Oxford Physics Interviews – Practice Questions

1. Interviewer places a pen on the table. The question is: "Is the pen in equilibrium?"

2. It is possible to ride a motorbike in a circular path around the inside of a vertical cylinder (see this video, though the wall in this case is not quite vertical). Draw a free body diagram for the motorcycle + rider combined (when viewed head-on).

   Are the vertical forces in equilibrium?
   Are the horizontal forces in equilibrium?
   Is there a resultant moment?

   If the coefficient of friction between the tyre and the wall is μ and the radius of the cylinder is r, how fast does the motorcyclist need to ride so that they don't fall?

3. If the amount of power incident on an umbrella from the sun at midday is sufficient to power a washing machine, calculate the rate of mass loss of the sun.

4. How many grains of sand are in a bucket on the beach?

5. A cube of ice floats in a beaker of water, the entire system at 0 degrees centigrade. Just enough heat is supplied to melt the cube without altering the system's temperature. Does the water level in the beaker rise, fall, or stay the same?

6. A small boy is sailing a plastic boat in the bathtub. It is loaded with nuts and bolts. If he dumps all this cargo into the water, allowing the boat to float empty, will the water level in the tub rise or fall?

7. Assume that a full cylindrical can of soda has its center of gravity at its geometric center, half way up and right in the middle of the can. As soda is consumed, the center of gravity is initially lowered. When the can is empty, however, the center of gravity is back at the center of the can. There must therefore be a point at which the center of gravity is lowest.

   Knowing the weight of an empty can and its weight when filled, how can one determine what level of soda in an upright can will move the center of gravity to its lowest possible point?

   Let's assume that the empty can weighs 1.5 ounces. It is a perfect cylinder and any asymmetry introduced by punching holes in the top is disregarded. The can holds 12 ounces of soda, therefore its total weight, when filled, is 13.5 ounces.

   How many ounces of soda are in the can when its center of gravity is lowest?

8. Two missiles speed directly toward each other, one at 9,000 miles per hour and the other at 21,000 miles per hour. They start 1,317 miles apart. Calculate how far apart they are one minute before they collide.

9. How is it that you can lean a ladder against a smooth wall with the feet on rough ground, but you can't lean a ladder against a rough wall with the feet on smooth ground? Draw free body diagrams to explain.

10. What is the drift speed of the electrons in the lead of a kettle when it is switched on?

11. How many carbon atoms are there in a full stop made with a pencil?