PART THREE: Chemistry, Nutmeg Oil Distillation [14.0 points]

After conducting experiment by using 120 g of ground nutmeg seed, you have obtained certain amount of nutmeg oil.			
Question	How much is the volume of nutmeg oil you have obtained?	**Points**	**Max**
Ch-1	Sample collected by students is free of water	2.00	4.50
	Volume of Nutmeg Oil (mL):		
	> 4.00	2.50	
	2.50 – 3.99	2.00	
	1.00 – 2.49	1.50	
	0.00 – 0.99	0.50	
	If wrong fraction (only water) is collected	0.00	
Question	It is known that the mass of exactly 1.00 mL of nutmeg oil is 0.862 g at 25 °C. What is the percentage by mass of nutmeg oil in nutmeg seed according to your experiment if it is measured at 25 °C?	**Points**	**Max**
Ch-2	Mass of nutmeg oil = volume (mL) x density (g/mL) =..... mL x 0.862 (g/mL) = ... g	0.75	1.50
	Percentage of nutmeg oil in nutmeg seed: = {mass of nutmeg oil (~~g~~)/mass of nutmeg seed (~~g~~)} x 100 % = ... %	0.75	
Question	It is known that the main component of nutmeg oil is myristicin. Assume that your sample of nutmeg oil contains 65% of myristicin ($C_{11}H_{12}O_3$) by mass. **(a) [1.5 point]** Calculate the number of myristicin molecules in your sample. **(b) [1.5 point]** Calculate the mass of the carbon in grams in the myristicin in your sample. (atomic mass of C = 12, H = 1, and O = 16)	**Points**	**Max**
Ch-3	Molecular mass of myristicin = (12 x 11) + (1 x 12) + (16 x 3) = 192	0.50	3.00
	Mass of myristicin in nutmeg oil: = volume of nutmeg oil (~~ml~~) x density (g/~~ml~~) x 0.65 **= ..... x 0.862 x 0.65 g**	0.50	
	Number of moles of myristicin: = (gram of myristicin)/192 = ... moles	0.50	
	Number of molecules of myristicin: = number of mole of myristicin × Avogadro number = number of mole of myristicin × 6.02×10^{23} molecule = ... $\times 10^{23}$ molecules	0.50	

	Mass of carbon in the myristicin of your nutmeg oil: = 132/192 x gram of myristicin = ... grams	1.00	
Question	Based on the result of your experiment, calculate how many kilograms of nutmeg seed powder are required to produce 100 grams of nutmeg oil?	**Points**	**Max**
Ch-4	Assume that the percentage of nutmeg oil in nutmeg seed obtained from question Ch-3 = a % The mass of nutmeg seed powder required to produce 100 grams (0.1 kg) of nutmeg oil: = (0.1 x 100)/a kg = ...kg	1.00	1.00
Question	What is the function of boiling stones added in your experiment? (a) to accelerate the heating of water (b) to speed up the separation of nutmeg oil from water (c) to assist the distribution of heat inside the cylindrical flask content.	**Points**	**Max**
Ch-5	Answer: (c) to assist the distribution of heat inside the cylindrical flask content.	0.50	0.50
Question	What is the main aim of using nutmeg seed powder rather than nutmeg seed granules in your experiment? (a) to increase the solubility of nutmeg seed in water (b) to increase the contact surface of nutmeg seed and water (c) to speed up the evaporation of water in the flask.	**Points**	**Max**
Ch-6	Answer: (b) to increase the contact surface of nutmeg seed and water	0.50	0.50
Question	The separation of water and nutmeg oil in the Dean-Stark apparatus reflects the principle of ..... (a) like dissolves like (b) vapor pressure difference (c) chemical equilibrium.	**Points**	**Max**
Ch-7	Answer: (a) like dissolves like	0.75	0.75
Question	If the flow of cooling water in your experiment is changed from upper to lower part of the condensor, the condensation of the steam and nutmeg oil will be ..... (a) more effective (b) less effective (c) no effect.	**Points**	**Max**
Ch-8	Answer (b) less effective	0.75	0.75

Question	Which of these following alternative separation techniques can be used to obtain nutmeg oil from the seed of nutmeg (a) Centrifugation (b) Solvent extraction (c) Paper chromatography	**Points**	**Max**
Ch-9	Answer: (b) Solvent extraction	0.75	0.75
Question	What kind of changes in the experimental design would not reduce the yield of nutmeg oil (a) Heating too rapidly (b) Using more boiling stones (c) Using too short water condensor	**Points**	**Max**
Ch-10	Answer: (b) Using more boiling stones	0.75	0.75

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