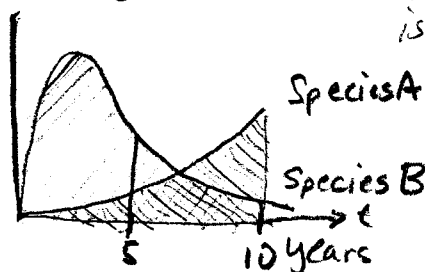




1. The populations of two species of plants have the growth rates shown in the graphs below. The population of the two species are equal at time $t=0$. Which species has the larger population after 5 years? After 10 years? Which species do you think will have the larger population after 20 years? Use the graph to explain all of your answers.

New plants per year



The areas under the "species per year" curves (shaded  for A, and  for B) is "plants / yr" \cdot "yr" = "plants" accumulated

From $0 \rightarrow 10$ yrs, The area under the B curve from $0 \rightarrow 5$ yrs. is larger than the area under A for the same period.

Same for $0 \rightarrow 10$ yrs, although species A is catching up. After 10 yrs, species

B looks like it has stopped growing new plants, but species A is accumulating area faster and faster. It will probably be larger in 20 yrs.

2. A helicopter gains altitude at a rate given by the formula $f(t) = e^{-t} + 2 + \frac{t^3}{9}$,

where f is measured in feet per second, and t is in seconds. At $t=1$, the helicopter is 50 feet off the ground.

- Write an expression which will give the total change in altitude of the helicopter during the time interval between $t=1$ and $t=3$.
- How high is the helicopter at $t=3$? (Use the fundamental theorem of calculus to evaluate the integral.)

$$a) \int_1^3 e^{-t} + 2 + \frac{t^3}{9} dt$$

b) The change in altitude from $t=1$ to 3 is the integral in part (a):

$$\int_1^3 e^{-t} + 2 + \frac{1}{9} t^3 dt = -e^{-t} + 2t + \frac{t^4}{36} \Big|_1^3$$

$$= \left(e^{-3} + 2 \cdot 3 + \frac{3^4}{36} \right) - \left(-e^{-1} + 2 + \frac{1}{36} \right)$$

$$= (8.2) - (1.7) = 6.5$$

Since the helicopter was already 50 ft. off the ground at $t=1$, it's 56.5 ft high at $t=3$.