Sigma Tournament

Day 1: Physics & Math

Tour 1

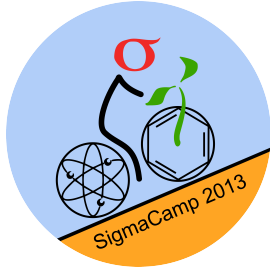1) Determine which statements below are true and which ones are false.
   1. Exactly one statement in this list is false.
   2. Exactly two statements in this list are false.
   3. Exactly three statements in this list are false.
   4. Exactly four statements in this list are false.
   5. Exactly five statements in this list are false.
   6. Exactly six statements in this list are false.
   7. Exactly seven statements in this list are false.
   8. Exactly eight statements in this list are false.
   9. Exactly nine statements in this list are false.
   10. Exactly ten statements in this list are false.

2) What angle do the hands of a clock make at 7:38?

3) It is known that $a + b = 1$ and $a^2 + b^2 = 2$. Find $a^4 + b^4$.

4) A ball is thrown from ground level at an angle of 45 degrees with the speed of 10m/s at a wall 3 meters away. How far away from the wall will the ball land? Free fall acceleration is 10 m/s^2. The collision with the wall is absolutely elastic.

5) A buoy of cylindrical shape is floating half-immersed in water. A playful sigma-fish pulls the buoy down. What is the minimal work that the fish must perform to fully immerse the buoy in the water? The mass and the length of the buoy are M and L respectively.

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Tour 2

Experimental problem!
(4 points for a complete solution)

Find the mass of a given ruler.

Equipment: ruler, US quarter (mass 5.670 g).

Remark: you can also use simple objects around you.