

Compound Interest Formula

Compound interest is deposited at regular intervals, and interest is earned on the new balance.

The formula is $A = P \left(1 + \frac{r}{n} \right)^{t \times n}$ where:

- A is the final amount;
- P is the principal;
- r is the interest rate, as a decimal;
- t is the time, in years;
- n is the number of compounds per year.

Typical compounding periods are: annual (1), semi-annual (2), quarterly (4), monthly (12), semi-monthly (24), bi-weekly (26), weekly (52), and daily (365).

Example 1: Determine the final amount of \$1600 invested at 4.8% compounded monthly after 5 years.

$$\begin{aligned} A &= P \left(1 + \frac{r}{n} \right)^{t \times n} \\ A &= 1600 \left(1 + \frac{0.048}{12} \right)^{5 \times 12} && \text{The final amount is \$2033.03} \\ A &= 1600 (1.004)^{60} \\ A &= 2033.03 \end{aligned}$$

Example 2: Determine the interest rate, compounded quarterly, needed to double an investment of \$5000 in 10 years.

$$\begin{aligned} A &= P \left(1 + \frac{r}{n} \right)^{t \times n} \\ 10000 &= 5000 \left(1 + \frac{r}{4} \right)^{10 \times 4} \\ 2 &= \left(1 + \frac{r}{4} \right)^{40} && \text{The interest rate needed is 7\%.} \\ \sqrt[40]{2} &= \left(1 + \frac{r}{4} \right) \\ 1.0175 &= 1 + \frac{r}{4} \\ 0.0175 &= \frac{r}{4} \\ 0.07 &= r \end{aligned}$$