

Math for Loans

P1a. Caroline borrowed \$650.00 to purchase a laptop, at a 3% yearly interest rate. Her bank told her she needed to make monthly interest payments but could repay her principal anytime. Caroline decides she's going to pay back her entire principal all at once. How much interest would she owe if she pays her principal in two years?

P1b. What if she made two principal payments, half after the first year and half after the second?

P2. Tim took a \$5,200.00 loan to purchase a used car, at a 5% interest rate compounded monthly. He and his bank agreed to a blended monthly payment plan - where the loan is paid in 3 months. Each payment is part interest, part principal. Assuming Tim's monthly payment is always \$1,747.80, Fill in the table blanks to calculate the interest he paid.

| Month | Starting balance | Interest paid | Principal paid | New balance |
|-------|------------------|---------------|----------------|-------------|
| 1 | \$5,200 | | | |
| 2 | | | | |
| 3 | | | | |

P3. Sam took a \$5,000.00 loan to purchase a used car, at a 3.5% interest rate. He and his bank agreed to a mixed monthly payment plan - where the loan is paid in 5 months. Each payment is part interest, part principal. Assuming Sam's monthly payment is always \$1,008.77. Fill in the table blanks to calculate the interest he paid.

| Month | Starting balance | Interest paid | Principal paid | New balance |
|-------|------------------|---------------|----------------|-------------|
| 1 | \$5,000 | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

Thinking and Inquiry

P4. Which of these three payment plans is the cheapest assuming everyone borrowed the same amount, at the same rate, for the same amount of time, made monthly payments, and Caroline made two principal payments? HINT: cheapest means lower overall interest cost.

P5. Explain the relationship between number of principal payments and interest cost.

Activity Answer Key

A1a.

$$\text{interest} = \text{yearly interest rate} \cdot \text{number of years} \cdot \text{loan principal}$$

$$\text{interest} = 0.03 \cdot 2 \cdot 650$$

$$\text{interest} = \$39.00$$

A1b.

$$\text{interest} = \text{interest}_1 + \text{interest}_2$$

$$\text{interest}_1 = \text{yearly interest rate} \cdot \text{loan principal}$$

$$\text{interest}_1 = 0.03 \cdot 650$$

$$\text{interest}_1 = \$19.50$$

After the first principal payment,

$$\text{loan principal} = \frac{650}{2}$$

$$\text{interest}_2 = 0.03 \cdot 325$$

$$\text{interest}_2 = \$9.75$$

$$\text{interest} = 19.50 + 9.75$$

$$\text{interest} = \$29.25$$

A2.

| Month | Starting Balance | Monthly Payment | Interest | Principal | Ending Balance | Total Interest |
|-------|------------------|-----------------|----------|------------|----------------|----------------|
| 1 | \$5,200.00 | \$1,747.80 | \$21.67 | \$1,726.13 | \$3,473.87 | \$21.67 |
| 2 | \$3,473.87 | \$1,747.80 | \$14.47 | \$1,733.32 | \$1,740.55 | \$36.14 |
| 3 | \$1,740.55 | \$1,747.80 | \$7.25 | \$1,740.55 | \$0.00 | \$43.39 |

$$\text{monthly interest} = \left(\frac{\text{yearly interest rate}}{\text{number of yearly payments}} \right) \cdot \text{loan principal}$$

A3.

| Month | Starting Balance | Monthly Payment | Interest | Principal | Ending Balance | Total Interest |
|-------|------------------|-----------------|----------|------------|----------------|----------------|
| 1 | \$5,000.00 | \$1,008.77 | \$14.58 | \$994.18 | \$4,005.82 | \$14.58 |
| 2 | \$4,005.82 | \$1,008.77 | \$11.68 | \$997.08 | \$3,008.73 | \$26.27 |
| 3 | \$3,008.73 | \$1,008.77 | \$8.78 | \$999.99 | \$2,008.74 | \$35.04 |
| 4 | \$2,008.74 | \$1,008.77 | \$5.86 | \$1,002.91 | \$1,005.83 | \$40.90 |
| 5 | \$1,005.83 | \$1,008.77 | \$2.93 | \$1,005.83 | \$0.00 | \$43.83 |

A5.

The key difference between these examples is that #3 borrowed less, at a lower rate than #2 - but ended up paying more in interest overall due to his loan having a term of two months longer.



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