Math Diversion 1089

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CONCERNING HORSES

Hast thou given the horse strength? hast thou clothed
his neck with thunder?
Canst thou make him afraid as a grasshopper? the
glory of his nostrils is terrible.
He paweth in the valley, and rejoiceth in his strength:
he goeth on to meet the armed men.
He mocketh at fear, and is not affrighted; neither
turneth he back from the sword.
— Job 39:19–22

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Source: https://www.algebra.com/algebra
Title: Question 12377
 Presenter: Patrick
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1 Problem

A rock is dropped from a cliff into the ocean. It travels $16t^2$ feet in t seconds. If the splash is heard 1.5 second later, how high is the cliff? [Note: Assume the speed of sound at sea level is 1100 feet per second.]

2 Solution

Let h be the height of the cliff and v be the speed of sound. The total time Δt from when the rock is released until the splash is heard is given as the sum (suppress units)

$$\begin{aligned}\Delta t &= \left[\begin{array}{c}\text{time for rock to}\\ \text{hit the water}\end{array}\right] + \left[\begin{array}{c}\text{time for sound of splash}\\ \text{to hit the ears}\end{array}\right]\\ &= \text{Extract\_Time}[h = 16t^2] + \text{Extract\_Time}[t = h/v]\\ &= \frac{\sqrt{h}}{4} + \frac{h}{1100}\,. \end{aligned} \tag{1}$$

But $\Delta t = 1.5$ seconds. So, letting $z \equiv \sqrt{h}$ and clearing of fractions, we get

$$z^2 + 275z - 1650 = 0\,, \tag{2}$$

with solution $z \approx 5.8745$. That gives us $h \approx 34.5$ feet.

Thus we see that the Extract_X function inputs an equation and returns the expression equivalent to X.