

2010 AP[®] CHEMISTRY FREE-RESPONSE QUESTIONS (Form B)

CHEMISTRY

Section II

(Total time—95 minutes)

Part A

Time—55 minutes

YOU MAY USE YOUR CALCULATOR FOR PART A.

CLEARLY SHOW THE METHOD USED AND THE STEPS INVOLVED IN ARRIVING AT YOUR ANSWERS. It is to your advantage to do this, since you may obtain partial credit if you do and you will receive little or no credit if you do not. Attention should be paid to significant figures.

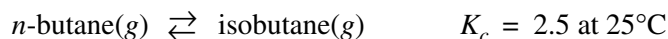
Be sure to write all your answers to the questions on the lined pages following each question in the goldenrod booklet. Do NOT write your answers on the lavender insert.

Answer Questions 1, 2, and 3. The Section II score weighting for each question is 20 percent.

1. The compound butane, C_4H_{10} , occurs in two isomeric forms, *n*-butane and isobutane (2-methyl propane). Both compounds exist as gases at 25°C and 1.0 atm.

- (a) Draw the structural formula of each of the isomers (include all atoms). Clearly label each structure.
- (b) On the basis of molecular structure, identify the isomer that has the higher boiling point. Justify your answer.

The two isomers exist in equilibrium as represented by the equation below.



Suppose that a 0.010 mol sample of pure *n*-butane is placed in an evacuated 1.0 L rigid container at 25°C.

- (c) Write the expression for the equilibrium constant, K_c , for the reaction.
- (d) Calculate the initial pressure in the container when the *n*-butane is first introduced (before the reaction starts).
- (e) The *n*-butane reacts until equilibrium has been established at 25°C.
 - (i) Calculate the total pressure in the container at equilibrium. Justify your answer.
 - (ii) Calculate the molar concentration of each species at equilibrium.
 - (iii) If the volume of the system is reduced to half of its original volume, what will be the new concentration of *n*-butane after equilibrium has been reestablished at 25°C? Justify your answer.

Suppose that in another experiment a 0.010 mol sample of pure isobutane is placed in an evacuated 1.0 L rigid container and allowed to come to equilibrium at 25°C.

- (f) Calculate the molar concentration of each species after equilibrium has been established.