**Name:**

# Physics 141, Quiz 6

This is the individual portion of your quiz. You will have 35 minutes to complete it. Your only allowed resources are writing implements, a calculator (provided), and the equation sheet (provided). Note that questions often have multiple parts, so if you get stuck on one part, just move to the next one. Generally, later parts will depend on previous ones, so if you need to, just say something like, "If I had found the velocity in part b, I'd do this with it…".

For full credit, you must show units during **all** calculations and you **must explain your math**. You don't need to say much, just tell me where you're getting your equations from (eg, "Newton's Second Law"'). All equations you use should come off of the equation sheet or be common knowledge; if not, you're probably doing something wrong! **You must begin each problem with a statement of what principle you will use and, if using an equation/formula, what the core formula (from the equation sheet) is!**

1. Euclid and Cantor are exploring Saturn's moon, Titan. Titan is bigger than our moon and has a surface gravitational acceleration of $1.352$ m/s², a dense atmosphere ($1.5 \times 10^5$ Pa) made of nitrogen, and hydrocarbon lakes. (**13 pts**)

   a) If the Kraken Mare, a sea near the south pole, is made mostly of liquid ethane. If ethane has a density of $1280$ kg/m³, what's the pressure 2 km deep into the lake? (**5 pts**)
   **Principle(s):**
   **Equation(s):**

   b) Cantor, being an expert on diving, has built a small robot submersible to explore Kraken Mare. It has a mass of 10.0 kg and a volume (measured on Earth) of $0.125$ m³. He's asked Euclid to work out the physics to make sure it'll work and she has agreed. What buoyancy force does it feel 2 km down?(**5 pts**)
   **Principle(s):**
   **Equation(s):**

   c) What is the buoyancy force 10 m under the surface? (**4 pts**)
   **Principle(s):**
   **Equation(s):**

2. The guinea pigs are still hard at work on their fire-fighting business. To protect our house, they have a tank of water on our roof. The bottom of the tank is $h = 5$ m above the ground and the tank is $d = 2$ m high and $R = 0.5$ m in radius. To get the water out, they have a hose leaving the bottom. (**16 pts**)

   a) If the hose ends at ground-level through a nozzle and the tank is open the air at the top, what is the speed that the water leaves the nozzle? (Hint: the tank is so much bigger than the nozzle that the speed of the water at the *top* of the tank is basically zero.)(**6 pts**)
   **Principle(s):**
   **Equation(s):**

   b) The hose leaving the tank has a radius of $r_1 = 2$ cm. If the nozzle has a radius of $r_2 = 1$ cm, what is the speed of the water just as it enters the hose out of the tank?(**6 pts**)
   **Principle(s):**
   **Equation(s):**

   c) How long will it take to drain the tank? (**4 pts**)
   **Principle(s):**
   **Equation(s):**