Water Distribution

Question:

Water enters your home plumbing at ground level. Where will you get the strongest spray from a shower?

1. In the ground floor shower.
2. In the basement shower.
3. In the second floor shower.

Fluid Motion (no gravity)

- Fluids obey Newton's laws
  - Net forces cause accelerations
  - Net forces are due to pressure imbalances
  - Fluids accelerate toward lowest pressures

Pressurizing Water

- To pressurize water,
  - use of Newton's third law
  - push inward on the water
  - water pushes outward on you
  - water's outward push is due to its pressure
  - water pressure rises as you squeeze it

Pumping Water (no gravity)

- Squeeze water to raise its pressure
- Water accelerates toward lowest pressure
- Water begins flowing
- You do work on the water
  - You keep squeezing as water flows
  - Water moves in direction of your force
  - In this case: Work = Pressure · Volume

Pressure Potential Energy

- Pumping water requires work
- Pumped water carries energy with it
- Energy isn't really stored, it's promised
  - but energy resembles a potential energy
  - so it's called pressure potential energy (PPE)
- PPE requires steady-state flow (SSF)

Energy Conservation (no gravity)

- In SSF through stationary obstacles, a fluid's energy and energy/volume are constants
- Energy is PPE + KE (Kinetic Energy)
- Bernoulli's equation (no gravity):

PPE + KE = Constant

PPE/Volume + KE/Volume = Constant/Volume

(*along a streamline*)

Fluid Motion (with gravity)

- Fluids obey Newton's laws
  - Weight also causes fluids to accelerate.
  - Fluids accelerate because of both pressure imbalances *and weight*.
  - Weight creates stable pressure gradients
    - Pressure decreases with altitude.
    - Pressure increases with depth.
  - Fluids have gravitational potential energy (GPE)

Energy Conservation (with gravity)

- Energy is PPE + KE + GPE
- Bernoulli's equation:

PPE + KE + GPE = Constant

PPE/Volume + KE/Volume + GPE/Volume = Constant/Volume

(*along a streamline*)

Question:

Water enters your home plumbing at ground level. Where will you get the most intense shower spray?

1. In the ground floor shower.
2. In the basement shower.
3. In the second floor shower.