

1. Nick is a runner, and his goal is to complete four laps around a circuit at an average speed of 10 mph. If he completes the first three laps at a constant speed of only 9 mph, what speed does he need to maintain in miles per hour on the fourth lap to achieve his goal?

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2. A tree has 10 pounds of apples at dawn. Every afternoon, a bird comes and eats x pounds of apples. Overnight, the amount of food on the tree increases by 10%. What is the maximum value of x such that the bird can sustain itself indefinitely on the tree without the tree running out of food?

3. Given that $f(x) + 2f(8 - x) = x^2$ for all real x , compute $f(2)$.

4. Compute the largest root of $x^4 - x^3 - 5x^2 + 2x + 6$.

5. Find all real x that satisfy $\sqrt[3]{20x + \sqrt{20x + 13}} = 13$.

6. In triangle ABC , $AC = 7$. D lies on AB such that $AD = BD = CD = 5$. Find BC .

7. Peter is chasing after Rob. Rob is running on the line $y = 2x + 5$ at a speed of 2 units a second, starting from the point $(0, 5)$. Peter starts running t seconds after Rob, running at 3 units a second. Peter also starts at $(0, 5)$, and catches up to Rob at the point $(17, 39)$. What is the value of t ?

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8. An isosceles right triangle is inscribed in a circle of radius 5, thereby separating the circle into four regions. Compute the sum of the areas of the two smallest regions.