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Algebra II

Mortgage and Annuities

1. 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 $M = P \bullet \frac{r(1+r)^N}{(1+r)^N - 1}$ 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. With a $20,000 down payment, determine Jim's mortgage payment, rounded to the *nearest dollar*.

M = mortgage payment = M
P = principal amount of loan = 152,600
r = monthly interest rate = .00305
N = # of monthly payments = 15(12) = 180

principal = total cost − down payment
P = 172,600 − 20,000
P = 152,600

$M = 152{,}600 \cdot \frac{.00305(1+.00305)^{180}}{(1+.00305)^{180} - 1}$

$M = 1102.94$

to find down payment, find P first!

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
P = P
r = .00305
N = 180

$1100 = P\left(\frac{.00305(1+.00305)^{180}}{(1+.00305)^{180} - 1}\right)$ → type whole thing into calculator

$\frac{1100}{.007\ldots} = \frac{P(.007\ldots)}{.007\ldots}$

$152{,}193\ldots = P$

$D = T - P$

$D = 172{,}600 - 152{,}193\ldots$

$D = 20{,}407$

2. 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*.

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

P_n = present amount borrowed = 21,000-1,000 = 20000
n = number of monthly pay periods = 5(12) = 60
PMT = monthly payment = X
i = interest rate per month = .00625

$$20000 = X\left(\frac{1-(1.00625)^{-60}}{.00625}\right)$$

$$\frac{20000}{499...} = \frac{X(499...)}{499...}$$

400.76 = X

P=T-D The affordable monthly payment is $300 for the same time period. Determine an appropriate down payment, to the *nearest dollar*.

$P_n = X$

$n = 5(12) = 60$

$PMT = 300$

$i = .00625$

$$X = 300\left(\frac{1-(1.00625)^{-60}}{.00625}\right)$$

X = ~~300~~ 14971...

P=T-D

14971... = 21,000 - D

-21000 -21000

$\frac{-6028...}{-1} = \frac{-D}{-1}$

6028 = D

3. 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 → m
P = amount borrowed $220{,}000 - 100{,}000 = 120{,}000$
r = annual interest rate $.048$
n = number of monthly payments $15(12) = 180$

The Banks family would like to purchase a home for $220,000. They qualified for an annual interest rate of 4.8%. If they put make a down payment of $100,000 and plan to spend 15 years to repay the loan, what will be the monthly payment rounded to the *nearest* cent?

$$m = \frac{120{,}000\left(\frac{.048}{12}\right)\left(1+\frac{.048}{12}\right)^{180}}{\left(1+\frac{.048}{12}\right)^{180}-1}$$

$m = 936.50$

If they want their monthly payment to be $1500, what would their down payment have to be?

$m = 1500$
$P = x$
$r = .048$
$n = 180$

$$1500 = x\left(\frac{\left(\frac{.048}{12}\right)\left(1+\frac{.048}{12}\right)^{180}}{\left(1+\frac{.048}{12}\right)^{180}-1}\right)$$

$$\frac{1500}{.0078\ldots} = \frac{x(.0078\ldots)}{.0078\ldots}$$

$192{,}205\ldots = x$

$D = T - P$

$D = 220{,}000 - 192{,}205$

$D = 27{,}794.43$

4. Malia wants to renovate the kitchen in her house and estimates that it will cost $39,000 to do so. She plans to make a down payment of $5,000 and then finance the rest at 0.25% interest per month over a ten-year period.
Use the following formula to determine Malia's monthly payment to the *nearest cent.*

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

P_n = present amount borrowed = $39{,}000 - 5{,}000 = 34{,}000$
n = number of monthly pay periods $10(12) = 120$
PMT = monthly payment = x
i = interest rate per month = $.0025$

$$34{,}000 = x\left(\frac{1-(1+.0025)^{-120}}{.0025}\right)$$

$$\frac{34{,}000}{103\ldots} = \frac{x(103\ldots)}{103\ldots}$$

$\$328.31 = x$

Malia can reasonably only afford a monthly payment of $275 per month at ~~most Malia's parents decide to help her with the cost of her new kitchen~~. What would her down payment have to be in order for her monthly payment to be $275?

find P

$P_n = P$

$n = 120$

$PMT = 275$

$i = .0025$

$$P = 275\left(\frac{1-(1+.0025)^{-120}}{.0025}\right)$$

$P = 28479\ldots$

$D = T - P$

$D = 39{,}000 - 28479\ldots$

$D = \$10{,}520.52$

$D = .2(380{,}000) = 76{,}000$

5. Mr. and Mrs. Jenkins just closed on a new home whose purchase price was $380,000. At the closing, they supplied a down payment of 20% of the purchase price. If on the day of the closing the monthly interest rate was .3125%, determine the Jenkins' monthly mortgage payment, to the *nearest cent*, if they were approved for a 30-year loan.

Use the formula $M = P \bullet \frac{r(1+r)^n}{(1+r)^n - 1}$ where M is the mortgage payment, P is the principal amount of the loan, r is the monthly interest rate, and n is the number of monthly payments.

$M = X$

$P = T - D \quad P = 380{,}000 - 76{,}000 = 304{,}000$

$r = .003125$

$n = 30(12) = 360$

$X = 304{,}000\left(\frac{.003125(1.003125)^{360}}{(1.003125)^{360} - 1}\right)$

$X = \$1407.87$

Algebraically determine and state the down payment, to the *nearest dollar*, Mr. and Mrs. Jenkins would need to initially supply in order to bring their monthly mortgage payment down to $1200.

$M = 1200$

$P = X$

$r = .003125$

$n = 30(12) = 360$

$1200 = X\left(\frac{.003125(1.003125)^{360}}{(1.003125)^{360} - 1}\right)$

$\frac{1200 = X(.00463\ldots)}{.00463\ldots \quad .00463\ldots}$

$259114\ldots = X$

$P = T - D$

$259{,}114\ldots = 380{,}000 - D$

$-380{,}000 \quad -380{,}000$

$-120885\ldots = -D$

$D = 120885$

6. Astrid just purchased a new car for $30,000. She traded in her old car and used the money she received from it to make a $4,000 down payment on the car. To the *nearest cent*, what will be Astrid's monthly payment on her new car if her loan has an interest rate of 0.05% per month and the life of the loan is ten years? Use the formula $A = R\left(\frac{1-(1+i)^{-n}}{i}\right)$ where A = present amount borrowed, R = monthly payment, n = number of monthly pay periods, and I = monthly interest rate.

A = present amount borrowed = T − D, 30,000 − 4,000 = 26,000

R = monthly payment = x

i = .0005

n = 10(12) = 120

$$26{,}000 = x\left(\frac{1-(1.0005)^{-120}}{.0005}\right)$$

$$\frac{26{,}000}{116...} = \frac{x(116...)}{116...}$$

$$223.29 = x$$

Astrid knows that she cannot afford a monthly payment of more than $200 for the same time period. By how much, to the *nearest dollar*, should she increase her down payment to satisfy this condition?

A = x

R = 200

i = .0005

n = 120

$$x = 200\left(\frac{1-(1.0005)^{-120}}{.0005}\right)$$

x = 23288...

6711 − 4000 = 2711

Principal = total − down payment

23288... = 30,000 − D

−30,000 −30,000

$$\frac{-6711...}{-1} = \frac{-D}{-1}$$

6711 = D

She will need an additional $2711 down.