Boyle’s Law

Density of Water = 64 lb/ft3 1 atm = 14.7 lb/in2

1. What is the weight in pounds of 1 in3 of water?
2. How many feet of water would there need to be to increase the pressure by 1 atm? (Hint: how tall would a column of water with a cross sectional area of 1 in2 need to be in order to weigh 14.7 lbs?)
3. What is the total pressure in atm at 33ft of water?
4. A diver at a depth of 99 ft releases a bubble that is 1 L in volume. What is the volume of the bubble at 66 ft, at 33 ft, and right before it reaches the surface?
5. A diver fills a balloon at the surface that is 1.5 L in volume. What is the volume of the balloon at 75 ft?
6. A scuba tank holds a volume of air that would be 80 ft3 at 1 atm. If the tank has a pressure of 3000 lb/in3 what is the volume of the scuba tank?
7. If a diver breathes in an average of 500 mL of air at 1 atm how many breathes should the diver expect to have at a depth of 66 ft?
8. Use Boyle’s Law to explain why a diver should not hold her breath while ascending from a depth.

Archimedes Principle

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. The Density of water is 1g/cm3 Find the density is kg/L
2. What is the weight in newtons of 100 kg of water?
3. What is the buoyancy force on a diver whose volume is 100 L?
4. If the mass of the diver is 90 kg will the diver sink or float?
5. How much mass must be added to the diver to achieve neutral buoyancy? Ignore the added volume of the mass added.
6. A diver wished to lift a 1 ton iron anchor off the ocean floor at 33 feet. How any dive tanks would the diver need to bring down with her? Use the following to solve this problem:

1 ton = 2000 lbs 1 kg = 2.2 lbs 1 dive tank = 80 ft3 at 1 atm

At 33 ft the pressure is 2 atm 1 ft3 = 28.3 L ρiron = 7870 kg/m3 1 m3 = 1000 L

Conservation of Momentum

1. Describe in your own words how a diver uses conservation of momentum in order to propel their body forward.
2. A 75 kg diver at rest kicks her flippers and swims horizontally to a velocity of 1.5 m/s.
   1. Write the conservation of momentum expression for the kick.
   2. Draw a force diagram for the water and for the swimmer. Put congruency marks on the forces and circle any 3rd Law pairs of forces.
   3. Will the water or the diver experience a greater force from the kick? Explain.
   4. Will the water or the diver experience a greater change in momentum? Explain.
   5. What is the impulse imparted to the water by the diver?
   6. What is the impulse imparted to the diver by the water?
   7. While kicking the diver moved a volume of water equal to 100 L. What was the velocity of the water moved?
   8. If the kick took 1.1 seconds what was the net force of the divers kick on the water?

Conservation of Energy

Use energy pie charts to analyze the energy changes for the diver.

* Indicate your system with a dotted line.
* Label the pies to correspond with the positions of the objects given.
* The pies should be divided and labeled with the energy storage mechanisms involved.
* When assigning energy changes think about:
  + Where does the energy come from?
  + What does the energy do?
  + Where does the energy go?

1. A diver at rest in the water
2. A diver swimming horizontally speeding up.



1. A diver surfacing at a constant speed.









1. A diver swimming down at a constant velocity







1. Complete the qualitative energy storage bar graph below. Don’t forget to circle your system of choice

Ek

Eg

Echem

Ek

Eg

Position A

Position B

Qualitative Energy Conservation Equation:

**System/Flow**

A B

v = 2 m/s v = 2 m/s

 

Echem

1. A 75 kg diver at rest at the floor of a coral reef kicks their flippers and swims horizontally to a speed of 1.5 m/s. While kicking the diver moved a volume of 100 L of water with a velocity of 1.125 m/s.
   1. Write the energy conservation equation for the diver.
   2. What was the change in the diver’s kinetic energy?
   3. How much work did the diver do on the water?
2. Explain using the energy concepts why a diver kicking off a wall will result in a greater velocity than kicking against water.
3. Explain using the work energy theorem and conservation of momentum why using a large flipper and kicking slowly is more efficient than using a bare foot and kicking quickly. (HINT: start with the mdivervdiver = mwatervwater and then look at the energy conservation equation Wdiver = KEwater)
4. Explain using the work energy theorem and conservation of momentum why using a large flipper and kicking slowly is more efficient than using a bare foot and kicking quickly. (HINT: start with the mdivervdiver = mwatervwater and then look at the energy conservation equation Wdiver = KEwater)