# 7.3 Models of Growth and Decay Exponential Functions

**Write an exponential function for each situation then solve the problem.**

1. There are now 300 insects in a colony. The population doubles every 5 days. What is the population in 18 days?

$A_0$ $c=2$ $T=5$ $t=18$

$$A = A_0(c)^{\frac{t}{T}}$$
$$= (300)(2)^{\frac{18}{5}}$$
$$= (300)(2)^{3.6}$$
$$= 3637.72$$

round down $\boxed{A = 3637 \text{ bugs}}$

2. For every meter a diver descends below the surface, the light intensity is reduced by 2.5%. $P$ is the percent of surface light present. At a depth of 10m how much light remains?

$c = 1 - 0.025 = 0.975$

$A_0 = 100\%$ $n = 10$

$A = ?$

$$A = A_0(c)^n$$
$$A = (100)(0.975)^{10}$$
$$\boxed{A = 77.6\%}$$

3. A radioactive substance has a half-life of 6 years. If 20 grams are present initially, how much will remain after 2 years?

$c = \frac{1}{2}$ $T = 6$ $A_0 = 20$ $A = ?$ $t = 2$

$$A = (20)\left(\frac{1}{2}\right)^{\frac{2}{6}}$$
$$= 20(0.7937)$$
$$\boxed{A = 15.87\text{g}}$$

**Write an exponential function for each situation then solve the problem algebraically.**

4. The half-life of radioactive iodine is 8.2 days. After how long will only 25% of the iodine be present?

$c = \frac{1}{2}$ $T = 8.2$ $t = ?$ $A = 25$, $A_0 = 100$

$$\frac{25}{100} = \frac{100\left(\frac{1}{2}\right)^{\frac{t}{8.2}}}{100}$$
$$0.25 = (0.5)^{\frac{t}{8.2}}$$
$$(0.5)^2 = (0.5)^{\frac{t}{8.2}}$$
$$2 = \frac{t}{8.2}$$

$\boxed{t = 16.4 \text{ days.}}$

5. A bacteria starts with 6250 bacteria and doubles every 3 hours. When will the bacteria count be 50000?

$A_0$ $c = 2$ $T = 3$ $t = ?$ $A$

$$\frac{50000}{6250} = \frac{6250(2)^{\frac{t}{3}}}{6250}$$
$$8 = 2^{\frac{t}{3}}$$
$$2^3 = 2^{\frac{t}{3}}$$

Exp only $3 = \frac{t}{3}$

$\boxed{t = 9 \text{ hours}}$

6. A colony of insects numbers 500 and doubles every 8 days. How long ago was the population 125?

$A$ $\quad A_0 \quad c=2 \quad T=8 \quad t=?$

$$\frac{125}{500} = \frac{500(2)^{\frac{t}{8}}}{500}$$

$$0.25 = 2^{t/8}$$

$$2^{-2} = 2^{t/8}$$

Exp. only $-2 = \frac{t}{8}$

$-16$ days $= t$

16 days ago

7. A radioactive substance has a half-life of 3.5 years. How long will it take for only 6.25% of it to remain?

$c = \frac{1}{2} \quad T \quad t=? \quad A = 6.25 \quad A_0 = 100$

$$\frac{6.25}{100} = \frac{100\left(\frac{1}{2}\right)^{t/3.5}}{100}$$

$$0.0625 = (0.5)^{t/3.5}$$

$$(0.5)^4 = (0.5)^{t/3.5}$$

Exp. only $4 = t/3.5$

$t = 14$ years

8. A painting triples in value every 8 years. It is currently worth \$1000. When will the painting be worth \$243000?

$A \quad c=3 \quad T=8 \quad A_0 \quad t=?$

$$\frac{243000}{1000} = \frac{1000(3)^{t/8}}{1000}$$

$$243 = (3)^{t/8}$$

$$3^5 = 3^{t/8}$$

Exp. only $5 = \frac{t}{8}$

40 years $= t$

9. A piece of machinery valued at \$30,000 depreciates at a rate of 10% per year. How much will it be worth in 7 years?

$t=7 \quad A_0 \quad c = 1-0.1 = 0.9 \quad A$

$$A = 30{,}000(0.9)^{\frac{7}{1}}$$

$$= 30{,}000(0.4783)$$

$A = \$14348.91$

10. \$1000 is invested at a rate of 3.2% compounded monthly. How much will it be worth in 50 years?

$P \quad r = 0.032 \quad n = 12 \quad A \quad t = 50$

$$A = P\left(1+\frac{r}{n}\right)^{nt}$$

$$= 1000\left(1+\frac{0.032}{12}\right)^{12\cdot 50}$$

$$= 1000(1.0027)^{600}$$

$A = \$4942.50$