1. Graph. List the intercepts, asymptotes, domain and range.

   (a) $y = -2^x + 1$
   Int: $(0, 0)$ A: $y = 1$ D: $(-\infty, \infty)$ Range: $(-\infty, 1)$

   (b) $y = 3^{-x} + 1$
   Int: $(0, 2)$ A: $y = 1$ D: $(-\infty, \infty)$ Range: $(1, \infty)$

   (c) $y = -e^{x-2}$
   Int: $(0, -e^{-2})$ A: $y = 0$ D: $(-\infty, \infty)$ Range: $(-\infty, 0)$

   (d) $y = -\log_2(-x)$
   Int: $(-1, 0)$ A: $x = 0$ D: $(-\infty, 0)$ Range: $(-\infty, \infty)$

   (e) $y = -\log_3(x - 2) + 1$
   Int: $(5, 0)$ A: $x = 2$ D: $(2, \infty)$ Range: $(-\infty, \infty)$

   (f) $y = \ln(x + e)$
   Int: $(0, 1), (0, 1 - e)$ A: $x = -e$ D: $(-e, \infty)$ Range: $(-\infty, \infty)$

2. A bacteria colony grows exponentially. The population starts with 1000. Four hours later the population is 5000.
   $N_0 = 1000$, $N(4) = 5000$

   (a) Find the growth constant $k$.

$$\begin{aligned} N(t) &= N_0 e^{kt} \\ 5000 &= (1000)e^{4k} \\ 5 &= e^{4k} \\ \ln 5 &= 4k \\ \frac{\ln 5}{4} &= k \end{aligned}$$

   (b) What is the population 3 hours after the start?

$$\begin{aligned} N(3) &= 1000(e^{3\frac{\ln 5}{4}} \\ &= (1000)5^{3/4} \\ &\approx 3343.7 \qquad \text{(not necessary)} \end{aligned}$$

   "The population is $(1000)5^{\frac{3}{4}}$ organisms after 3 hours."

   (c) How long will it take for the population to reach 10,000?

$$\begin{aligned} 10000 &= (1000)e^{t\frac{\ln 5}{4}} \\ 10 &= 5^{t/4} \\ \log_5 10 &= \frac{\ln 10}{\ln 5} = \frac{t}{4} \\ t &= \frac{4\ln 10}{\ln 5} \approx 5.722 \end{aligned}$$

(not necessary)

"It will take $\frac{4\ln 10}{\ln 5}$ years for the population to reach 10,000"