001
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McCord CH302

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Exam 2

Mar 13, 2019

Wednesday 7:30 - 9:00 PM

A-L in UTC 2.112A

M-Z In BUR 106

Remember to refer to the Periodic Table handout that is separate from this exam copy.

NOTE: Please keep this exam copy intact (all pages still stapled - including this cover page). You must turn in ALL the materials that were distributed. This means that you turn in your exam copy (name and signature included), bubble sheet, periodic table handout, and all scratch paper. Please also have your UT ID card ready to show as well.

This print-out should have 20 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 5.0 points

Calculate the pH of a 0.018 M $Ba(OH)_2$ solution.

1. 1.44

2. 12.56

3. 5.26

4. 8.44

5. 1.74

6. 12.26

002 5.0 points

A rection has an equilibrium constant equal to 1.36×10^{-4}. You place only reactants into a container. Which of the following statements is/are true?

I. $\Delta G > 0$

II. $\Delta G^\circ > 0$

III. The reaction will occur spontaneously until $K = 1$

IV. The reaction will not occur spontaneously because $Q > K$

V. The reaction will occur spontaneously until $Q = K$

1. II and IV only

2. I, II, and III only

3. I, II, and IV only

4. I and III only

5. I, II, and V only

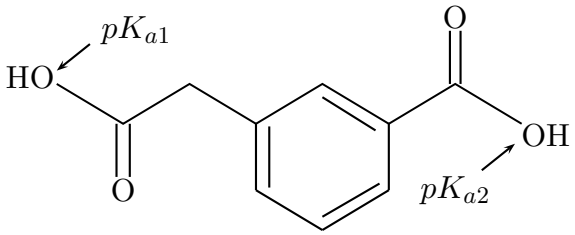
6. V only

7. II and V only

8. II and III only

003 5.0 points

The molecule below is diprotic with pK_a values equal to 3.90 and 5.95.



What is the charge on the overall molecule if it is placed into a 0.05 M NaOH solution?

1. -1

2. -2

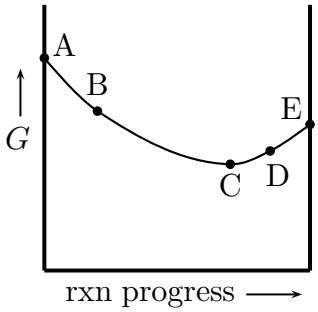
3. 0

4. +2

5. +1

004 5.0 points

Consider the free energy diagram:



If the reaction depicted above is exothermic, which of the following statements is false?

1. The ΔG_{rxn} for this reaction is negative at all points to the right of C

2. Point C is simultaneously the lowest free energy value on this diagram and the point in which ΔG_{rxn} is equal to zero

3. The standard reaction represented by this diagram is product preferred

4. ΔG° is represented by the difference in free energy between points A and E

5. Point C is lower in free energy than E due to the entropy of mixing products and reactants

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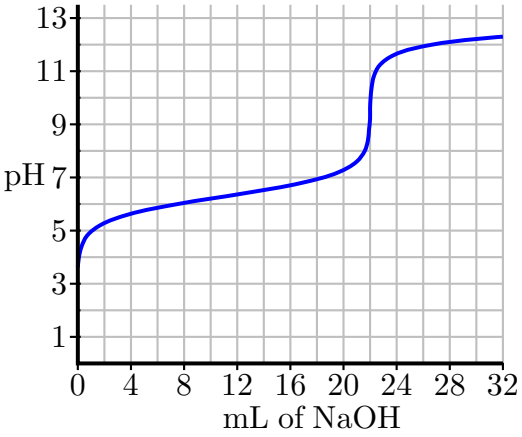
005 (part 1 of 3) 5.0 points

A sample of 30 mL of a weak acid (HA) solution was titrated with 0.075 M NaOH. The pH curve for this titration is shown.



What is the concentration of the original weak acid solution (the 30 mL) ?

1. 0.055 M

2. 0.048 M

3. 0.022 M

4. 0.075 M

5. 0.032 M

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006 (part 2 of 3) 5.0 points

Which of the following is the value of K_a for the weak acid, HA ?

1. 1.2×10^{-7}

2. 5.0×10^{-7}

3. 7.6×10^{-5}

4. 3.2×10^{-10}

5. 1.3×10^{-6}

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007 (part 3 of 3) 5.0 points

Below is a listing of five indicators and their associated pK_a values. Which indicator would be the best one to use for this titration?

1. methyl red, 5.0

2. bromophenol blue, 4.1

3. thymol blue, 9.3

4. alizarin yellow, 10.9

5. phenol red, 7.4

6. bromocresol purple, 6.4

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008 5.0 points

Combining which two solutions will result in an ideal buffer where pH = 8.23?

1. 80 mL 0.2 M HCl and 160 mL 0.2 M NH_2NH_2

2. 160 mL 0.2 M HCl and 160 mL 0.2 M C_5H_5N

3. 80 mL 0.2 M HCl and 160 mL 0.2 M C_5H_5N

4. 80 mL 0.2 M HCl and 80 mL 0.2 M NH_2NH_2

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009 5.0 points

A reaction is at equilibrium and then the entire mixture is compressed to half the original volume. As expected, the pressure initially doubles, but then falls slightly to a lower pressure. Which of the following generic reactions listed is the only one capable of this response?

1. $C(g) + J(s) \rightleftharpoons Y(g)$

2. $A(g) + C(g) \rightleftharpoons 3D(g)$

3. $B(g) \rightleftharpoons Z(g)$

4. $A(g) + B(g) \rightleftharpoons 2C(g)$

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010 5.0 points

What is the correct equilibrium relation for the following reaction beginning with 1.2 atm dicobalt octacarbonyl, $Co_2(CO)_8$?

$$Co_2(CO)_8(g) \rightleftharpoons 2Co(s) + 8CO(g)$$

1. $K = \frac{(2x)^2(8x)^8}{1.2-x}$

2. $K = \frac{1}{1.2-x}$

3. $K = \frac{(8x)^8}{1.2-x}$

4. $K = \frac{8x}{1.2-x}$

5. $K = \frac{-8x}{1.2+x}$

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011 5.0 points

What is the pH of a 0.12 M solution of hydroxylammonium bromide (NH_3OHBr)?

1. 6.04

2. 9.56

3. 4.44

4. 3.33

5. 3.61

6. 3.48

7. 3.72

8. 3.24

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012 5.0 points

Rank the following acids in increasing order of acidity.

HCN NH_3OH^+ HNO_2 HBrO

1. $HCN < HBrO < NH_3OH^+ < HNO_2$

2. $HNO_2 < HBrO < HCN < NH_3OH^+$

3. $HNO_2 < NH_3OH^+ < HBrO < HCN$

4. $NH_3OH^+ < HNO_2 < HBrO < HCN$

5. $NH_3OH^+ < HBrO < HCN < HNO_2$

6. $HCN < NH_3OH^+ < HNO_2 < HBrO$

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013 5.0 points

What is the dominant species in solution at the equivalence point of a weak base-strong acid titration?

1. Strong base

2. Weak base

3. Equal parts weak acid and weak base

4. Neutral salt

5. Strong acid

6. Weak acid

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014 5.0 points

What is the ratio of potassium acetate to acetic acid necessary to make a buffer with a pH equal to 5.12?

1. 0.42

2. 9.86

3. 2.4

4. 2.9

5. 3.1

6. 0.38

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015 5.0 points

What is the pH after 250 mL of 0.25 M

HNO_3 is added to 350 mL of 0.50 M CH_3NH_2 (methylamine) ?

1. 10.64

2. 3.62

3. 3.36

4. 10.38

5. 6.21

6. 2.29

7. 5.05

8. 10.90

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016 5.0 points

A weak acid, HA, ionizes 7.65% at a 0.250 M concentration. What is the hydroxide ion concentration in this solution?

1. 1.91×10^{-16} M

2. 1.31×10^{-13} M

3. 5.23×10^{-13} M

4. 1.00×10^{-14} M

5. 1.91×10^{-2} M

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017 5.0 points

Although difficult to obtain, chlorous acid is a powerful oxidizing agent in its pure form. What is the pH of a 0.15 M $HClO_2$ solution?

1. 1.92

2. 1.43

3. 2.00

4. 0.82

5. 2.02

6. 1.37

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018 (part 1 of 2) 5.0 points

Consider the following reaction for the next two questions:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

Beginning at equilibrium, which of the following will result in a shift toward the right of this reaction?

1. Adding an inert gas at constant pressure

2. Removing CO gas

3. Adding CH_3OH gas

4. Reducing the volume of the container

5. Adding an inert gas at constant volume

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019 (part 2 of 2) 5.0 points

If this reaction is exothermic, lowering the temperature will cause the reaction to...

1. shift right due to a larger K value

2. shift left due to a smaller K value

3. remain at equilibrium

4. shift left due to a smaller Q value

5. shift right due to a decreased Q value

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020 5.0 points

0.834 atm A, 0.565 atm B, and 1.24 atm C are placed into a container to run the following reaction:

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

At equilibrium, 0.435 atm C remains. What is K_p for this reaction?

1. 0.0526

2. 0.107

3. 18.8

4. 8.12

5. 0.0230