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Part I: Matching

_____1_____ Percentage increase formula

_____2_____ Compound interest formula

_____3_____ Installment loan formula

_____4_____ Present value of 20 years worth of monthly payments of $100 at 5% monthly interest

_____5_____ Future value of $100 after one period of 5% and three periods of 20% interest

_____6_____ Present value of three monthly payments of $100 at 5% monthly interest

_____7_____ Future value of three monthly payments of $100 at 5% monthly interest

(1) $N = A(1+p)$, N is new value, A is the old value, p is percentage as a decimal

(2) $F = P(1+p)^T$, F is future value, P is present value, p is periodic interest rate, T is number of periods

(3) $P = Mq\frac{1-q^T}{1-q}$, P is present value, M is periodic payment, p is periodic interest rate, T is number of periods, $q = 1/(1+p)$ helps discount future payments into the present

(4) $\$100(1/1.05)\frac{1-(1/1.05)^{240}}{1-(1/1.05)}$

(5) $\$100(1.05)(1.2)^3$

(6) $\$100/(1.05) + \$100/(1.05)^2 + \$100/(1.05)^3$

(7) $\$100(1.05)^2 + \$100(1.05) + \$100$

Percentage Increase

1. If $300 is increased by 25%, what is the result?

$$\$300 (1.25) = \$375$$

or
25% of $100 is $25
25% of $300 is $75
so $375 is $300 + $75

2. If $300 is decreased by 12%, what is the result?

$$\$300 (1 - 0.12) = \$300 (0.88) = \$264$$

or 12% of $300 is $36, so $300 - $36 = $264

3. If $300 is increased by 10%, and the result is increased by 10%, what is the final result?

$$\$300 (1.1)(1.1) = \$363$$

or

$$\$300 \xrightarrow[\$30]{10\%} \$330 \xrightarrow[\$33]{10\%} \$363$$

4. If $300 is increased by 2%, the result is decreased by 3%, and that result is increased by 4%, what is the final result?

$$\$300 (1 + 0.02)(1 - 0.03)(1 + 0.04)$$
$$= \$300 (1.02)(0.97)(1.04)$$
$$= \$308.69$$

5. Which is the smaller number: (a) $300 or (b) the result of first increasing $200 by 50%, and then decreasing the result by 50%?

(a) is $300

(b) is $200 (1.5)(0.5) = $150

b is smaller

↑
probably should
be $300
$$300 (1.5)(0.5)$$
is 225, still smaller

Compound interest

1. How much does one pay back a year later, if one borrows $300 at 1.5% per month interest?

$P = 300$
$F = ?$
$p = 0.015$ per month
$T = 12$ months

$F = 300(1.015)^{12} = \$358.69$

2. How much can one borrow today at 1.5% per month interest, if one is willing to repay $500 two years from now?

$P = ?$
$F = 500$
$p = 0.015$ per month
$T = 24$ months

$P = 500/(1.015)^{24} = \$349.77$

3. If one borrows at 19% per month interest (crazy), how many months until the debt has doubled?

Months	Value
0	$100\% = 1$
1	$119\% = 1.19$
2	$141.61\% = (1.19)^2$
3	$168.516\% = (1.19)^3$
4	$200.534\% = (1.19)^4$

4 months gives 200%, double.

(to be precise, very slightly less than 4 months)

4. If one borrows $300 and repays $336 a month later, what is the monthly interest rate?

$P = 300$
$F = 336$
$p = ?$
$T = 1$

$336 = (1+p)^1 (300)$

$\dfrac{336}{300} = 1+P$

$1.12 = 1+P$

$0.12 = P$

$P = $ **12% per month**

5. Which is the smaller number: (a) The amount to repay a $300 debt a year later at 2% per month interest, (b) The amount to repay a $300 debt a year later at 0.5% per week interest (assuming 52 weeks in a year)?

(a) $\$300(1.02)^{12} = \$380.47$

(b) $\$300(1.005)^{52} = \$388.83$

(a) is smaller

Amortized loans

1. How much do you owe after 6 months if you borrow $300 at 1.3% per month interest and pay back $50 at the end of every month (a total of $300)?

Each New month is

$(\text{Old}) \cdot (1.013) - 50$

↑ Plus Interst   ↑ Minus Payment

# Months	Debt
0	300.00
1	253.90
2	207.20
3	159.89
4	111.97
5	63.43
6	14.25

$14.25 left after six months

2. How much can you borrow now at 1% per month if you are willing to pay back $50 every month for a year?

$P = ?$
$M = 50$ per month
$\ell = 0.01$ per month
$T = 12$ months
$g = 1/1.01$

$P = Mg(1-g^T)/(1-g) = 50(1/1.01)(1-1/1.01^{12})/(1-1/1.01)$

$P = \$562.75$

3. How much should you pay back every month if you want to borrow $500 now at 1% per month and be done paying it back after 7 months?

$P = 500$
$M = ?$ per month
$\ell = 0.01$ per month
$T = 7$ months
$g = 1/1.01$

$500 = M(1/1.01)(1-1/1.01^7)/(1-1/1.01)$
$500 = M(6.72819)$
$M = \$500/6.72819 = \$74.3/$

4. Which is the smaller amount: (a) $50 per month for a year, or (b) the monthly payment to repay a $500 at 3% per month interest in a year.

(a) $50 per month

(b) $500/((1/1.03)(1-1/1.03^{12})/(1-1/1.03)) = \$50.23$ per month

(a) is slightly smaller