Assigned questions for Lecture 17 are listed below. The questions occur in the following editions of "Physical Chemistry" by P.W. Atkins:

10th edition	9th edition	8th edition

Note: The letter "P" in front of a number indicates that the question is in the "Problem" category as opposed to the "Exercise" category in Atkins' books. Updates are highlighted in yellow.

Question 17.01

5B.4	5.7	5.7

Same in all editions
5B.4(a) The osmotic pressure of an aqueous solution at 300 K is 120 kPa. Calculate the freezing point of the solution.
5B.4(b) The osmotic pressure of an aqueous solution at 288 K is 99.0 kPa. Calculate the freezing point of the solution.

Question 17.02

5A.4	5.8	5.8

Same in all editions
5A.4(a) Consider a container of volume 5.0 dm³ that is divided into two compartments of equal size. In the left compartment there is nitrogen at 1.0 atm and 25 °C; in the right compartment there is hydrogen at the same temperature and pressure. Calculate the entropy and Gibbs energy of mixing when the partition is removed. Assume that the gases are perfect.
5A.4(b) Consider a container of volume 250 cm³ that is divided into two compartments of equal size. In the left compartment there is argon at 100 kPa and 0 °C; in the right compartment there is neon at the same temperature and pressure. Calculate the entropy and Gibbs energy of mixing when the partition is removed. Assume that the gases are perfect.

Question 17.03

5A.5 and 5B.5	5.9	5.9

Same questions, but different numbers in 10th vs. earlier editions.
5.9(a) Air is a mixture with a composition given in *Example 1.3*. Calculate the entropy of mixing when it is prepared from the pure (and perfect) gases (you can also try the composition described by Self-Test 1.4 in Ch. 1, which corresponds to the compositions given in 5A.5(b) below).
5.9(b) Calculate the Gibbs energy, entropy, and enthalpy of mixing when 1.00 mol C_6H_{14} (hexane) is mixed with 1.00 mol C_7H_{16} (heptane) at 298 K; treat the solution as ideal.

5A.5(a) Air is a mixture with mass percentage composition 75.5 (N_2), 23.2 (O_2), 1.3 (Ar). Calculate the entropy of mixing when it is prepared from the pure (and perfect) gases.
5A.5(b) (corresponds to self test mentioned in 5.9(a) above) When carbon dioxide is taken into account, the mass percentage composition of air is 75.52 (N_2), 23.15 (O_2), 1.28 (Ar), and 0.046 (CO_2). What is the change in entropy from the value in the preceding exercise?

5B.5(b) Calculate the Gibbs energy, entropy, and enthalpy of mixing when 1.00 mol C_6H_{14} (hexane) is mixed with 1.00 mol C_7H_{16} (heptane) at 298 K; treat the solution as ideal.

Question 17.04

5B.6	5.10	5.10

Same questions in all editions.

5B.6(a) What proportions of hexane and heptane should be mixed (i) by mole fraction, (ii) by mass in order to achieve the greatest entropy of mixing?
5B.6(b) What proportions of benzene and ethylbenzene should be mixed (i) by mole fraction, (ii) by mass in order to achieve the greatest entropy of mixing?

Question 17.05

5A.11	5.11	5.11

Same questions, different references back to previous questions.

5A.11(a) Use Henry's law and the data in Table 5A.1(10th)/Table 5.1(9th, 8th) to calculate the solubility (as a molality) of CO_2 in water at 25 °C when its partial pressure is (i) 0.10 atm, (ii) 1.00 atm.
5A.11(b) The mole fractions of N_2 and O_2 in air at sea level are approximately 0.78 and 0.21. Calculate the molalities of the solution formed in an open flask of water at 25 °C.

Question 17.06

5A.12	5.12	5.12

Same in all editions.

5A.12(a) A water carbonating plant is available for use in the home and operates by providing carbon dioxide at 5.0 atm. Estimate the molar concentration of the soda water it produces.
5A.12(b) After some weeks of use, the pressure in the water carbonating plant mentioned in the previous exercise has fallen to 2.0 atm. Estimate the molar concentration of the soda water it produces at this stage.

Question 17.07*

n/a	n/a	n/a

Missing from 8th edition onward.

(7.17a, 7th edition) Calculate the freezing point of a glass of water of volume 250 cm³ sweetened with 7.5 g of sucrose (hint - look up the ebullioscopic constant in your book or on web).
(7.17b, 7th edition) Calculate the freezing point of a glass of water of volume 200 mL in which 10 g of fructose has been dissolved.

Question 17.08

5B.8	5.14	5.14

Same questions in all editions.

5B.8(a) The osmotic pressure of solutions of polystyrene in toluene were measured at 25 °C and the pressure was expressed in terms of the height of the solvent of density 1.004 g cm^{-3}:

$c/(g\,dm^{-3})$	2.042	6.613	9.521	12.602
h/cm	0.592	1.910	2.750	3.600

Calculate the molar mass of the polymer.

5B.8(b) The molar mass of an enzyme was determined by dissolving it in water, measuring the osmotic pressure at 20 °C, and extrapolating the data to zero concentration. The following data were obtained:

$c/(mg\,cm^{-3})$	3.221	4.618	5.112	6.722
h/cm	5.746	8.238	9.119	11.990

Calculate the molar mass of the enzyme.

Answers
(7.17a, 7th edition) ΔT = -0.16 °C
(7.17b, 7th edition) ΔT = -0.52 °C

A-list answers for the 9th edition:
5.7   -0.09 °C
5.8 $\Delta_{mix}G$ = -0.35 kJ; $\Delta_{mix}S$ = = +1.2 J K^{-1}
5.9   +4.7 J K^{-1} mol^{-1}
5.10   (a) 1; (b) 0.8600
5.11   (a) b = 3.4 mmol kg^{-1}; (b) b = 34 mmol kg^{-1};
5.12   0.17 mol kg^{-1}
5.14   slope = 0.29 cm/(g L^{-1}); M = 87 kg mol^{-1}

Answer 17.07*

n/a	n/a	n/a

Missing from 8th edition onward.

E7.17(a) $\Delta T = K_f b_B$ [7.37]; $K_f = 1.86 \, \text{K kg mol}^{-1}$ [Table 7.2]

$$\Delta T = (1.86 \, \text{K kg mol}^{-1}) \times \frac{\left(\frac{7.5 \, \text{g}}{342.3 \, \text{g mol}^{-1}}\right)}{0.25 \, \text{kg}} = 0.16 \, \text{K}$$

Hence, the freezing point will be approximately $\boxed{-0.16^{\circ}\text{C}}$.

E7.17(b) $M(\text{glucose}) = 180.16 \, \text{g mol}^{-1}$

$\Delta T = K_f b_B$ $K_f = 1.86 \, \text{K kg mol}^{-1}$

$$\Delta T = (1.86 \, \text{K kg mol}^{-1}) \times \left(\frac{10 \, \text{g}/180.16 \, \text{g mol}^{-1}}{0.200 \, \text{kg}}\right) = 0.52 \, \text{K}$$

Freezing point will be $0^{\circ}\text{C} - 0.52^{\circ}\text{C} = -0.52^{\circ}\text{C}$