Exploring Two Nearby Stars to the Sun.

The Hubble Space Telescope recently took a picture of the currently nearest star to our sun, Proxima Centauri, which is at a distance of 4.243 light years (1 light year = 9.5 trillion km). The orbits of several other stars near the sun are also known, and during the next 80,000 they will replace Proxima Centauri as the nearest star to our sun.

For this problem we will study the two stars Ross 128 and Gliese 445.

The quadratic equations that approximate the distance to each star from our sun in light years are given by:

Gliese 445 : $D = 0.0104\,T^2 - 0.942\,T + 25.382$

Ross 128 : $D = 0.0007\,T^2 - 0.1197\,T + 11.003$

where T is the number of years from the current year in <u>multiples</u> of 1000 years.

Problem 1 – What are the distance ranges for each star over the time interval from 10,000 to 70,000 in the future?

Problem 2 – For what values of T, in years, will the distances be identical?

Problem 3 – What will be the distances to the stars when their distances are identical?

Problem 4 – When will the two stars be exactly 3.00 light years apart sometime over the time range from 30,000 to 80,000 years from now?

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Problem 1 – What are the distance ranges for each star over the time interval from 10,000 to 70,000 in the future?

Answer: Gliese 445: T=10 so D = 17.00 Ly; T = 70 so D = 10.40 ly **[10.40 , 17.00]**
Ross 128: T=10, so D = 9.88 ly ; T=70 so D = 6.05 ly **[6.05 , 9.88]**

Problem 2 – For what values of T, in years, will the distances be identical?

Answer: Set the two equations equal to each other and solve the resulting quadratic equation for its two roots using the Quadratic Formula.

$0 = (0.0104-0.0007)T^2 + (-0.942 + 0.1197)T + (25.382 – 11.003)$

So the coefficients are a = +0.0097 b= -0.822 and c = +14.379

The roots are $T = [–b +/- (b^2-4ac)^{1/2}]/ 2a$ so
$T = 42.37 +/- 51.54 (0.6757-0.5579)^{1/2}$

T1 = 24,700 years and T2 = 60,000 years.

Problem 3 – To the nearest tenth of a light year what will be the distances to the stars when their distances are identical?

Answer: At 24,700 years, T = 24.7 so D = **8.5 light years**
60,000 years, T=60 so D = **6.3 light years**

Problem 4 – When will the two stars be exactly 3.00 light years apart sometime over the time range from 30,000 to 80,000 years from now?

Answer: We want the difference between the two quadratic equations to be 10.0

$3.0 = 0.0097T^2 – 0.822T + 14.379$ so we solve $0 = 0.0097T^2 – 0.822T + 11.379$

$T = [0.822 +/- (0.6757 – 0.4415)^{1/2}] / 0.0194$
T = 42.37 +/- 51.54(0.4839)
T1 = 67.3
T2 = 17.4

So the only solution in the required time interval is **67,300** years from now.