GROWTH, DECAY, & LOGS

A population increases from 100 to 120 to 144.

- Find the growth rate r between each interval.
- Find the growth factor a.
- Explain the relationship between a and r.

$r = \frac{120-100}{100} = \frac{20}{100} = 0.20 = 20\%$

$r = \frac{144-120}{120} = \frac{24}{120} = 0.20 = 20\%$

$a = 1 + 0.20 = 1.2$

decay $\quad$ 0.40 - 1 = 0.6

A medication loses 40% of its amount each hour. Initial dose: $\underbrace{500}_{P}$ mg.

- Write the exponential decay model. ✓
- How much remains after 3 hours? ✓

$A(t) = Pr^t = A(t) = 500(0.6)^t$

$A(3) = 500(0.6)^3 = 108$ mg

A population of insects doubles every 6 days. Initially there are 120 insects.

2

c

t/6

- Write the exponential model.
- How many insects after 18 days?

$P(t) = C \cdot a^{t}$ $\quad P(t) = 120 \cdot 2^{t/6}$

$P(18) = 120 \cdot 2^{18/6} = 120 \cdot 2^{3} = 120 \cdot 8 = 960$ insects

A town's population grows continuously at 1.8% per year. In 2020, the population was 42,000.

0.018

Pe^{rt} $\quad P$

- Write the model.✓
- Predict the population in 2030. $t=10$
- When will the population reach 60,000? $P(t)$

$P(t) = 42{,}000\, e^{0.018 \cdot t}$

$P(10) = 42{,}000\, e^{0.018 \cdot 10} = 42{,}000 \cdot 1.197 \approx 50{,}300$ People

$\frac{60{,}000}{42{,}000} = \frac{\cancel{42{,}000}\, e^{0.018t}}{\cancel{42{,}000}} = \ln 1.43 = \cancel{\ln e}^{0.018t}$

$\frac{\ln 1.43}{0.018} = \frac{0.018t}{0.018} = t = 19.8$ year