Name_____

Homework Assignment #3 due in class Wednesday, September 20

Cover sheet : Staple this page in front of your solutions.

INSTRUCTIONS : Write the requested *answers* (without calculations) on this page;
write the detailed *solutions* (your work written clearly; no scratch paper) on your own paper.

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[11] Problem 2.2.* *Answer: the value of β is*

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[12] Problem 2.3.* *Answer: the Reynolds number (part b) is*

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[13] Problem 2.10.** *Answer: the terminal speed is*

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[14] Problem 2.18.* *Answer: the Taylor series for $\ln(1+\delta)$ is*

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[15] Problem 2.26.* *Answer: the time to slow to 15 m/s is*

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[16] The terminal velocity of a drop of water (diameter = D, mass = m) is the velocity such that $F = mg - bv - cv^2 = 0$. The parameter values for air at STP are

$b = (1.6 \times 10^{-4}\ Ns/m^2)\ D$ and $c = (0.25\ Ns^2/m^4)\ D^2$;

also, $m = (0.52 \times 10^3\ kg/m^3)\ D^3$.

Determine v_{ter} as a function of D. Plot an accurate graph of v_{ter} versus D, from D = 0.1 mm to 3 mm. (Use a computer to make the plot.) The result shows why water droplets in a cloud do not fall as rain. Hand in the plot.

Answer here: Explain why water droplets in a cloud do not fall as rain.

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[17] Consider these equations for a baseball fly ball near the surface of the Earth:

$m\,x'' = -c\,(v_x^2 + v_y^2)\cos\theta$; $m\,y'' = -mg - c\,(v_x^2+v_y^2)\sin\theta$; $\tan\theta = v_y/v_x$.

[Initial values: $(x_0,y_0) = (1,0)$ m and $(v_{0x},v_{0y}) = (30,30)$ m/s ; terminal speed = 40 m/s.]

Hand in an accurate plot of the trajectory, i.e., y versus x. (Use a computer.)