Math 156 Applied Honors Calculus II Fall 2009

hw5 , due: Tuesday, October 13

section 8.8 (improper integrals) page 575 / 71 , 78

note: the Laplace transform in 575/71 is used in solving differential equations (Math 256)

chapter 8 (problems plus) page 580 / 1

note: in 580/1, once you find the formula, solve it using a calculator or Maple

1. Find the antiderivatives below using the suggested method. Note that we derived these antiderivatives in class using different methods. Check and make sure your answer is equivalent to the one we obtained in class.

(a) $\int \sec\theta \, d\theta$, write it as $\int \sec\theta \, \frac{\sec\theta+\tan\theta}{\sec\theta+\tan\theta} \, d\theta$ and substitute $u = \sec\theta + \tan\theta$

(b) $\int \frac{du}{1-u^2}$, write it as $\int \frac{1-u+u}{1-u^2} \, du = \int \frac{1-u}{1-u^2} \, du + \int \frac{u}{1-u^2} \, du = \int \frac{du}{1+u} + \int \frac{u \, du}{1-u^2}$ and then integrate each piece

2. Van der Waal's equation of state gives the pressure P of a gas in terms of its volume V and temperature T as $P = \frac{RT}{V-b} - \frac{a}{V^2}$, where R, a, b are positive constants depending on the chemical composition of the gas molecules. In an isothermal change of state, T is constant and the work done in compressing the gas from volume V_1 to volume V_2 is given by $W = \int_{V_1}^{V_2} P \, dV$. Find W.

3. Consider a sector of a circle of radius r and angle θ, as shown in the figure. Let L be the arclength of the curved edge of the sector and let A be the area of the sector. Derive the formulas $L = r\theta$ and $A = \frac{1}{2}r^2\theta$ by setting up and evaluating appropriate integrals, using the formulas for the arclength of a graph, $L = \int_a^b \sqrt{1 + (f'(x))^2} \, dx$, and the area under a graph, $A = \int_a^b f(x) \, dx$. (Hint: in each case choose the appropriate $a, b, f(x)$ and evaluate the resulting integrals to obtain the formulas for L and A.)