Mr. Konichek
Math 111
5.6 Pg 399 (1, 3, 7, 8, 9)

1.

$$Q(t) = 300e^{0.02t}$$

a. $K = 0.02$ for this problem (IN THIS CASE)

b. $Q_0 = Q(0) = 300$ because $t = 0$ and $e^{0.02t} = e^0 = 1$

c.

t	0	10	20	100	1000
Q	300	366.42	447.55	2216.7	1.5×10^{11}

I used my graphing calculator
1. Y=
2. TBLSET
3. TABLE

3. Growth of Bacteria under ideal laboratory conditions

a. (from example Pg 392) $\quad Q(t) = Q_0 e^{kt}$

given: $\quad Q(0) = 100e^{k(0)} = 100$

$$Q(20) = 100e^{20k} = 200$$

$$e^{20k} = \frac{200}{100} = 2$$

$$\ln e^{20k} = \ln 2$$

$$20k \ln e = .6931$$

$$20k = .6931$$

$$k = \frac{.6931}{20} = \cancel{.04455}\ .03466$$

$$\boxed{\text{Thus } Q(t) = 100e^{.03466t}}$$

b.

$$100e^{.03466t} \doteq 1{,}000{,}000$$

$$e^{.03466t} \doteq \frac{1{,}000{,}000}{100} = 10{,}000$$

$$.03466t \ln e \doteq \ln 10^4$$

$$t \doteq \frac{4 \ln 10}{.03466} \doteq 265.734 \doteq \boxed{266 \text{ minutes}}$$

c. The K for Escherichia coli would not change just Q_0

so $\quad Q(t) = 1000e^{.03466t}$

Sec 5.6 Pg 399 (#7)

7. Atmospheric Pressure (cool, I am a high mt. climber)

$$P = P_0 e^{-kh}$$

given: $P(0) = 15e^{-k(0)} = \boxed{15 \text{ lb/in}^2 \text{ at sea level}}$

$$P(4000) = 15e^{-4000k} = 12.5$$

$$e^{-4000k} = \frac{12.5}{15} = .83\bar{3}$$

$$\ln e^{-4000k} = \ln(.8\bar{3})$$

$$-4000k \doteq -.182322$$

$$k \doteq \frac{-.182322}{-4000} \doteq .00004558$$

$$P(12000) = 15e^{(-.00004558)(12000)}$$

$$P(12000) = 15e^{-.546966}$$

$$P(12000) \doteq 8.680544 \doteq \boxed{8.7 \text{ lb/in}^2 \text{ at } 12{,}000 \text{ ft}}$$

$$p'(h) = \frac{d}{dh}\left(15e^{-0.00004558h}\right)$$

$$P'(h) \doteq -0.0006837e^{-0.00004558h}$$

$$P'(12000) \doteq -0.0006837e^{-0.00004558(12{,}000)}$$

$$P'(12000) \doteq -0.00039566157$$

Thus the atmospheric pressure is declining at the rate of about 0.0004 lb/in²/ft

The highest mountain in the world is Aconcagua (according to Geography prof.)

extra because I was interested: at 22,841 ft

$$P(22{,}841) = 15e^{(-.00004558(22{,}841))} \doteq \boxed{5.296 \text{ lb/in}^2 \text{ at where I was}}$$

$$P'(22{,}841) \doteq -0.0006837e^{-0.00004558(22{,}841)} \doteq -.00024139 \text{ lb/in}^2/\text{ft}$$

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Math 111 Homework
5.6 Pg 399 (1, 3, 7, 8, 9)
Cont.

Sec. 5.6 Cont.

Pg 399 (8, 9)

8. Given: $Q(t) = Q_0 \cdot 2^{-(t/140)}$

$Q(280) = 20\,mg$

$Q(280) = Q_0\, 2^{-280/140} = 20$

$Q_0 \cdot 2^{-2} = 20$

$\frac{1}{4} Q_0 = 20$ Thus $\boxed{Q_0 = 80\ mg}$

note [from examples 2 & 3 (Pg 393, Pg 394)]. decay constant

9. P-32 at T is given by $Q(t) = Q_0\, e^{-kt}$

first find K for P-32

$$\frac{1}{2} Q_0 = Q_0\, e^{-14.2K}$$

$$e^{-14.2K} = \frac{1}{2}$$

$$-14.2K = \ln \frac{1}{2}$$

$$K = -\frac{\ln(1/2)}{14.2} \approx .0488$$

So $\boxed{Q(t) = 100e^{-0.0488t}}$

$Q(7.1) = 100e^{-.0488(7.1)}$

$= 100e^{-0.34648}$

$\boxed{Q(7.1) \approx 70.717 \text{ grams}}$

$Q'(t) = 100(-0.0488)e^{-0.0488t} = -4.88e^{-0.0488t}$

$Q'(7.1) = -4.88\, e^{-0.0488(7.1)}$

≈ -3.451 g/day

In case you cannot read it last two lines rewritten

$Q'(t) = -4.88e^{-0.0488t}$ so $Q'(7.1) = -4.88e^{-0.0488(7.1)} \approx \boxed{-3.451 \text{ g/day}}$ rate of decay