Total time: 1 hr **Total Points: 10 pt** **Student Name:**

Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

$$g = 9.8 \text{ m/s}^2 \qquad F = ma \qquad F_g = mg \qquad F_{fr} = \mu F_N$$

$$\text{density} = \frac{\text{mass}}{\text{volume}} \quad \text{specific gravity} = \frac{\text{density}}{\text{water density}}$$

$$\text{stress} = \frac{F}{A} \quad \text{strain (relative stretch)} = \frac{\text{stretch}}{\text{length}}$$

$$\text{Hooke's Law for Elastic Springs} \quad F = (\text{stiffness}) \times (\text{stretch})$$

$$\text{Pressure} \quad P = \frac{F}{A}$$

1. A packing crate 2.50 m by 0.80 m by 0.45 m weighs 1.41×10^5 N. Find the stress (in kPa) exerted by the crate on the floor in each of its three possible positions.

Solution: Depending on how we place the crate, we have three different situations:

$$\text{stress} = \frac{F}{A} = \frac{1.41 \times 10^5}{(2.50 \times 0.80)} = 70.5 \text{ kP}$$

$$\text{stress} = \frac{F}{A} = \frac{1.41 \times 10^5}{(2.50 \times 0.45)} = 125.3kP$$

$$\text{stress} = \frac{F}{A} = \frac{1.41 \times 10^5}{(0.8 \times 0.45)} = 391.7kP$$

2. A spring is stretched 12.0 in by a force of 30.0 lb. How far will it stretch if a force of 90.0 lb is applied?

Solution: If the force is three times as large, then the stretching will be three times bigger, that is $3 \times (12) = 36$ in

3. A spring is stretched 24.0 in by a force of 54.0 lb. How far will it stretch if a force of 104 lb is applied?

Solution: First, we need to find the stiffness of the spring

$$F = \text{stiffness} \times \text{stretch}$$

$$54.0 \text{ lb} = (\text{stiffness}) \times (24.0\text{in}) \rightarrow \text{stiffness} = \frac{54.0}{24.0} = 2.25 \text{ lb/in}$$

Now, we can calculate the new stretch

$$F = \text{stiffness} \times \text{stretch} \rightarrow (104 \text{ lb}) = (2.25 \text{ lb/in}) \times (\text{stretch})$$

$$\text{stretch} = \frac{104}{2.25} = 46.22 \text{ in}$$

4. A spring is stretched 24.0 in by a force of 48.0 lb. What force will stretch the spring 9.00 in?

Solution: First, we need to find the stiffness of the spring

$$F = \text{stiffness} \times \text{stretch}$$

$$48.0 \text{ lb} = (\text{stiffness}) \times (24.0\text{in}) \rightarrow \text{stiffness} = \frac{48.0}{24.0} = 2.0 \text{ lb/in}$$

Now, we can calculate the force necessary for 9.00 in stretch

$$F = \text{stiffness} \times \text{stretch} = (2.0) \times (9.00) = 18.0 \text{ lb}$$

5. An object has a specific gravity of 0.78. If you place it in water will it sink or float?

Solution: It will float because it has specific gravity less than one (that is its density is less than water)

6. You apply a 50-lb force over 3.0 square inch area. What is the pressure in psi?

Solution: $P = \frac{50}{3.0} = 16.7$ psi

7. What force will create a 1000-Pa pressure over area of 2.0 m^2?

Solution: $F = P \times A = (1000)(2.0) = 2.0$ kPa

$d = \dfrac{m}{V}$ buoyancy force = difference in weight measured in air and water (just as in lab)

$$\text{hydrostatic pressure} = d_{\text{water}}(g)V_{\text{object}}$$

8. Find the density of a metal rectangular block with mass 380.0 g and dimensions 1.25 cm by 7.8 cm by 3.4 cm.

Solution:

$$\text{Volume} = (1.25) \times (7.8) \times (3.4) = 33.15 \text{ cm}^3$$

$$\text{density} = \frac{380.0}{33.15} = 11.5 \frac{\text{kg}}{\text{m}^3}$$

9. A rock of mass 10.8 kg displaces 3200 cm^3 of water when submerged. What is its density?

Solution: When you submerge an object in water, the water displaced has the same volume as the object itself. So, the displaced volume of 3200 cm^3 is the same as the volume of the object. Next, we need to convert the kg in g so that we can work with the cm^3. The mass is then 10.8 kg = 10,800 g. The density now will be:

$$d = \frac{10,800}{3200} = 3.375 \frac{\text{kg}}{\text{m}^3}$$

10. How much will be the absolute pressure at 10 m below the water surface?

Solution: Don't forget to count the atmospheric pressure at the surface. Then add the hydrostatic pressure:

$$P = 101,300 \text{ Pa} + (1000 \frac{\text{kg}}{\text{m}^3})(9.8 \frac{\text{m}}{\text{s}^2})(10 \text{ m}) = 199,300 \text{ Pa} = 199.3 \text{ kPa}$$

11. You measure the mass of a rectangular block to be 200 g in air. You place it in water, and its mass appears to be only 85 g. How much is the buyoyancy force of the water on the block?

Solution: We must switch to kg in order to calculate the weight in Newtons. Weight in Air: $(0.200 \text{ kg})(9.8 \frac{\text{m}}{\text{s}^2}) = 1.96$ N Apparent Weight in Water: $(0.085 \text{ kg})(9.8 \frac{\text{m}}{\text{s}^2}) = 0.833$ N The buoyancy force of fluid on the object will be the difference:

$$F_B = 1.96 - 0.833 = 1.127 \text{ N}$$