

Supplemental Problems 1

1. A spring scale measures force, not mass. A spring generally acts in a linear fashion and follows $F=kx$ where F is the force, k is the spring constant, and x is the linear displacement of the spring.



a) A spring having a constant of $k=10 \text{ lb}_f/\text{in}$ is displaced $\frac{1}{2}$ ft on earth where the acceleration of gravity is 32 ft/s^2 . What is the force exerted on the spring?

b) If the same spring is displaced on the moon where the acceleration of gravity is 5.37 ft/s^2 what is the force exerted on the spring?

2a. Little Jonny steps on an inexpensive bathroom scale (a spring scale) where the acceleration of gravity is 32.1 ft/s^2 . The scale reads 80 lb. Is this lb_f or lb_m ? Does Jonny want to know how much force he exerts on the surface of the earth or his body mass? How much does Jonny "weigh"?

2b. Convert the answers above to the SI system of units (force and mass).

2c. Jonny steps on a more costly scale at the doctor's office (beam balance) where the acceleration of gravity is 32.1 ft/s^2 . The scale reads 80 lb. Is this lb_f or lb_m ?

2d. When you go to the store to buy a pound of butter do you want 1 lb_f or 1 lb_m ?

2e. Now Jonny somehow makes his way to the moon where the acceleration of gravity is 5.37 ft/s^2 . How much does he weigh in lb_f ? What is his body mass in lb_m ?

3. For the configurations below: draw the system, indicate the boundary with a dotted line, indicate if the system is closed or open, and if open, indicate whether the system is SSSF or transient.

a) barbecue tank filled with propane

b) the combustion chamber of a lawn mower engine

c) lawn sprinkler with the water turned on

d) balloon just released after inflating and flying around the room

4. One half kilogram of nitrogen is contained in a vessel having a volume of 2 m^3 . Determine the density and specific volume of the nitrogen.

5. Air has a density of 0.7156 kg/m^3 . Determine the specific volume.
6. Air contained in a flexible vessel initially at 200°C and 150 kPa is heated isothermally to 400 kPa . Draw the pT diagram and indicate State 1, State 2, and the process.
7. Methane at 100 kPa contained in a flexible vessel with a volume of 0.25 m^3 undergoes an isobaric process to a final volume of 0.5 m^3 . Draw the pV diagram and indicate State 1, State 2, and the process.
8. A 0.1 m^3 cylinder is filled with 0.5 kg of air at 100 kPa . The cylinder volume is changed to 0.05 m^3 . The pressure is measured at 200 kPa . Heat is added at constant volume until the pressure is 300 kPa (State 3). The cylinder volume is changed back to 0.1 m^3 and the pressure is measured at 150 kPa (State 4). The air is then cooled until it returns to its original state. Draw the State 1, State 2, State 3, State 4, and the processes on a pV diagram. Is this a cycle?