AFM Application Problems Unit 5

Round to the hundredths place when necessary and do not forget units.

1. A bacterial culture doubles every 2 hours. If the culture started with 24,000 bacteria, how many bacteria will be present in 5 hours?

$A = 24{,}000(2)^{5/2}$

$A = 135{,}765$ bacteria rounded up

2. The half life of a radioactive sample is 4 hours. If 60 g of the sample was initially present, how much will remain after 7 hours?

$A = 60(1/2)^{7/4}$

$A = 17.84$ g

3. The population of a town triples every 6 years. If 4000 people are present in 2006, how many people will be in the town in 2016?

$A = 4000(3)^{10/6}$

$A = 24{,}962$ people

4. The half life of a radioactive sample is 6.2 hours. If 2000 g of the sample is present after 7 hours, how much was initially present?

$2000 = P(1/2)^{7/6.2}$

$P = 4{,}375$ g.

5. A bacterial culture doubles every 5 hours. How long will it take for a culture to quadruple?

$4 = (2)^{t/5}$ $t = 10$ hours

6. A radioactive sample has a half life of 3 days. How long will it take for only 1/8 of the sample to remain?

$1/8 = (1/2)^{t/3}$ $t = 9$ days

7. The population of a town triples every 8 years. How many years will it take for the population to double?

5.05 years

$30 = 10e^{8k}$ $\frac{\ln 3}{8} = k$ $2 = e^{\frac{\ln 3}{8} \cdot t}$

8. The population of a town halves every 15 years. In how many years will 20% of the population have fled?

$.8 = (1/2)^{t/15}$

$t = \frac{15 \log .8}{\log .5}$ $t \approx 4.83$ years

9. A radioactive sample has a half life of 3 years, and has an initial mass of 68 g. How many **months** will it take for the sample to lose 8 g?

$60 = 68(1/2)^{t/36}$

$\log 60/68 = t/36 \log(1/2)$

$t = \frac{36 \log(60/68)}{\log(1/2)}$ $t \approx 6.5$ months

10. $5000 is invested at 7.2% compounded annually for 4 years. What is the amount of money at the end of the 4 years?

$A = 5000(1 + .072)^4$

$A = \$6{,}603.12$

11. $2300 is invested at 6% compounded monthly for 7 years. How much interest is earned?

$A = 2300\left(1 + \frac{.06}{12}\right)^{84}$

$A = \$3496.85$

Interest $= \$1196.85$

12. $300 is invested at 10% compounded quarterly. How many years must it stay in the bank to double?

$2 = \left(1 + \frac{.10}{4}\right)^{4t}$ $\quad t = \frac{\log 2}{4 \log 1.025}$

$\log 2 = 4t \log(1.025)$ $\quad t = 7.02$ years

13. An investment is invested at 5% compounded continuously. How many years will it take to triple in value?

$3 = e^{.05t}$

$\ln 3 = .05t \ln e$ $\quad t = 21.97$ years

$t = \frac{\ln 3}{.05}$

14. A small tremor of magnitude 3.4 is followed by a stronger one of magnitude 4.1. How much stronger is the second tremor than the first?

$= 10^{4.1-3.4}$

$= 10^{.7}$ $\quad I \approx 5.01$

15. An earthquake has a magnitude of 6.5, and the following day a stronger earthquake occurs with double the intensity. What is the magnitude of the stronger earthquake?

$2 = 10^{x-6.5}$

$\log 2 + 6.5 = x$ $\quad x \approx 6.8$

16. A strong earthquake with a magnitude of 6.7 is three times more intense than a weaker earthquake. What is the magnitude of the weaker earthquake?

$3 = 10^{6.7-x}$

$\log 3 = (6.7 - x) \log 10$

$x = 6.7 - \log 3$ $\quad x \approx 6.22$

17. A small tremor of magnitude 2.3 is then followed by a stronger one of magnitude 5.3. How much stronger is the second tremor than the first?

$10^{5.3-2.3}$

$= 10^3$ $\quad 1{,}000$ times

18. An earthquake has a magnitude of 6.7, and the following week a stronger earthquake occurs with six times the intensity. What is the magnitude of the stronger earthquake?

$6 = 10^{x-6.7}$

$\log 6 + 6.7 = x$ $\quad x \approx 7.48$

19. An earthquake with a magnitude of 5.9 is one thousand times more intense than a weaker earthquake. What is the magnitude of the weaker earthquake?

$1000 = 10^{5.9-x}$

$x = 2.9$

20. The formula for acid strength is: $pH = -\log[H^+]$, where PH is the acid strength and H^+ is the concentration of hydrogen ion. A beaker of acid has a hydrogen concentration of 3.5×10^{-6} mol/L. Calculate the pH of the acid.

$pH = -\log[3.5 \times 10^{-6}]$

$pH = 5.46$