PHY 250: Midterm Retake

November 10th, 2020

Name:

Part 1: Test Your Understanding (30 p)

Q1

If there were a great migration of people toward the Earth's equator, would the length of the day (a) get longer because of conservation of angular momentum; (b) get shorter because of conservation of angular momentum; (c) get shorter because of conservation of energy; (d) get longer because of conservation of energy; or (e) remain unaffected?

Q2

A force $F = F\hat{\jmath}$ is applied to an object at a position $r = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$ where the origin is at the CM. Does the torque about the CM depend on x? on y? on z?

Q3

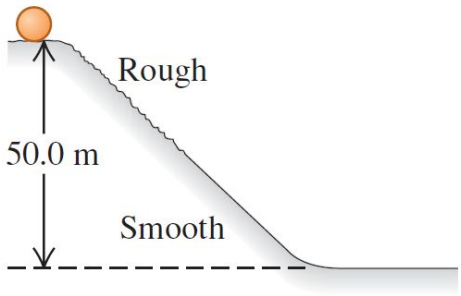
An ice cube floats in a glass of water filled to the brim. What can you say about the density of ice? As the ice melts, will the water overflow? Explain.

Q4

Why does the stream of water from a faucet become narrower as it falls

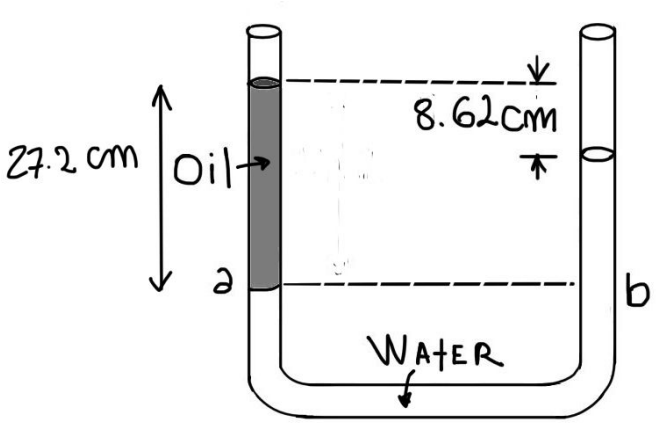
Part 2: Solve exercises (70 p)

Exercise 1



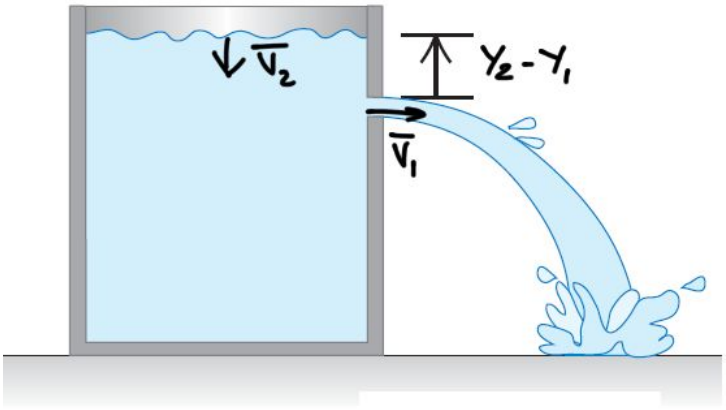
A solid, uniform, spherical boulder starts from rest and rolls down a $50.0 - m$ high hill. The top half of the hill is rough enough to cause the boulder to roll without slipping, but the lower half is covered with ice and there is no friction. What is the translational speed of the boulder when it reaches the bottom of the hill?

Exercise 2



Water and then oil (which don't mix) are poured into a U-shaped tube, open at both ends. They come to equilibrium as shown in the figure. What is the density of the oil? [Hint: Pressures at points a and b are equal.]

Exercise 3



Take into account the speed of the top surface of the tank and show that the speed of fluid leaving the opening at the bottom is

$$v_1 = \sqrt{\frac{2gh}{(1 - A_2^2/A_2^2)}}$$

where $h = y_2 - y_1$, and A_1 and A_2 are the areas of the opening and of the top surface, respectively.

Questions

Exercise 1

Exercise 2

Exercise 3