W6 – 6.5 – Applications of Logarithms AND Exponentials in Physical Sciences MHF4U

Exponential Formulas

$$A(t) = A_0 (1+i)^t$$

$$A(t) = A_0 \left(\frac{1}{2}\right)^{\frac{t}{H}}$$

$$A(t) = A_0(2)^{\frac{t}{D}}$$

general, where *i* is percent growth(+) or decay(-)

half-life, *H* is the half-life period

doubling, *D* is the doubling period

Logarithmic Formulas

$$pH = -\log[H^+]$$

$$\beta_2 - \beta_1 = 10 \log \left(\frac{I_2}{I_1}\right)$$

$$M = \log(\frac{I}{I_0})$$

Where pH is acidity and [H+] is concentration of hydronium ions mol/L

Where β is loudness in dB and I is intensity of sound in W/m²

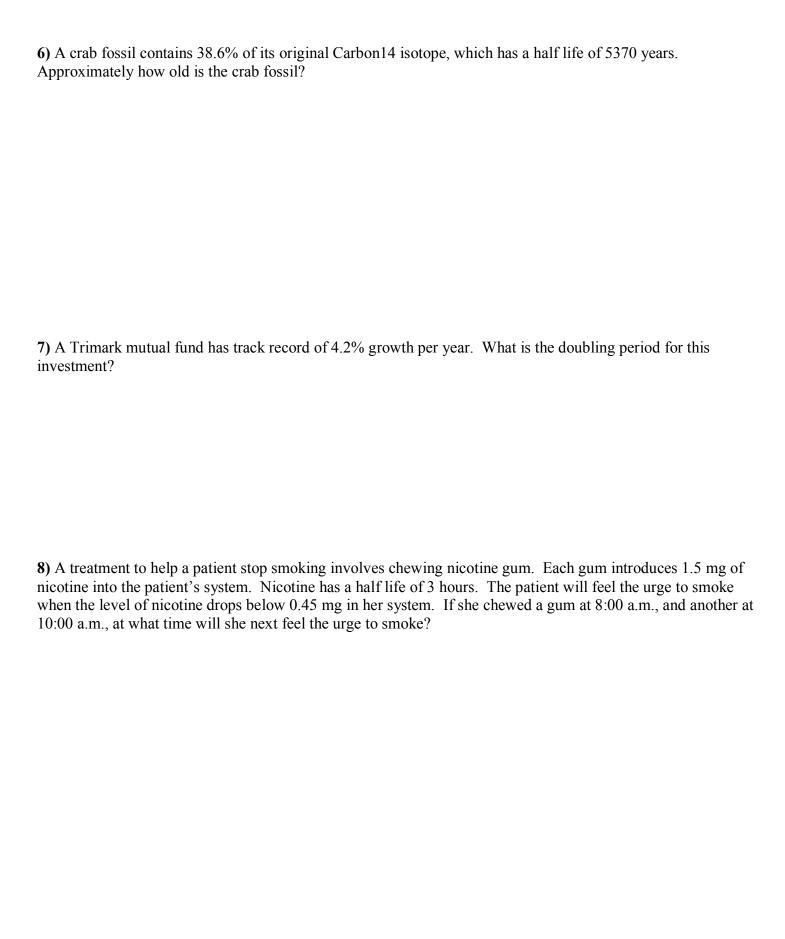
Where M is magnitude measure by richters, I is intensity

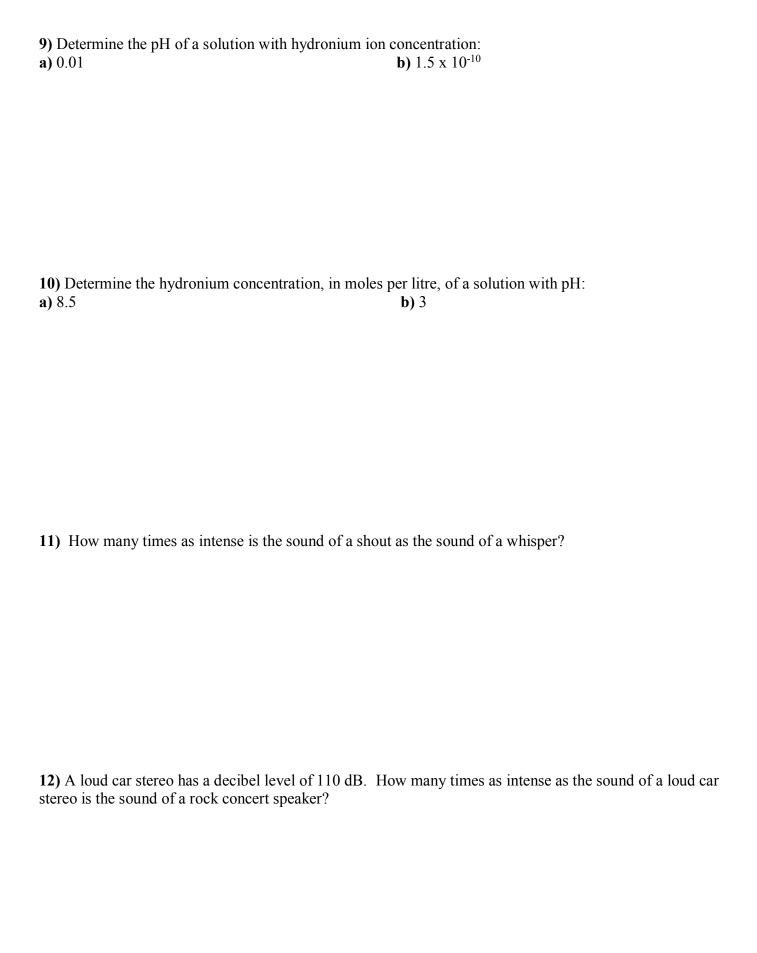
- 1) The half-life of a radioactive form of tritium is about 2 years. How much of a 5-kg sample of this material would remain after ...
 - a) 8 years

b) 12 months

2) The population of Littleton is currently (2014) 23000, and is increasing exponentially with a growth rate of 2% per year. Estimate when Littleton will have a population of 30000.

3) The population of purple martins in Algonquin park was estimated to be 35000 in 1992. Ten years later, in 2002, the population had risen to 44400.a) What is the annual growth rate for the purple martin population?
b) Estimate the population for 2010 to the nearest hundred.
4) After an accident at a nuclear plant, the radiation level in the plant was 950 R (roentgens). Five hours later the level was 800 R. How long will it take before safe levels of radiation are reached, which is less than 0.01 R?
5) The value of a new minivan drops 40% after the first year, and then decreases exponentially at a rate of 12% per year after that. When will a minivan that cost \$35000 new be worth less than \$10000?





13) The sound intensity of a pin drop is about 1/30 000 of the sound intensity of a normal conversation. What is the decibel level of a pin drop?
14) On September 26, 2001, an earthquake in North Bay, Ontario, occurred that was 10 000 times as intense as I_0 . What was the measure of this earthquake on the Richter scale?
15) On February 10, 2000, an earthquake happen in Welland, Ontario, that measured 2.3 on the Richter scale. a) How many times as intense was this as a standard low-level earthquake?
b) On July 22, 2001, an earthquake in St. Catharines measured 1.1 on the Richter scale. How many times as intense as the St.Catharines earthquake was the Welland earthquake?

16) The stellar magnitude scale compares the brightness of stars using the equation $m_2 - m_1 = \log(\frac{b_1}{b_2})$, where
m_2 and m_1 are the apparent magnitude of the two stars being compared (how bright they appear in the sky) and
b ₁ and b ₂ are their brightness (how much light they actually emit). This relationship does not factor in how far
from Earth the stars are.

a) Sirius is the brightest-appearing star in our sky, with an apparent magnitude of -1.5. How much brighter does Sirius appear than Betelgeuse, whose apparent magnitude in 0.12?

b) The Sun appears about 1.3×10^{10} times as brightly in our sky as does Sirius. What is the apparent magnitude of the Sun?