PROBLEM 1 – 15 points

You have three identical balls, and three beakers containing different liquids. Each ball has a density of 600 kg/m^3. You place one ball in each beaker.
In beaker A the ball floats with 50% of its volume submerged.
In beaker B the ball floats with 25% of its volume submerged.
In beaker C the ball sinks to the bottom.

[3 points] (a) Sketch these three situations.

[3 points] (b) Rank the liquids based on their densities, from largest to smallest. Use > and/or = signs in your ranking, such as B>A=C.

[3 points] (c) Compare situations A and B. In which situation does the ball experience a larger buoyant force? The ball experiences a larger buoyant force in

[   ] beaker A   [   ] beaker B   [   ] neither – the buoyant forces are equal

Briefly justify your answer:

[3 points] (d) Compare situations B and C. In which situation does the ball experience a larger buoyant force? The ball experiences a larger buoyant force in

[   ] beaker B   [   ] beaker C   [   ] neither – the buoyant forces are equal

Briefly justify your answer:

[3 points] (e) What is the density of the liquid in beaker A?

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PROBLEM 2 – 10 points

You have three balls, which have equal volumes but different densities, and three beakers of water. Water has a density of 1000 kg/m^3. You place one ball in each beaker.
Ball A floats with 30% of its volume submerged.
Ball B floats with 70% of its volume submerged.
Ball C sinks to the bottom.

[2 points] (a) Sketch these three situations.

[2 points] (b) Rank the balls based on their densities, from largest to smallest. Use > and/or = signs in your ranking, such as B>A=C.

[3 points] (c) Compare balls A and B. Which ball experiences a larger buoyant force?

[ ] ball A   [ ] ball B   [ ] neither – the buoyant forces are equal

Briefly justify your answer:

[3 points] (d) When **ball C** is resting at the bottom of its beaker it experiences a buoyant force of 50 N, directed up. Use this information to solve for the mass of **ball A**. Use g = 10 m/s^2.

PROBLEM 3 – 10 points

When there are no people standing on a large wooden raft that is floating on a lake, the raft floats with 35% of its volume submerged.

raft is 35% submerged

When two people, each with a mass of 60 kg, stand on the raft, the raft floats with 55% of its volume submerged.

60 kg— —60 kg

[2 points] (a) Sketch the free-body diagram for the raft when it has nobody on it.

raft is 55% submerged
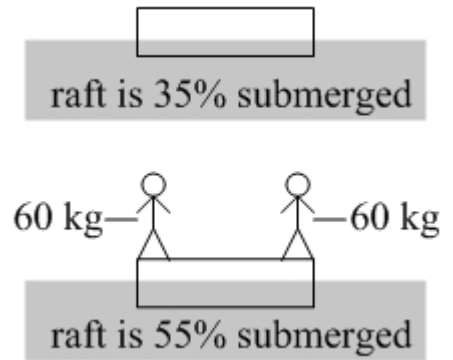
[2 points] (b) Sketch the free-body diagram for the system of the raft and the two people.

[2 points] (c) If one more person, with a mass of 60 kg, gets on the raft, what percentage of the raft will be submerged?

[2 points] (d) What is the maximum number of people, each with a mass of 60 kg, that the raft can support without sinking? (Your answer should be an integer.)

[2 points] (e) Calculate the mass of the raft.