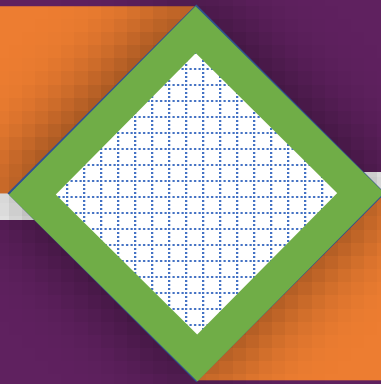




3 Major Concerns

Students Face in Solving Percentage Problems



3 Major Concerns Students Face in Solving Percentage Problems

The topic of Percentage has a very wide range of application in the GMAT examination. Apart from various types of direct questions, percentage has other application in different topics like savings and interest, mixtures, sales and purchases, and many more.



Objective of this article

With such a wide range of application, we researched through the different types of questions, primarily available as official resources, and the responses of students in solving those questions. From the responses, we have shortlisted the 3 major areas of concern of the students. In this article, we are going to discuss those 3 major areas, with the help of proper examples. In the work out, we will show the common errors that students make, along with the best possible approaches to solve the question.

Area of Concern 1: Incorrect base for percentage calculation

Example 1

e-GMAT example with explanation

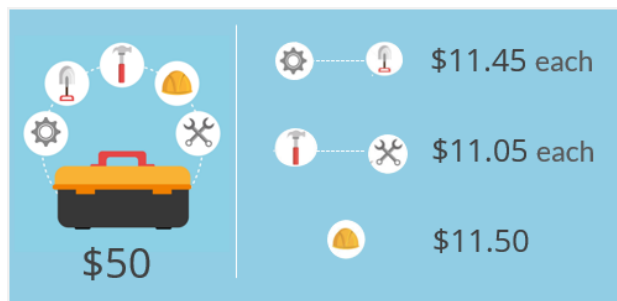
- ? A hardware toolkit containing 5 individual tools sells for \$50. If the tools are purchased individually, 2 of them are priced at \$11.45 each, 2 at \$11.05 each, 1 at \$11.50. The amount saved by purchasing the kit is what percent of the total price of the 5 individual tools purchased individually?**

⚙️ Solution:

Understanding the Question:

In this question, it is provided that,

- A hardware toolkit containing 5 individual tools sells for \$50
- If the tools are purchased individually, 2 of them are priced at \$11.45 each, 2 at \$11.05 each, and 1 at \$11.50



We need to find out:

- The amount saved by purchasing the kit is what percent of the total price of the 5 tools purchased individually

Common Approach Used by Students:

In this case, the purchase can happen in 2 ways – either individually unit wise or all together

When the purchase is done individually unit wise,

- Total price = $2 \times 11.45 + 2 \times 11.05 + 11.5 = 56.5$

When the purchase is done together as a single unit,

- Total price = 50

$$\text{Therefore savings percentage} = \frac{56.5 - 50}{50} \times 100 = 13\%$$

If you have calculated 13% as the answer, then you are wrong.

The Error:

This solution demonstrated the most frequent conceptual error that students commit.

When we need to calculate the savings percentage, the calculation is shown as $\frac{56.5 - 50}{50} \times 100$

Here the value of savings has been calculated correctly, but while calculating the savings percentage, the base of the calculation has been assumed incorrectly.

Whenever we calculate percentage change, the base of the calculation will always depend on what has been asked in the question. If nothing is specified, then we assume the base as the initial value.

For example, in this question, while we are considering the savings percentage, we must understand that the savings is happening with respect to the larger expenditure – i.e. with respect to \$56.5 and not \$50.

The Correct Approach and Solution:

When the purchase is done individually unit wise,

- Total price = $2 \times 11.45 + 2 \times 11.05 + 11.5 = 56.5$

When the purchase is done together as a single unit,

- Total price = 50

Therefore, we can find the savings percentage as =

$$\frac{(\text{total value in individual purchase} - \text{total value in combined purchase})}{\text{total value in combined purchase}} \times 100$$
$$= \frac{56.5 - 50}{56.5} \times 100 = 11.5\%$$

Hence, the savings percentage is 11.5%

Area of Concern 2: The incorrect assumption

Example 2

e-GMAT example with explanation

- ? The price of a bottle of mineral water is 25 percent less than the price of a bottle of cola and 10 percent less than the price of a bottle of fruit juice. The price of a bottle of cola is what percent greater than the price of a bottle of fruit juice?**

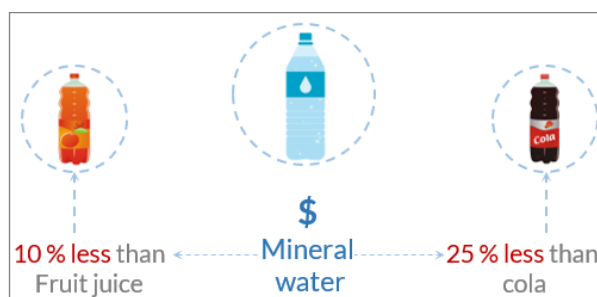
⚙️ Solution:

Understanding the Question:

This question is very much straight forward and with some amount of calculation, students can solve it. However, students often misinterpret the language of these types of cases, which results in incorrect answer. Let's take a look at it:

First let's look at the information present in the question:

- The price of a bottle of mineral water is 25% less than the price of a bottle of cola
- The price of a bottle of mineral water is 10% less than the price of a bottle of fruit juice



We need to find out:

- The price of a bottle of cola is what percent greater than the price of a bottle of fruit juice

Common Approach Used by Students:

Let us assume the price of a bottle of mineral water is x

It is given that the price of a bottle of mineral water is 25% less than the price of a bottle of cola

- As the price of a bottle of mineral water is x , therefore, the price of a bottle of cola is $1.25x$

It is also given that price of a bottle of mineral water is 10% less than the price of a bottle of fruit juice

- As the price of a bottle of mineral water is x , therefore, the price of a bottle of fruit juice is $1.10x$

Therefore, the price of cola as a percent greater than the price of fruit juice = $\frac{1.25x}{1.10x} \times 100 = 113.6\%$

OR,

The price of cola as a percent greater than the price of fruit juice = $\frac{1.25x - 1.10x}{1.25x} \times 100 = 12\%$

OR,

The price of cola as a percent greater than the price of fruit juice = $\frac{1.25x - 1.10x}{1.10x} \times 100 = 13.6\%$

If your answer matches any one of the above, then you have approached the question incorrectly.

The Error:

The approach shown above consists of many errors – both conceptual and calculation based. Let us identify them one at a time.

Error 1: The 1st error is the most common one students make. When it is given that “*the price of a bottle of mineral water is 25% less than the price of a bottle of cola*”, it **does not** necessarily mean that “*the price of a bottle of cola is 25% more than the price of a bottle of mineral water*.” This is the most common assumption students make, which leads into incorrect result.

We can take a similar example to demonstrate this. Assuming the values of two articles A and B are 100 and 120 respectively. We can say the value of article B is 20% more than the value of article A. But we cannot state the reverse statement to be true, i.e. value of article A is 20% less than the value of article B.

The primary reason for this is similar to the error pointed out in the previous case – the base, on which the percentage change is calculated, becomes different as the value changes. Hence, the assumptions that the price of a bottle of cola is 1.25x or price of a bottle of fruit juice is 1.10x are both incorrect.

Error 2: When it is asked to calculate the price of a bottle of cola as a percentage greater than the price of a bottle of fruit juice, we need to take into account the greater part.

- When we are calculating as $\frac{1.25x}{1.10x} \times 100$, effectively we are calculating the price of a bottle of cola, with respect to the price of a bottle of fruit juice and not considering the *greater* part.

- When we are calculating as $\frac{1.25x - 1.10x}{1.25x} \times 100$, although the greater part is taken into account, the greater percentage needs to be calculated with respect to the price of a bottle of fruit juice, not cola.
- When we are calculating as $\frac{1.25x - 1.10x}{1.10x} \times 100$, there is no error in the method of solving. The only error happened due to the incorrect value calculation of the price of cola and fruit juice, as mentioned earlier.

The Correct Approach:

Let us assume the price of a bottle of mineral water is x

It is given that the price of a bottle of mineral water is 25% less than that of cola

- If we assume the price of cola is y , then we can say $x = y - 0.25y = 0.75y$

○ Or, $y = \frac{x}{0.75} = \frac{4x}{3}$

It is also given that price of a bottle of mineral water is 10% less than that of fruit juice

- If we assume the price of fruit juice is z , then we can say $x = z - 0.1z = 0.9z$

○ Or, $z = \frac{x}{0.9} = \frac{10x}{9}$

Therefore, the price of cola, greater than the price of fruit juice, as a percentage

$$= \frac{\frac{4x}{3} - \frac{10x}{9}}{\frac{10x}{9}} \times 100 = 20\%$$

The Alternate Approach:

It is given that the price of a bottle of mineral water is 25% less than that of cola

- If we assume the price of cola is y , then we can say $x = y - 0.25y = 0.75y$

It is also given that price of a bottle of mineral water is 10% less than that of fruit juice

- If we assume the price of fruit juice is z , then we can say $x = z - 0.1z = 0.9z$

Equating the values of x from both the equations, we can write:

- $0.75y = 0.9z$

Or, $\frac{y}{z} = \frac{0.9}{0.75} = \frac{6}{5}$

Now, y is greater than z , in percent $= \frac{y-z}{z} \times 100 = \left(\frac{y}{z} - 1\right) \times 100 = \left(\frac{6}{5} - 1\right) \times 100 = 20\%$

Hence, we can say the price of a bottle of cola is 20% greater than the price of a bottle of fruit juice.

Mistake 3: Not using fractions, in place of decimals

Example 3

[e-GMAT](#) example with explanation

- ? Last year the price of crude oil in the global market was 20% greater in February than in January, 25% less in March than in February, 55.5% less in April than in March, 25% greater in May than in April, and 100% greater in June than in May. What is the approximate percentage change in price of crude oil in June, compared to the price in January?
- A. 0
B. 50% decrease
C. 50% increase
D. 100% decrease
E. 100% increase

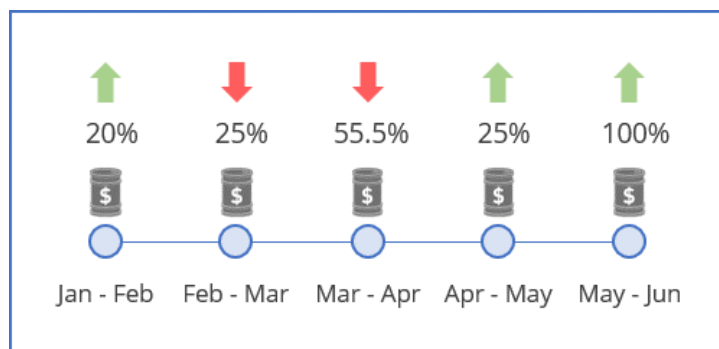
[Solution:](#)

Understanding the Question:

In this question, the different changes in the price of crude oil, from the month of January to June, was given in terms of percentage values. This question deals with multiple percentage change values, hence students often find it very difficult to do the calculations and arrive at the correct answer. Many-a-times, the calculation takes longer than usual time, leaving less time for other questions to solve.

The following information was provided about the change in price of crude oil, in different months:

- January to February: 20% increase
- February to March: 25% decrease
- March to April: 55.5% decrease
- April to May: 25% increase
- May to June: 100% increase



We need to find out the percentage change in the price of crude oil in the month of June, compared to the price of crude oil in the month of January

Common approach used by students:

Let us assume that the price of crude oil in January is x

Considering the given percentage changes in price, the price in the other months:

- February (+20%) = $x \times 1.20 = 1.2x$
- March (-25%) = $1.2x \times 0.75 = 0.9x$
- April (-55.5%) = $0.9x \times 0.44 = 0.396x$
- May (+25%) = $0.396x \times 1.25 = 0.495x$
- June (+100%) = $0.495x \times 2 = 0.99x$, which is almost equal to x

As the prices in both January and June are equal to x , we can say there is no percentage change in the price.

Hence, the answer is 0.

The Issue with the Solution:

If you observed closely, there has been nothing wrong with the solution above. In fact, it actually resulted in the correct answer. So where is the issue?

The issue is the approach in which the question is solved. To arrive at the solution, one has to do 5 multiplications, all involving decimal numbers. Thankfully the final price is also same as the initial price, hence, no more calculation was required to find out the percentage change. Even without that the calculation seems a lengthy one.

The Correct Approach:

In this situation, the application of fractions comes into picture. One can significantly reduce the solving time by converting the percentages into corresponding fractions. Let's check the following approach:

Let us assume that the price of crude oil in January is x

Considering the given percentage changes in price, the price in the other months:

- February (+20%) = $x \times \frac{6}{5}$
- March (-25%) = $x \times \frac{6}{5} \times \frac{3}{4}$
- April (-55.5%) = $x \times \frac{6}{5} \times \frac{3}{4} \times \frac{4}{9}$
- May (+25%) = $x \times \frac{6}{5} \times \frac{3}{4} \times \frac{4}{9} \times \frac{5}{4}$
- June (+100%) = $x \times \frac{6}{5} \times \frac{3}{4} \times \frac{4}{9} \times \frac{5}{4} \times 2 = x$

As the price in June is also x , it is same as the price in January.

Therefore, the percentage change is 0.

You can see effectively there is no calculation involved in the whole process, once you convert the given percentages into corresponding fractional equivalents.

Key Takeaways from the article

1. The base value in the calculation of percentage generally indicates the initial value, with respect to which the change is happening.
 - If the value increases or decreases, then percentage change needs to be calculated with respect to the value before the increase or decrease, unless specified otherwise.
2. If the value of an article, say x , is increased by $P\%$ to get a value, say y , then you can never get back the value x just by decreasing y by the same $P\%$.
 - In the case of increase, the $P\%$ was calculated with respect to x , whereas in the case of decrease, the $P\%$ was calculated with respect to y . As $y > x$, the calculated $P\%$ values are different from each other.
3. There are many cases where it is better to convert the percentages into fractions, to make the process of problem solving much easier and less calculation intensive.



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