Most people have heard about meteorites, and have seen meteors streaking across the night sky. These 'rocks' travel through space at thousands of kilometers per hour and can strike any other object in their way.

Astronomers have studied these recovered meteorites for over a century and have learned about their ages, compositions and in some cases their origins in the solar system.

The above meteorite sample is called the Esquel Pallasite, and was part of a 1000 kilogram 'fall' that occurred over Esquel, Argentine in 1951. The sample has a mass of 350 grams and was sliced, polished and stained to reveal the details of its composition. Pallasites contains small stone 'inclusions' of the mineral olivine, that are embedded in an iron-nickel alloy called a matrix.

It is thought that pallesites are small pieces of rock left over from the destruction of a large asteroid, which was not large enough for the iron-nickel and stony materials to segregate. For Earth, it was massive enough for its iron and nickel to form a dense core surrounded by the lighter, stony materials.

Meteorite samples fall into several dozen different families that seem to indicate that there were several dozen ancient bodies that disintegrated during collisions to form these remnants that we can now collect when they strike Earth.

Problem 1 – The density of the iron-nickel matrix is 8.2 grams/cm^3 and the olivine density is 3.3 grams/cm^3. If the total mass of the Esquel sample is 350 grams, and 20% of the sample is composed of olivine, what was the mass of each of the two ingredients to the pallasite?

Problem 2 - Meteorite collectors find and sell samples by the gram. The price of a gram of the Esquel pallasite is about $106. What was the price of the sample in Problem 1?

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Answer: This is a very typical problem that also appears in chemistry classes in various different guises.

First, what are the volumes of the two ingredients?
Olivine = 20%
and so Iron/nickel = 80%.

Now, the product of density and volume = mass, so we can write the equation for the mass as:

8.2 x0.8V + 3.3 x 0.2V = 350 where V is the total volume of the sample.

Simplify and solve for V to get (6.56 + 0.66) V = 350 so V = 48.5 cm^3.

Then for the **olivine** we have 3.3 x 0.2 x (48.5) = **32 grams**
And for the **iron/nickel** we have 8.2 x 0.8x(48.5) = **318 grams**
for a total of 350 grams

Problem 2 - Meteorite collectors find and sell samples by the gram. The price of a gram of the Esquel pallasite is about $106. What was the price of the sample in Problem 1?

Answer: 350 grams x ($106 / 1 gram) = **$37,100**.