

Your Name _____ Section _____

HOMEWORK #5 - 8.01 MIT - Prof. Kowalski

Due 4:00PM Thursday Oct. 9, 2003

Topics: Friction, circular dynamics, and Work-Kinetic Energy

Any following problems designated with a bold number indicate problems from Young and Freedman 11th edition.

6. **5.80**

7. **5.86**

8. **5.90**

9. **5.104**

5. Work on Sliding Box – 5 points

A box of mass M is initially at $x_0 = 0$ sliding along the horizontal x -axis with velocity v_0 . It is observed to stop at x_1 due to friction. Write down the work-energy relationship, substitute in variables given above, and thereby find the work, W_f done *on* the box by friction, Note: you do not know the coefficient of friction; this problem uses only W_f and F_f as unknowns.

- Express W_f in terms of F_f and other given variables.
- Express W_f in terms of the friction force, F_f , and find the magnitude of F_f .
- Find the time that the box takes to stop, eliminating F_f , W_f , and M from your answer

A person now pushes on the box against the force of friction, sliding it to point x_2 where it has speed v_1 .

- Find the work done by the person on the box (no W_f in your answer, please).

6. U-Control Model Airplane

A u-control airplane of mass M is attached by control wires of length L (and negligible mass) to the “pilot” who controls the lift provided by the wing. (The wires control the plane’s elevator.) The plane’s engine keeps it moving at constant speed v .

- Find the total tension T in the wires when the plane is flying in a circle at an altitude such that the wires make an angle θ with the ground. Remember that the wings can provide lift only in the direction perpendicular to their area, i.e. in a direction perpendicular to the wires. Think carefully before selecting the angle of your coordinate system.
- The plane will go out of control and crash if the tension is not maintained in the control wires. Given a particular speed of the plane, v , is there some angle θ_{crit} which you would advise the pilot not to exceed?
- If possible, exhibit a speed v_{safe} , at which the plane would be safe at any angle.

