

# Percentages

The problems on percentages may not appear directly but the applications are omni present in profit and loss, simple and compound interest and data interpretation and other areas.

Percent means for every hundred.  $x\% = \frac{x}{100}$

Percentage conversions: You must commit to memory these percentage equivalents.

$$1 = 100\% ;$$

$$\frac{1}{2} = 50\% ;$$

$$\frac{1}{3} = 33\frac{1}{3}\% \text{ or } 33.33\% ;$$

$$\frac{1}{4} = 25\% ; \frac{3}{4} = 75\% ;$$

$$\frac{1}{5} = 20\% ;$$

$$\frac{1}{6} = 16\frac{2}{3}\% \text{ or } 16.66\% ;$$

$$\frac{1}{7} = 14\frac{2}{7}\% \text{ or } 14.28\% ;$$

$$\frac{1}{8} = 12\frac{1}{2}\% \text{ or } 12.5\% ;$$

$$\frac{1}{9} = 11\frac{1}{9}\% \text{ or } 11.11\% ;$$

$$\frac{1}{10} = 10\% ;$$

$$\frac{1}{11} = 9\frac{1}{11}\% \text{ or } 9.09\% ;$$

$$\frac{1}{12} = 8\frac{1}{3}\% ;$$

## Formula 1:

A is what percentage of B?  $\Rightarrow \frac{A}{B} \times 100$

**Formula 2:**

A is howmuch percent greater than B?  $\Rightarrow \frac{A-B}{B} \times 100$

**Formula 3:**

A is howmuch percent less than B?  $\Rightarrow \frac{B-A}{B} \times 100$

**Formula 4:**

If A is increased by K% then the new number is  $(100 + K)\% \times A$

But there are several methods available to calculate easily.

Example: A is increased by 20% then the new number can be calculated as

Method 1:  $(100 + 20)\% \times A \Rightarrow 120\% \times A$

Method 2: Calculate 20% of the given number and add to the original number A.  $\Rightarrow A + (20\% \times A)$

Method 3: If basic ratio is available for the given percentage then  $\Rightarrow A + (\frac{1}{5} \times A) \Rightarrow \frac{6}{5} \times A$

**Formula 5:**

If A is decreased by K% then the new number is  $(100 - K)\% \times A$

But there are several methods available to calculate easily

Example: A is decreased by 20% then the new number can be calculated as

Method 1:  $(100 - 20)\% \times A \Rightarrow 80\% \times A$

Method 2: Calculate 20% of the given number and subtract from the original number A.  $\Rightarrow A - (20\% \times A)$

Method 3: If basic ratio is available for the given percentage then  $\Rightarrow A - (\frac{1}{5} \times A) \Rightarrow \frac{4}{5} \times A$

**Formula 6:**

$A\%(B) = B\%(A)$

**Formula 7:**

If several percentages are acting on the same number then we can add all the percentages.

$x_1\%(K) + x_2\%(K) + x_3\%(K) \dots = (x_1 + x_2 + x_3 \dots)\%(K)$

**Formula 8:**

If a number K got increased by A% and B% successively then the final percentage is given by  $(A + B + \frac{AB}{100})\%$

**Note1:** If decreased then substitute +A% with -A%

**Note2:** Any two dimensional diagram like square, rectangle, rhombus, triangle, circle, parrellogram, sides got increased or decreased by certain percentages, then the percentage change in the area can be calculated by the above formula

## Practice Problems

(Level - 1)

1. The price of petrol increased by 25% and so a person reduced his consumption by 25%. What percentage is the rise or fall in the expenditure incurred by him on petrol ?

Method 1: Use above formula  $(25 - 25 - \frac{25 \times 25}{100})\% \Rightarrow -\frac{625}{100}\% \Rightarrow -6.25\%$

So reduction of 6.25% in his expenditure.

Method 2: Assume he consumes 100 liters of petrol, and petrol costs him Rs.100/-

His total expenditure = Rs.10000/-

Now price got increased by 25%. If a value got increased by 25% then the new value is 125% of the previous value. so  $125\%(100) = \text{Rs.}125$

But he reduced his consumption by 25%, so his new consumption is  $75\%(100) = 75$

His total expenditure =  $125 \times 75 = \text{Rs.}9375$

Percentage change in the expenditures =  $\frac{10000 - 9375}{10000} \times 100 \Rightarrow 6.25\%$

2. Radius of the base of a right circular cylinder is increased by 10% and height is decreased by 10%. What is the percentage increase or decrease in

I. Area of the base ?

II. Volume of a right circular cylinder ?

I. As the base of the cylinder is a two dimensional figure so if radius got increased by 10% then the change in the

base of area =  $(10 + 10 + \frac{10 \times 10}{100})\% \Rightarrow 21\%$

II. To calculate the change in the volume we can substitute A = 21 and B = -10, as the height got decreased by 10%

$(21 - 10 - \frac{21 \times 10}{100})\% \Rightarrow 8.9\%$

3. A man bought some apples of which 13% of them were rotten. He sold 75% of the balance and was left with 261 apples. How many apples did he have originally?

Look at the diagrammatic representation of the problem



Now take initial number of apples X.

Then  $X \times (100 - 13)\% \times (100 - 75)\% = 261$

$\Rightarrow X = \frac{261}{(87)\% \times (25)\%} \Rightarrow \frac{261 \times 100 \times 100}{87 \times 25} \Rightarrow 1200$

4. 15 litres of a mixture contains 20% alcohol and rest water. If 3 litres of water is added in it, per cent of alcohol in the new mixture will be?

$$\text{Alcohol in the mixture} = \frac{1}{5} \times 15 = 3 \text{ litres}$$

Mixture becomes  $(15 + 3)$  litres = 18 litres on adding 3 litres of water.

$$\text{Therefore, Percentage of alcohol in the new mixture} = \frac{3}{18} = \frac{1}{6} = 16.67\%$$

5. A student has to secure 40% marks in an examination to qualify. He gets 120 marks and fails by 80 marks. The maximum marks are

$$\text{Minimum passing marks} = 120 + 80 = 200$$

$$\Rightarrow 40\% \text{ of the maximum marks} = 200$$

$$\Rightarrow \text{Maximum marks} = \frac{200}{40\%} = 200 \times \frac{100}{40} = 500$$

6. A student got 42% marks and has secured 12 marks more than the minimum passing marks. Another student got 45% has obtained 30 marks more than the minimum passing marks. The maximum marks are:

$$\text{Difference in percentage of marks} = 45\% - 42\% = 3\%$$

$$\text{Difference in marks} = 30 - 12 = 18 \text{ (i.e. 6 times of 3)}$$

$$\text{Therefore, Maximum marks} = 6 \times 100 = 600$$

7. A person saves 10% of his income. If his income is increased by 20% and he saves 15% of the new income, by what percent his savings will increase?

$$\text{Let previous income} = \text{Rs. } 100$$

$$\text{Previous savings} = 10\% \text{ of Rs. } 100 = \text{Rs. } 10$$

$$\text{Increased income} = \text{Rs. } 100 + 20\% \text{ of Rs. } 100 = \text{Rs. } 120$$

$$\text{Increased savings} = 15\% \text{ of Rs. } 120 = \text{Rs. } 18$$

$$\text{Therefore, Increase in savings} = \text{Rs. } 18 - \text{Rs. } 10 = \text{Rs. } 8$$

$$\text{Therefore, Percent increase in savings} = \frac{8}{10} \times 100 = 80\%$$

8. In an election contest between A and B, A wins by the margin of 240 votes. If A gets 60% of the total votes, total votes are:

$$\text{Votes casted in favour of A} = 60\%$$

$$\text{Votes casted in favour of B} = (100 - 60)\% = 40\%$$

$$\text{Therefore, A wins by } (60\% - 40\%) = 20\% \text{ of the votes} = 240 \text{ (i.e. 12 times of 20)}$$

$$\text{Therefore, Total votes} = 12 \times 100 = 1200$$

Hint: We assume that no vote was invalid.

9. Sum of 5% of a number and 9% of other number is equal to sum of 8% of first number and 7% of the second number. Find ratio between the numbers.

Let the numbers are x and y.

Then 5% of x + 9% of y = 8% of x + 7% of y

Therefore, 3% of x = 2% of y

Therefore, x : y = 2 : 3

10. A man spends 10% of his income on food and 80% of the remaining income on clothing. If he still has a balance of Rs. 180. what is his total income?

$$\begin{aligned}\text{Total Income} &= 180 \times \frac{100}{100-10} \times \frac{100}{100-80} \\ &= 180 \times \frac{100}{90} \times \frac{100}{20} = \text{Rs. } 1000\end{aligned}$$

11. A's salary is 20% more than B's, B's salary is 10% less than C's. If A's salary is Rs. 1080, find C's salary.

If B's salary is Rs. 100, then A's salary = Rs. 100 + Rs. 20 = Rs. 120

$$\text{Therefore, B's salary} = \text{Rs. } 1080 \times \frac{100}{120}$$

If C's salary is Rs. 100, then B's salary = Rs. 100 - Rs. 10 = Rs. 90.

$$\text{Therefore, C's salary} = \text{Rs. } 1080 \times \frac{100}{120} \times \frac{100}{90} = \text{Rs. } 1000$$

12. In an examination, 50% students failed in English and 40% in Math and 15% students failed in both subjects. If 200 students passed in both the subjects, find the number of students appeared in the exam.

Students failed in English only = (50 - 15)% = 35%

Students failed in Math only = (40 - 15)% = 25%

Students failed in both subjects = 15%

Therefore, Students failed in either or both subjects = 35 + 25 + 15 = 75%

Therefore, Students passed in both subjects = (100 - 75)% = 25%

But students passed = 200 (i.e. 8 times of 25)

Therefore, Students appeared = 8 x 100 = 800

### MCQ's

1. The length of a rectangle is increased by 60%. By what percent would be width have to be decreased to maintain the same area ?

a.  $37\frac{1}{2}$  %

b. 60%

c. 75%

d. None of these

Correct Option: A

Explanation:

Let length = 100 m, breadth = 100 m

New length = 160 m, new breadth = x m

Then  $160 \times x = 100 \times 100$

$$\text{or } x = \frac{100 \times 100}{160} = \frac{125}{2}$$

$$\text{Decrease in breadth} = \left(100 - \frac{125}{2}\right)\% = 37\frac{1}{2}\%$$

2. If the side of a square is increased by 30% , its area is increased by :

- a. 9%
- b. 30%
- c. 60%
- d. 69%

Correct Option: D

Explanation:

Let, side = 100 cm

$$\text{Area} = (100 \times 100) \text{ cm}^2 = 10000 \text{ cm}^2$$

$$\text{New area} = (130 \times 130) \text{ cm}^2 = 16900 \text{ cm}^2$$

$$\text{Increase in area} = \left(\frac{6900}{10000} \times 100\right)\% = 69\%$$

3. The price of an article has been reduced by 25%. In order to restore the original price, the new price must be increased by :

- a.  $33\frac{1}{3}\%$
- b.  $11\frac{1}{9}\%$
- c.  $9\frac{1}{11}\%$
- d.  $66\frac{2}{3}\%$

Correct Option: A

Explanation:

Let original price = Rs.100

Reduced price = Rs.75

Increase on Rs.75=Rs.25

$$\text{Increase on Rs.100} = \left(\frac{25}{75} \times 100\right)\% = 33\frac{1}{3}\%$$

4. p is six times as large as q. The percent that q is less than p is :

- a.  $83\frac{1}{3}\%$
- b.  $16\frac{2}{3}\%$
- c. 90
- d. 60

Correct Option: A

Explanation:

$p=6q$ . Then q is less than p by 5q.

q is less than p by  $(\frac{5q}{6q} \times 100)\% = 83\frac{1}{3}\%$

5. Sameer spends 40% of his salary on food articles and  $\frac{1}{3}$ rd of the remaining on transport. If he saves Rs.450 per month which is half of the balance after spending on food items and transport, what is his monthly salary?

- a. Rs.1125
- b. Rs.2250
- c. Rs.2500
- d. Rs.4500

Correct Option: B

Explanation:

Suppose, salary = Rs.100

Expenditure on food = Rs.40

Balance = Rs.60

Expenditure on transport

$$= \frac{1}{3} \times 60 = \text{Rs.}20$$

Now balance = Rs.40

Saving = Rs.20

If saving is 20, salary = Rs.100

If saving is 450,

$$\text{salary} = \text{Rs.}(\frac{100}{20} \times 450) = \text{Rs.}2250$$

6. The population of a town increases 4% annually but is decreased by emigration annually to the extent of  $(\frac{1}{2})\%$ . What will be the increase percent in three years ?

- a. 9.8
- b. 10
- c. 10.5
- d. 10.8

Correct Option: D

Explanation:

Increase in population 4% and reduction due to emigration  $(\frac{1}{2})\%$ . So net percentage increase =  $4 - (\frac{1}{2})\% = 3\frac{1}{2}\% = (\frac{7}{2})\%$

Increase in 3 years over 100

$$\begin{aligned} &= 100 \times (1 + \frac{7}{200})^3 \\ &= (100 \times \frac{207}{200} \times \frac{207}{200} \times \frac{207}{200}) \\ &= \frac{(200+7)^3}{80000} \\ &= \frac{(200)^3 + (7)^3 + 4200(200+7)}{80000} \end{aligned}$$

$$\frac{8869743}{80000} = 110.8718$$

Increase % = 10.8%

7. A man's basic pay for a 40 hour week is Rs.20. Overtime is paid for at 25% above the basic rate. In a certain week he worked overtime and his total wage was Rs.25. He therefore worked for a total of :

- a. 45 hours
- b. 47 hours
- c. 48 hours
- d. 50 hours

Correct Option: C

Explanation:

$$\text{Basic rate per hour} = \text{Rs.} \left( \frac{20}{40} \right) = \text{Rs.} \frac{1}{2}$$

$$\text{Overtime per hour} = 125\% \text{ of Rs.} \frac{1}{2} = \frac{125}{100} \times \frac{1}{2} = \text{Rs.} \frac{5}{8}$$

Suppose he worked x hours overtime.

$$\text{Then, } 20 + \frac{5}{8}x = 25 \quad \text{or} \quad \frac{5}{8}x = 5$$

$$x = \frac{5 \times 8}{5} = 8 \text{ hours}$$

So he worked in all for (40+8) hours = 48 hours.

8. On decreasing the price of T.V.sets by 30% , its sale is increased by 20%. What is the effect on the revenue received by the shopkeeper ?

- a. 10% increase
- b. 10% decrease
- c. 16% increase
- d. 16% decrease

Correct Option: D

Explanation:

Let, price = Rs.100, sale = 100

Then, sale value = Rs.(100 × 100) =Rs.10000

New sale value = Rs.(70 × 120) = Rs.8400

$$\text{Decrease \%} = \left( \frac{1600}{10000} \times 100 \right) \% = 16\%$$

9. Water tax is increased by 20% but its consumption is decreased by 20%. Then, the increase or decrease in the expenditure of the money is :

- a. No change
- b. 5% decrease
- c. 4% increase
- d. 4% decrease

Correct Option: D



Explanation:

Let tax=Rs.100 and

Consumption=100 units

Original expenditure = Rs.(100 × 100) = Rs.10000

New expenditure = Rs.(120 × 80) = Rs.9600

Decrease in expenditure

$$= \left( \frac{400}{10000} \times 100 \right) \% = 4\%$$

10. The price of sugar is increased by 20%. If the expenditure is not allowed to increase, the ratio between the reduction in consumption and the original consumption is :

- a. 1:3
- b. 1:4
- c. 1:6
- d. 1:5

Correct Option: C

Explanation:

Reduction in consumption

$$= \left( \frac{20}{120} \times 100 \right) \% = \frac{50}{3} \%$$

$$\frac{\text{Reduction in consumption}}{\text{Original consumption}} = \left( \frac{50}{3} \times \frac{1}{100} \right)$$
$$= \frac{1}{6} = 1 : 6$$

11. The price of cooking oil has increased by 25%. The percentage of reduction that a family should effect in the use of cooking oil so as not to increase the expenditure on this account is :

- a. 15%
- b. 20%
- c. 25%
- d. 30%

Correct Option: B

Explanation:

Reduction in consumption:

$$= \left( \frac{25}{125} \times 100 \right) \% = 20\%$$

12. What will be 80 percent of a number whose 200 percent is 90 ?

- a. 144
- b. 72
- c. 36
- d. None of these

Correct Option: C

Explanation:

$$200\% \text{ of } x = 90 \Rightarrow x = \frac{90 \times 100}{200} = 45$$

$$80\% \text{ of } x = \left(\frac{80}{100} \times 45\right) = 36$$

13. In an election between two candidates, the candidate who gets 30% of the votes polled is defeated by 15000 votes. The number of votes polled by the winning candidate is :

- a. 11250
- b. 15000
- c. 26250
- d. 37500

Correct Option: C

Explanation:

Let the votes polled by the winning candidate be x, then

$$(x - 15000) = 30\% \text{ of } x$$

$$[x - (x - 15000)] \text{ of } x = 26250$$

14. In a college election, a candidate secured 62% of the votes and is elected by a majority of 144 votes. The total number of votes polled is :

- a. 600
- b. 800
- c. 925
- d. 1200

Correct Option: A

Explanation:

If winner gets 62%, then the loser gets  $(100 - 62) = 38\%$  of votes. But given that winner got 144 votes more than loser.

$$(62\% \text{ of } x - 38\% \text{ of } x) = 144 \text{ or } 24\% \text{ of } x = 144$$

$$x = \frac{144 \times 100}{24} = 600$$

15. A student who secures 20% marks in an examination fails by 30 marks. Another student who secures 32% marks gets 42 marks more than those required to pass. The percentage of marks required to pass is :

- a. 20
- b. 25
- c. 28
- d. 30

Correct Option: B

Explanation:

Let the pass mark is P. Then  $P = 20\% \text{ of } x + 30$  Also  $P = 32\% \text{ of } x - 42$

Equating both,

20% of  $x+30=32\%$  of  $x-42$

or  $12\%$  of  $x=72$ . So  $x=\frac{72 \times 100}{12} = 600$

Pass marks =  $20\%$  of  $600 + 30=150$

Pass percentage =  $(\frac{150}{600} \times 100) \% = 25\%$

16. 5% Income of A is equal to 15% Income of B and 10% Income of B is equal to 20% Income of C. If income of C is Rs.2000, then total income of A, B and C is :

- a. Rs.6000
- b. Rs.18000
- c. Rs.20000
- d. Rs.14000

Correct Option: B

Explanation:

$5\% A = 15\% B$  and  $10\% B = 20\% C$

$$\frac{A}{20} = \frac{3B}{20} \text{ and } \frac{B}{10} = \frac{C}{5} \text{ or } B = 2C$$

$$\frac{A}{20} = \frac{3}{20} \times 2C = \frac{3}{10}C$$

$$= \frac{3}{10} \times 2000 = 600$$

$$A=(600 \times 20) = 12000$$

$$B=(2 \times 2000) = 4000$$

$$A+B+C=(12000+4000+2000)=18000$$

Alternatively:

You can solve this question by calculating B's income from C's and then A's

17. In mathematics exam a student secured 30% marks in the first paper out of a total of 180. How much should he score in second paper out of a total of 150, If he is to get an over all average of at least 50% ?

- a. 74%
- b. 76%
- c. 70%
- d. 80%

Correct Option: A

Explanation:

$30\%$  of  $180 + x\%$  of  $150 = 50\%$  of  $(180+150)$

$$\text{or } 54 + \frac{x}{100} \times 150 = 165 \text{ or } \frac{3x}{2} = 111$$

$$\text{or } x = \frac{111 \times 2}{3} = 74$$

18. 75% of a number when added to 75, is equal to a number. The number is :

- a. 150
- b. 200

c. 225

d. 300

Correct Option: D

Explanation:

$$75 + 75\% \text{ of } x = x$$

$$75 + \frac{3}{4}x = x \Rightarrow \frac{1}{4}x = 75$$

$$x = 75 \times 4 = 300$$

19. After spending 40% in machinery, 25% in building, 15% in raw material and 5% on furniture, Harilal had a balance of Rs.1305. The money with him was :

a. Rs.6500

b. Rs.7225

c. Rs.8700

d. Rs.1390

Correct Option: C

Explanation:

$$x - [40\% \text{ of } x + 25\% \text{ of } x + 15\% \text{ of } x + 5\% \text{ of } x] = 1305$$

$$\text{or } x - 85\% \text{ of } x = 1305$$

$$\text{or } 15\% \text{ of } x = 1305$$

$$x = \frac{1305 \times 100}{15} = 8700$$

20. A man donated 5% of his income to a charitable organisation and deposited 20% of the remainder in a bank. If he now has Rs.1919 left, what is his income ?

a. Rs.2558.60

b. Rs.2525

c. Rs.2500

d. Rs.2300

Correct Option: B

Explanation:

Let his income be Rs.100x . Then, donation = 5% (100x) = 5x.

$$\text{Remaining amount} = 100x - 5x = 95x$$

$$\text{Deposited money} = 20\% (95x) = \frac{1}{5} (95x) = 19x$$

$$\text{So remaining money} = 95x - 19x = 76x$$

$$\text{But given that } 76x = 1919 \Rightarrow x = \frac{1919}{76} = \frac{101}{4}$$

$$\text{So his income} = 100x = \frac{101}{4} \times 100 = 2525$$

21. Rakesh credits 15% of his salary in his fixed deposit account and spends 30% of the remaining amount on groceries. If the cash in hand is Rs.2380, what is his salary?

a. Rs.3500

b. Rs.4000

c. Rs.4500

d. Rs.5000

Correct Option: B

Explanation:

Let salary be Rs.x. Then,

$$x - 15\% \text{ of } x - 30\% \text{ of } 85\% \text{ of } x = 2380$$

$$\text{or } x - \frac{15x}{100} - \frac{30 \times 85 \times x}{100 \times 100} = 2380$$

$$\text{or } 200x - 30x - 51x = 2380 \times 200$$

$$\text{or } 119x = 2380 \times 200 \quad \text{or } x = \frac{2380 \times 200}{119} = 4000$$

22. The income of a broker remains unchanged though the rate of commission is increased from 4% to 5%. The percentage of slump in business is :

a. 8%

b. 1%

c. 20%

d. 80%

Correct Option: C

Explanation:

Let the business value changes from x to y.

$$\text{Then, } 4\% \text{ of } x = 5\% \text{ of } y \text{ or } \frac{4}{100} \times x = \frac{5}{100} \times y$$

$$\text{or } y = \frac{4}{5}x$$

$$\text{Change in business} = (x - \frac{4}{5}x) = \frac{1}{5}x$$

Percentage slump in business

$$= (\frac{1}{5}x \times \frac{1}{x} \times 100) \%$$

23. The price of an article is cut by 10%. To restore it to the former value, the new price must be increased by

a. 10%

b.  $9\frac{1}{11}\%$

c.  $11\frac{1}{9}\%$

d. 11%

Correct Option: C

Explanation:

Let original price = Rs.100

Then, new price = Rs.90

Increase on Rs.90=Rs.100

$$\text{Increase \%} = (\frac{10}{90} \times 100) \% = 11\frac{1}{9} \%$$

24. By how much is 30% of 80 greater than  $\frac{4}{5}$ th of 25?

- a. 2
- b. 4
- c. 10
- d. 15

Correct Option: B

Explanation:

$$\text{It is } \left( \frac{30}{100} \times 80 - \frac{4}{5} \times 25 \right) = (24 - 20) = 4$$

25. 12.5% of 192 = 50% of ?

- a. 48
- b. 96
- c. 24
- d. None of these

Correct Option: A

Explanation:

Let 12.5% of 192 = 50% of x.

$$\text{Then, } \frac{12.5}{100} \times 192 = \frac{50}{100} \times x$$

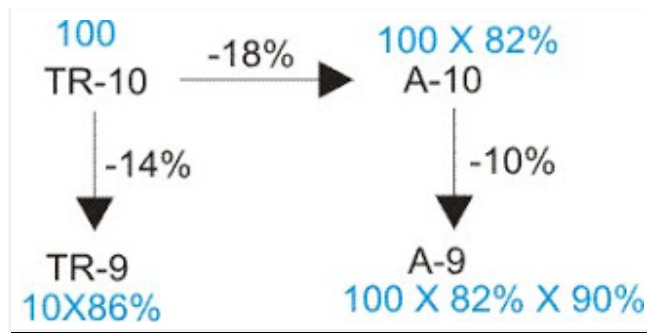
$$\text{Then, } x = \frac{12.5 \times 192}{50} = 48$$

**level - 2**

1. In printing test papers for Excel, Gayatri found that if she used Arial font size 10 instead of Times Roman font size 10 there was a reduction of 18% in the number of pages required for test papers. Further, if she reduced the font size from 10 to 9, the savings were 10% and 14% in Times Roman and Arial fonts respectively. If an test papers printing in Times Roman font size 9 is converted to Arial font size 9, what is the percentage reduction in the number of pages?

- a. 25.8
- b. 20.8
- c. 14.1
- d. 21.6

**Explanation:**



From the above diagram it is clear that from TR-10 to A - 10 there is a reduction of 18% in the number of pages.  
and From TR-10 to TR-9 14% reduction, A - 10 to A - 9 10% reduction.

Assume Test paper in TR- 10 is 100 pages. So in TR- 9 the number of pages are  $100 \times 86\% = 86$

Now in A-10 total pages are  $100 \times 82\% = 82$

Now in A - 9 total pages are  $82 \times 90\% = 73.8$  so

So total change in the number of pages =