

Projects spanning an extended timeline require rigorous financial evaluation to account for capital accumulation. When capital is placed inside an interest-bearing environment where accumulation occurs more than once a year, simple interest models become inadequate. Instead, we deploy the framework of **Compound Interest**, which operates on the principle that interest earned during a specific sub-period is converted into principal, thereby earning additional interest in all successive periods.

When analyzing compound interest configurations, it is vital to distinguish between the **Nominal Annual Interest Rate (r)**—the standardized annual rate openly quoted by financial entities—and the **Effective Interest Rate per Period (i)**. The true growth pattern depends heavily on the compounding frequency (m), which specifies how many times per calendar year the accumulated interest is calculated and added back to the principal base. To determine the total compound growth of a present capital sum over time, we utilize the fundamental Single-Payment Compound Amount formula:

$$F = P(1 + i)^n$$

$$F = P\left(1 + \frac{r}{m}\right)^{m \cdot t}$$

Where P represents the present principal amount, r is the nominal annual rate, m is the compounding frequency per year, t is the total time horizon in years, and $n = m \cdot t$ represents the total number of compound interest intervals across the entire asset lifecycle.

If ₱9,000 shall accumulate for 11 years at 15% compounded quarterly. Find the compound interest at the end of 11 years.

To analyze this scenario using professional textbook conventions, we extract and classify each structural parameter:

- **Initial Capital Base / Principal (P):** ₱9,000
- **Total Time Horizon (t):** 11 years
- **Nominal Annual Interest Rate (r):** 15% = 0.15 per annum
- **Compounding Frequency (m):** Because the interest is "compounded quarterly," the interest accumulates four times per year, meaning $m = 4$.

The objective of the problem is to calculate the total **Compound Interest (I_c)** accumulated at the terminal date. Compound interest is defined as the net difference between the total future accumulated amount (F) and the original present principal (P):

$$I_c = F - P$$

Step 1: Compute the Periodic Interest Rate (i) and Total Compounding Periods (n)

Before substituting values into the compound amount model, we calculate the internal compounding sub-parameters:

1. **Periodic Interest Rate (i):** This is the actual interest rate applied at the end of each quarterly interval:

$$i = \frac{r}{m} = \frac{0.15}{4} = 0.0375 \text{ (or 3.75\% per quarter)}$$

2. **Total Compounding Intervals (n):** This represents the total number of cycles the asset earns interest over 11 years:

$$n = m \cdot t = (4)(11) = 44 \text{ quarters}$$

Step 2: Calculate the Total Accumulated Future Value (F)

Substitute the principal $P = \text{₱}9,000$, periodic rate $i = 0.0375$, and total intervals $n = 44$ into the compound factor formula:

$$F = 9,000(1 + 0.0375)^{44} \approx \text{₱}45,469.39$$

This value represents the total compound sum (principal plus accumulated interest) available at the end of year 11.

Step 3: Extract the Net Compound Interest (I_c)

To isolate the standalone interest earned over the 11-year cycle, subtract the initial principal from the final accumulated future value:

$$I_c = F - P = 45,469.39 - 9,000$$

$$I_c = \text{₱}36,469.3917$$