Jean made a New Year’s resolution to get in shape. She decides to run for 30 minutes on Tuesdays, Thursdays, Saturdays and Sundays. If Jean plans to run at an average speed of 6 mi/h, how many miles will she run during the month of February 2017?

There are 4 Tuesdays, 4 Thursdays, 4 Saturdays and 4 Sundays in February, which means that she will run for 0.5 hour × 4 × 4 = 8 hours during February. Thus, Jean will run 8 × 6 = 48 miles in February.

After some consideration, Jean decides that it might be better to run for 30 minutes at an average speed of 5 mi/h on her first day of running in February and then increase her average speed by 1/10 mi/h each day she runs, thereafter. Based on this, how many fewer total miles will Jean run in February than if she were to run for 30 minutes at an average speed of 6 mi/h each day she runs?

Calculating the number of miles Jean runs each day in February, 5 × 0.5 = 2.5 miles, 5.1 × 0.5 = 2.55 miles, 5.2 × 0.5 = 2.6 miles, 5.3 × 0.5 = 2.65 miles, we quickly see that this forms an arithmetic sequence. Each time she increases her speed by 0.1 mi/h, her distance increases by 0.05 mile. To calculate the sum of the number of terms in a finite arithmetic sequence, we find the sum of the first and last terms, multiply the result by the number of terms, and then divide by 2. The 16th term (the number of miles she would run on her last running day in February) is 2.5 + (0.05 (16 – 1)) = 3.25 miles. Thus, the total number of miles Jean would run is ((2.5 + 3.25) × 16)/2 = 46 miles. That is 48 – 46 = 2 miles fewer than if she ran at an average rate of 6 mi/h each time she ran in February.

By following the new plan, by what percent will Jean have increased her average running speed in February from the first day she runs to the last day she runs?

If Jean starts in February, running at an average speed of 5.0 mi/h and increases her speed by 0.1 mi/h each time she runs, the last day she runs in February she will run at an average speed of 5.0 + (0.1(16 – 1)) = 6.5 mi/h. That is an increase of 6.5 – 5.0 = 1.5 mi/h, which is a percent increase of 1.5/5.0 × 100 = 30%.
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