Problem 3.A: Matlab exercise. Starting with the general equation for a Taylor series expansion (inside front cover of the text),

> **(a)** explicitly calculate the first five terms to expand $f(z) = \cos(z)$ about $a = 0$. Your answer should agree with the expansion for cos(*z*) shown on the inside front cover.
>
> **(b)** Now expand $f(z) = \cos(z)$ about $a = 0.4$. Show only the first four terms, and do not expand terms like $(x-a)^2$, etc., just leave them in their natural form.
>
> **(c)** In Matlab, plot cos(*z*) vs. *z*, with *z* ranging from $-\pi$ to π (i.e. *z* = -pi:0.001:pi;), then overplot the successive approximations given by adding your expansion terms in part (b) one at a time. For example, if your terms are $f_0 + f_1 + f_2 + f_3$, first overplot f_0 vs. *z*, then overplot $f_0 + f_1$ vs. *z*, then overplot $f_0 + f_1 + f_2$ vs. z, etc. To plot the constant term f_0, you will have to plot $f_0 + z*0$. Do not forget to use .^ for the powers. Clean up the plot by using a thick line for cos(z), and different colors for the different approximations. Add a legend and label the legend curves cos(z), constant, linear, quadratic, cubic. Print your plot and turn it in along with your calculations from parts (*a*) and (*b*). You should be able to see how the successive approximations do a better and better job of following the curve cos(*z*). [You can use the Matlab graphic window zoom and pan tools to zoom in and explore the plot.]

Problem 3.B: A second stage rocket is already traveling at $0.25v_{ex}$ when its engine lights, where v_{ex} is the exhaust velocity of its engine. If its final velocity when it runs out of fuel is $2\,v_{ex}$, what percentage of the second stage initial mass is fuel? Recall that the relevant equation is Eq. 3.8 of the text.

Problem 3.C: Phun exercise: Verify Phun's quantitative calculation of energy for a rotating square. First, set up the scene by creating a square (hold the shift key to force your rectangle to be square). With the square selected, choose "Add center hinge" from the "Geometry actions…" menu. Start the square rotating by grabbing it with the hand, so it rotates once every few seconds. Open the Information window for the rotating square (see Fig. 1). From the answer to problem 3.33 for the moment of inertia of a square (if you could not solve problem 3.33, note that the answer is in the back of the book), show that the energy of the rotating square is $E = ½\, I\omega^2. = 1/12\, MA\omega^2$, where M is the mass and A is the area of the square. Write down the values of M, A and ω in the information window, and use them to calculate the energy. Compare your answer with the energy in the information window to show that they agree.

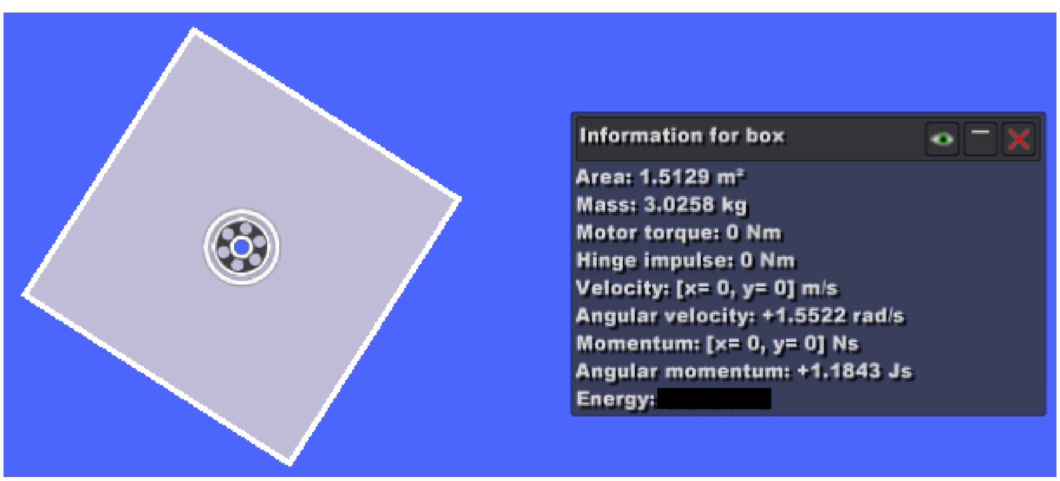

Figure 1: Screenshot of the rotating square and its information window. Make your own scene and use its values, DO NOT use the numbers in this figure.