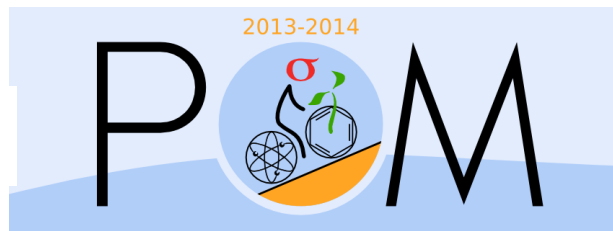


PROBLEM OF THE MONTH



February 2013

MATHEMATICS

Two spheres, which are tangent to each other, are also tangent to a plane and to a line perpendicular to that plane.

What is the ratio of the spheres' radii if the points where the spheres touch the plane form:

- (i) a right triangle with the point at which the line intersects the plane?
- (ii) an isosceles triangle with the point at which the line intersects the plane?

PHYSICS

A year on the planet X lasts exactly 300 days. Any day on its equator lasts exactly 24 hours. What could be the period of the planet's rotation about its axis (in seconds)?

Note: a day is defined as a time between two sunsets.

CHEMISTRY

A major qualitative characteristic of solutions is their **concentration**. Concentration is a number that shows the amount of a dissolved substance (a solute) per 1 liter (or one kilogram, one gallon, etc.) of the solution. Sometimes, a concentration is measured in percents. For example, a 10% aqueous solution of $NaCl$ (table salt) contains 10 grams of $NaCl$ per 100 grams of the *solution* (not per 100 grams of water).

In my lab, I need to prepare the 8% solution of sulfuric acid (H_2SO_4). I found 30% and 5% solutions of H_2SO_4 on my shelf. In which ratio should I mix them to obtain an 8% solution?

BIOLOGY

"We are of the same blood you and I"- told Mowgli in Kipling's "Jungle Book". In some cases this phrase may not only uphold health, but also save lives.

People differ from each other in blood type the same way that they differ in hair and eye color. It is of utmost importance in the flow of life, does not take into consideration nationality, gender, or age, is handed down genetically, and lends itself to an individual set of characteristics for each of us.

In modern times, four blood types are known to mankind, which came about in the process of evolution: O, A, B, and AB. The most common type is O, while the least common is AB. Is there a significant difference between them? We'll try to figure it out.

1. In what ways do the blood types differ from one another?
2. Why can the O type be transfused to everyone? What other factor is crucial to consider while selecting a blood donor?
3. At a maternity ward in a hospital, two girls were mixed up. One of them was found to have an O blood type, while the other has AB. One set of parents has the blood types O and A, while the other has A and B. Match the daughters to the parents.

COMPUTER SCIENCE

Write a Java program that takes 10 numbers as user input and outputs them in increasing order. Java library sort methods cannot be used in your program.