Topic: Sales decline

Question: A t-shirt company noticed that their inventory of blue shirts was declining exponentially at a rate of $23\,\%$ per year. They currently have 300 blue shirts in stock and they don't plan to purchase any more. How many blue shirts will they have in stock in 3 years?

Answer choices:

A 250

B 200

C 150

D 100

Solution: C

Both the interest rate and time have units in years, so with matching units we can plug directly into the exponential decay formula to find the number of blue shirts the company will have in stock in 3 years.

$$S(t) = S_0 e^{-\lambda t}$$

$$S(t) = 300e^{-0.23(3)}$$

$$S(t) = 300e^{-0.69}$$

$$S(t) \approx 150$$

Topic: Sales decline

Question: A pet store noticed that sales of generic cat food was declining at an exponential rate of $8\,\%$ per year. If they currently sell 600 bags of generic cat food in one year, how many years will it take before they're only selling 100 bags annually?

Answer choices:

A 22.4 years

B 24.4 years

C 24.2 years

D 42.4 years

Solution: A

Both the interest rate and time have units in years, so with matching units we can plug directly into the exponential decay formula to find the number of years until sales reach the level of 100 bags per year.

$$S(t) = S_0 e^{-\lambda t}$$

$$100 = 600e^{(-0.08)t}$$

$$\frac{1}{6} = e^{-0.08t}$$

Apply the natural logarithm to both sides.

$$\ln \frac{1}{6} = \ln(e^{-0.08t})$$

$$\ln \frac{1}{6} = -0.08t$$

$$t = \frac{\ln \frac{1}{6}}{-0.08}$$

$$t \approx 22.4$$

Topic: Sales decline

Question: Pixie stick sales are declining at a candy store. Two years ago, the store sold 450 pixie sticks, but this year they're only selling 150. Assuming that sales have declined exponentially, what's been the annual rate of decline?

Answer choices:

A $5\,\%$

B $5.50\,\%$

C $0.55\,\%$

D $55\,\%$

Solution: D

Both the interest rate and time have units in years, so with matching units we can plug directly into the exponential decay formula to find the rate of decline.

$$S(t) = S_0 e^{-\lambda t}$$

$$150 = 450e^{-\lambda(2)}$$

$$\frac{1}{3} = e^{-2\lambda}$$

Apply the natural logarithm to both sides.

$$\ln \frac{1}{3} = \ln(e^{-2\lambda})$$

$$\ln \frac{1}{3} = -2\lambda$$

$$\lambda = \frac{\ln \frac{1}{3}}{-2}$$

$$\lambda = 0.55$$