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LESSON #7: MORTGAGE FORMULAS

1. Monthly mortgage payments can be found using the formula below:

$$M = \frac{P\left(\frac{r}{12}\right)\left(1+\frac{r}{12}\right)^{n}}{\left(1+\frac{r}{12}\right)^{n}-1}$$

M = monthly payment
P = amount borrowed
r = annual interest rate
n = number of monthly payments

r P

The Banks family would like to borrow $120,000 to purchase a home. They qualified for an annual interest rate of 4.8%. Algebraically determine the *fewest* number of whole years the Banks family would need to include in the mortgage agreement in order to have a monthly payment of no more than $720.

calc ≤ ↳ n calc want: n

$$720 \geq \frac{120{,}000\left(\frac{.048}{12}\right)\left(1+\frac{.048}{12}\right)^{n}}{\left(1+\frac{.048}{12}\right)^{n}-1}$$

calc

$$\frac{720}{1} \geq \frac{480(1.004)^{n}}{(1.004)^{n}-1}$$

$$480(1.004)^{n} \geq 720\left((1.004)^{n}-1\right)$$

$$480(1.004)^{n} \geq 720(1.004)^{n}-720$$

$$-720(1.004)^{n} \quad -720(1.004)^{n}$$

$$\frac{-240(1.004)^{n}}{-240} \geq \frac{-720}{-240}$$

$$(1.004)^{n} \geq 3$$

$\log_{1.004} 3 = n \rightarrow n = 275.2020$ months

$\div 12 =$ 23 years

PMT

Using the formula below, determine the monthly payment on a 5-year car loan with a monthly percentage rate of 0.625% for a car with an original cost of $21,000 and a $1000 down payment, to the *nearest cent*.

2a. $i = .00625$ $P_n = 21000 - 1000$

$P_n = 20{,}000$

$$P_n = PMT\left(\frac{1-(1+i)^{-n}}{i}\right)$$

P_n = present amount borrowed 20,000

n = number of monthly pay periods $5 \times 12 = 60$ months

PMT = monthly payment ?

i = interest rate per month .00625

$$20000 = PMT\left(\frac{1-(1+.00625)^{-60}}{.00625}\right)$$

calc

$$\frac{20000}{49.9053} = PMT\ \frac{(49.9053)}{49.9053}$$

PMT = $400.76

2b.

The affordable monthly payment is $300 for the same time period. Determine an appropriate down payment, to the *nearest dollar*. PMT

$$21000 - X = 300\left(\frac{1-(1+.00625)^{-60}}{.00625}\right)$$

$21000 - X = 14971.5924$

$-21000 \quad -21000$

$-X = -6028.4075$

$X = 6028.41$

X = $6028 down payment

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MORE PRACTICE!

Jim is looking to buy a vacation home for $172,600 near his favorite southern beach. The formula to compute a mortgage payment, M, is $M = P \cdot \frac{r(1+r)^N}{(1+r)^N - 1}$ where P is the principal amount of the loan, r is the monthly interest rate, and N is the number of monthly payments. Jim's bank offers a monthly interest rate of 0.305% for a 15-year mortgage.

$r = .00305\%$ $N = 15 \times 12 = 180$ month

With no down payment, determine Jim's mortgage payment, rounded to the *nearest dollar*.

want: m

$$M = 172{,}600 \cdot \underbrace{\left(\frac{.00305(1+.00305)^{180}}{(1+.00305)^{180}-1}\right)}_{\text{calc}}$$

$m \approx 172{,}600 \cdot .007227$

$m = 1247.49$

$\boxed{m = \$1247}$

Algebraically determine and state the down payment, rounded to the *nearest dollar*, that Jim needs to make in order for his mortgage payment to be $1100.

m

$$1100 = 172{,}600 - x \cdot \left(\frac{.00305(1+.00305)^{180}}{(1+.00305)^{180}-1}\right)$$

$$\frac{1100}{.007227} = \frac{(172{,}600 - x)(.007227)}{.007227}$$

$152193.191 = 172{,}600 - x$

$-172{,}600 \quad -172{,}600$

$-20406.8089 = -x$

$\boxed{x = \$20407}$