DAY 21

1. Using Bernoulli's principle, explain why cigarette smoke flows out the barely-open window of a moving car. Does the smoke flow out if the car is stopped at a light?

2. A 120 foot tall water tower has a leak 5 ft up from the bottom. At what speed will the stream of water emerge from the leak and how far will it travel before hitting the ground? Ignore friction. The tower is full of water.

3. A golfer stands ready to drive a golf ball. The view from above is shown:

   Use Bernoulli's principle to explain what will happen if the golfer strikes the ball above the ball's center of mass, causing it to rotate "forwards" as seen from above (topspin)? What will happen if the golfer strikes the ball below the ball's c.m.? What will happen if the golfer does not hit the ball perpendicularly with the club, with the result that the ball has a dramatic clockwise spin as seen from above?

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4. Calculate the pressure a 6000 lb truck exerts on the ground if each tire has a contact patch that measures 10 inches by 10 inches. Compare this to the pressure a 120 lb woman exerts on the ground if she is wearing high heels that measure 0.5 inch x 0.5 inch and 80% of her weight is on her heels.

5. A clear vinyl "suction cup" is stuck to a vertical glass door on a shower stall. The cup measures 1.5 inch in diameter. The coefficient of static friction between glass and clear vinyl is 0.4. The cup has a hook on it from which items may be hung. What is the maximum weight in lbs that can be hung from the cup if the cup is not to slide down the door?

6. The profile of a particular airplane wing is such that the distance air has to move to traverse the top of the wing is 20% greater than the distance the air must travel to traverse the bottom of the wing. (This shape is an "airfoil".) If air is flowing steadily across the wing, then the air molecules that part ways (one to go over the top of the wing and one to go across the bottom of the wing) at the leading edge of the wing must come back together again at the trailing edge.

   Calculate the lifting force generated per square foot if the wing is moving through the air at 200 mph (airspeed measured across the bottom of the wing). What size wing (in square feet) is needed to support a 3000 lb aircraft?

7. During floods water sometimes is seen spurting out the top of manhole covers in the street due to the pressure in the sewer lines beneath the street. If water is observed to be squirting out a hole in a manhole cover at a 45° angle, and hitting the ground 2 ft away, what is the pressure in the sewer in psi?
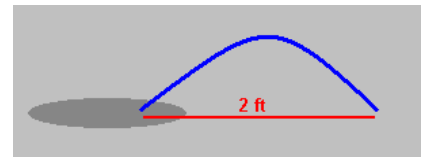
8. Some burrowing animals ventilate their burrows by having one hole in a raised location where the wind can blow across it ("A" in the figure). This draws fresh air in through the other holes in the burrow. Explain how this works.