

1. [12 pts.] In 1910 the population of Mars was about 12 million and growing at 3.5% annually.

(a) Write an expression for the function  $f(t)$  that gives the population of Mars, in millions,  $t$  years after 1910.

$$f(t) = P_{10} \cdot e^{rt} = 12 \cdot e^{rt} = 12 (1.035)^t$$

write  $e^{rt} = 1.035^t \Rightarrow rt = t \cdot \ln 1.035 \Rightarrow r = \frac{\ln 1.035}{1} \approx .0344$

so  $f(t) = 12 e^{.0344t}$

Final answer to (a):

$$f(t) = 12 e^{.0344t}$$

(b) Find the rate of growth, in people/year, of the population of Mars in 1915.

$$\text{growth rate} = \frac{df}{dt}(5) = \frac{d}{dt} (12 e^{.0344t}) \Big|_{t=5} \approx .4128 e^{(.0344) \cdot 5}$$

$$\approx .4903$$

Final answer to (b):

$$.4903$$

(c) Interpret the statement  $(f^{-1})'(30) = 0.96895$  in practical terms.

when the population is 30 million, it

is increasing at a rate of  $\frac{1}{.96895} \approx 1.032$  million/yr