Physics 2 – Classical Mechanics (with Mr. Lim)

Practice questions – Equilibrium, Elasticity

INSTRUCTIONS: Answer the problems in your notebook and submit a photocopy of your solutions, diagrams (not required, but drawing them will help you) and answers (I will check that the photocopy is indeed from your notebook.) The deadline for submission is the beginning of the first period next week, before you take the first long test.

NOTE: Photocopies will be accepted on or before the beginning of the long test. Late work will **NOT** be accepted.

Equilibrium

1. Two people carry a heavy electric motor by placing it on a light board 2.00 m long. One person lifts at one end with a force of 400 N, and the other lifts the opposite end with a force of 600 N. What is the weight of the motor, and where along the board is the center of gravity located?
2. Suppose that you can lift no more than 450 N unaided. a) How much can you lift using a 2.0-m long wheelbarrow? Assume that the wheelbarrow weighs 80 N and that its center of gravity is 0.70 m from the wheel. Assume that the load carried in the wheelbarrow is also 0.70 m from the wheel. b) Where does the force come from to enable you to lift more than 450 N when you use the wheelbarrow?

Elasticity

3. A relaxed biceps muscle requires a force of 25.0 N for an elongation of 3.0 cm; the same muscle under maximum tension requires a force of 500 N for the same elongation. Find Young's modulus for the muscle tissue under each of these conditions if the muscle is assumed to be a uniform cylinder with length 0.200 m and cross-sectional area 50.0 cm^2.
4. A circular steel wire 2.00 m long must stretch no more than 0.25 cm when a tensile force of 400 N is applied to each end of the wire. What minimum diameter is required for the wire?
5. Two round rods, one steel and the other copper, are joined end to end. Each rod is 0.750 m long and 1.50 cm in diameter. The combination is subjected to a tensile force with magnitude 4000 N. For each rod, what is a) the strain? b) the elongation?
6. A vertical solid steel post 25 cm in diameter and 2.50 m long is required to support a load of 8000 kg. You can ignore the weight of the post. What is a) the stress in the post? b) the strain in the post? c) the change in the post's length when the load is applied?
7. A petite young woman distributes her 500 N weight equally over the heels of her high-heeled shoes. Each heel has an area of 0.750 cm^2. a) What is the pressure exerted on the floor by each heel? b) With the same pressure, how much weight could be supported by two flat-bottomed sandals, each of area 200 cm^2?
8. In the Challenger Deep of the Marianas Trench, the depth of seawater is 10.9 km and the pressure is 1.16×10^8 Pa (about 1.15×10^3 atm). a) If a cubic meter of water is taken from the surface to this depth, what is the change in its volume? (Normal atmospheric pressure is about 1.0×10^5 Pa. Assume that *B* for seawater is the same as that of freshwater.) b) What is the density of seawater at this depth? (At the surface, seawater has a density of 1.03×10^3 kg/m^3.)
9. A specimen of oil having an initial volume of 600 cm^3 is subjected to a pressure increase of 3.6×10^6 Pa, and the volume is found to decrease by 0.45 cm^3. What is the bulk modulus of the material?
10. A square steel plate is 10.0 cm on a side and 0.500 cm thick. a) Find the shear strain that results if a force of magnitude 9.0×10^5 N is applied to each of the four sides, parallel to the side. b) Find the displacement in centimeters.