

## Financial Math

Financial math is used in a wide variety of real-life applications:

- investments and pensions for retirement
- school loans
- mortgages

When money is invested, we usually consider two types of interest that can be collected: simple interest and compound interest.

### **Simple Interest**

Simple interest is earned or paid only on the original investment. In other words, the interest is NOT reinvested.

For example, if \$100 is invested at 10% interest annually, \$10 is earned after the first year. This \$10 is then moved outside of the account. In the second year, the account still has a balance of \$100 so, again, another \$10 is earned. This continues for each year over the duration of the investment; the investor keeps earning an additional \$10 each year and moving it outside of the investment. The overall balance including the interest that was moved outside of the investment each year would look like this:

End of Year	Interest each year (\$)	Balance + Accumulated Interest (\$)
<b>0</b>	-----	<b>100</b>
<b>1</b>	<b>10</b>	$100 + 10 = 110$
<b>2</b>	10	$100 + 20 = 120$
<b>3</b>	10	130
<b>4</b>	10	140

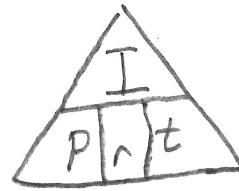
Notice that the balance grows and accumulated interest grow linearly.

This is a very atypical manner of investing. Typically, an investor would reinvest the interest back into the account and earn a greater amount of interest each year. This is called compound interest and will be dealt with in much more detail in the next lesson.

To calculate simple interest, we use the formula:

$$I = Prt$$

$$\frac{I}{rt} = \frac{Pr}{rt} \quad P = \frac{I}{rt}$$



where

I --> total interest

P --> principal (initial amount being invested)

r --> interest rate (expressed as a decimal)

t --> the number of times interest is earned

The value of the entire investment is equal to the principal (P) plus the total interest earned I.

$$A = P + I$$

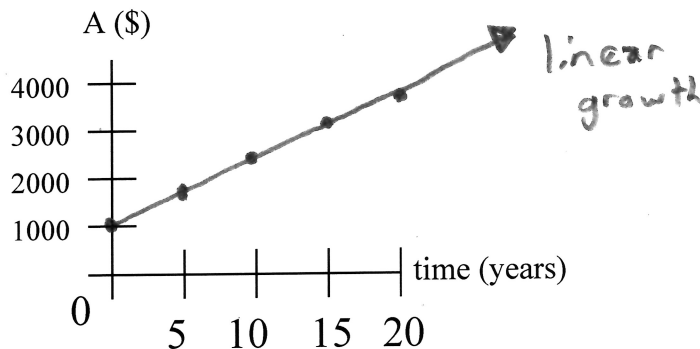
### Example 1

Elaine invests \$1000 that earns 12% simple interest annually.

a) Complete the table of values below (fill in the ~~three~~ blanks).

	$I = Prt$	$A = P + I$
time (years)	total interest earned	investment (balance and interest)
0	0	1000
5	$(1000)(0.12)(5) = 600$	$1000 + 600 = 1600$
10	$(1000)(0.12)(10) = 1200$	$1000 + 1200 = 2200$
15	$(1000)(0.12)(15) = 1800$	$1000 + 1800 = 2800$
20	2400	$1000 + 2400 = 3400$

b) Use your table of values to sketch the total value of the investment 'A' as a function of time.



If the graph is drawn properly, you should notice a linear pattern with a positive correlation (the line goes up from left to right).

### Example 2

Kramer borrows \$2500 that charges 8% simple interest annually. How much will he have to pay back after 120 days.

Solution

$$I = ?$$

$$P = 2500$$

$$r = 0.08$$

$$t = \frac{120}{365}$$

$$I = Prt$$

$$I = 2500(0.08)\left(\frac{120}{365}\right) \\ = 65.75$$

$$A = P + I$$

$$A = 2500 + 65.75 \\ = 2565.75$$

Note that  $t = \frac{120}{365}$  in this question since the money was invested for a fraction of one year; we assume one year to be 365 days.

### Example 3

Jerry invests \$8000 for 6 years. What annual simple interest rate must Jerry make to earn \$1500 interest?

$$I = 1500$$

$$P = 8000$$

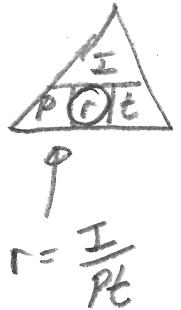
$$r = ?$$

$$t = 6$$

Rearrange  $\frac{I}{Pt} = \frac{Pr}{Pt}$  by isolating  $r$  to get...

$$r = \frac{I}{Pt} \\ = \frac{1500}{8000(6)} \\ = \frac{1500}{48000} \\ = 0.03125$$

or  
3.125% / year



Practice: pg 481 # 1ab, 2, 3, 4, 5ab, 6, 7, 8, 9, 11, 12, 14