ChE 263

Assignment #18 (Mathcad® HW #1)

Note: This homework assignment is to be done using Mathcad®. Try each problem alone for at least 5 min before working in a group or asking for help. If you need help initially you could consider MathCad Help or the in-class demonstration files on the course web-site.

1. **(Competency 5.3, 10 points)** Write the following text at the top of your Mathcad page. "Assignment #8, Mathcad HW #1"

2. **(Competency 5.3, 30 points)** Evaluate the following expressions.
   a. $\left(x^{0.5} + \frac{1}{x}\right)^{-2}$ when x = 4. Define what x equals before you enter the expression.
   b. $\sqrt[3]{\frac{4}{3}\pi r^3} - e^x$ when r = 10 and x = 3.54. Define what x and r equal to before you enter the expression. Use x and r in the equation as shown. Note that e is a predefined constant equal to the exponential or exp (i.e. 2.718….)

3. **(Competency 5.3, 10 points)** Evaluate the following expression. Where c is the speed of light, g is the gravitational constant, and π is 3.14…….
   $$c * g/\pi$$

4. **(Competency 5.3, 20 points)** Symbolically **simplify** the following expression two different ways. The first time, I do not want a number but an equation which includes x, the second time simplify the equation with x = 1.
   a. $\frac{x}{x+4} - \frac{12}{x+2}$

5. **(Competency 5.3, 10 points)** Symbolically **expand** the following expression. I do not want a number but an equation which includes x.
   a. $(x+1)^7$

6. **(Competency 5.3, 10 points)** Symbolically **factor** the following expression. I do not want a number but an equation which includes x.
   a. $x^5 + 10x^4 + 35x^3 + 50x^2 + 24x$

7. **(5pts)** Align the two equations above with the  button.

8. **(Competency 3.1.1, 5.3; 15 points)** Do the following unit conversions.
   a. Convert the speed of light, 2.998 x 10^8 m/sec, to miles per hour.
   b. Convert the density of water at room temperature, 62.4 lb_m/ft^3, to kg/m^3.
   c. Convert the ideal gas constant, Rg = 0.08206 L atm/(mole K), to Joules/(mole K).
   d. Convert the idea gas constant, Rg, to BTU/(lbmol Rankine). *Hint:* lbmol := 1 lb/gm mol
   e. Convert 300 cubits to yards.

9. **(Competency 3.1.1, 5.3; 15 points)** The volume of a cylinder is given by
   $$V_{cyl} = \pi R^2 L$$
   Define a new volume unit bbl = 42 US gallons. Find the volume in bbl (barrels), of a cylindrical tank, with R = 25 feet and L = 5 meters

10. **(Competency 3.1.1, 5.3, 6.1; 50 points)** The rate of heat transfer from a heated flat plate with a cool fluid stream flowing across it is given by:

$$Nu = 0.332 \sqrt[3]{\mathrm{Pr}}\sqrt{\mathrm{Re}}$$

where Nu=hL/k is the dimensionless Nusselt Number, Pr = $\mu c_p/k$ is the dimensionless Prandtl number, and Re = $vL\rho/\mu$ is the dimensionless Reynold's number. In these equations: h is the heat transfer coefficient, L is the plate length, k is the fluid thermal conductivity, μ is the fluid viscosity, and c_p is the fluid heat capacity. **The <u>heat transfer rate</u>, q, is given by q = h ΔT.**

What is the heat transfer rate, in units of cal/cm^{2}min, from a flat plate 1 meter long and temperature 80^o C, if a stream of water passes over it at a velocity, of 1.45 meters per second? The temperature of the water is 70 ^{o}F. Water properties are: μ = 0.979 centipoise, ρ = 62.3 lb/ft^3, k = 0.347 BTU/(hr*ft*^{o}F), and c_p = 0.998 BTU/(lb*^{o}F).

Hint: ΔT is the difference in temperature from the flat plate and the water. Whether it is negative or positive depends on which direction you define as positive. For this problem it can be negative or positive. Remember how to convert from ^{o}F to R and ^{o}C to K. Also switch in R for ^{o}F when it is on the denominator (look up the direct switch of R for ^{o}F in the Cp equation found in lesson demo solution notes on blackboard). Also centipoise is 1/100 of poise.

Upload the completed assignment to LearningSuite.