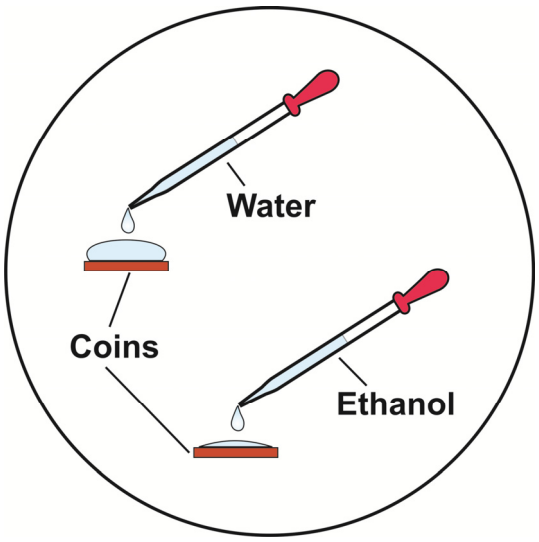
Drops on Coins



Equipment:

2 clean coins of the same type (US pennies, 5 Euro cent coins, etc.)
2 Pasteur pipettes with small rubber bulbs
2 beakers (25 mL)
paper towel

Chemicals:

tap water
ethanol

Safety:

ethanol (C_2H_5OH):

H225-319
P210-240-305 + 351 + 338-403 + 233

Liquid and vapor are highly flammable. Therefore, open flames have to be avoided. Ethanol also causes severe eye irritation; that means it is necessary to wear safety glasses.

Procedure:

The two coins are placed on a piece of paper towel on a flat surface with the same side up (meaning they are showing either both “heads” or “tails”). Both the water and the alcohol are poured into one of the beakers. Subsequently, the water is added very carefully with the pipette drop by drop to the center of one of the coins (the pipette should be hold just above the top of the drop already on the coin without touching it so that each new droplet has to fall only a short distance before it merges with the drop already present). The number of drops necessary until the water spills over the coin should be counted. The experiment is repeated with the alcohol.

Observation:

When water is dropped onto a coin a growing dome is formed even after touching the edges of the coin. Eventually, the dome breaks and the water spills over. The alcohol, however, does not form as large a bead of liquid on the coin. Therefore, noticeably more drops of water can be added to the coin than drops of alcohol.

Explanation:

The surface tension of water is especially high (σ = 72 mN m^{-1}) due to the high polarity of water molecules and the resulting relatively strong hydrogen bonds between them. The water molecules at the surface of the drop are pulled inward and they stick together so strongly that they form a dome. Eventually, though, gravity overcomes this force and the dome breaks, spilling water over the sides of the coin. The surface tension of ethanol (σ = 22 mN m^{-1}) is considerably smaller than that of water. Therefore, fewer drops are able to be added to the coin.

Disposal:

The paper towel that soaked up the water can be put in the waste paper basket; however, the one that soaked up the ethanol should be disposed of in a fire safe container.