1. Which of the following solutions is NOT likely to cause the protein to unfold if added to an aqueous solution of the protein? (2 points)
   (a) H₂SO₄ (sulfuric acid)  (d) a sucrose (sugar) solution
   (b) KOH (potassium hydroxide)  (e) a highly polar liquid
   (c) a soap solution

2. Adding acid or a base to an aqueous solution of the protein in Expt. 1 caused the protein to unfold (denature). The most likely reason that this occurs is (2 points)
   (a) the higher acidity in an acid solution causes the protein to coil up more tightly to prevent protons from entering into the protein chain
   (b) the acid and base cause the different groups on the surface of the protein to rearrange
   (c) the acid or base cause charges on some groups (due to protonation or proton removal) and so change the interactions between different parts of the molecule
   (d) the acid or base react with the protein and cause it to decompose into its constituent amino acid groups

3. Explain, briefly, what a colloid is. (3 points)

4. Acetone causes the protein used in Experiment 1 to denature when added to the aqueous protein solution by formation of hydrogen bonds with the water. The Lewis structure of acetone is shown to the right. Show on this diagram how water and acetone interact to form hydrogen bonds. (2 points)

5. Define what is meant by “the vapor pressure of a pure liquid”. (3 points)

6. (a) Would you expect that the vapor pressure to INCREASE or DECREASE as the temperature increases? (Circle the correct answer). (1 point)
   (b) If the atmospheric pressure is 760 mm Hg, what will be the vapor pressure (in mm Hg) of ethanol at its boiling point (78.5°C)? (1 point)
   (a) 78.5  (b) 100  (c) 380  (d) 760 (e) 1520

   The vapor pressure of any liquid at its boiling point will always equal the external (atmospheric) pressure, in this case 760 mm Hg.
7. The graph below shows a plot of $\ln P$ against $1/T$ (K$^{-1}$) for acetone, where $P$ is the vapor pressure (in mm Hg) and $T$ is the temperature. Calculate the enthalpy of vaporization ($\Delta H_{\text{vap}}$) (in kJ mol$^{-1}$) for acetone (show your workings clearly otherwise you will lose points). Gas constant value, $R = 8.314$ J mol$^{-1}$ K$^{-1}$. Be careful with the units and significant figures! (6 points)

\[
\text{Plot of } \ln P \text{ against } (1/T) \text{ for acetone}
\]

Since $\ln P = -\frac{\Delta H_{\text{vap}}}{RT} + \text{const.}$, a plot of $\ln P$ vs. $\frac{1}{T}$ will have a slope given by $-\frac{\Delta H_{\text{vap}}}{R}$. So we need to calculate the slope.

\[
\text{Slope} = -\frac{3750 K}{R} = -\frac{\Delta H_{\text{vap}}}{R}
\]

Rearrange to: $\text{Slope} \times R = -\Delta H_{\text{vap}}$

$-3750 K \times R = -\Delta H_{\text{vap}}$

$\Delta H_{\text{vap}} = 31.975 \text{ kJ mol}^{-1}$. So $\Delta H_{\text{vap}} = 31.975 \text{ kJ mol}^{-1}$

Our answer needs to be in kJ/mol & we need to address the sig figs.

\[
\Delta H_{\text{vap}} = +31 \times 10^2 \text{ J mol}^{-1} = 31 \text{ kJ mol}^{-1}
\]