The compound interest formula has several equivalent forms that you can use to solve compound interest problems.

To determine the future value, use $A = P(1 + i)^{nt}$.

To determine the present value, or principal, use $P = \frac{A}{(1+i)^{nt}}$ $\quad i = \frac{r}{n}$

To compare investments, use the rate of return, $\frac{A}{P} = (1+i)^{nt}$

$3000 = P\left(1+\left(\frac{0.067}{2}\right)\right)^{10}$

Example 1: Ethan has won a valuable cash award in a science fair. He plans to invest some of the cash in an account that offers 6.7% interest, compounded semi-annually. He wants the investment to have a future value of $3000 after 5 years. How much does Ethan need to invest now?

$$P = \frac{A}{\left(1+\frac{r}{n}\right)^{tn}} = \frac{3000}{\left(1+\frac{0.067}{2}\right)^{5\cdot 2}} = \frac{3000}{1.3903} = \$2157.81$$

Example 2: Emma has invested $12 300 in a registered education savings plan (RESP). Emma wants her investment to grow to at least $40 000, so that her newborn can go to university at age 18. What interest rate, compounded annually, will result in a future value of $40 000?

$A = P\left(1+\frac{r}{n}\right)^{tn}$

$40000 = 12360\left(1+\frac{r}{1}\right)^{18\cdot 1}$

$\frac{40000}{12360} = \frac{12360(1+r)^{18}}{12360}$

$\sqrt[18]{3.2520} = \sqrt[18]{(1+r)^{18}}$

$1.0677 = 1 + r$

$-1 \quad -1$

$0.0677 = r \qquad 6.8\% = r$

Example 3: Wyatt has a choice between two investments.

- Investment A: A 10 year bond with an interest rate of 4.8%, compounded annually, and a future value of $70 000
- Investment B: A 5 year bond with an interest rate of 4.8%, compounded annually, and a future value of $35 000

Which investment has the greatest ratio of future value to present value? Explain briefly what this means.

$\frac{A}{P} = \left(1+\frac{r}{n}\right)^{tn}$

Invest A $= \left(1+\frac{0.048}{1}\right)^{10\cdot 1} = 1.598$

$\Rightarrow$ less P

Invest B $= \left(1+\frac{0.048}{1}\right)^{5\cdot 1} = 1.264$

$\Rightarrow$ more P