3.5 Day 2 WS
HPC

Name:____________________
Hour:______

Find an exponential function having the given values.

a. $f(0) = 5, f(3) = 40$

$y = ab^x$
$40 = 5(b)^3$
$8 = b^3$
$b = 2$
$\boxed{y = 5(2)^x}$

b. $f(3) = 16, f(6) = 128$

$y = ab^x$
$128 = ab^6$
$16 = ab^3$
$8 = b^3$
$b = 2$
$16 = a(2)^3$
$a = 2$
$\boxed{y = 2(2)^x}$

2. A colony of bacteria decays so that the population t days from now is given by $(t) = 1000\left(\frac{1}{2}\right)^{\frac{t}{4}}$.

a. What is the amount present when $t = 0$? $\boxed{\text{1000 bacteria}}$

b. How much will be present in 4 days? $1000\left(\frac{1}{2}\right)^{4/4} = \boxed{\text{500 bacteria}}$

c. What is the half-life? $\boxed{\text{4 days}}$

3. The table shows the amount $A(t)$ in grams of a radioactive element present after t days. Suppose that $A(t)$ decays exponentially.

t days	0	2	4	6	8	10
$A(t)$	320	226	160	115	80	57

a. What is the half-life of the element? $\boxed{\text{4 days}}$

b. About how much will be present after 16 days? $320\left(\frac{1}{2}\right)^{16/4} = \boxed{20\text{ g}}$

c. Find an equation for $A(t)$. $\boxed{A(t) = 320\left(\frac{1}{2}\right)^{t/4}}$

5. An amount A_0 of a radioactive iodine has a half-life of 8.1 days. In terms of A_0, how much is present after 5 days?

$A_0\left(\frac{1}{2}\right)^{5/8.1}$

$\boxed{.65A_0}$

6. In a research experiment, a population of fruit flies is increasing according to the law of exponential growth. After 2 days, there are 125 flies, and after 4 days, there are 350 flies. How many flies will be there after 6 days? *Round down to the nearest whole number.*

$(2, 125)$ $(4, 350)$

$350 = ab^4$
$125 = ab^2$
$\frac{14}{5} = b^2$

$b = \sqrt{\frac{14}{5}}$

$125 = a\left(\sqrt{\frac{14}{5}}\right)^2$
$125 = a \cdot \frac{14}{5}$
$a = \frac{625}{14}$

$y = \frac{625}{14}\left(\sqrt{\frac{14}{5}}\right)^6$
$\frac{625}{14} \cdot \frac{2744}{125}$
$\boxed{y = 980\text{ flies}}$

7. The population P (in thousands) of Las Vegas, Nevada can be modeled by $P = 258.0e^{kt}$ where t is the year, with $t = 0$ corresponding to the year 1990. In 2000, the population was 478,000.

a. Find the value of k for the model. Round your result to four decimal places.

$478{,}000 = 258000e^{10k}$

$\frac{478000}{258000} = e^{10k}$

$\frac{\ln\left(\frac{478000}{25800}\right)}{10} = k$

$k = 0.0617$

b. Use your model to predict the population in 2017.

$258e^{.0617(27)}$

$\boxed{P \approx 1{,}364{,}931}$

8. The population of the world in 2000 was 6.1 billion, and the estimated relative growth rate was 1.4% per year. If the population continues to grow at this rate, when will it reach 122 billion? Use $y = ae^{bt}$

$122 = 6.1e^{.014t}$

$\frac{122}{6.1} = e^{.014t}$

$\frac{\ln(122/6.1)}{.014} \approx t$

$t \approx 213.9$

$\boxed{\text{year } 2213}$

9. A culture starts with 10000 bacteria and the number doubles every 40 minutes.

a. In the half-life formula, use a 2 instead of $\frac{1}{2}$ to find a function that models the number of bacteria at time t. $\boxed{A = 10000(2)^{t/40}}$

b. Find the number of bacteria after 1 hour. $10000(2)^{60/40} = \boxed{28284 \text{ bacteria}}$

a. After how many minutes will there be 50000 bacteria?

$50000 = 10000(2)^{t/40}$

$5 = 2^{t/40}$

$\log 5 = \frac{t}{40}\log 2$

$t = \frac{40\log 5}{\log 2}$

$\boxed{t = 92.88 \text{ min}}$

10. A culture starts with 8600 bacteria. After 1 hour, the count is 10000.

a. Find a function that models the number of bacteria after t hours. Use $y = ae^{bt}$

$10000 = 8600e^{b}$ $\quad \frac{10000}{8600} = e^{b}$ $\quad \ln(10000/8600) = b$

$b \approx .1508$

$y = 8600e^{.1508t}$

b. Find the number of bacteria after 2 hours.

$8600e^{.1508(2)}$

$\approx \boxed{11627}$

c. After how many minutes will the number of bacteria double?

$17200 = 8600e^{.1508t}$

$2 = e^{.1508t}$

$\frac{\ln 2}{.1508} = t$

$\boxed{t \approx 4.60 \text{ hours}}$