

AMDM Interest Simple Interest Formulas and Notes

Interest: is money paid for the use of money. If you borrow from the bank to buy a car, the bank will charge you interest for its use. If you open a savings account at the bank, the bank will pay you interest for as long as the account is open. Banks usually charge compound interest, not simple interest. We will practice with compound interest in a few days.

Simple Interest: the interest is calculated once on the original investment.

$$I = Prt$$

I = interest; the dollar amount earned or owed

P = principal; the amount of money borrowed or invested

r = rate; It will be given as a percent. You must change it to a decimal to use it in the problem. Move the decimal 2 places to the left to change from percent form to decimal form.

Example: 25% = .25 5.2% = .052 7% = .07 12.5% = .125

t = time in years. If time is given in months, you have to put it over 12. Example: If the time is 3 months, put 3/12 when you plug into the formula.

Balance = Principal + interest; These phrases are asking you to find the balance: "how much will you owe back," or "how much money will be in the account at the end of ____ years," All of these phrases mean, "find the balance."

Model question: You get a student loan to pay for your educational expenses this year.

a.) Find the interest on the loan if you borrowed \$2,000 at 8% for 1 year.

b.) How much will you pay back to the bank in all?

a.) $P = \$2,000$ $r = 8\%$ or .08 $t = 1$

$$I = 2,000(.08)(1) = \$160$$

b.) It is asking me to find the balance. Balance is principal + interest. $2000 + 160 = \$2,160$

Questions 1-4: since P, r, and t are already identified, just write what you will type in the calculator and then the answer. *Round final answers to 2 decimal places because you are finding an amount of money.*

1.) $P = \$4000$ $r = 6\%$ $t = 1 \text{ year}$

2.) $P = \$260$ $r = 4\%$ $t = 3 \text{ years}$

3.) $P = \$5000$ $r = 8.5\%$ $t = 9 \text{ months}$

4.) $P = \$18,000$ $r = 7\%$ $t = 18 \text{ months}$

Questions 5- 9: Identify P , r , and t . Then plug those values into the formula and multiply. *You must show all work.* Refer to the model question above so you will know exactly what I expect.

- 5.) You are starting up a small business. Find the interest on the loan if you borrow \$10,000 from the bank at 9% interest for 5 years.
- 6.) For your senior trip, you decide that you want to take a cruise. You take out a loan for \$1,000 to pay for the cruise. You borrow the money at 11% interest for 3 years?
- How much interest will you end up paying?
 - How much will you pay back to the bank in all?
- 7.) Find the interest on a loan of \$2,500 that is borrowed at 9% interest for 7 *months*.
- 8.) How much would you pay back for the loan in question 3?
- 9.) You got a substantial amount of money in graduation gifts. You decide to deposit \$500 into a savings account that earns 4% interest. How much money will you have if you leave the money alone for
- 1 year
 - 3 years
 - 7 years

AMDM Simple Interest Formula, solving for P, r, or t

You will use the simple interest formula from Day 11 to solve these problems. You will be solving for variables other than I. For each question, write out the formula $I = Prt$. Then substitute in the values you know and solve for the missing variable.

****Use the following example for questions 1-3:**

Example of solving for r: $I = \$155$ $P = \$2500$ $t = .5 \text{ year}$

$$155 = 2500 \times r \times .5 \quad (\text{do } 2500 \text{ times } .5 \text{ in calculator})$$

$$155 = 1250r \quad (\text{divide both sides by } 1250 \text{ to isolate } r)$$

$$\frac{155}{1250} = \frac{1250r}{1250}$$

$$0.124 = r \quad \text{Now, turn } 0.124 \text{ into a percent. Final answer is: } r = 12.4\%$$

Questions 1-3: Solve for r. Your answer will be in decimal form, so you need to change it to a percent for the final answer.

- 1.) $I = \$150$ $P = \$2000$ $t = 1 \text{ year}$
 - 2.) $I = \$4060$ $P = \$10,000$ $t = 2 \text{ years}$
 - 3.) $I = \$900$ $P = \$5000$ $t = 2 \text{ years}$
-

****Use the following example for questions 4-6:**

Example of solving for P: $I = \$12,350$ $r = 9.5\%$ $t = 5 \text{ years}$

either change the percent to a decimal or use the % key in calculator

$$12350 = P \times 0.095 \times 5 \quad (\text{multiply } 0.095 \text{ and } 5)$$

$$12350 = 0.475P \quad (\text{divide both sides by } 0.475 \text{ to isolate the } P)$$

$$\frac{12350}{0.475} = \frac{0.475P}{0.475}$$

$$P = \$26,000$$

Question 4-6: Solve for P

- 4.) $I = \$350$ $r = 5\%$ $t = 1 \text{ year}$
- 5.) $I = \$125$ $r = 3\%$ $t = 2 \text{ years}$
- 6.) $I = \$180$ $r = 6\%$ $t = 1 \text{ year}$

****Use the following example for questions 7-9:**

Example of solving for t: $I = \$288$ $P = \$1800$ $r = 8\%$

Turn 8% into a decimal or use the percent key in the calculator

$$288 = 1800 \times 0.08 \times t \text{ (multiply 1800 and 0.08)}$$

$$288 = 144t \text{ (divide both sides by 144 to isolate the t)}$$

$$\frac{288}{144} = \frac{144t}{144}$$

$$t = 2 \text{ years}$$

Question 7-9: Solve for t

7.) $I = \$10.80$ $P = \$180$ $r = 3\%$

8.) $I = \$5,841.26$ $P = \$10,158.74$ $r = 11.5\%$

9.) $I = \$12,240$ $P = \$24,000$ $r = 8.5\%$

Question 10: Real world problem of solving for r.

- 10.) You borrow \$5000 from a friend and promise to pay back \$6800 in 2 years. What is the simple interest rate you will pay. Hint: I did not give you the interest in this problem. I gave you the BALANCE. The amount you are paying back is the balance. To find the interest, do balance minus principal. Once you have the interest, follow the example of solving for r.

AMDM Simple Interest Mixed Review

You will use the simple interest formula, $I = Prt$, on all problems on this page. You will be solving for different variables. The questions are not grouped as they were on the previous days, so read carefully to determine which variables you have and which one you will have to solve for.

Directions: For each question identify the variables, write down what you will type in the calculator, and then write your final answer. Round all final answers to 2 decimal places. Refer to the given examples on Days 11 and 12 if you need help setting up a problem.

- 1.) In order to pay for baseball uniforms, a school takes out a simple interest loan for \$20,000 for 7 months at a rate of 7%.
 - a.) How much interest must the school pay?
 - b.) Find the future value of the loan. (Find the balance, how much they will have to pay back altogether.)

- 2.) A bank offers a CD that pays a simple interest rate of 6.5%. You deposit \$2654.87. After some amount of time, your account balance is \$3000. How long must you have left the money in the account for this to have happened. Hint: I did not give you the interest. I gave you the balance and the principal. Find interest by doing balance minus principal.

- 3.) You deposit \$3,500 into a savings account which has a 5.2% interest rate.
 - a.) Find the amount of interest after 2 years.
 - b.) Find the balance after 2 years.

- 4.) A student took out a simple interest loan for \$2600 for 3 years at a rate of 7%.
 - a.) What is the interest on the loan?
 - b.) How much money will the student have to pay back (the balance)?

- 5.) A loan of \$1060 has been made at 6.5% interest for 3 *months*.
- Find the amount of interest.
 - Find the future value of the loan (the balance).
- 6.) You deposited \$7000 into a savings account and after 3 years it had earned \$840 in interest. What must have been the interest rate?
- 7.) You deposited \$6400 into a savings account. In 2 years, the balance on the account is \$6937.60. Determine the interest rate on the account. Hint: I did not give you the interest. You can calculate the interest by balance minus principal.
- 8.) You borrowed \$5000 to start a small business. The bank gave you an interest rate of 4%. You will end up paying the bank \$1000 in interest. How much time is the loan for?
- 9.) You deposited \$3600 into a savings account with 3% interest. After some time, you had earned \$216 in interest. How much time must have passed?
- 10.) You need \$2500. You deposit some money into a Certificate of Deposit that earns 10% simple interest. If you plan to leave the money there for 5 years, how much do you need to deposit now?

AMDM Compound Interest Formulas and Notes

Compound Interest: Interest that is earned or paid on both the principal *and* previously earned interest. In other words, it is interest paid on interest. Many savings accounts pay compound interest. With compound interest you earn more money as the value of n increases.

Compound Interest Formula:

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

A = the accumulated value (the balance); These phrases mean solve for A (the normal way we do it): "how much will you end up paying back," "how much will be in the account after _____ years," and "what is the future value of the account."

P = principal; The money borrowed or invested

r = rate; The interest rate is the percentage in the problem. Always change it to a decimal before plugging it in or use the % key on the calculator.

t = time, in years. If the time is given in months, put it over 12. If time is 3 months, $t = 3/12$.

n = number of compounding periods per year. This number changes in each scenario. These are the different values of n :

annually	n = 1	semi-annually	n = 2
Quarterly	n = 4	Monthly	n = 12
Weekly	n = 52	Daily	n = 365

Example 1: \$1200 was invested at a rate of 2%, compounded *quarterly*. How much will be in the account in 2 years?

Step 1: Identify P, r, t, and n. Compounded quarterly means $n = 4$

$$P = 1200 \quad r = 0.02 \quad t = 2 \quad n = 4$$

Step 2: Write out what you will type in the calculator: $1200\left(1 + \frac{0.02}{4}\right)^{4 \times 2}$

Step 3: Enter in calculator. Round final answers to 2 decimal places because we are solving for a monetary value.

The calculator gave me: 1248.848... Rounded to 2 decimal places the final answer is **\$1248.85**.

Example 2: \$15,000 was invested at a rate of 4.8% compounded *monthly*. How much will be in the account in 3 years?

Step 1: $P = 15,000$ $r = 0.048$ $t = 3$ $n = 12$ compounded monthly means $n = 12$.

Step 2: $15,000(1 + \frac{0.048}{12})^{12 \times 3}$

Step 3: 17318.286 rounds to **\$17,318.29**

What if you want to determine how much money you should deposit now to have a specific amount of money in a certain amount of time? You can use the

Present Value Formula: $P = \frac{A}{(1 + \frac{r}{n})^{nt}}$

P = the present value or principal (what you need to deposit now)

A = the amount of money you want to end up with

r = interest rate; The rate is the percentage. You must change the percent to a decimal before you use it in your calculation.

t = time, in years; If time is given in months, put it over 12. 8 months = 8/12

n = number compounding periods per year (the same values for n apply here)

Example 3: How much money should be deposited today in an account that earns 6% interest compounded *monthly* so that it will accumulate to \$20,000 in 5 years?

A = 20,000

r = 0.06

t = 5

n = 12 (compounded monthly)

$$\frac{20000}{(1 + \frac{0.06}{12})^{12 \times 5}}$$

*You can type this in the calculator by 1st selecting the fraction button. Type 20,000 in the top. Arrow down and type the bottom just like it is written. Don't forget to use the x^ box key to be able to enter the exponent of 12 times 5.

The calculator gave me 14827.44392 so my **final answer is \$14,827.44**

Compound Interest Problems

For Questions 1-6: Determine how much money will be in the account after the given number of years. Round final answers to 2 decimal places. Use the regular compound interest formula.

PRINCIPAL (P)	RATE (r)	COMPOUNDING PERIODS (n)	TIME (t)
1.) \$10,000	4%	Annually	2 years
2.) \$3000	5%	Semi-annually	4 years
3.) \$9500	6%	Quarterly	5 years
4.) \$4500	6.5%	Monthly	3 years
5.) \$20,000	4.5%	Daily	20 years
6.) \$1200	7%	Weekly	8 years

- 7.) At the time of a child's birth, \$12,000 was deposited in an account paying 6% interest compounded semi-annually. What will be the value of the account at the child's 21st birthday? Use the regular compound interest formula.

QUESTIONS 8- 10: USE THE PRESENT VALUE FORMULA

- 8.) How much money should be deposited today in an account that earns 6% compounded semi-annually so that it will accumulate to \$10,000 in 3 years?
- 9.) How much money should be deposited today in an account that earns 10.5% compounded monthly so that it will accumulate to \$22,000 in 4 years?
- 10.) How much money should be deposited today in an account that earns 7% compounded semi-annually so that it will accumulate to \$12,000 in 4 years?

- 3.) If you borrow \$433 at an interest rate of 10% compounded weekly for 9 years, how much money will you end up paying back.
- 4.) If you borrow \$711 at 8% interest compounded daily for 2 years, how much will you end up paying back?
- 5.) If I invest \$573 into an account with an interest rate of 6.5% compounded weekly, how much money will I have in the account in 1 year?
- 6.) At the time of a child's birth, \$8000 was deposited in an account pay 5% interest compounded quarterly. What will be the value of the account on the child's 21st birthday?
- 7.) You deposit \$3000 in an account that pays 3.5% interest compounded once a year. Your friend deposits \$2500 in an account that pays 4.8% compounded monthly.
- a.) Who will have more money in their account after 1 year? How much more?
- b.) Who will have more money in their account after 5 years? How much more?
- c.) Who will have more money in their account after 20 years? How much more?

Questions 8: Use the PRESENT VALUE FORMULA (REFER TO DAY 14)

- 8.) How much money should be deposited today in an account that earns 9.5% compounded monthly so that it will accumulate to \$10,000 in 3 years?

AMDM Simple and Compound Interest Mixed Practice

These questions will be solved using the simple interest formula or the compound interest formula. Refer to previous pages for examples.

Simple Interest Formula: $I = Prt$

Compound Interest Formula: $A = P\left(1 + \frac{r}{n}\right)^{nt}$

Present Value Formula: $P = \frac{A}{\left(1 + \frac{r}{n}\right)^{nt}}$ used when the question says, "How much should I invest today..."

Questions 1-4: Find the simple interest. Round final answers to 2 decimal places. You must write down what you will type in the calculator as well as the final answer.

Principal (P)	Rate (r)	Time (t)
1.) \$6000	3%	1 year
2.) \$8400	5%	6 years
3.) \$20,000	8.5%	9 months
4.) \$36,000	15%	2 months

5.) In order to pay for tuition and books, a student borrows \$3500 for 4 **months** at 10.5% simple interest.

a.) How much interest must the student pay?

b.) How much will the student pay back altogether (the balance)?

6.) You borrow \$1500 from a friend and promise to pay back \$1800 in 6 **months**. What simple interest rate will you pay? Hint: First find the amount of interest by doing Balance minus principal.

Questions 7-10: Use the compound interest formula to find the amount in the account in the specified number of years. Round answers to 2 decimal places.

Principal (P)	Rate (r)	Compounding Periods (n)	Time (t)
7.) \$7000	3%	Annually	5 years
8.) \$30,000	2.5%	Quarterly	10 years
9.) \$2500	4%	Monthly	20 years
10.) \$800	5%	Semi-annually	7 years

Use this space to show work.

Questions 12 – 13: Use the Present Value Formula. Round final answers to 2 decimal places.

11.) How much money should parents deposit today in an account that earns 7% interest compounded monthly so that it will accumulate to \$100,000 in 18 years for their child's college education?

12.) How much money should be deposited today in an account that earns 5% compounded quarterly so that it will accumulate to \$75,000 in 35 years for retirement?

AMDM Compounded Continuously Formula and Notes

Continuous Compounding: Some banks use continuous compounding, where the compounding periods increase infinitely (compounding interest every trillionth of a second, every quadrillionth of a second, etc.) As n , the number of compounding periods in a year, increases without bound (goes to infinity) the expression from our other formula $(1 + \frac{1}{n})^n$ approaches the irrational number e . $e \approx 2.71828$ So, if we replace the $()$ with e , the new formula that we will use is $P = e^{rt}$. I usually call this the "pert" formula.

Compounded Continuously Formula: $P = e^{rt}$

P = principal; The money that is invested or borrowed.

r = rate; The interest rate is the percentage. Always change the percent to decimal form.

t = time, in years

e is a button in the calculator. On the classroom calculators, push shift then the \ln button to get the e^{}

Example: A sum of \$10,000 is invested at an annual rate of 8%. Find the balance in the account after 5 years subject to

a.) quarterly compounding

$$P = 10,000 \quad r = 0.08 \quad t = 5 \quad n = 4$$

$$10,000(1 + \frac{0.08}{4})^{4 \times 5} = 14859.47396$$

Final Answer is: \$14,859.47

b.) continuous compounding

$$P = 10,000 \quad r = 0.08 \quad t = 5$$

$$Pe^{rt} = 10,000e^{0.08 \times 5} = 14918.24698$$

Final Answer is: \$14,918.25

Use the Compounded Continuously Formula. Round final answers to 2 decimal places.

Principal (P)	Rate (r)	Time (t)
1.) \$6,000	4%	9 years
2.) \$2,700	5.8%	5 years
3.) \$750	12%	3 years
4.) \$1,880	14%	7 years
5.) \$5,400	3.5%	1 year
6.) \$13,500	4.6%	10 years
7.) \$500	15%	2 years
8.) \$7200	6%	4 years
9.) \$620	8.5%	6 years
10.) \$5,500	7.2%	15 years

AMDM Compound and Compounded Continuously Mixed Review

- 1.) You decide to invest \$8000 for 6 years and you have a choice between two bank accounts. The first bank pays 7% interest compounded monthly. The second bank pays 6.85% compounded continuously.
 - a.) For the first bank, how much money would you have in your account in 6 years?

 - b.) For the second bank, how much money would you have in your account in 6 years?

 - c.) Which bank account is the better investment? Why?

- 2.) Find the accumulated value of an investment of \$10,000 for 5 years at an interest rate of 5.25% if the money is:
 - a.) compounded semi-annually

 - b.) compounded quarterly

 - c.) compounded monthly

 - d.) compounded continuously

- 3.) Suppose that you have \$6000 to invest. Which investment yields the greater return over 4 years:
 - a.) 8.25% compounded quarterly

 - b.) 8.3% compounded semi-annually?

 - c.) Which investment yields the greater return (which one gets you the most money)?

- 4.) You have inherited \$25,000. You want to invest it to get the best return possible. You have done some research and have found 5 possibilities. You will leave the money in the account for 10 years. Determine how much money will be in the account for each of the following.
- a.) compounded annually, 6%
 - b.) compounded quarterly, 5.5%
 - c.) Compounded monthly, 5.3%
 - d.) Compounded semi-annually, 5.6%
 - e.) compounded continuously, 5.25%
 - f.) Which account would you deposit the money into? Why?

Percent, Sales Tax, and Discounts

Percents: are the result of expressing numbers as part of 100. The word *percent* literally means, per hundred. So, 57% is the same thing as 57/100.

How to change a fraction to a percent:

- 1.) Multiply the quotient (what you get from step 1) by 100. This is the same thing as moving the decimal place 2 places to the right.
- 2.) Add a percent sign.

How to change a percent into a decimal:

- 1.) Move the decimal 2 places to the left or divide by 100.
- 2.) Remove the percent sign

Sales Tax and Discounts

Sales tax amount = tax rate (in decimal form) x item's cost

Example 1: Suppose the local sales tax rate is 7.5% and you purchase a bicycle for \$894.

a.) How much tax is paid?

to find the tax first change 7.5% to a decimal by moving the decimal 2 places left. 0.075
Next, multiply the decimal by the cost of the bicycle. $0.075 \times 894 = \$67.05$ is the tax that will be paid

b.) What is the bicycle's total cost?

the total cost is the cost of bicycle + tax; $894 + 67.05 = \$961.05$

Discount amount = discount rate (in decimal form) x original price

Sale price = original amount – discount

Example 2: A computer with an original price of \$1460 is on sale at 15% off.

a.) What is the discount amount?

change 15% to a decimal: 0.15

multiply the decimal and the price of the computer: $0.15 \times 1460 = \$219$ is the discount

b.) What is the sale price?

Original price – discount = sale price

$1460 - 219 = \$1241$ is the sale price.

Questions 1 - 4: Express each fraction as a percent.

1.) $\frac{2}{5}$

2.) $\frac{3}{10}$

3.) $\frac{3}{4}$

4.) $\frac{1}{2}$

Questions 5 - 8: Express each percent as a decimal.

5.) 25%

6.) 12.5%

7.) 3.5%

8.) 7%

9.) Suppose the local sales tax rate is 6%, and you purchase a car for \$32,800.

- a.) How much tax is paid?
- b.) What is the car's total cost?

10.) Suppose the local sales tax rate is 7.5%, and you purchase a graphing calculator for \$96.

- a. How much tax is paid?
- b. What is the calculator's total cost?

11.) An exercise machine with an original price of \$860 is on sale at 12% off.

- a. What is the discount amount?
- b. What is the sale price of the exercise machine?

12.) A book that normally sells for \$16.50 is on sale at 40% off.

- a. What is the discount amount?
- b. What is the sale price of the book?

Percent of Change-Increase or Decrease

There is one formula for percent of change. You know it is an increase if your answer is positive. If your answer is negative it is a decrease.

Percent of Change Formula: $\frac{\text{New amount} - \text{Old amount}}{\text{Old amount}} \times 100$

Example 1: In 1995, the average math score for a fourth-grade student in the US was 518. In 2007 the average score was 529. What was the percent of change?

$$\frac{529-518}{518} \times 100 \approx 2.1\% \text{ increase}$$

Example 2: A sofa regularly sells for \$840. This week it is on sale for \$714. Find the percent of change.

$$\frac{714-840}{840} \times 100 = -15, 15\% \text{ decrease}$$

Find the percent of change for each question. State if it is an increase or a decrease.

- 1.) A shirt that normally sells for \$20 is on sale for \$15. Find the percent of change and state if it is an increase or a decrease.

- 2.) Hand sanitizer is suddenly in high demand. It used to cost \$3.99 for a 24 oz bottle and now it costs \$5.99. Find the percent of change and state if it is an increase or a decrease.

- 3.) A new version of the iPhone came out and the old version went from \$1000 to \$650. Find the percent of change and state if it is an increase or a decrease.

- 4.) A used car was advertised for \$1500. A few days later the price had changed to \$1250. Find the percent of change and state if it is an increase or a decrease.

- 5.) The new version of the TI graphing calculator costs \$189. The older version costs \$150. Find the percent of change between these two prices. Is it an increase or a decrease?