<u>Linear</u> functions represent quantities that <u>change at a constant rate</u>. Now we'll talk about <u>exponential</u> functions which represent change at a <u>constant percent rate</u>.

An exponential function is given by $\boxed{Q = f(t) = ab^t}$, where

a is the initial amount   ($t = 0 \Rightarrow ab^0 = a$)

b is the growth factor

$\boxed{b = 1 + r}$, with r being the growth rate.

- If you have exponential growth, then $r > 0$ and $b > 1$
  - If you have exponential decay, then $r < 0$ and $0 < b < 1$ (b is still positive)

$Q = ab^t$

$b > 1$
$r > 0$

a

$Q = ab^t$

$r < 0$
and $0 < b < 1$

a
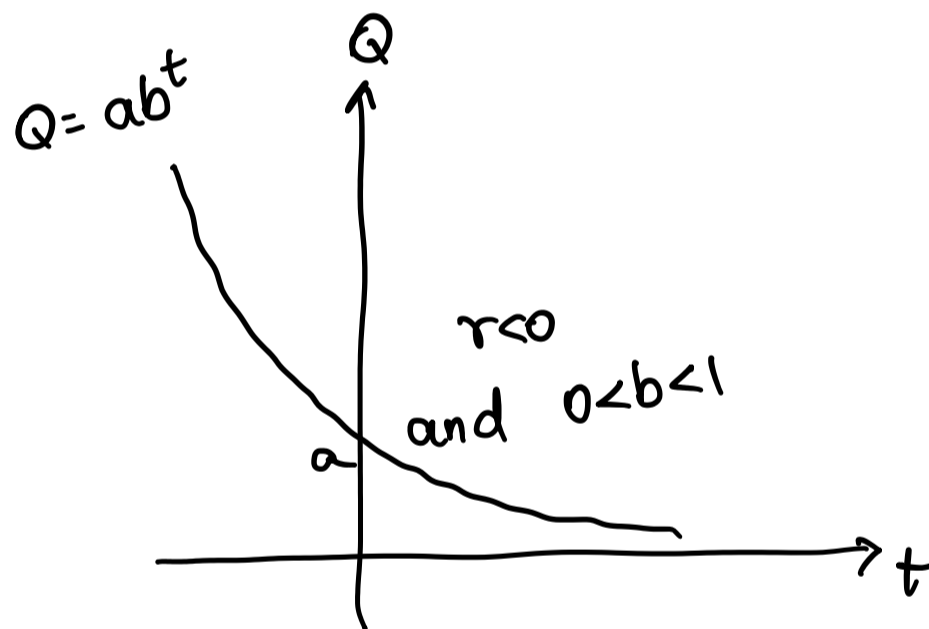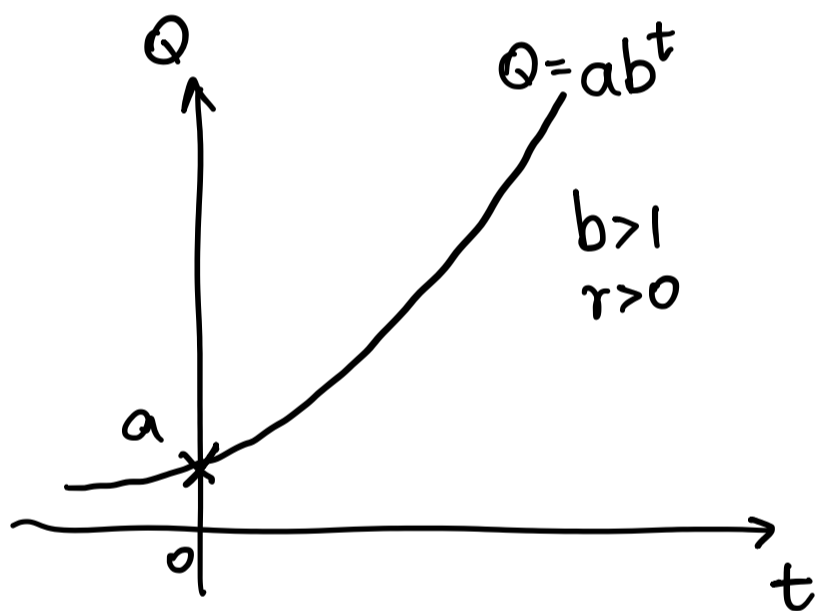
<u>Concave up</u>

<u>Example</u>. Twelve percent of a radioactive substance decays in 10 years. By what percent does the substance decay each year?

$\boxed{y = ab^t}$ ← $t = 10$

at $t = 10$, $y = 0.88a$
   $t = 0$, $y = a$

$\boxed{ab^{10} = 0.88a}$

$b^{10} = 0.88$

$b = (0.88)^{1/10}$

Recall $b = 1 + r$
          ↑
  growth / decay rate

$\Rightarrow$ $r = b - 1$

     $= (0.88)^{1/10} - 1$

Percent decay each year: $100\left((0.88)^{1/10} - 1\right)\%$