Interest and Discount Relationships

A man borrowed money from a bank with 23% simple interest. The interest is automatically deducted from the principal at the time the money is released. Find the actual interest charged to him after 1 year.

The problem states that a man borrows money from a bank at a quoted “23% simple interest" rate, but with a critical stipulation: the interest amount is automatically deducted from the principal at the very moment the funds are released.

In standard commercial banking and engineering economics, when interest is collected or deducted upfront, the transaction is structurally a **bank discount** rather than a standard loan. The quoted interest rate is actually a **nominal discount rate (d)**, and the total amount the borrower agrees to pay back at maturity is the **Future Worth (F)** or face value of the loan. The amount of cash the borrower actually walks away with is the **Present Worth (P)**, which is the future worth minus the upfront discount (D).

Imagine you go to a bank to borrow **₱100** (this is the **Future Worth, F**), and the bank says, *"Sure, but we charge 23% interest, and we take it right now."*

Instead of giving you the full ₱100 and letting you pay the interest later, the bank immediately subtracts **₱23** (the **Discount, D**) from your loan. They hand you only **₱77** cash in hand (the **Present Worth, P**).

Here is the catch:

- You only got **₱77** to take home and spend.
- But in 1 year, you have to pay the bank back the full **₱100**.
- That means you paid **₱23** for the privilege of using **₱77**.

The **"quoted" rate** (23%) is called a **Discount Rate (d)** because it was figured out based on the big ₱100 number you *never actually got to hold*.

The **"actual" interest rate (i)** is what matters to your wallet. It calculates how much that ₱23 fee actually cost you compared to the ₱77 you *actually used*.

<u>Step 1:</u> Establish the Variables and Upfront Deductions

Let F represent the face value or the future worth of the loan that the man must repay to the bank at the end of 1 year (n = 1). The bank charges a nominal rate of 23%, which acts as our discount rate (d = 23%).

The total discount dollar amount (D) deducted in advance is found by multiplying the future worth by the rate and the time period:

$$D = F \cdot d \cdot n$$

$$D = F(0.23)(1) = 0.23F$$

Step 2: Determine the Actual Cash Proceeds (Present Worth, P)

The actual amount of money released to the borrower (P) is the face value minus the deducted interest:

$$P = F - D$$

$$P = F - 0.23F$$

$$P = 0.77F$$

This shows that the borrower only receives 77% of the nominal loan amount requested, yet remains legally obligated to repay 100% of F at maturity.

Step 3: Compute the True Interest Rate (i) Charged on the Received Capital

To find the actual interest rate (i) experienced by the borrower, we analyze the transaction from a standard single-payment compound or simple interest perspective over that 1-year duration. The standard relationship states that the future worth is equal to the present worth accumulated by the true interest rate:

$$F = P(1 + ni)$$

Since n = 1, the formula simplifies directly to:

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

Substitute the relationship $P = 0.77F$ into this equation:

$$F = (0.77F)(1 + i)$$

To isolate the variable i, divide both sides of the equation by F (which cancels out the arbitrary loan volume, proving the rate is independent of the amount borrowed), we can solve for i:

$$i = 29.87\%$$

From a borrower's perspective, upfront deductions (**bank discounts**) are disadvantageous because they reduce your usable capital and raise your effective interest rate. It is always financially better to receive the full principal today and pay the interest later at maturity.

The bank advertises a lower number (23%) because they base it on the full loan amount. But because they take that money away from you immediately, you are left with less cash to use. Paying a big fee for a smaller amount of spendable cash means your true, real-world borrowing rate is actually much higher (29.87%)