PRECALCULUS: COMPOUND INTEREST WORKSHEET

Compound Interest Formula

$$P(t) = P_0 \cdot (1 + r)^t$$

- $P(t)$ is the value after t time steps.
- P_0 is the principal or initial value.
- r is the interest rate. Express as a decimal or fraction, not a percentage.
- t is the number of time steps. This must be a whole number.

Practice Problems.

(1) You owe \$300 on a credit card. Assuming you are charged an interest rate of 2% each month the bill goes unpaid. If you don't make any payment for a year, how much will you owe at the end of the year?
(2) What if the interest rate was instead 4% per month? How much would you owe at the end of the year?
(3) For both the 2% and 4% interest rates, assuming you continue to make no payments, how many months will it be until you owe \$600?
(4) You have $\$5,000$ in a bank account. Assuming you are paid out 2% interest once per year, how many years until you double your balance?
(5) You have P_0 dollars in your savings account. Assuming you are paid out 2% interest once per year, how many years until you double your balance? Does your answer depend on the value of P_0? Why do you think that is?
(6) You have P_0 dollars in your savings account. Assuming you are paid out r interest once per year, how many years until you double your balance? Your answer should be a formula based on r.
(7) In finance, the Rule of 72 states that the time for something's value to double under compound interest is approximately 72 divided by the interest rate (expressed here as a percentage). Using your formula from the previous problem, test the accuracy of this rule for different interest rates. For which interest rate is this rule most accurate?

Exploring Further: Annual Percentage Rates (APRs)

Common practice in finance is to report interest rates standardized to one year, instead of the compounding period. This *annual percentage rate (APR)* is calculated as

$$\text{APR} = \text{interest rate per period} \times \text{number of periods per year.}$$

For example, 2% per quarter would be 8% APR, or 6% APR compounded monthly would be 0.5% per month.

(1) Write a formula that tells you the value $P(t)$ of something after t years of compound interest, based on the following parameters:
   - P_0 the principal,
   - r the APR,
   - n the number of compounding periods,
   - t the number of years.
(2) What if you instead wanted a formula with t not in years but the same as your compounding period (e.g. months for monthly)? How would you change your formula for this different unit?