**SUBC Fluids Team Questions**

*(to which you must know the answers)*

**FLUIDS**

1. 1 knot = how many m/s?
   1. 0.514444 m/s
2. How are the terms ‘fluid’ and ‘liquid’ distinct?
   1. Liquid: a type of fluid that conforms to any volume but is nearly incompressible.
3. Is water a compressible or incompressible fluid?
   1. Nope it is not.
4. For water at a given state:
   1. Name the two key parameters most needed by hydrodynamicists
   2. Describe what those parameters represent, and give their units
   3. Name a third parameter, on which the above two depend
5. What is the speed of a water particle on the surface of a fast-moving submarine (in x-direction)?
6. At what temperature is freshwater most dense?
7. Which is more dense – freshwater or seawater? Give numbers
8. Using an old adage, estimate the density of ice
9. Conservation of mass and momentum equations are solvable in a fluid – true or false?
10. Reynolds Number:
    1. What is the equation, and the ratio that it represents?
    2. What is the significance of this number?
    3. What is Reynolds Equivalence?
11. List 3 famous fluid dynamicists (from any of Eng, Phys, Math), from 3 different countries
12. Russian like speed. They hold world record of most fast sub and torpedo (underwater). Give:
    1. The name of the submarine, year of record, and speed in kt, kmh, m/s
    2. Ditto for the torpedo
    3. There are a number of (classified) competitors/usurpers for the sub speed record. List 2
13. What is the absolute pressure (in atm) at:
    1. The surface of water at a competition Naval Base or in Vancouver (*i.e.*, at sea level)?
    2. At 15m depth, our current hull rating?
    3. At 3m depth, our likely performance depth
14. What is a Boundary Layer? (Tough. Be detailed, and look at diagrams. Bonus: what is BL separation?)
    1. a layer of more or less stationary fluid (such as water or air) immediately surrounding an immersed object in relative motion with the fluid.

**HULL**

1. Draw an airfoil. Why is this shape special?
2. What does NACA stand for, in aerodynamics/aeronautics?
3. What is the meaning of, *e.g.*, NACA 0012? Be specific
4. Flow over a good-quality airfoil in standard configuration to generate lift. Which pressure is higher, top or bottom? What about flow velocity?
5. List 3 names of submarine hull shapes (*e.g.,* “Pufferfish”, “Cone Frustum”, “Romulan Cruiser”)
6. List 3 military submarine hull requirements that we civvies don’t need to worry about on SUBC
7. What are the names for the submarine hull’s: front, back, left, and right?
8. What is Archimedes’ Principle?
9. What is the equation for the weight of water in a sphere of diameter 1m?
10. What is trim?
11. Submarine motion:
    1. How many degrees of freedom does a submarine have?
    2. Give the name of motion in each axis of freedom
12. Drag: what is it, and what is the standard equation for it?
13. What is the standard drag-velocity proportionality relation?
14. What are the 2 largest kinds of drag on a submarine (many names exist)? Which one is larger?

**PROPELLERS**

1. Define:
   1. Span
   2. Chord
2. What is the ratio of span to chord called?
3. What is the cross-sectional shape of any good-quality propeller?
4. What geometric path/shape does a propeller blade *tip* follow, as it rotates and propels forward?
5. What are some pro’s and con’s of 2-bladed propellers vs. 3- or 4-bladed propellers?
6. List 3 pro’s and 3 con’s of contra-rotating propellers
7. A 1-propeller submarine with 4 rear fins usually has a propeller with how many blades – 3, 5, 6, 7, or 9? Why? Why not 2, 4, or 8?
8. Why are the sets of contra-rotating propellers almost never equal (*i.e.*, 2 and 3, 3 and 5)?
9. What is propeller blade pitch?
10. Variable pitch:
    1. What does “Variable Pitch Propellers” mean?
    2. What’s the difference between “constantly variable” and “ground adjustable” pitch propellers?
11. What is the Advance Ratio (meaning and equation)?
12. Lift:
    1. What is it?
    2. What is the standard equation for it?
    3. What is the most important angle related to lift?
13. What is airfoil camber?
14. Cavitation:
    1. What is it?
    2. Why is it a problem?
    3. Is it a problem for us?
    4. What is Supercavitation, and why are people interested in it?
15. What is propeller twist? (Bonus: why is it desirable?)
16. What is propeller skew, and what purpose(s) does it serve?
17. What is propeller slip? (this one’s a bit tough)
18. Stab in the dark: guess our maximum rotational speed on our sub, underwater (rps or Hz)?

**MATERIALS**

1. What is specific gravity? What is the value for water, and at what temperature?
2. What is the density and SG (1 or 2 sig figs) of:
   1. Aluminum?
   2. Steel?
3. What is galvanic corrosion, and why would we care?
   1. Dunk two metal into water. Rust occurs first. Make sure the redox doesn’t work out.
   2. Sacrificial anode can be used to make sure the two metals don’t corrode each other. Like Zinc.
4. List 3 other metals/alloys that might be used to make propellers
5. What is a composite material, and what (usually) are the two main component names?
6. List 2 composite materials that:
   1. Are often used to make propellers
   2. We would never use to make propellers
   3. We would use for our hull body
7. What are thermoplastics? List 3 that can be rigid and transparent (read: for viewport)
8. What is CNC machining, and why is it important?

**LIFE**

1. **If you don’t make \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, you won’t learn half as much as you should**