Assignment #2 Physics 346

Due 4:30 pm **Friday** January 22, 2010

Use Phys 346 drop box located at entrance to Physics Dept. off main floor of AQ.

1. Hubbert's model for oil production is a differential equation with the form

$$\frac{dQ}{dt} = kQ(1 - \frac{Q}{Q_\infty}) \tag{1}$$

   Verify that the following function is a solution of this differential equation by differentiation and substitution.

$$Q = \frac{Q_\infty}{1 + e^{k(t_m - t)}} \tag{2}$$

2. In the homework folder you will find a spreadsheet containing oil production data for Denmark. Similar to the analysis described in class, from this data, plot dQ/dt vs. year, $Q(t)$vs. year and $1/Q(dQ/dt)$ vs. $Q(t)$ for Denmark oil using excel or a graphing program. Display the data using markers (not lines). From the last of these three curves, obtain an estimate for the constants k and Q_∞. Then use these two values to plot modelled values of dQ/dt and Q vs. year as we did in class. You will have to adjust the value of t_m to get a "good" fit. Plot your modelled values using lines (not markers) on the same graph as the data (see lecture notes).

3. Calculate the heat required to fully vapourize 10kg of water at an initial temperature of 60°C (liquid) and ending at a final temperature of 120°C (vapour). Useful data are given in your lecture notes or text.

4. A typical coal fired steam turbine operates with steam at 500°C. If heat is rejected at 100°C, what is the maximum possible conversion efficiency (work out/ heat in)? If the steam temperature is increased to 700°C, how does this value change?

5. Question #9 from chapter 4 of your text.