Euclidiad Olympiad Training LEVEL 1
Day 5 – Notes

Percentages

- Percent means "per hundred."
- Percent is a shorthand way of writing the ratio of a number to 100.
- For example, 25 percent means 25 out of 100, or 25/100.

Warm up questions

1. When we increase 24 by 75%, what number do we get?

2. When we decrease 60 by 40%, what number do we get?

3. Find an expression for the number that results when we increase x by $k\%$. Find an expression for the number that results when we decrease x by $k\%$.

Note: If a number, x is increased by $k\%$, then the result is

$$x\left(1+\frac{k}{100}\right).$$

If a number, x is decreased by $k\%$, then the result is

$$x\left(1-\frac{k}{100}\right).$$

Examples given in class

Example 1. When a number is reduced by 40%, the result is 36. What is the original number?

Example 2. If t is 25% of u, then what percent of $4t$ is $2u$?

Example 3. Shwe Yee uploaded a video to a website where viewers can vote that they like or dislike a video. Each video begins with a score of 0, and the score increases by 1 for each like vote and decreases by 1 for each dislike vote. At one point, Shwe Yee saw that her video had a score of 90, and that 65% of the votes cast on his video were like votes. How many votes had been cast on Shwe Yee's video at that point?

Example 4. I need to make \$450 per week after tax in order to pay all my bills. The income tax rate is 25%. What is the smallest pre-tax weekly salary I can earn and still be able to pay my bills after I pay my income tax?

Example 5. On Monday, U Law Ba the storekeeper decides to increase the price of avocados by 20%. On Tuesday, he increases this price by another 25%. What percent of the original avocado price is the price of avocados after both increases?

Ko Shan Solution:

First the price is increased by 20%, then by 25%, so the total price increase is 20% + 25% = 45%. Therefore, our new price is 100% + 45% = 145% of the original price.

WARNING! Percentages applied one right after another **don't** add- they multiply!

Ko Shan Solution:

Since the new price is 150% of the old price, it is 50% higher than the old price. Therefore, we must reduce the new price by 50% to get back to the old price.

Example 6. Suppose that 6% of the eighth graders and 3% of the seventh graders of a private school participate in 2020 Winter OMMO. There are 1.5 times as many 8^{th} graders as 7^{th} graders at the school. What percentage of the 7^{th} graders and 8^{th} graders, taken together, participate in OMMO?

Example 7. Dr. Nyan has 180 mL of solution that is 20% acid. How many mL of the solution must be replaced with a 100% acid solution in order to have a solution that is 30% acid?

Ko Shan Solution:
In the beginning, we have $0.2(180) = 36$ mL of acid in the solution.
We need to have $0.3(180) = 54$ mL of acid, so we add 18 mL of a 100% acid solution to make a 30%

Example 8. The base of a triangle is increased by 10% and its height is increased by 20%. Find the new area of the triangle as a percentage of the original one. Find the percentage of the area increased when compared to the original one.

Example 9. A store increased the original price of a shirt by a certain percent and then decreased the new price by the same percent. Given that the resulting price was 84% of the original price, by what percent was the price increased and decreased?

Example 10. A test has two parts. The first part is worth 60% and the second part is worth 40%. If a student gets 95% of part one correct, what exact percent correct must the student achieve on part two to average 90% for the whole test?

Example 11. In a warehouse, 1/4 of all the boxes are empty. A man opens 1/4 of all the boxes, and sees that 1/5 of the boxes he opened are not empty. Which percentage of the boxes he hasn't opened is empty?

Euclidiad Olympiad Class LEVEL 1
Day 5 – Homework

Homework code: **HWA102**
Issued on: 25th January 2021
Due date: 8th February 2021

Submit the solutions to at least 6 of the homework problems before due date.
Each of the problems 1 – 10 is worth 5 points. Challenge problems worth 10 points each.

1. How many minutes are in 20% of a day?

2. If p is 50% of q and r is 40% of q, then what percent of r is p?

3. Ms. A owns a house worth \$10000. She sells it to Mr. B at 10% profit. Mr. B sells the house back to Ms. A at a 10% loss. How much money does Ms. A make?

4. My While eating out, Mike and Joe each tipped their server 2 dollars. Mike tipped 10% of his bill and Joe tipped 20% of his bill. What was the difference, in dollars between their bills?

5. For the game show "Who Wants To Be A Millionaire?", the dollar values of each question are shown in the following table (where K = 1000).

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value	100	200	300	500	1K	2K	4K	8K	16K	32K	64K	125K	250K	500K	1000K

Between which two questions is the percent increase of the value the smallest?

(A) From 1 to 2 (B) From 2 to 3 (C) From 3 to 4
(D) From 11 to 12 (E) From 14 to 15

6. In a high school with 500 students, 40% of the seniors play a musical instrument, while 30% of the non-seniors do not play a musical instrument. In all, 46.8% of the students do not play a musical instrument. How many non-seniors play a musical instrument?

7. The volume of a cup of water increases by 10% when it turns to ice. By how much does the volume of ice decreases after it melts completely to water again? Give your answer in percentage.

8. The length of a rectangle is increased by 20% and its width is decreased by 20%. Find the new area of the rectangle as a percentage of the original one. Find the percentage of the area increased/decreased when compared to the original one.

9. I have 2 cartons of eggs. 20% of the eggs in the first carton are red, while 25% of the eggs in the second carton are red. If the second carton has 3 times as many eggs as the first, what percentage of my eggs are red?

10. How many pounds of water must be evaporated from 50 pounds of a 3% salt solution so that the remaining solution will be 5% salt?

Challenge Problems

1. Ko Ko and Nyi Nyi are both students in Euclidiad math class. Last night they each solved half of the problems in their homework assignment alone and then solved the other half together. Ko Ko had correct answers to only 80% of the problems he solved alone, but overall, 88% of his answers were correct. Nyi Nyi had correct answers to 90% of the problems he solved alone. What was Nyi Nyi's overall percentage of correct answers?

2. A woman has part of \$4500 invested at 4% and the rest at 6%. If her annual return on each investment is the same, then what is the average rate of interest which she realizes on the \$4500?

3. Country A has c % of the world's population and owns d % of the world's wealth. Country B has e % of the world's population and f % of its wealth. Assume that the citizens of A share the wealth of A equally, and that those of B share the wealth of B equally. Find the ratio of the wealth of a citizen of A to the wealth of a citizen of B.