

Homework: Topics 1 - 4

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Topic 1: Algebraic Expressions and Linear Equations

Problem 1. Do the following problems at the end of section 5.1 in the text: 22-25, 28-30, 32, 34, 37.

Problem 2. Use the distributive property to carry out the following products:

- (a) $(x - y)(x - y)$.
- (b) $(x - y)(x + y)$.
- (c) $(x + y)(x + y)$.

(Note: Problem 2(b) says that for any numbers a and b , one has $a^2 - b^2 = (a + b)(a - b)$. This is called a “difference of squares” and is helpful in algebraic manipulations. For example, $x^2 - 4 = (x + 2)(x - 2)$.)

Problem 3. Do the following problems at the end of section 5.2 in the text: 1, 3, 11, 15, 28-29, 32.

Problem 4. Suppose that Bob and Alice each open savings accounts. Bob initially deposits \$1 000 and plans to save \$100 every month. Alice initially deposits \$5 000 and plans to save \$75 every month.

- (a) Write down a linear equation relating Bob’s savings with respect to time (in years).
- (b) Write down a linear equation relating Alice’s savings with respect to time (in years).
- (c) Will Bob eventually surpass Alice’s savings? If so, how long will it take? If not, explain why.

Problem 5. The goal of this problem is to find all numbers such that the product of that number with itself is the same as the sum of that number with itself.

- (a) Let x be a variable standing for any number. Write down two expressions: one that represents the product of x with itself and one that represents the sum of x with itself.
- (b) Write an equation that represents the statement: the product of x with itself is the same as the sum of x with itself.
- (c) What numbers satisfy this statement? (Note: Thanks to an important result called the “fundamental theorem of algebra,” we know that there are exactly two solutions to the equation you found in part (b). This means that there are no other numbers aside from the two you found here that has this property.)

Topic 2: Ratios, Proportions, and Percents

Problem 1. Do the following problems at the end of section 5.4 in the text: 1, 6, 11-12, 21-22, 25.

Problem 2. Solve the equation $\frac{x}{10} = \frac{13}{7} + 5$ for x .

Problem 3. A Mazda 3 gets 37 miles per gallon. How many gallons of gas is used to drive 400 miles?

Problem 4. Do the following problems at the end of section 6.1 in the text: 1, 2, 5, 7, 11-12, 15, 21.

Topic 3: Percents and Discounts, Markups, Taxes, and Simple Interest

Problem 1. Do the following problems at the end of section 6.2 in the text: 1-4, 13-16, 21, 25.

Problem 2. The shop *Corner Gifts* receives a shipment of books, which they bought for \$12 each. To make profit, a markup of 65% is applied. Given that sales tax is 7%, how much does a customer pay for one shirt in total?

Problem 3. Do the following problems at the end of section 6.3 in the text: 7, 16, 19, 24, 41, 56.

Problem 4. The goal of this problem is to, using simple interest, understand the mechanics of *compound interest*. Interest is *compounding* if it is always applied to the present value (compare to simple interest only being applied to the principal). We will study compound interest in Topic 4.

A savings account is opened initially with \$100.

- (a) For a *simple* interest rate of 12%, compute the future value of the account after 1 year. What is the interest earned?
- (b) Now suppose the value found in part (a) is withdrawn and then deposited back into the same bank, so that the new principal is the value in found part (a). Compute the future value again after 1 year, but with this new principal. What is the interest earned? Do you earn more or less in interest this time around?

Topic 4: Compound Interest and Methods of Savings/Investing

Problem 1. Do the following problems at the end of section 6.3 in the text: 9, 13, 15, 23, 25, 38.

Problem 2. The S&P 500 returns roughly, on average, 10% every year (in reality, the S&P 500 has volatile annual returns. In 2022, the S&P 500 had a loss of 19%, and in 2025 the S&P 500 had a gain of 16%, for example). Bob wants to purchase a home in 25 years and is considering two options:

1. Bob can invest \$10 000 into the S&P 500 now and let it grow for the full 25 years.
2. Bob can save for 13 years and then invest \$25 000 into the S&P 500, letting it grow for 12 years.

Compute the future values of these two choices for his investment, and compare.

Problem 3. Alice prefers the consistency of a Certificate of Deposit (CD), which offers a guaranteed interest rate of 4.75% compounded daily. Alice buys a \$10 000 CD for 25 years. How much money does Alice have after her CD matures?