# UNIVERSITY OF SWAZILAND

# FINAL EXAMINATION 2016, MAY

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**TITLE OF PAPER** : Introductory Chemistry II

**COURSE NUMBER** : CHE152

**TIME** : Three Hours

**INSTRUCTIONS** :

1. **Answer all questions in Section A (Total 50 marks). Use the provide answer sheet**
2. **Answer any two questions in Section B (each question is 25 marks)**

**NB:** Non-programmable electronic calculators may be used

A data sheet, a periodic table and answer sheet (for **Section A**) are attached

**Useful data and equations:**

1 atm = 760 Torr = 760 mmHg

1 atm = 101325 Pa

Arrhenius equation: $k = Ae^{-E_a/RT}$ or $lnk = lnA - \frac{E_a}{RT}$

Van der Walls equation: $P = \frac{nRT}{V-nb} - \frac{n^2a}{V^2}$

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This Examination Paper Contains Fourteen Printed Pages Including This Page

***You are not supposed to open the paper until permission to do so has been granted by the Chief Invigilator.***

## SECTION A

1 What is the $[H_3O^+]$ for a solution at 25°C that has pOH = 5.640?

A. $2.34 \times 10^{-4}$ *M* B. $2.29 \times 10^{-6}$ *M* C. $4.37 \times 10^{-9}$ *M*

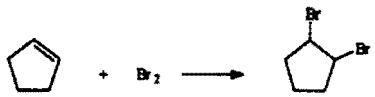
D. $4.27 \times 10^{-11}$ *M* E. 8.360 *M*

2. Hydrogen gas exerts a pressure of 466 torr in a container. What is this pressure in atmospheres?

A. 0.217 atm B. 0.466 atm C. 0.613 atm

D. 1.63 atm E. 4.60 atm

3. The reaction of bromine with an alkene such as cyclopentene is a good laboratory test for the presence of a double bond in a compound. What type of reaction is it?




A. addition B. elimination C. substitution

D. displacement E. reduction

4. $2NOBr(g) \rightarrow 2NO(g) + Br_2(g)$

| [NOBr](mol $L^{-1}$) | Rate (mol $L^{-1}s^{-1}$) |
|---|---|
| 0.0450 | $1.62 \times 10^{-3}$ |
| 0.0310 | $7.69 \times 10^{-4}$ |
| 0.0095 | $7.22 \times 10^{-5}$ |

Based on the initial rate data above, what is the value of the rate constant?

A. 0.0360 L $mol^{-1}s^{-1}$ B. 0.800 L $mol^{-1}s^{-1}$ C. 1.25 L $mol^{-1}s^{-1}$

D. 27.8 L $mol^{-1}s^{-1}$ E. 0.0360 $s^{-1}$

5. Which of the lines on the figure below is the best representation of the relationship between the volume of a gas and its pressure, other factors remaining constant?

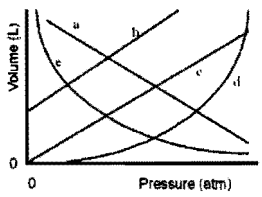
A. a

B. b

C. c

D. d

E. e




6. A 500-mL sample of argon at 800 torr has its absolute temperature quadrupled. If the volume remains unchanged what is the new pressure?

A. 200 torr B. 400 torr C. 800 torr

D. 2400 torr E. 3200 torr

7. A sample of nitrogen gas is confined to a 14.0 L container at 375 torr and 37.0°C. How many moles of nitrogen are in the container?
   A. 0.271 mol  B. 2.27 mol  C. 3.69 mol
   D. 206 mol  E. 227 mol

8. What is the density of carbon dioxide gas at -25.2°C and 98.0 kPa?
   A. 0.232 g/L  B. 0.279 g/L  C. 0.994 g/L
   D. 1.74 g/L  E. 2.09 g/L

9. If 0.750 L of argon at 1.50 atm and 177°C and 0.235 L of sulfur dioxide at 95.0 kPa and 63.0°C are added to a 1.00-L flask and the flask's temperature is adjusted to 25.0°C, what is the resulting pressure in the flask?
   A. 0.0851 atm  B. 0.244 atm  C. 0.946 atm
   D. 1.74 atm  E. 1.86 atm

10. Magnesium metal (0.100 mol) and a volume of aqueous hydrochloric acid that contains 0.500 mol of HCl are combined and react to completion. How many liters of hydrogen gas, measured at STP, are produced?
    $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$
    A. 2.24 L of $H_2$  B. 4.48 L of $H_2$  C. 5.60 L of $H_2$
    D. 11.2 L of $H_2$  E. 22.4 L of $H_2$

11. "The volume of an ideal gas is directly proportional to the number of moles of the gas at constant temperature and pressure" is a statement of _____ Law.
    A. Charles'  B. Boyle's  C. Amontons'
    D. Avogadro's  E. Dalton's

12. A system that does no work but which transfers heat to the surroundings has
    A. $q < 0, \Delta E > 0$  B. $q < 0, \Delta E < 0$  C. $q > 0, \Delta E > 0$
    D. $q > 0, \Delta E < 0$  E. $q < 0, \Delta E = 0$

13. A system delivers 1275 J of heat while the surroundings perform 855 J of work on it. Calculate $\Delta E$ in J.
    A. -2130 J  B. -420 J  C. 420 J
    D. 2130 J  E. -1275 J

14. A sample of nitrogen gas at 298 K and 745 torr has a volume of 37.42 L. What volume will it occupy if the pressure is increased to 894 torr at constant temperature?
    A. 22.3 L  B. 31.2 L  C. 44.9 L
    D. 112 L  E. 380 L

15. Sand is converted to pure silicon in a three step process. The third step is
    $SiCl_4(g) + 2Mg(s) \rightarrow 2MgCl_2(s) + Si(s)$  $\Delta H = -625.6$ kJ

What is the enthalpy change when 25.0 mol of silicon tetrachloride is converted to elemental silicon?
    A. -25.0 kJ  B. -7820 kJ  C. $-1.56 \times 10^4$ kJ
    D. $-3.13 \times 10^4$ kJ  E. None of these choices is correct.

16. Galena is the ore from which elemental lead is extracted. In the first step of the extraction process, galena is heated in air to form lead(II) oxide.
    $2PbS(s) + 3O_2(g) \rightarrow 2PbO(s) + 2SO_2(g)$  $\Delta H = -827.4$ kJ

What mass of galena is converted to lead oxide if 975 kJ of heat are liberated?

A. 203 g B. 282 g C. 406 g
D. 478 g E. 564 g

17. Calculate the enthalpy change for the reactions
$NO(g) + O(g) \rightarrow NO_2(g)$
from the following data:
$NO(g) + O_3(g) \rightarrow NO_2(g) + O_2(g)$ $\Delta H = -198.9$ kJ
$O_3(g) \rightarrow 1.5O_2(g)$ $\Delta H = -142.3$ kJ
$O_2(g) \rightarrow 2O(g)$ $\Delta H = 495.0$ kJ

A. -551.6 kJ B. -304.1 kJ C. 190.9 kJ
D. 153.8 kJ E. 438.4 kJ

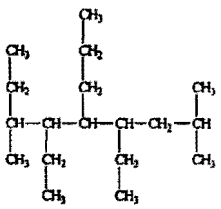
18. Which one of the following statements about standard states is incorrect?
A. The standard state of a solid compound is the pure solid.
B. The standard state of a liquid compound is the pure liquid.
C. The standard state of a gaseous compound is the gas at a pressure of 1 atmosphere.
D. The standard state of an aqueous solute is a saturated solution in water.
E. The standard state of an element is the form in which it is stable at 1 atm and a specified temperature, usually 25°C.

19. Which one of the following is not a correct formation reaction? (products are correct)
A. $H_2(g) + O(g) \rightarrow H_2O(l)$ B. $\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(g)$
C. $6C(\text{graphite}) + 3H_2(g) \rightarrow C_6H_6(l)$ D. $C(\text{graphite}) \rightarrow C(\text{diamond})$
E. $6C(\text{graphite}) + 6H_2(g) + 3O_2(g) \rightarrow C_6H_{12}O_6(s)$

20. Arrange the following gases in order of increasing rate of effusion.
$C_2H_6$ Ar HCl $PH_3$

A. $Ar < HCl < PH_3 < C_2H_6$ B. $C_2H_6 < PH_3 < HCl < Ar$ C. $Ar < PH_3 < C_2H_6 < HCl$
D. $C_2H_6 < HCl < PH_3 < Ar$ E. $Ar < PH_3 < HCl < C_2H_6$

21. Select the correct name for the following compound.



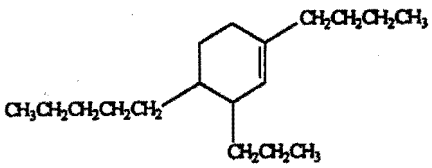
A. 1,2-diethyl-1-methyl-3-propyl-4-isobutylhexane
B. 1,6,6-trimethyl-1,2,4-triethyl-3-propylhexane
C. 1,1,6-trimethyl-3,5,6-triethyl-4-propylhexane
D. 4,6-diethyl-2,7-dimethyl-5-propylnonane
E. 3,5-diethyl-1,1,6-trimethyl-4-propyloctane

22. Which of the following is not a state function?
A. internal energy B. volume C. work
D. pressure E. enthalpy

23. Calculate the $\Delta H°_{rxn}$ for the decomposition of calcium carbonate to calcium oxide and carbon dioxide.
$\Delta H°_f [CaCO_3(s)] = -1206.9$ kJ/mol; $\Delta H°_f [CaO(s)] = -635.1$ kJ/mol; $\Delta H°_f [CO_2(g)] = -393.5$ kJ/mol

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
A. -2235.5 kJ B. -1448.5 kJ C. -178.3 kJ
D. 178.3 kJ E. 2235.5 kJ

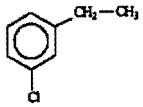
24. Select the correct name for the following compound.



A. 1-butyl-4-pentyl-3-propylcyclohexene
B. 1-butyl-4-pentyl-5-propylcyclohexene
C. 2-butyl-5-pentyl-6-propylcyclohexene
D. 4-butyl-1-pentyl-2-propylcyclohexene
E. 1-butyl-4-pentyl-3-propylbenzene

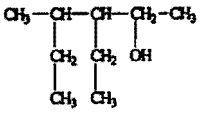
25. Which one of the following relationships is always correct?
A. potential energy + kinetic energy = constant
B. $E = q + w$
C. $\Delta E = \Delta H - P\Delta V$
D. $H = E + PV$
E. $\Delta H = q_v$

26. Select the correct name for the following compound.



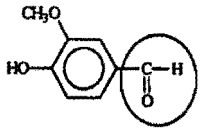
A. *meta*-chloroethylcyclohexene
B. 1-chloro-5-ethylcyclohexene
C. *meta*-chloroethylbenzene
D. 1-chloro-5-ethylbenzene
E. 1-chloro-3-ethylcyclohexane

27. Select the correct name for the following compound.



A. 3,4-diethyl-4-methyl-2-butanol
B. 2,3-diethyl-4-pentanol
C. 3,4-diethyl-2-pentanol
D. 3-ethyl-4-methyl-2-hexanol
E. 3-ethyl-4-methyl-2-hexanal

28. Vanillin is a flavouring agent which occurs naturally in the vanilla bean, the seed of an orchid. Identify the functional group circled.



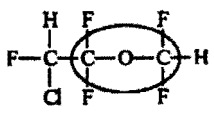
A. aldehyde
B. ketone
C. alcohol
D. carboxylic acid
E. carbonyl

29. For the reaction
$A(g) + 2B(g) \rightarrow 2C(g) + 2D(g)$
the following data was collected at constant temperature. Determine the correct rate law for this reaction.

| Trial | Initial [A] (mol/L) | Initial [B] (mol/L) | Initial Rate (mol/(L·min)) |
|---|---|---|---|
| 1 | 0.125 | 0.200 | 7.25 |
| 2 | 0.375 | 0.200 | 21.75 |
| 3 | 0.250 | 0.400 | 14.50 |
| 4 | 0.375 | 0.400 | 21.75 |

A. Rate = $k$[A] [B]
B. Rate = $k$[A]$^2$ [B]
C. Rate = $k$[A] [B]$^2$
D. Rate = $k$[A]
E. Rate = $k$[A]$^3$

30. Enflurane is an effective gaseous anesthetic with relatively low flammability. Identify the functional group circled.



A. aldehyde
B. ketone

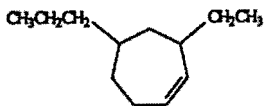
C. ester
D. ether
E. alcohol

31. The compound $RX_3$ decomposes according to the equation
$3RX_3 \rightarrow R + R_2X_3 + 3X_2$
In an experiment the following data were collected for the decomposition at 100°C. What is the average rate of reaction over the entire experiment?

| *t*(s) | $[RX_3]$(mol $L^{-1}$) |
|---|---|
| 0 | 0.85 |
| 2 | 0.67 |
| 6 | 0.41 |
| 8 | 0.33 |
| 12 | 0.20 |
| 14 | 0.16 |

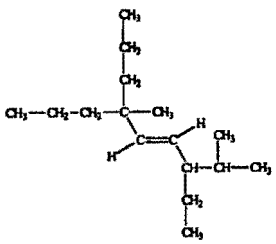
A. 0.011 mol $L^{-1}s^{-1}$ B. 0.019 mol $L^{-1}s^{-1}$ C. 0.044 mol $L^{-1}s^{-1}$
D. 0.049 mol $L^{-1}s^{-1}$ E. 0.069 mol $L^{-1}s^{-1}$

32. Select the correct name for the following compound.
A. 2-ethyl-4-propylcycloheptene
B. 3-ethyl-5-propylcycloheptene
C. 6-ethyl-4-propylcycloheptene
D. 7-ethyl-5-propylcycloheptene
E. 3-ethyl-5-propylcyclohexene



33. Consider the reaction
$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$
If the rate $\Delta[H_2]/\Delta t$ is 0.030 mol $L^{-1}$ $s^{-1}$, then $\Delta[NH_3]/\Delta t$ is
A. -0.045 mol $L^{-1}$ $s^{-1}$ B. -0.030 mol $L^{-1}$ $s^{-1}$ C. -0.020 mol $L^{-1}$ $s^{-1}$
D. -0.010 mol $L^{-1}$ $s^{-1}$ E. None of these choices is correct.

34. Select the correct name for the following compound.

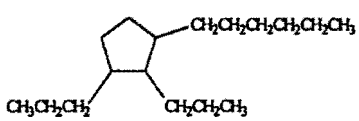


A. *cis*-3-ethyl-2,6-dimethyl-6-propyl-4-nonene
B. *trans*-3-ethyl-2,6-dimethyl-6-propyl-4-nonene
C. *cis*-7-ethyl-4,8-dimethyl-4-propyl-5-nonene
D. *trans*-7-ethyl-4,8-dimethyl-4-propyl-5-nonene
E. None of these choices is correct.

35. What is the pOH of a 0.0250 *M* HI solution?
A. 0.944 B. 1.602 C. 12.398
D. 13.056 E. None of these choices is correct.

36. Which one of the following sets of units is appropriate for a second-order rate constant?
A. $s^{-1}$ B. mol $L^{-1}$ $s^{-1}$ C. L $mol^{-1}$ $s^{-1}$
D. $mol^2$ $L^{-2}$ $s^{-1}$ E. $L^2$ $mol^{-2}$ $s^{-1}$

37. Select the correct name for the following compound.
A. *ortho*-dipropylcyclopentylhexane
B. 2,3-dipropylcyclopentylhexane



C. 2-hexyl-1,5-dipropylcyclopentane
D. 1-hexyl-2,3-dipropylcyclopentane
E. 1,2-dipropyl-3-hexylcyclopentane

38. The reaction A → B is first-order overall and first-order with respect to the reactant A. The result of doubling the initial concentration of A will be to
A. shorten the half-life of the reaction.
B. increase the rate constant of the reaction.
C. decrease the rate constant of the reaction.
D. shorten the time taken to reach equilibrium.
E. double the initial rate.

39. What is the molecularity of the following elementary reaction?
$NH_2Cl(aq) + OH^-(aq) \rightarrow NHCl^-(aq) + H_2O(l)$
A. unimolecular B. bimolecular C. termolecular
D. tetramolecular E. The reaction order must be known before molecularity can be determined.

40. When a catalyst is added to a reaction mixture, it
A. increases the rate of collisions between reactant molecules.
B. provides reactant molecules with more energy.
C. slows down the rate of the back reaction.
D. provides a new pathway (mechanism) for the reaction.
E. does none of these.

41. Which of the following has an effect on the magnitude of the equilibrium constant?
A. activation energy of the forward reaction
B. concentrations of the reactants and products
C. presence of a catalyst
D. change in volume of container
E. change in temperature

42. What is the reaction quotient, $Q_c$, for the following chemical reaction equation.
$2C_6H_6(g) + 15O_2(g) \rightleftharpoons 12CO_2(g) + 6H_2O(g)$

A. $\frac{[CO_2][H_2O]}{[C_6H_6][O_2]}$ B. $\frac{[CO_2]^{12}[H_2O]^6}{[C_6H_6]^2[O_2]^{15}}$ C. $\frac{[C_6H_6][O_2]}{[CO_2][H_2O]}$
D. $\frac{[C_6H_6]^2[O_2]^{15}}{[CO_2]^{12}[H_2O]^6}$ E. $\frac{[12CO_2][6H_2O]}{[2C_6H_6][15O_2]}$

43. What is the reaction quotient, $Q_c$, for the following chemical reaction.
$Zn(s) + 2Ag^+(aq) \rightleftharpoons Zn^{2+}(aq) + 2Ag(s)$

A. $\frac{[Zn^{2+}][Ag(s)]^2}{[Zn(s)][Ag^+]^2}$ B. $\frac{[Zn(s)][Ag^+]^2}{[Zn^{2+}][Ag(s)]^2}$ C. $\frac{[Zn^{2+}]}{[Ag^+]}$
D. $\frac{[Ag^+]^2}{[Zn^{2+}]}$ E. $\frac{[Zn^{2+}]}{[Ag^+]^2}$

44. Consider the reactions of cadmium with the thiosulfate anion.

$Cd^{2+}(aq) + S_2O_3^{2-}(aq) \rightleftharpoons Cd(S_2O_3)(aq)$ $K_1 = 8.3 \times 10^3$

$Cd(S_2O_3)(aq) + S_2O_3^{2-}(aq) \rightleftharpoons Cd(S_2O_3)_2^{2-}(aq)$ $K_2 = 2.5 \times 10^2$

What is the value for the equilibrium constant for the following reaction?

$Cd^{2+}(aq) + 2S_2O_3^{2-}(aq) \rightleftharpoons Cd(S_2O_3)_2^{2-}(aq)$

A. 0.030 B. 33 C. $8.1 \times 10^3$
D. $8.6 \times 10^3$ E. $2.1 \times 10^6$

45. Hydrogen sulfide will react with water as shown in the following reactions.

$H_2S(g) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HS^-(aq)$ $K_1 = 1.0 \times 10^{-7}$

$HS^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + S^{2-}(aq)$ $K_2 = ?$

$H_2S(g) + 2H_2O(l) \rightleftharpoons 2H_3O^+(aq) + S^{2-}(aq)$ $K_3 = 1.3 \times 10^{-20}$

What is the value of $K_2$?

A. $1.3 \times 10^{-27}$ B. $2.3 \times 10^{-7}$ C. $1.3 \times 10^{-13}$
D. $7.7 \times 10^{12}$ E. $7.7 \times 10^{26}$

46. Which one of the following pairs is not a conjugate acid-base pair?

A. $H_2O/OH^-$ B. $H_2O_2/HO_2^-$ C. $OH^-/O^{2-}$
D. $H_2PO_4^-/HPO_4^{2-}$ E. $HCl/H^+$

47. The equilibrium constant, $K_p$, for the reaction

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

is 55.2 at 425°C. A rigid cylinder at that temperature contains 0.127 atm of hydrogen, 0.134 atm of iodine, and 1.055 atm of hydrogen iodide. Is the system at equilibrium?

A. Yes.
B. No, the forward reaction must proceed to establish equilibrium.
C. No, the reverse reaction must proceed to establish equilibrium.
D. The volume of the container must be known before deciding.
E. The starting concentrations of all substances must be known before deciding.

48. Compounds A, B, and C react according to the following equation.

$3A(g) + 2B(g) \rightleftharpoons 2C(g)$

At 100°C a mixture of these gases at equilibrium showed that [A] = 0.855 *M*, [B] = 1.23 *M*, and [C] = 1.75 *M*. What is the value of $K_c$ for this reaction?

A. 0.309 B. 0.601 C. 1.66
D. 3.24 E. > 10

49. The reaction system

$POCl_3(g) \rightleftharpoons POCl(g) + Cl_2(g)$

is at equilibrium. Which of the following statements describes the behavior of the system if POCl is added to the container?

A. The forward reaction will proceed to establish equilibrium.
B. The reverse reaction will proceed to establish equilibrium.
C. The partial pressures of $POCl_3$ and POCl will remain steady while the partial pressure of chlorine increases.

D. The partial pressure of chlorine remains steady while the partial pressures of $POCl_3$ and POCl increase.
E. The partial pressure of chlorine will increase while the partial pressure of POCl decreases.

50. The reaction system
$CS_2(g) + 4H_2(g) \rightleftharpoons CH_4(g) + 2H_2S(g)$
is at equilibrium. Which of the following statements describes the behavior of the system if the partial pressure of hydrogen is doubled?
A. As equilibrium is re-established, the partial pressure of carbon disulfide increases.
B. As equilibrium is re-established, the partial pressure of methane, $CH_4$, decreases.
C. As equilibrium is re-established, the partial pressure of hydrogen decreases.
D. As equilibrium is re-established, the partial pressure of hydrogen sulfide decreases.
E. As equilibrium is re-established, all the partial pressures will decrease.

## Section B

### Question 1

a) Recall that density is mass per volume. What happens to the density of a gas as (6)

***(Your answer should be increase, decrease or no change)***

i. the gas is heated in a constant-volume container;

ii. the gas is compressed at constant temperature;

iii. Additional gas is added to a constant-volume container?

b) In the first step in the industrial process for making nitric acid, ammonia reacts with oxygen in the presence of a suitable catalyst to form nitric oxide and water vapor:

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

How many liters of $NH_3(g)$ at 850°C and 5.00 atm are required to react with 1.00 mol of $O_2(g)$ in this reaction? (8)

c) Indicate whether each of the following molecules is capable of geometrical (cis-trans) isomerism. For those that are, draw the structures: (6)

i. 1,1-dichloro-1-butene

ii. 2,4-dichloro-2-pentyne

iii. 1-chloro-1-pentene

**d)** Give the name and structure of the product of the reaction of 6-ethyl-3-nonene with HBr. (5)

### Question 2

a) For the reaction:

$$H_2(g) + I_2(g) \rightleftharpoons 2\,HI(g)$$

$K_p$ = 794 at 298 K and $K_p$ = 55 at 700 K. Is the formation of HI favored more at the higher or lower temperature? (3)

b) Write the following equilibrium-constant expressions: (4)

i. $K_c$ for $Cr(s) + 3\,Ag^+(aq) \rightleftharpoons Cr^{3+}(aq) + 3\,Ag(s)$

ii. $K_p$ for $3\,Fe(s) + 4\,H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4\,H_2(g)$

c) Sulfur trioxide decomposes at high temperature in a sealed container:

$$2\,SO_3(g) \rightleftharpoons 2\,SO_2(g) + O_2(g)$$

Initially, the vessel is charged at 1000 K with $SO_3(g)$ at a partial pressure of 0.500 atm. At equilibrium the $SO_3$ partial pressure is 0.200 atm. Calculate the value of $K_p$ at 1000 K. (10)

d) For the reaction

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g) \qquad \Delta H° = 87.9\ kJ$$

in which direction will the equilibrium shift when

**i.** $Cl_2(g)$ is removed,

**ii.** the volume of the reaction system is increased,

**iii.** $PCl_3(g)$ is added? (8)

## Question 3

**a)** What is the conjugate base of $HClO_4$, $H_2S$, $PH_4^+$, $HCO_3^-$? (4)

**b)** What is the conjugate acid of $CN^-$, $SO_4^{2-}$, $H_2O$, $HCO_3^-$? (4)

**c)** The hydrogen sulfite ion ($HSO_3^-$) is amphiprotic. Write an equation for the reaction of $HSO_3^-$ with water (4)

a. in which the ion acts as an acid and

b. In which the ion acts as a base.

(In both cases identify the conjugate acid–base pairs)

**d)** Calculate the concentration of $OH^-(aq)$ in a solution in which (3)

a. $[H^+] = 2 \times 10^{-6}\ M$;

b. $[H^+] = 100 \times [OH^-]$.

**e)** A sample of freshly pressed apple juice has a pOH of 10.24. Calculate $[H^+]$. (2)

**f)** A 0.100 M solution of an unknown weak acid, HX, has a pH of 1.414. What is the $K_a$ for HX? (8)

**UNIVERSITY OF SWAZILAND**

**CHEMISTRY DEPARTMENT**

**C112 SECTION A ANSWER SHEET**

**STUDENT ID NUMBER:**_____

The correct answer must be indicated by putting a circle on the letter for that answer on the answer sheet provided. If you change your answer, please cancel the wrong answer with a cross and then put a circle around the correct one. If more than one option has a circle around it a zero will be given for that question.

| | | | | | |
|---|---|---|---|---|---|
| 1 | A | B | C | D | E |
| 2 | A | B | C | D | E |
| 3 | A | B | C | D | E |
| 4 | A | B | C | D | E |
| 5 | A | B | C | D | E |
| 6 | A | B | C | D | E |
| 7 | A | B | C | D | E |
| 8 | A | B | C | D | E |
| 9 | A | B | C | D | E |
| 10 | A | B | C | D | E |
| 11 | A | B | C | D | E |
| 12 | A | B | C | D | E |
| 13 | A | B | C | D | E |
| 14 | A | B | C | D | E |
| 15 | A | B | C | D | E |
| 16 | A | B | C | D | E |
| 17 | A | B | C | D | E |
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| 23 | A | B | C | D | E |
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| 27 | A | B | C | D | E |
| 28 | A | B | C | D | E |
| 29 | A | B | C | D | E |
| 30 | A | B | C | D | E |
| 31 | A | B | C | D | E |
| 32 | A | B | C | D | E |
| 33 | A | B | C | D | E |
| 34 | A | B | C | D | E |
| 35 | A | B | C | D | E |
| 36 | A | B | C | D | E |
| 37 | A | B | C | D | E |
| 38 | A | B | C | D | E |
| 39 | A | B | C | D | E |
| 40 | A | B | C | D | E |
| 41 | A | B | C | D | E |
| 42 | A | B | C | D | E |
| 43 | A | B | C | D | E |
| 44 | A | B | C | D | E |
| 45 | A | B | C | D | E |
| 46 | A | B | C | D | E |
| 47 | A | B | C | D | E |
| 48 | A | B | C | D | E |
| 49 | A | B | C | D | E |
| 50 | A | B | C | D | E |

## SI Units and Conversions

| Unit | Symbol | SI units |
|---|---|---|
| Newton | N | $kg.m.s^{-2}$ |
| Pascal | Pa | $kg.m^{-1}.s^{-2}$ or $N.m^{-2}$ |
| Joule | J | $kg.m^{2}.s^{-2}$ or N.m or AVs |
| Watt | W | $kg.m^{2}.s^{-3}$ or $J.s^{-1}$ |
| Coulomb | C | A.s |
| Volt | V | $kg.m^{2}.s^{-3}.A^{-1}$ or $J.C^{-1}$ |
| Ohm | Ω | $kg.m^{2}.s^{-3}.A^{-2}$ or $v.A^{-1}$ |
| Amp | A | $1Cs^{-1}$ |

## Pressure Units and conversion factors

| | |
|---|---|
| Pa | I Pa = 1 $N.m^{-2}$ |
| Bar | 1 bar = $10^{5}$ Pa |
| Atmosphere | 1 atm = 101.325 kPa |
| Torr | 760 Torr = 1 atm |
| | 760 Torr = 760 mmHg= 101.325 kPa |

## General data and Fundamental Constants

| | | |
|---|---|---|
| Gas constant | R | 8.314 51 $J.K^{-1}.mol^{-1}$<br>8.314 51 x $10^{-2}$ $L.bar.K^{-1}.mol^{-1}$<br>8.205 78 x $10^{-2}$ $L.atm.K^{-1}.mol^{-1}$<br>62.364 $L.Torr.K^{-1}.mol^{-1}$ |
| Avogadro constant | $N_A$ | 6.022169 x $10^{23}$ $mol^{-1}$ |
| Molar volume of an ideal gas at 0°C and 1 atm | $V_m$ | 22.414 $dm^3$ |

# UNIVERSITY OF SWAZILAND

## Department of Chemistry