# 2.016 HW #6
Out: November 1, 2005
Due: November 8, 2005

1) Concept questions:
   a. The majority of ocean waves are caused by what force? Discuss.
   b. On the "Motion of a Fluid Particle" slide in the Free-Surface Waves handout, two equations are given for the velocities of a fluid particle (call him Bob): $u = \frac{d\xi_p}{dt}, w = \frac{d\eta_p}{dt}$. What do they mean? Why are these equations valid? (Hint: your answer should use the words: "Eulerian" and "Lagrangian"…)
   c. For linear deep water waves, sketch the particle orbits. How deep must a scuba diver go before he or she doesn't notice any motion due to the waves?
   d. For linear shallow water waves, describe what a scuba diver on the bottom experiences.

2) For each of the following scenarios, determine whether the waves are linear or not. If so, determine the wavelength, $\lambda$.
   a. $\omega$= 10 rad/s, H = 1 m, a = 0.02 m
   b. $\omega$= 10 rad/s, H = 0.1 m, a = 0.06 m
   c. $\omega$= 2 rad/s, H = 100 m, a = 5 m
   d. $\omega$= 1 rad/s, H = 100 m, a = 2 m
   e. $\omega$= 5 rad/s, H = 0.5 m, a = 0.1 m
   f. $\omega$= 4 rad/s, H = 0.5 m, a = 0.05 m

3) Consider a cylinder of radius, R, and length, L, held in place a distance, d, under the surface of the water by a slender post. The axis of the cylinder is parallel to the sea floor and perpendicular to incoming linear free-surface waves. Given $\omega, \lambda, a$, and H, calculate the added mass forces on the cylinder, $F_1$ and $F_3$, as a function of time. (Hint: the cylinder is not moving, so the simple added mass equation applies.)

4) A packet of waves $(\omega_1, k_1, a_1)$ are send down a wavetank of height, $H << \lambda_1, \lambda_2$. A second packet $\left(\omega_2, k_2 < k_1 \frac{\omega_2}{\omega_1}, a_2\right)$ is generated $\tau$ seconds later. At what time will the second packet overtake the first?

5) Compare and contrast the vertical Foude-Krylov force to the restoring force due to buoyancy. What causes each force, and why are they different?