EXAM 3 ANSWER KEY

FORM 3M:

1. D	2. D	3. E	4. D	5. D	6. E
7. C	8. D	9. B	10. B	11. D	12. E
13. B	14. A	15. B	16. A	17. A	

FORM 3N:

1. A	2. C	3. D	4. B	5. E	6. C
7. B	8. D	9. A	10. E	11. B	12. E
13. E	14. C	15. D	16. C	17. C	

PART 2 FORM 3M

Dr. Heising CHEM 101 Sections 572-580 EXAM 3 November 20, 2001

NAME: _____

SID #: _____

SIGNATURE: _____

Free Response (48 pts total, see margin for point values). Show all work for partial credit!

(6 pts) 18. At 30 °C a sample of CH_4 occupies a volume of 250 ml under a pressure of 4.0 atm. What volume would it occupy at a pressure of 2.0 atm?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\quad (250mL)(4.0atm) = (x\,mL)(2.0atm)$

$x = 500\,mL$

19. Succinic acid, $H_2C_4H_4O_4$, is a diprotic acid, molar mass = 118.1 g/mol.

(6 pts) a) If you dissolve 2.00 g of succinic acid in enough water to make 100 ml of solution, what is the normality of the solution?

$$2.00g\,acid \times \frac{1mol}{118.1g} \times \frac{1}{0.100L} \times \frac{2\,equivalents}{1mol} = 0.339N$$

(6 pts) b) You have 10.0 ml of a 2.5N solution of succinic acid. How many milliliters of 1.0 N NaOH are required to fully react with the succinic acid?

$(10.0mL)(2.5N) = (x\,mL)(1.0N)$

$x = 25\,mL$

20. One of the products formed upon the reaction of succinic acid, $H_2C_4H_4O_4$, a weak acid, with NaOH in aqueous solution is the soluble salt $Na_2C_4H_4O_4$.

(6 pts) a) write a balanced formula equation to describe the reaction complete with phase labels (*s, l, aq*, etc.). write a balanced formula equation to describe the reaction complete with phase labels (*s, l, aq*, etc.).

base → conjugate acid

$$H_2C_4H_4O_{4(aq)} + 2NaOH_{(aq)} \longrightarrow Na_2C_4H_4O_{4(aq)} + 2H_2O_{(l)}.$$

acid → conjugate base

(2 pts) b) Label the acid/conjugate base and the base/conjugate acid pairs on the equation.

(4 pts) c) write the total ionic equation for the reaction.

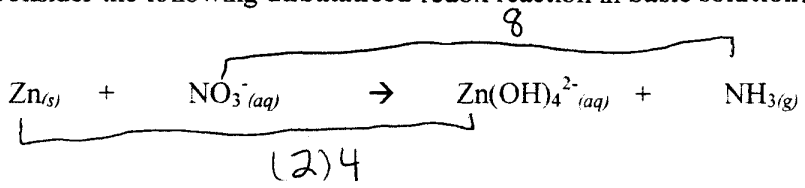
$$H_2C_4H_4O_{4(aq)} + 2Na^+_{(aq)} + 2OH^-_{(aq)} \longrightarrow 2Na^+_{(aq)} + C_4H_4O_4^{2-}{}_{(aq)} + 2H_2O_{(l)}$$

(2 pts) d) write the net ionic equation.

$$H_2C_4H_4O_{4(aq)} + 2OH^-_{(aq)} \longrightarrow C_4H_4O_4^{2-}{}_{(aq)} + 2H_2O_{(l)}$$

(2 pts) e) which of the three acid/base theories best describes this reaction? arrhenius

21. Consider the following **unbalanced** redox reaction in **basic solution**:



(6 pts) a) The Zn atom is oxidized from 0 to 2+.
(oxidation numbers)

The N atom is reduced from 5+ to 3−.
(oxidation numbers)

(8 pts) b) balance the reaction using the method of your choice. **SHOW YOUR WORK.**

$4Zn + NO_3^- \rightarrow 4Zn(OH)_4^{2-} + NH_3$

0 1− 8− 0

$+7OH^-$ (wait to add H_2O because I need H on this side of equation anyway)

$4Zn + NO_3^- + 7OH^- \rightarrow 4Zn(OH)_4^{2-} + NH_3$

7H ~~7H~~ $+6H_2O$ (12H) ~~16~~ ~~3H~~ 19H 19 − 7 = 12H

$4Zn + NO_3^- + 7OH^- + 6H_2O \rightarrow 4Zn(OH)_4^{2-} + NH_3$

3 + 7 + 6 = 16 0 16 0 ✓ balanced

PART 2 FORM 3N

Dr. Heising CHEM 101 Sections 572-580 EXAM 3 November 20, 2001

NAME: _____

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Free Response (48 pts total, see margin for point values). Show all work for partial credit!

(6 pts) 18. At 25°C a sample of CO_2 occupies a volume of 500 ml under a pressure of 2.0 atm. What volume would it occupy at a pressure of 4.0 atm?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $(500)(2.0) = (x\ mL)(4.0)$

$x = 250\ mL$

19. Oxalic acid, $H_2C_2O_4$, is a diprotic acid, molar mass = 90.0 g/mol.

(6 pts) a) If you dissolve 1.00 g of oxalic acid in enough water to make 100 ml of solution, what is the normality of the solution?

$1.00\ g\ acid \times \frac{1\ mol}{90.0\ g} \times \frac{1}{0.100\ L} \times \frac{2\ eq}{1\ mol} = 0.222N$

(6 pts) b) You have 20.0 ml of a 1.5N solution of oxalic acid. How many milliliters of 1.0 N NaOH are required to fully react with the oxalic acid?

$(20.0\ mL)(1.5N) = (x\ mL)(1.0N)$

$x = 30\ mL$

20. One of the products formed upon the reaction of oxalic acid, $H_2C_2O_4$, a weak acid, with NaOH in aqueous solution is the soluble salt $Na_2C_2O_4$.

(6 pts) a) write a balanced formula equation to describe the reaction complete with phase labels (*s, l, aq*, etc.).

$$H_2C_2O_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2C_2O_{4(aq)} + 2H_2O_{(l)}$$

base → conjugate acid

acid → conjugate base

(2 pts) b) Label the acid/conjugate base and the base/conjugate acid pairs on the equation.

(4 pts) c) write the total ionic equation for the reaction.

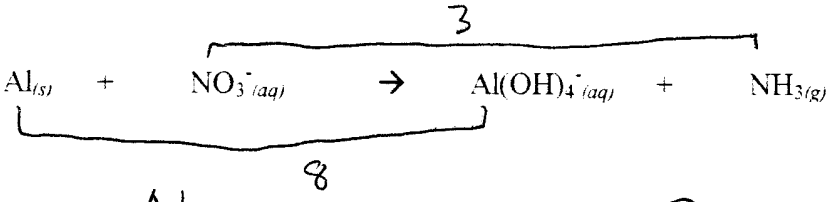
$$H_2C_2O_{4(aq)} + 2Na^+_{(aq)} + 2OH^-_{(aq)} \rightarrow 2Na^+_{(aq)} + C_2O_4^{2-}{}_{(aq)} + 2H_2O_{(l)}$$

(2 pts) d) write the net ionic equation.

$$H_2C_2O_{4(aq)} + 2OH^-_{(aq)} \rightarrow C_2O_4^{2-}{}_{(aq)} + 2H_2O_{(l)}$$

(2 pts) e) which of the three acid/base theories best describes this reaction? arrhenius

21. Consider the following **unbalanced** redox reaction in **basic solution**:



(6 pts) a) The Al atom is oxidized from 0 to 3+ (oxidation numbers).

The N atom is reduced from 5+ to 3− (oxidation numbers).

(8 pts) b) balance the reaction using the method of your choice. **SHOW YOUR WORK.**

$8Al + 3NO_3^- \longrightarrow 8Al(OH)_4^- + 3NH_3$

0 3− 8− 0

$+ 5OH^-$ (wait to add H_2O as I need H on this side)

counting H: 5 32 9 = 41

41 − 5 = 36 H needed / 2 = $18H_2O$

$8Al + 3NO_3^- + 5OH^- + 18H_2O \longrightarrow 8Al(OH)_4^- + 3NH_3$ ✓

O: 9 5 18 = 32 32