 81.4\text{ g/mole}$  d)  $M_{\text{wt}} = 85.4\text{ g/mole}$
18. The Molarity .....  
a)  $M = 0.123\text{ mole/liter}$  b)  $M = 0.222\text{ mole/liter}$  c)  $M = 0.231\text{ mole/liter}$  d)  $M = 0.256\text{ mole/liter}$
19. The vapor pressure lowering of solution is .....  
a)  $\Delta P = 1.2\text{ mmHg}$  b)  $\Delta P = 0.855\text{ mmHg}$  c)  $\Delta P = 2\text{ mmHg}$  d)  $\Delta P = 3.6\text{ mmHg}$
20. The osmotic pressure of the resulting solution at  $27^{\circ}\text{C}$  is .....  
a)  $\pi = 3\text{ atm}$  b)  $\pi = 2\text{ atm}$  c)  $\pi = 3.5\text{ atm}$  d)  $\pi = 2.5\text{ atm}$

A galvanic cell has the reaction  $\text{Sn}^{++}(\text{aq}) + \text{Pb}^{++}(\text{aq}) \rightleftharpoons \text{Sn}^{+++}(\text{aq}) + \text{Pb}$ , where:-



$T = 298\text{ K}$ ,  $[\text{Sn}^{+++}] = 0.1\text{ molar}$ ,  $[\text{Pb}^{++}] = 10^{-4}\text{ molar}$ ,  $[\text{Sn}^{++}] = 10^{-5}\text{ molar}$ , and  $F = 96500\text{ coulombs/mole electron}$ .

21. The standard potential is .....  
a)  $E^{\circ}_{\text{cell}} = -0.276\text{ V}$  b)  $E^{\circ}_{\text{cell}} = 0.024\text{ V}$  c)  $E^{\circ}_{\text{cell}} = 0.276\text{ V}$  d)  $E^{\circ}_{\text{cell}} = -0.024\text{ V}$
22. The potential is .....  
a)  $E_{\text{cell}} = -0.512\text{ V}$  b)  $E_{\text{cell}} = 0.431\text{ V}$  c)  $E_{\text{cell}} = 0.512\text{ V}$  d)  $E_{\text{cell}} = -0.431\text{ V}$
23. The change in free energy is .....  
a)  $\Delta G_r = -80.3\text{ kJ}$  b)  $\Delta G_r = 99.4\text{ kJ}$  c)  $\Delta G_r = -99.4\text{ kJ}$  d)  $\Delta G_r = 80.3\text{ kJ}$
24. The change in standard free energy is .....  
a)  $\Delta G^{\circ}_r = -60\text{ kJ}$  b)  $\Delta G^{\circ}_r = -53.3\text{ kJ}$  c)  $\Delta G^{\circ}_r = 53.3\text{ kJ}$  d)  $\Delta G^{\circ}_r = 60\text{ kJ}$
25. The equilibrium constant is .....  
a)  $K_{\text{eq}} = 5.6 \times 10^{-9}$  b)  $K_{\text{eq}} = 7.6 \times 10^{-10}$  c)  $K_{\text{eq}} = 4.6 \times 10^{-10}$  d)  $K_{\text{eq}} = 2 \times 10^{-20}$

*With our Best Regards and Good Luck*

Examiner:  
Prof. Dr. Ahmed Alsarawy,  
Prof. Dr. Mohamed Elhalwany, and  
Dr. Mahmoud Hanafy

(Given that  $N = 14\text{ g/atom}$ ,  $C = 12\text{ g/atom}$ ,  $H = 1\text{ g/atom}$ , and  $O = 16\text{ g/atom}$ )



### Model (4)

#### Question (1)

(15 Marks)

Which of the following statements are True (T) and which are false (F)?

1. Raoult's law govern the "fizz" in soda pop.
2. In calculating the quantity of gas collected over water, correction must be made for the partial pressure of water in the container.
3. The relationship between free energy and cell potential,  $\Delta G_r = -n F E_{\text{cell}}$ .
4. The boiling point of the solution is higher than that of the pure solvent.
5. The average kinetic energy of the gas molecules is proportional to absolute temperature.
6. The reaction between  $\text{CO}_2(\text{g})$  and  $\text{C}(\text{s})$  to form  $\text{CO}(\text{g})$  is an example of decreasing randomness (entropy).
7. The molality of a solution is the number of moles of the solute per kilogram of solvent contained in solution.
8. One method divides corrosion into low-temperature and high temperature corrosion.
9. Isolated system means that  $Q = 0$ ,  $W = 0$  and at the same time the mass of the system is constant
10. The attractive and repulsive forces differ from one substance to another.
11. If one solution is of lower osmotic pressure, it is described as being hypotonic with respect to the more concentrated solution.
12. In dilute solutions of nonvolatile nonelectrolytes, the relative lowering in vapor pressure of solvent equals to the mole fraction of the solute.
13. Isochoric or isometric process is the process takes place at constant Volume where,  $W \neq 0$ .
14. When an electrical field is applied to electrolyte solution, the positive ions will migrate toward the electrode with the positive charge.
15. We can deduce from Avogadro's hypothesis that the volume fraction of any component in the gas mixture is the same as the mole fraction.
16. The galvanic cell is an electrochemical cell where the spontaneous occurrence of electrode reactions produces electrical energy.
17. The electrolytic cell is an electrochemical cell where non spontaneous electrode reactions.
18. If the solute concentration are increased, the raise of a solution osmotic pressure occur.
19. Passivity refers to the loss of chemical activity experienced by certain metals and alloys under particular environmental condition.
20. Electrochemistry focuses on reactions in which electrons are transferred from substance to another.
21. Dry corrosion occurs when a liquid is present.
22. Deviation from ideal behavior increase in magnitude as pressure decreases and as temperature decrease.
23. Corrosion is defined as the destruction of metals by interaction with the environment.
24. At constant volume the pressure of a gas is inversely proportional to its temperature.
25. A property is a state function, if its value depends only on the path of the system.
26. If a metal is placed in the proper environment, it will corrode and return to its more stable oxidized state.
27. Anergic process means that no work is performed, (i.e.  $W = 0$ ).
28. A solute that can be dissolved in water to become a solution which conducts electricity is called electrolyte.
29. Activation polarization refers to electro-chemical reaction, which are controlled by the diffusion in the electrolyte.
30. A spontaneous process at any temperature are these that are exothermic and that lead to a lower degree of order in the system.

### Question (2)

Choose the correct answer

(10 Marks)

- Aggregate state of matter may be found, in .....states according to external conditions such as pressure and temperature.  
a- Solid b- Liquid c- Gaseous d- All of them
- ..... is the process that takes place at constant Enthalpy.  
a- isentropic b- Anergic c- Isochoric d- Non of these
- The assumptions of the kinetic theory of gases include: A molecule has a.....  
a- Negligible size b- Small size c- large size d- Definite size
- The entropy of a system depends on a number of factors which are .....  
a- Phase changes b- Temperature c- Processes mixing d- All of them
- For a certain chemical reaction,  $\Delta H^\circ_r = +35.4 \text{ kJ}$  and  $\Delta S^\circ_r = -85.5 \text{ J/K}$ . The reaction .....  
a- Spontaneous at all temperature. b- Spontaneous at Height temperature.  
c- Spontaneous at low temperature. d- Non spontaneous at all temperature.
- Heat is not a property of the state of a system but, ..... the path taken by the process.  
a- Independent on b- Depends on c- a and b d- Non of these
- A decrease in .....charge or the consumption of .....signifies a reduction or cathodic reaction. .  
a) valence, neutron b) valence, proton c) valence, electrons d- Non of them
- The second law of thermodynamics tells us that in any spontaneous process the entropy of the universe.....  
a-  $\Delta S < 0$  b-  $\Delta S > 0$  c-  $\Delta S = 0$  d- Non of them
- The work, (W), heat, (Q) and the change in internal energy, ( $\Delta E$ ) are related through the following relation; .....which is one of the forms of the first law of thermodynamics.  
a-  $Q = \Delta E + W$  b-  $Q = \Delta E - W$  c-  $\Delta E = W - Q$  d- Non of them.
- Molecules in a real gas posses .....volume and thus undergo frequent collisions with one another.  
a- Large volume b- Small volume c- Negligible volume d- Finite volume
- The value of the Universal gas constant R =.....  
a)  $R = 1.98 \text{ cal/mole}\cdot\text{K}$  b-  $R = 8.314 \times 10^7 \text{ erg/K}\cdot\text{mole}$  c-  $R = 0.082 \text{ atm}\cdot\text{liter/K}\cdot\text{mole}$  d) all of them
- During metallic corrosion, the rate of oxidation ..... the rate of reduction.  
a- lower than b- higher than c- Equal d- All of them
- During corrosion, .....one oxidation and one reduction reaction may occur  
a- More than b- Less than c- a and b d- Equal
- ..... refers to an electrochemical process, which is controlled by the reaction sequence at the metal electrolyte interface.  
a- Activation polarization b- Concentration polarization c- Polarization d- a and b
- For some metals and it's alloys, at very high concentrations of oxidizers, or in the presence of very powerful oxidizers, the corrosion rate again increases with increasing oxidizer power. This region is termed the.....  
a- Transpassive region b- Passive region c- Active region. d- All of them
- When an electrical field is applied to electrolyte solution, the positive ions will migrate toward the electrode with the .....  
a- Cathode. b- Anode c- a and b d- Non of them
- Thermodynamic and electrochemistry are of great importance for understanding and controlling.....  
a- Corrosion b- Destruction of metals c- Deterioration of a material d- all of them
- The relationship between the equilibrium constant and the standard cell potentialis .....  
a-  $\ln(K_{eq}) = -n FE^\circ / RT$  b-  $\ln(K_{eq}) = n FE^\circ / RT$  c-  $\ln(K_{eq}) = -n RT / FE^\circ$  d-  $\ln(K_{eq}) = FE^\circ / RT$
- Acid solutions containing .....will be more corrosive than air free acids.  
a- dissolved nitrogen b- dissolved carbon dioxide c- dissolved oxygen d- Non of them
- The electrolytic cell is an electrochemical cell where .....electrode reactions.  
a- Spontaneous b- Non- spontaneous c- Equilibrium d- Non of them

### Question (3)

Choose the correct answer

(25 Marks)

The blower delivers dry air with ammonia at STP. 100 g/min of sample of the gaseous mixture indicates 67%  $\text{N}_2$ , 16%  $\text{O}_2$ , and 17%  $\text{NH}_3$  by weight. Your are given that:- dry air composition is  $\text{O}_2 = 21\%$  and  $\text{N}_2 = 79\%$  by volume and  $M_{wt}$  of air = 28.7 g/mole.

- The mole fraction of  $\text{NH}_3$  out of the blower is .....  
a)  $Y = 0.14$  b)  $Y = 0.26$  c)  $Y = 0.13$  d)  $Y = 0.10$
- The number of moles of dry air delivery by blower are .....  
a)  $n = 2.89 \text{ mol/min}$  b)  $n = 2.63 \text{ mole/min}$  c)  $n = 2.5 \text{ mole/min}$  d)  $n = 3.4 \text{ mole/min}$
- The volumetric flow rate of dry air delivery by blower in L/min is .....  
a) 64.73 b) 50.17 c) 61.15 d) 30.15
- The average  $M_{wt}$  of the gaseous mixture out of the blower is .....  
a)  $M_{wt} = 30.17 \text{ g/mol}$  b)  $M_{wt} = 28.53 \text{ g/mol}$  c)  $M_{wt} = 21.52 \text{ g/mol}$  d)  $M_{wt} = 25.69 \text{ g/mol}$
- The density of dry air delivery by blower at in g/L .....  
a)  $\rho = 2.34 \text{ g/L}$  b)  $\rho = 2.46 \text{ g/L}$  c)  $\rho = 1.28 \text{ g/L}$  d)  $\rho = 1.81 \text{ g/L}$

When 32 g of methane gas, ( $\text{CH}_4$ ), are compressed isobarically at 2492.8 torr., from 0.015  $\text{m}^3$  to 5 liters by cooling the gas. Consider methane behaves as an ideal gas during this process and the specific heat of methane gas at constant pressure ( $C_p$ ) varies with temperature  $c_p = (5.34 + 0.0115 T) \text{ cal/mole}\cdot\text{K}$ .

- The number of moles of  $\text{CH}_4$  is .....  
a)  $n = 1 \text{ mole}$  b)  $n = 2 \text{ mole}$  c)  $n = 3.5 \text{ mole}$  d)  $n = 1.75 \text{ mole}$
- The Temperature changed between state 1 and state 2 is .....  
a)  $\Delta T = 514 \text{ K}$  b)  $\Delta T = 400 \text{ K}$  c)  $\Delta T = 200 \text{ K}$  d)  $\Delta T = 230 \text{ K}$
- The work done on the system is .....  
a)  $W = 791 \text{ cal}$  b)  $W = 408 \text{ cal}$  c)  $W = -791 \text{ cal}$  d)  $W = -408 \text{ k cal}$
- The heat changed from state 1 to state 2 is .....  
a)  $\Delta Q = -3056 \text{ cal}$  b)  $\Delta Q = 3056 \text{ cal}$  c)  $\Delta Q = -5274 \text{ cal}$  d)  $\Delta Q = 5274 \text{ cal}$
- The internal energy changed, is .....  
a)  $\Delta E = 2275 \text{ cal}$  b)  $\Delta E = -2265 \text{ cal}$  c)  $\Delta E = 5274 \text{ cal}$  d)  $\Delta E = -5274 \text{ cal}$

Glucose is oxidized to produce  $\text{CO}_2$ , according to reaction:  $\text{C}_6\text{H}_{12}\text{O}_6 (\text{aq}) + 6 \text{O}_2 (\text{g}) \rightarrow 6 \text{CO}_2 (\text{g}) + 6 \text{H}_2\text{O} (\text{g})$ . Referring to given data in the attached table at 25  $^\circ\text{C}$ :-

- The change in standard enthalpy of the reaction is .....  
a)  $\Delta H^\circ_r = -2795 \text{ kJ}$  b)  $\Delta H^\circ_r = +2795 \text{ kJ}$  c)  $\Delta H^\circ_r = -2000 \text{ kJ}$  d)  $\Delta H^\circ_r = +2000 \text{ kJ}$
- The change in standard entropy of the reaction is .....  
a)  $\Delta S^\circ_r = -0.256 \text{ kJ/K}$  b)  $\Delta S^\circ_r = 0.256 \text{ kJ/K}$  c)  $\Delta S^\circ_r = -0.2 \text{ kJ/K}$  d)  $\Delta S^\circ_r = +0.2 \text{ kJ/K}$
- The change in standard free energy of the reaction is .....  
a)  $\Delta G^\circ_r = -200.3 \text{ kJ}$  b)  $\Delta G^\circ_r = -2871.3 \text{ kJ}$  c)  $\Delta G^\circ_r = +200.3 \text{ kJ}$  d)  $\Delta G^\circ_r = -2871.3 \text{ kJ}$
- The standard free energy of formation of  $\text{CO}_2$  is .....  
a)  $\Delta G^\circ_f = -357.21 \text{ kJ}$  b)  $\Delta G^\circ_f = +357.21 \text{ kJ}$  c)  $\Delta G^\circ_f = -300.21 \text{ kJ}$  d)  $\Delta G^\circ_f = +300.21 \text{ kJ}$
- The effect of temperature on the spontaneity is .....  
a) Spontaneous at all temperature b) non-Spontaneous at all temperature  
c) Spontaneous at low temperature d) Spontaneous at high temperature

Compound	State	$\Delta H^\circ_f$ (KJ/mol)	$\Delta G^\circ_f$ (KJ/mol)	$S^\circ$ (J/mol K)
$\text{C}_6\text{H}_{12}\text{O}_6$	S	-1273	-910	212
$\text{O}_2$	G	0.0	0.0	205
$\text{CO}_2$	G	-393	.....	213
$\text{H}_2\text{O}$	L	-285	-273	70



# تعليمات

تاريخ الامتحان : 11/01/2020

BME-L000

- استخدام القلم الجاف الأسود أو الأزرق للتظليل الدائره الداله علي إختيارك بشكل كامل ومعتم مع رسم دائره معتمه وممنوع الكتابة على أي بار كود
- يمنع نهائيا التظليل علي أكثر من إجابة للسؤال الواحد وكذلك الشطب و الكشط

رقم الامتحان : 14151

اساسيات الكيمياء الهندسية

رقم الطالب : 000

إسم الطالب : نموذج إجابة

رقم الجلوس : 000

غائب

الاسم بالكامل :

نموذج رقم : 1

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د. محمد عبد الحليم  
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2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	1940	1939	1938	1937	1936	1935	1934	1933	1932	1931	1930	1929	1928	1927	1926	1925	1924	1923	1922	1921	1920	1919	1918	1917	1916	1915	1914	1913	1912	1911	1910	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890	1889	1888	1887	1886	1885	1884	1883	1882	1881	1880	1879	1878	1877	1876	1875	1874	1873	1872	1871	1870	1869	1868	1867	1866	1865	1864	1863	1862	1861	1860	1859	1858	1857	1856	1855	1854	1853	1852	1851	1850	1849	1848	1847	1846	1845	1844	1843	1842	1841	1840	1839	1838	1837	1836	1835	1834	1833	1832	1831	1830	1829	1828	1827	1826	1825	1824	1823	1822	1821	1820	1819	1818	1817	1816	1815	1814	1813	1812	1811	1810	1809	1808	1807	1806	1805	1804	1803	1802	1801	1800	1799	1798	1797	1796	1795	1794	1793	1792	1791	1790	1789	1788	1787	1786	1785	1784	1783	1782	1781	1780	1779	1778	1777	1776	1775	1774	1773	1772	1771	1770	1769	1768	1767	1766	1765	1764	1763	1762	1761	1760	1759	1758	1757	1756	1755	1754	1753	1752	1751	1750	1749	1748	1747	1746	1745	1744	1743	1742	1741	1740	1739	1738	1737	1736	1735	1734	1733	1732	1731	1730	1729	1728	1727	1726	1725	1724	1723	1722	1721	1720	1719	1718	1717	1716	1715	1714	1713	1712	1711	1710	1709	1708	1707	1706	1705	1704	1703	1702	1701	1700	1699	1698	1697	1696	1695	1694	1693	1692	1691	1690	1689	1688	1687	1686	1685	1684	1683	1682	1681	1680	1679	1678	1677	1676	1675	1674	1673	1672	1671	1670	1669	1668	1667	1666	1665	1664	1663	1662	1661	1660	1659	1658	1657	1656	1655	1654	1653	1652	1651	1650	1649	1648	1647	1646	1645	1644	1643	1642	1641	1640	1639	1638	1637	1636	1635	1634	1633	1632	1631	1630	1629	1628	1627	1626	1625	1624	1623	1622	1621	1620	1619	1618	1617	1616	1615	1614	1613	1612	1611	1610	1609</
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رقم الامتحان : 14151

## اساسيات الكيمياء الهندسية

رقم الطالب : 000

اسم الطالب : نموذج إجابة

رقم الجلوس : 000





























































## غائب


الاسم بالكامل :

## نموذج رقم : 2

③

**الرقم القومي :**

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5-    Ⓐ   b   c   d	6-    a   Ⓑ   c   d	7-    Ⓐ   b   c   d	8-    Ⓐ   b   c   d				
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۹۰۰ دا محمد علی کلا

## BME-LO00

**إسم الطالب : نموذج إجابة**

**الرقم القومي :**

									
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P. د. محمد الحلو  
فيلسوف

# تعليمات

تاريخ الامتحان : 11/01/2020

BME-L000

- استخدام القلم الجاف الأسود أو الأزرق لتظليل الدائرة الدالة علي اختيارك بشكل كامل ومعتم مع رسم دائره معتمه ومملوع الكتابة علي اى بار كود
- يمنع نهائيا التظليل علي أكثر من إجابة للسؤال الواحد وكذلك الشطب و الكشط

رقم الامتحان : 14151

رقم الطالب : 000

اساسيات الكيمياء الهندسية

إسم الطالب : نموذج إجابة

رقم الجلوس : 000

غالب

الاسم بالكامل :

نموذج رقم : 4

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د. محمد عبد الله  
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