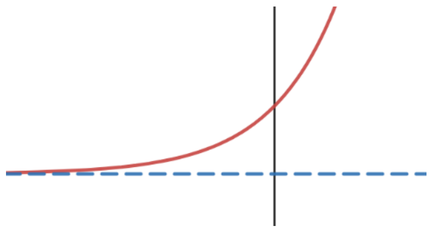
Modelling Exponential Functions

KNOW	DO	UNDERSTAND
The basic shape an exponential model will follow.	Can solve problems involving exponential functions	*Function Characteristics*: Can build a model for an exponential function. Understands the significance of the asymptote to the model and the behaviour around the asymptote. Can justify when an exponential function will reach the asymptote.
Vocab & Notation • None		

When we model an exponential problem there are four cases that the exponential could look like:

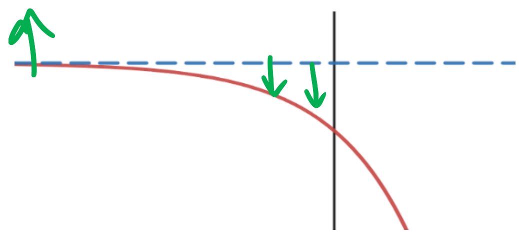
1



→ interest growth

→ population growth (start) ☆

2

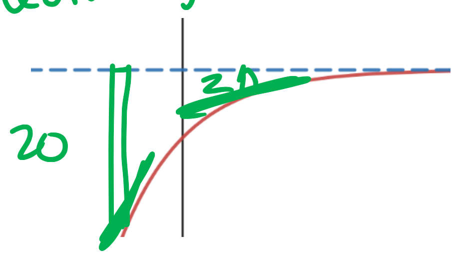


→ population decline from stable (start)

→ value of something (investment acount) with regular withdrawl rate

3

→ collection growth (random)

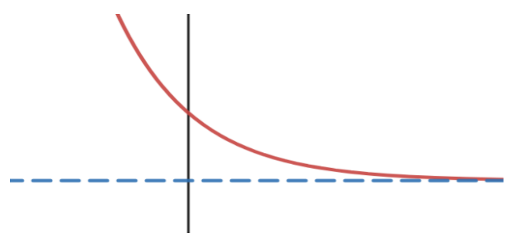


→ infection thru a population (end) ☆ (popularity)

→ heating

→ population growth (to stable) (end)

4



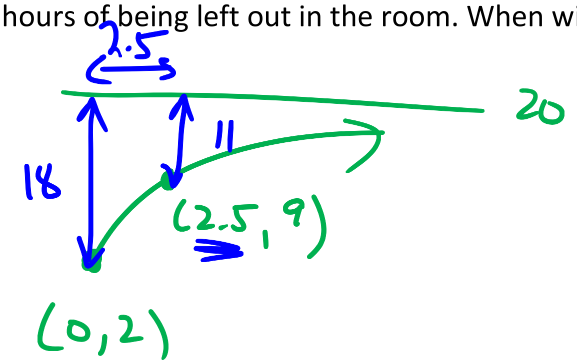
→ cooling temperature

→ # new infected (end)

→ population decay (to stable) (end)

→ how many left to collect

Example: A glass of ice water (2°C) is left in a room that is 20°C. If it is left for 2.5 hours, at which time the temperature of the glass of water warmed to 9°C. Determine a function for the temperature of water after t hours of being left out in the room. When will the water be 15°C? When will the water be room temperature?



$\exp(x) = e^x$

$$T(t) = -18\left(\frac{11}{18}\right)^{\frac{t}{2.5}} + 20$$

CP
shift = 0

$$T(t) = -18 \exp\left(\frac{t}{2.5} \ln\left(\frac{11}{18}\right)\right) + 20$$

$T: \mathbb{Q} \to \mathbb{N} \cap [2, 20]$

$t \geq 0$

$$15 = -18 \exp\left(\frac{t}{2.5} \ln\left(\frac{11}{18}\right)\right) + 20$$

$$t = \frac{\ln\left(\frac{15-20}{-18}\right)}{\ln\left(\frac{11}{18}\right)} \cdot 2.5 = 6.5 \Rightarrow \text{6 hrs 30 min to } 15°C$$

$$19.5 = -18 \exp\left(\frac{t}{2.5} \ln\left(\frac{11}{18}\right)\right) + 20 \quad , \quad 19.5 \equiv 20$$

equivalent

$$t = \frac{2.5 \ln\left(\frac{19.5-20}{-18}\right)}{\ln(11/18)} = 18.2 \Rightarrow \text{18 hrs + 15 min}$$

Practice Problems: 7.3 page 364-365 # 8-14
8.4 page 414-415 # 11, 13, 15-17