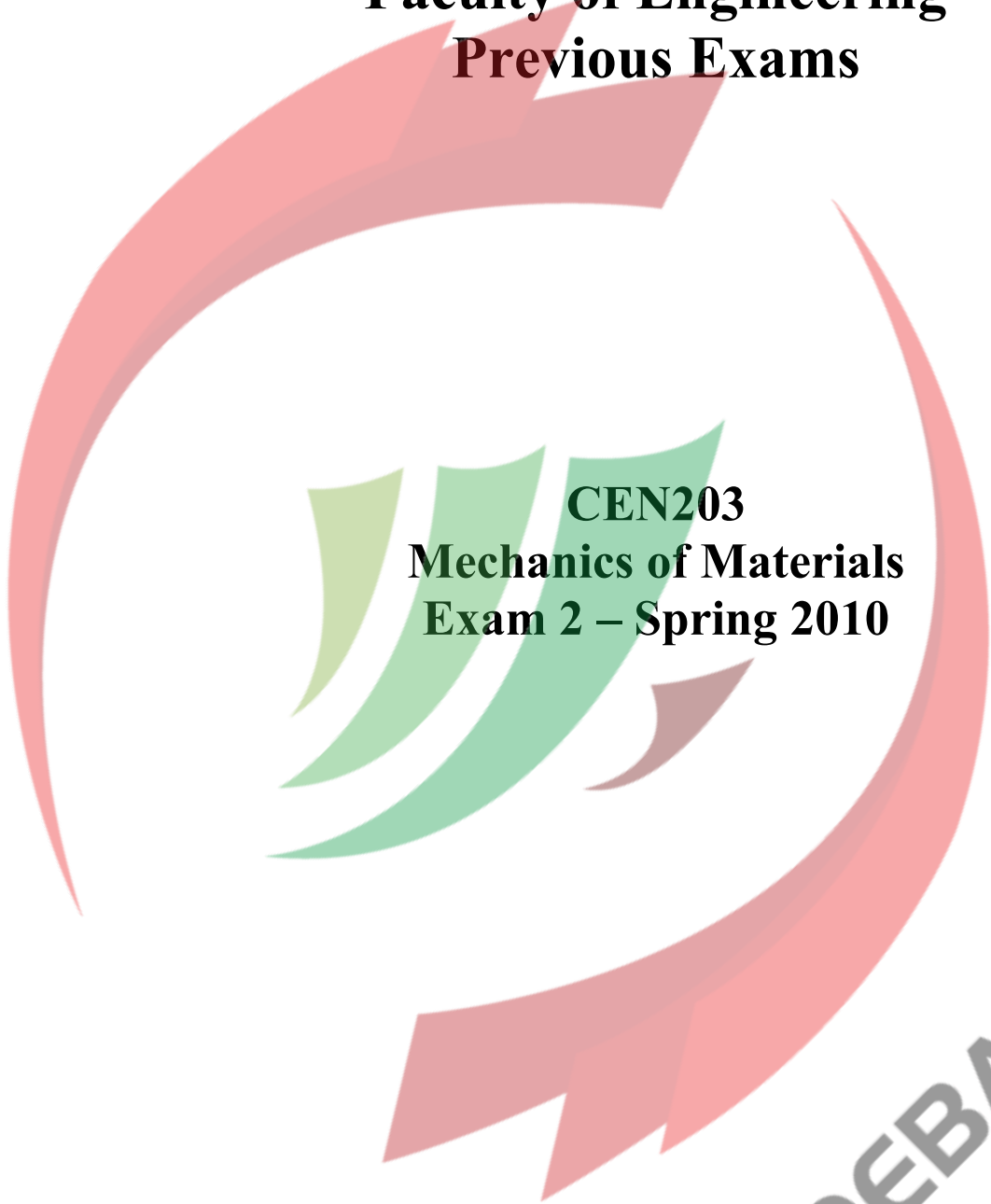


**Notre Dame University
Faculty of Engineering
Previous Exams**



**CEN203
Mechanics of Materials
Exam 2 – Spring 2010**

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THE DEBATE CLUB

1] What is the pH of the solution prepared by mixing 25 mL of 0.024 M HF with 15 mL of 0.15 M NaF? $K_a(\text{HF})=1.5 \times 10^{-4}$

a) 4.39

b) 7.00

c) 7.39

d) 4.03

e) 2.97

2] Determine the pH of 0.15 M benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$) $K_a(\text{benzoic acid})=7 \times 10^{-3}$

a) 2.06

b) 1.49

c) 4.22

d) 7.00

e) 3.11

3] Calculate the pH at the halfway point for the titration of 100 mL of 0.1 M ethylamine ($\text{C}_2\text{H}_5\text{NH}_2$, $K_b=4.2 \times 10^{-4}$) against 0.2 M nitric acid (HNO_3).

a) 7.00

b) 8.8

c) 10.6

d) 11.9

e) 9.7

The Debate Club

4] If 10 mL of 0.2 M NaOH is added to 20 mL of 0.25 M acetic acid ($\text{CH}_3\text{CO}_2\text{H}$, $K_a=1.8 \times 10^{-5}$), what is the pH of the resultant solution?

a) 4.56

b) 5.34

c) 3.22

d) 11.67

e) 6.12

5] For the reaction: $2\text{Cl}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g}) \leftrightarrow 4\text{HCl}(\text{g}) + \text{O}_2(\text{g})$ at 600°C $K_p=18.0$ atm.

A system contains 2.0 atm $\text{Cl}_2(\text{g})$, 2.0 atm $\text{H}_2\text{O}(\text{g})$, 4.0 atm $\text{HCl}(\text{g})$, and 1.0 atm $\text{O}_2(\text{g})$ at 600°C . Which one of the following statements is correct?

a) Net reaction will occur from left to right

b) $K_c = K_p \cdot RT$

c) Net reaction will occur from right to left

d) No net forward or reverse reaction will occur

6] The solubility of magnesium carbonate (MgCO_3) in water at 20°C is 0.0089 mol/l, calculate K_{sp} for the salt.

a) 4.1×10^{-4}

b) 5.6×10^{-6}

c) 7.9×10^{-5}

d) 2.9×10^{-6}

e) 7.8×10^{-9}

The Debate Club

7] What mass of NH_4Cl (MM= 53.5 g/mol) must be added to 0.5 L of 0.45 M NH_3 to prepare a buffer solution with pH of 10.55? Assume no variation of volume, $K_b(\text{NH}_3)=1.4 \times 10^{-4}$

- a) 9.4 g
- b) 4.7 g**
- c) 3.5 g
- d) 7.6 g
- e) 6.2 g

8] Imagine that the temperature is decreased for the following equilibrium



What effect would be expected?

- a) No shift in the equilibrium occurs
- b) The equilibrium shifts to the right
- c) The equilibrium shifts to the left**
- d) No enough information to answer

9] In a titration, 20 mL of HCl requires 32 mL of 0.5 M $\text{Mg}(\text{OH})_2$ for complete neutralization. Calculate the molar concentration of acid.

- a) 0.64 M
- b) 1.6 M**
- c) 1.92 M
- d) 3.20 M
- e) 1.60 M

10] Predict whether an aqueous solution of NH_4F is

$K_a(\text{HF})=3.5 \times 10^{-4}$, $K_b(\text{NH}_3)=1.8 \times 10^{-5}$

- a) **acidic**
- b) basic
- c) neutral
- d) no enough information to answer

11] $K_p=3.1 \times 10^{-8}$ for $2\text{H}_2\text{S}(\text{g}) \leftrightarrow 2\text{H}_2(\text{g}) + \text{S}_2(\text{g})$, what is the equilibrium partial pressure of S_2 if H_2S , initially at 0.5 atm and H_2 , initially at 0.01 atm, are allowed to come to equilibrium?

- a) 8.8×10^{-3}
- b) 1.3×10^{-3}
- c) **7.75×10^{-5}**
- d) 3.1×10^{-6}
- e) 2.85×10^{-4}

12] Consider the reaction : $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \leftrightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$

Which of the following causes the equilibrium shown to shift to reverse (left) direction?

- a) **removal of CH_4**
- b) removal H_2O
- c) addition of CH_4
- d) decreasing the volume of the container
- e) none of these

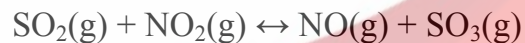
13] The percent dissociation is 4.45% in a 1 M solution of ethylamine ($\text{CH}_3\text{CH}_2\text{NH}_2$), calculate K_b ?

- a) 7.4×10^{-4}
- b) 6.3×10^{-5}
- c) 2.1×10^{-3}**
- d) 3.6×10^{-6}
- e) 5.7×10^{-4}

14] What is the solubility of BaF_2 in 0.15 M NaF. $K_{sp}(\text{BaF}_2) = 1.7 \times 10^{-6}$

- a) 1.7×10^{-6}
- b) 2.7×10^{-5}
- c) 6.8×10^{-6}
- d) 1.3×10^{-3}
- e) 7.56×10^{-5}**

15] A reaction mixture was prepared by mixing 0.2 mol SO_2 , 0.2 mol NO_2 , 0.15 mol NO and 0.15 mol SO_3 in a 5 litre reaction vessel. At 260°C , $K_p = 0.25$ for



What is the equilibrium concentration of SO_2 ?

- a) $[\text{SO}_2] = 0.0466$**
- b) $[\text{SO}_2] = 0.0366$
- c) $[\text{SO}_2] = 0.233$
- d) $[\text{SO}_2] = 0.175$
- e) $[\text{SO}_2] = 0.2$

Bonus:

Which equation correctly describes the relationship between K_p and K_c for the following reaction?



- a) $K_p = K_c$
- b) $K_p = K_c * (RT)^{-3}$**
- c) $K_p = K_c * (RT)^{-5}$
- d) $K_p = K_c * (RT)^3$
- e) $K_p = K_c * (RT)^5$

The Debate Club