AME 20231
Homework 7
Due: Thursday, 3 March 2022, 9:00 AM, on Sakai

1. 4.12, instead let the mass flow rate in be 9 kg/min.

2. Consider flow in a pipe with constant cross-sectional area A. Flow enters a fixed control volume at the inlet i and exits at the exit e. The velocity in the x direction is v. Derive the control volume version of the linear x-momentum equation for a fluid in a fashion similar to that used in lecture for the mass and energy equations. The only force you need to consider is a pressure force; neglect all wall shear forces and gravity forces. The final form should be of the form

$$\frac{d}{dt}\int_V \rho \mathsf{v}\; dV = \dot{m}_i \mathsf{v}_i - \dot{m}_e \mathsf{v}_e + P_i A - P_e A.$$

   You may wish to consult any of a variety of undergraduate fluid mechanics textbooks for more guidance.

3. 4.26, instead, let the final pressure be 600 kPa.

4. 4.50, instead let the inlet pressure be 1800 kPa.

5. Take data from Table A.8 for CO_2 and develop your own second order polynomial curve fit for $u(T)$. That is find a_0, a_1, a_2, such that

$$u(T) \sim a_0 + a_1 T + a_2 T^2,$$

   well describes the data in the range 200 K $< T <$ 3000 K. Give a plot which gives the predictions of your curve fit $u(T)$ as a continuous curve for 200 K $< T <$ 3000 K. Superpose on this plot discrete points of the actual data. Take an appropriate derivative of the curve fit for $u(T)$ to estimate $c_v(T)$. Give a plot which gives your curve fit prediction of $c_v(T)$ for 200 K $< T <$ 3000 K. Superpose discrete estimates from a simple finite difference model $c_v \sim \Delta u/\Delta T$, where the finite difference estimates come from the data in Table A.8, onto your plot. You will find a discussion on least squares curve fitting in the online course notes to be useful for this exercise.