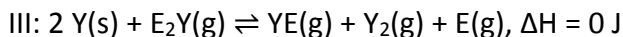
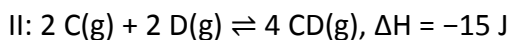
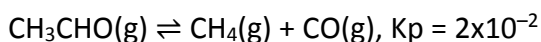


1) For which of the following reactions does $K_c = K_p$ at 25°C ?



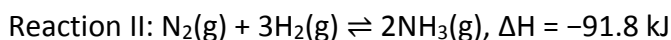
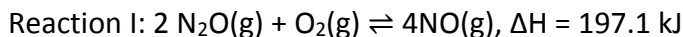
- A) I only
- B) II only
- C) III only
- D) I and II only
- E) II and III only

2) The decomposition of acetaldehyde is shown by the reaction below. After twelve minutes, the partial pressures are the following: $P_{\text{CH}_3\text{CHO}} = 3.4 \text{ atm}$, $P_{\text{CH}_4} = 0.1 \text{ atm}$, $P_{\text{CO}} = 0.2 \text{ atm}$, what must be true for the reaction to reach equilibrium?



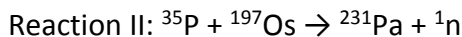
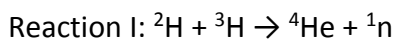
- A) $Q < K$ and shifts forwards
- B) $Q < K$ and shifts backwards
- C) $Q > K$ and shifts forwards
- D) $Q > K$ and shifts backwards

3) When are the following reactions spontaneous? Answer in order.



- A) At high temperatures; At high temperatures
- B) At low temperatures; At low temperatures
- C) At high temperatures; At low temperatures
- D) At low temperatures; At high temperatures
- E) At high temperatures; At all temperatures

4) Which of the following reactions produce energy and how much energy is produced?

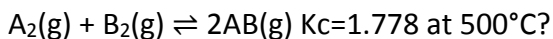


Masses (amu): ${}^1_0\text{n}$ (1.0087); ${}^2\text{H}$ (2.0141); ${}^3\text{H}$ (3.0160); ${}^4\text{He}$ (4.0026); ${}^{35}\text{P}$ (34.9733); ${}^{90}\text{Sr}$ (89.9077); ${}^{142}\text{Xe}$ (141.9297); ${}^{197}\text{Os}$ (196.9684); ${}^{231}\text{Pa}$ (231.0358); ${}^{235}\text{U}$ (235.0439)

- A) Reaction I: $1.7 \times 10^{12} \text{ J}$
- B) Reaction II: $9.3 \times 10^{12} \text{ J}$
- C) Reaction I: $1.7 \times 10^{15} \text{ J}$

- D) Reaction II: 9.3×10^{15} J
 E) Neither reaction produces energy

5) What is the percent yield of AB for the following reaction at equilibrium if 1.00 mole of each reactant was placed in a 2L flask and heated to 500°C?



- A) 86%
 B) 39%
 C) 60%
 D) 27%
 E) 40%

Use the following information to answer question 6:



- 6) Select the **false** statement below.
- A) The H-A bond length in H_2A is likely longer than the H-B bond length in H_2B
 B) The H-A bond length in HAO_2 is likely longer than the H-B bond length in HBO_2
 C) The electronegativity of A is likely greater than the electronegativity of B
 D) The k_a of HAO_3 is greater than the k_a of HAO_2 , and this is likely related to the greater oxidation state of A in HAO_3
 E) HA^- can act as a Bronsted-Lowry acid or a Bronsted-Lowry base, but it is stronger as an acid
- 7) Predict whether the following solutions will be acidic, basic, or neutral.
 The k_a of ammonium is 5.6×10^{-10} and the k_a of nitrous acid is 7.2×10^{-4}
 KNO_2 KNO_3 NH_4NO_3 NH_4NO_2
- A) Acidic, basic, neutral, basic
 B) Basic, acidic, neutral, acidic
 C) Basic, neutral, acidic, acidic
 D) Acidic, neutral, basic, neutral
 E) Neutral, acidic, acidic, acidic
- 8) Predict the pH of a saturated solution of $Ca(OH)_2$ at 25°C. $k_{sp} = 7.9 \times 10^{-6}$
- A) 7.22
 B) 12.40

- C) 1.59
- D) 6.78
- E) 10.30

9) You wish to make a formate/formic acid buffer solution with a pH of 3.50 by dissolving 20.0g of solid sodium formate into 2.00L of a formic acid solution. Which of the following is closest to the concentration of formic acid required to make this happen? Assume no significant volume change during dissolution. K_a of formic acid is 1.80×10^{-4}

- A) 0.039 M
- B) 0.085 M
- C) 0.13 M
- D) 0.26 M
- E) 0.51 M

10) A current of 11.3 A is applied to 1.25 L of a solution of 0.552 M HBr converting some of the H^+ to $H_2(g)$, which bubbles out of solution. What is the pH of the solution after 73 minutes?

- A) 0.161
- B) 0.258
- C) 0.387
- D) 0.669
- E) 0.849

11) Which of the following statements is true about an electrolytic cell?

- A) electrons flow toward the anode
- B) a nonspontaneous reaction is forced to occur
- C) an electric current is produced by a chemical reaction
- D) oxidation occurs at the cathode
- E) none of the above

12) Which of the following nuclides would be predicted to go through positron emission/e⁻ capture?

I: ^{67}Zn

II: ^{115}Sn

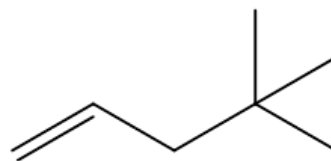
III: ^{184}W

IV: ^{229}Th

- A) Only I
- B) Only II
- C) I and III
- D) II and IV
- E) I, II, and III

13) What is the name of the molecule on the right?

- A) 1,1,1-trimethyl-3-propene
- B) 1,1,1-trimethyl-3-butene
- C) 2,2-dimethyl-4-butane
- D) 3,3-dimethyl-1-butene
- E) 2,2-dimethyl-4-pentene
- F) 4,4-dimethyl-1-pentene



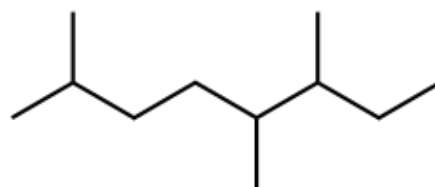
14) How many of the following is/are named correctly?



1-methyl-2-bromocyclohexane



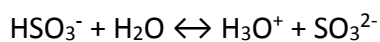
1,1,2-trimethylpentane



3,4,7-trimethyloctane

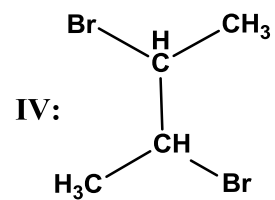
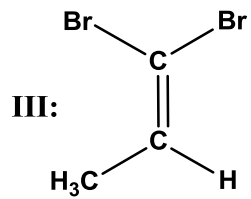
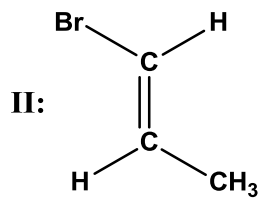
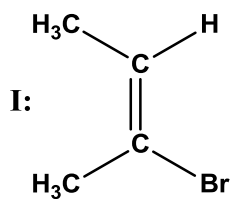
- A) Zero B) One C) Two D) Three

15) Given the following reaction, which of the following is true:



- A) The desired buffer pH should be ± 1 pH unit from the pH of H_2SO_3
- B) Incoming strong acid like HCl will be consumed by reacting with SO_3^{2-}
- C) One possible way to prepare this buffer would be a calculated mixture of SO_3^{2-} and NaOH
- D) One possible way to prepare this buffer would be a calculated mixture of HSO_3^- and HCl
- E) The optimal buffer will exhibit a ratio of $[\text{A}^{2-}/\text{HA}^-]$ either greater than 10 or less than 0.10

16) Which of the following can exhibit cis-trans isomerism?



- A) Only I
- B) Only IV
- C) I and II
- D) III and IV
- E) II and III