Percentage

PERCENTAGE

The word "per cent" is derived from the latin words "per centum", which means "per hundred".

It is denoted by the symbol %.

Thus 25 per cent is written as 25% and it means 25 out of 100.

This is written in the ratio form as $\frac{25}{100}$.

Percentage Increase, Decrease or Error

- Increase % or percentage increase $= \frac{\text{Increase value}}{\text{Original value}} \times 100\%$
- Decrease % or percentage decrease $= \frac{\text{Decrease value}}{\text{Original value}} \times 100\%$
- Error percent $= \frac{\text{Error}}{\text{Correct value}} \times 100\%$

Note

If the value of any thing increases, then percentage change is the percentage increase and if the value of any thing decreases, then percentage change is the percentage decrease. Thus,

Percentage change = Percentage increase, if value of the thing increases

and Percentage change = Percentage decrease, if value of the thing decreases.

POPULATION FORMULA

- If the original population of a town is P, and the annual increase is r %, then the population after n years is $P\left(1+\frac{r}{100}\right)^n$ and population before n years $= \frac{P}{\left(1+\frac{r}{100}\right)^n}$.
- If the annual decrease be r%, then the population after n years is $P\left(1-\frac{r}{100}\right)^n$ and population before n years $= \frac{P}{\left(1-\frac{r}{100}\right)^n}$.

STUDENT AND MARKS

- The percentage of passing marks in an examination is x%. If a candidate who scores y marks fails by z marks, then the maximum marks, $M = \frac{100(y+z)}{x}$.
- A candidate scoring x% in an examination fails by 'a' marks, while another candidate who scores y% marks gets 'b' marks more than the minimum required passing marks.

  Then the maximum marks, $M = \frac{100(a+b)}{y-x}$.
- In an examination x% and y% students respectively fail in two different subjects while z% students fail in both subjects. Then the % of student who pass in both the subjects will be $\{100-(x+y-z)\}$%.

EXERCISE

1. In a college election between two candidates, one candidate got 55% of the total valid votes. 15% of the votes were invalid. If the total votes were 15,200, what is the number of valid votes the other candidate got ?
(a) 7106 (b) 6840 (c) 8360 (d) 5814
(e) None of these

2. The red blood cells in a blood sample grows by 10% per hour in first two hours, decreases by 10% in next one hour, remains constant in next one hour and again increases by 5% per hour in next two hours. If the original count of the red blood cells in the sample is 40000, find the approximate red blood cell count at the end of 6 hours.
(a) 40000 (b) 45025 (c) 48025 (d) 50025

3. Twenty five percent of Pranab's annual salary is equal to eighty percent of Surya's annual salary. Surya's monthly salary is forty percent of Dheeru's monthly salary. If Dheeru's annual salary is ₹ 6 lacs,what is Pranab's monthly salary ? (At some places annual income and in some place monthly income is given.)
(a) ₹ 7.68 lacs (b) ₹ 56,000
(c) ₹ 8.4 lacs (d) ₹ 64,000
(e) None of these

4. In a big garden 60% of the trees are coconut trees, 25% of the number of coconut trees are mango trees and 20% of the number of mango trees are apple trees. If the number of apple trees in the garden is 1440. Then find the number of trees in the garden is:
(a) 48000 (b) 50000
(c) 51000 (d) 45000

5. Mr. *X* spends 20% of his monthly income on household expenditure. Out of the remaining 25% he spends on children's education, 15% on transport, 15% on medicine and 10% on entertainment. He is left with ₹ 9, 800 after incurring all these expenditures. What is his monthly income?
(a) ₹ 35,000 (b) ₹ 28,000
(c) ₹ 65, 333 (d) ₹ 48,400
(e) None of these

6. Aman's expense is 30% more than Vimal's expense and Vimal's expense is 10% less than Raman's expense. If the sum of their expense is ₹ 6447, then what would be the Aman's expense?
(a) ₹ 2, 200 (b) ₹ 2, 457
(c) ₹ 1, 890 (d) ₹ 2, 100
(e) None of these

7. Twenty percent of Anuj's annual salary is equal to seventy five percent of Raj's annual salary. Raj's monthly salary. Raj's monthly salary is 60% of Ravi's monthly salary. If Ravi's annual salary is ₹ 1.44 lac,s what is Anuj's monthly salary?
(a) ₹ 2,70,000 (b) ₹ 27,000
(c) ₹ 34,000 (d) ₹ 54,000
(e) None of these

8. Twelve percent of Kaushal's monthly salary is equal to sixteen percent of Nandini's monthly salary. Suresh's monthly salary is half that of Nandini's monthly salary. If Suresh's annual salary is ₹ 1.08 lacs, what is Kaushal's monthly salary?
(a) ₹ 20,000 (b) ₹ 18,000
(c) ₹ 26,000 (d) ₹ 24,000
(e) None of these

9. In a school there are 2000 students out of whom 36 percent are girls. Each boy's monthly fee is ₹ 480 and each girl's monthly fee is 25 percent less than a boy. What is the total of the monthly fees of girls and boys together?
(a) ₹ 8,73,400 (b) ₹ 8,67,300
(c) ₹ 8,76,300 (d) ₹ 8,73,600
(e) None of these

10. A sum of ₹ 731 is divided among *A*, *B* and *C*, such that '*A*' receives 25% more than '*B*' and '*B*' receives 25% less than '*C*'. What is C's share in the amount?
(a) ₹ 172 (b) ₹ 200 (c) ₹ 262 (d) ₹ 258
(e) None of these

11. An HR Company employs 4800 people, out of which 45 percent are males and 60 percent of the males are either 25 years or older. How many males are employed in HR Company who are younger than 25 years?
(a) 2480 (b) 2320 (c) 1278 (d) 864
(e) None of these

12. Dinesh's monthly income is four times Suresh's monthly income Suresh's monthly income is twenty percent more than Jyoti's monthly income. Jyoti's monthly income is ₹ 22,000. What is Dinesh's monthly income?
(a) ₹ 1,06,500 (b) ₹ 1,05,600
(c) ₹ 1,04,500 (d) ₹ 1,05,400
(e) None of these

13. Ruby's monthly income is three times Gayatri's monthly income. Gayatri's monthly income is fifteen percent more than Priya's monthly income, Priya's monthly income is ₹ 32,000. What is Ruby's Annual income?
(a) ₹ 1,20,300 (b) ₹ 13,24,800
(c) ₹ 38,800 (d) ₹ 54,600
(e) None of these

14. Akash scored 73 marks in subject *A*. He scored 56% marks in subject *B* and *x* marks in subject *C*. Maximum marks in each subject were 150. The overall percentage marks obtained by Akash in all the three subjects together were 54%. How many marks did he score in subject *C*?
(a) 84 (b) 86 (c) 79 (d) 73
(e) None of these

15. In a company '*XYZ*', the respective ratio between the total number of under-graduate employees and the total number of graduate employees is 13 : 23. The Company has only two branches, one in Mumbai and other in Delhi. If the total number of under-graduate employees in Mumbai branch is 351, which is 30% of the total undergraduate employees in the company, what is the total number of graduate employees in the company?
(a) 2185 (b) 1955 (c) 2070 (d) 2691
(e) None of these

16. In a competitive examination in state '*A*', 6% candidates got selected from the total appeared candidates. State '*B*' had an equal number of candidates appeared and 7% candidates got selected with 80 more candidates got selected than state '*A*'. What was the number of candidates appeared from each state?
(a) 8000 (b) 8400
(c) 7600 (d) Data inadequate
(e) None of these

17. In a recent survey 40% houses contained two or more people. Of those houses containing only one person 25% were having only a male. What is the percentage of all houses, which contain exactly one female and no males?
(a) 75% (b) 40%
(c) 15% (d) Cannot be determined
(e) None of these

18. The strength of a school increases and decreases every alternate year. It startes with increase by 10% and thereafter the percentage of increase/decrease is the same. Which of the following is **definitely true** about the strength of the school in 2000 as compared to that in 1996?
(a) Increase approximately by 2%
(b) Decrease approximately by 2%
(c) Increase approximately by 0%
(d) Decrease approximately by 0%
(e) None of these

19. 405 sweets were distributed equally among children in such a way that the number of sweets received by each child is 20% of the total no. of children. How many sweets did each child receive?
(a) 15 (b) 45 (c) 9 (d) 18
(e) None of these

20. Mr. Sarang invests 6% of his monthly salary i.e., ₹ 2,100 on insurance policies. Also he invests 8% of his monthly salary on family mediclaim policies and another 9% of his salary on NSCs. What is the total annual amount invested by Mr. Sarang?
(a) ₹ 11,400 (b) ₹ 96.600
(c) ₹ 8,050 (d) ₹ 9,050
(e) ₹ 9,500

21. Ms. Pooja Pushpan invests 13% of her monthly salary, i.e., ₹ 8554 in Mediclaim Policies. Later she invests 23% of her monthly salary on Child Education Policies. Also she invests another 8% of her monthly salary on Mutual Funds. What is the total annual amount invested by Ms. Pooja Pushpan?
(a) ₹ 28952 (b) ₹ 43428
(c) ₹ 347424 (d) ₹ 173712
(e) None of these

22. In a vessel there is 40 litres mixture of milk and water. There is 15% water in the mixture. The milkman sells 10 litres of mixture to a customer and thereafter adds 12.5 litres of water to the remaining mixture. What is the respective ratio of milk and water in the new mixture?
(a) 2 : 3 (b) 3 : 2
(c) 3 : 4 (d) 4 : 3
(e) None of these

23. In a 90 litres mixture of milk and water, percentage of water is only 30%. The milkman gave 18 litres of this mixture to a customer and then added 18 litres of water to the remaining mixture. What is the percentage of milk in the final mixture?
(a) 64 (b) 48 (c) 52 (d) 68
(e) 56

24. Mrs. Sharma invests 15% of her monthly salary, i.e., ₹ 4428 in Mutual Funds. Later she invests 18% of her monthly salary on Pension Policies and she also invests another 9% of her salary on Insurance Policies. What is the total monthly amount invested by Mrs. Sharma?
(a) ₹ 113356.8 (b) ₹ 12398.4
(c) ₹ 56678.4 (d) Can't be determined
(e) None of these

25. A number is such that when it is multiplied by '8', it gives another number which is as much more than 153 as the original number itself is less than 153. What is 25% of the original number?
(a) 8 (b) 7.5 (c) 10 (d) 8.5
(e) 6.5

26. A number is such that when it is multiplied by 6, it gives another number which is more than 168 as the original number itself is less than 168. What is 15% of the original number?
(a) 8.4 (b) 7.8 (c) 6.6 (d) 8.8
(e) 7.2

27. Sujata scored 2240 marks in an examination that is 128 marks more than the minimum passing percentage of 64%. What is the percentage of marks obtained by Meena if she scores 907 marks less than Sujata?
(a) 35% (b) 40% (c) 45% (d) 36%
(e) 48%

28. In a village 60% votes were cast in an election. A and B were the contestants. A won by 600 votes. If B had got 40% more votes, there would have been a tie between them. Find the number of recognised voters in the village.
(a) 4500 (b) 2800 (c) 3500 (d) 3600
(e) 3900

29. An interview panel found that a candidate has given a wrong detail about his height. While filling up his form he filled up 20% more than his actual height. His actual height is 5 feet inches. By what approximate percent should be reduce his height to get actual height?
(a) 15% (b) 14% (c) 18% (d) 17%
(e) None of these

30. In an examination there are three subjects of 100 marks each. A student scores 60% in the first subject and 80% in the second subject. He scored 70% in aggregate. His percentage of marks in the third subject is
(a) 80 (b) 60 (c) 65 (d) 70

Hints & Solutions

1. (d) Total valid votes = 85% of 15200 = 12920

∴ Number of valid votes to other candidate

= 45% of 12920 = 5814

2. (c)

1st hour ⟶	10	11
2nd hour ⟶	10	11
3rd & 4th hour ⟶	10	9
5th hour ⟶	20	21
6th hour ⟶	20	21
	400000	480249

400000 Units = 40000

$1 \text{ unit} = \frac{40000}{400000} = \frac{1}{10}$

then 480249 → 48024.9 = 48025 (approx)

3. (d) Dheeru's monthly salary $= \frac{600000}{12} =$ ₹ 50000

Surya's monthly salary $= 50000 \times \frac{40}{100} =$ ₹ 20000

Pranab's monthly salary $= 20000 \times \frac{80}{25} =$ ₹ 64000

4. (a) If the number of trees in the garden be x, then

$$x \times \frac{60}{100} \times \frac{25}{100} \times \frac{20}{100} = 1440$$

$$\Rightarrow \quad x \times \frac{3}{5} \times \frac{1}{4} \times \frac{1}{5} = 1440$$

$$\Rightarrow \quad x = \frac{1440 \times 5 \times 4 \times 5}{3} = 48{,}000$$

5. (a) Let the monthly income of X be ₹ x.

Expenditure on household articles = ₹ $\frac{x}{5}$

Remaining amount = ₹ $\frac{4x}{5}$

Total percentage expenditure in the remaining amount = Remaining amount

$= 35\% \text{ of } \frac{4x}{5} =$ ₹ $\left(\frac{35}{100} \times \frac{4x}{5}\right) = \frac{7x}{25} = \frac{7x}{25} = 9800$

$\Rightarrow \quad x =$ ₹ $\left(\frac{9800 \times 25}{7}\right) =$ ₹35000

6. (b) Let Vimal's expense be ₹ 100

∴ Aman's expense = ₹ 130

Raman's expenses $= \frac{100}{90} \times 100 = \frac{1000}{9}$

∴ Ratio of the expenses of Vimal. Aman and Raman respectively

$= 100 : 130 : \frac{1000}{9} = 90 : 117 : 100$

∴ Aman expense $= \frac{117}{90+117+100} \times 6447$

$= \frac{117}{307} \times 6447 =$ ₹ 2457

7. (b) Monthly salary of Raj $= \frac{1.44 \times 60}{12 \times 100} =$ ₹ 0.072 lakh

Raj's monthly salary $\times \frac{3}{4}$ = Anuj's monthly salary $\times \frac{1}{5}$

Anuj's monthly salary = ₹ $\left(0.072 \times \frac{3}{4} \times 5\right)$ lakh

= ₹ 27000

8. (d) Suresh's monthly salary $= \frac{108000}{12} =$ ₹ 9000

Nandini's monthly salary = ₹ 18000 (= 2 × 9000)

∴ Kaushal's monthly salary $\times \frac{12}{100}$

$= \frac{18000 \times 16}{100} = 2880$

∴ Kaushal's monthly salary

$= \left(\frac{2880 \times 100}{12}\right) =$ ₹ 24000

9. (d) Girls $\Rightarrow \frac{2000 \times 36}{100} = 720$

Boy $\Rightarrow 2000 - 720 = 1280$

Each girl's fee $= 480 \times \frac{75}{100} =$ ₹ 360

∴ Total monthly fee

= ₹ [(1280 × 480) + (720 × 360)]

= ₹ (614400 + 259200) = ₹ 873600

10. (e) Let C receives ₹ 100

B receives 25% less i.e. ₹ 75

A receives 25% more than $B = \frac{5}{4} \times 75 = \frac{375}{4}$

	A	: B	: C
	$\frac{375}{4}$	: 75	: 100
⇒	375	: 300	: 400
⇒	15	: 12	: 16

Total sum = 731

C's share $= \frac{16}{43} \times 731 =$ ₹ 272

11. (d) Number of males in company

$$= \frac{4800\times45}{100} = 2160$$

$\therefore$ Number of males younger than 25 years.

$$= \frac{2160\times40}{100} = 864$$

12. (b) Suresh's monthly income $= \frac{22000\times120}{100} = ₹\ 26400$

$\therefore$ Dinesh's monthly income

$= ₹\ (4 \times 264000) = ₹\ 105600$

13. (b) Gayatri's monthly income

$$= \frac{32000\times115}{100} = ₹\ 36800$$

$\therefore$ Ruby's annual income $= ₹\ (12 \times 3 \times 36800)$

$= ₹\ 13,24,800$

14. (b) Marks obtained by Akash in subject $B = \frac{150\times56}{100} = 84$

Total marks obtained by Akash $= \frac{450\times54}{100} = 243$

$\therefore$ Marks obtained in subject $C = 243 - 73 - 84 = 86$

15. (c) Number of undergraduates in Mumbai branch = 351

$\therefore$ Number of undergraduates employees

$$= \frac{100}{30}\times351 = 1170$$

$\therefore$ Total graduate employees $= \frac{23}{13}\times1170 = 2070$

16. (a) No. of candidates appeared in state A

= No. of candidates appeared in state $B = x$

$$\therefore \quad \frac{7x}{100} - \frac{6x}{100} = 80$$

$x = 8000$

17. (e) 40% houses have two or more people.

$\therefore$ 60% of all houses have only one person. Of these 60%, 25% have only a male.

25% of 60% = $0.25 \times 0.60 = 0.15 = 15\%$

Rest of the houses have exactly one female and no males

$= (60 - 15)\% = 45\%$

18. (b) Let the strength of the school in 1996 be 100

The strength increases and decreases every alternate year by 10%

$\therefore$ Strength in 1997 = 110

Strength in 1998 $= 110\times\frac{90}{100} = 99$

Strength in 1999 $= 99\times\frac{110}{100} = 108.9$

Strength in 2000 $= 108.9\times\frac{90}{100} = 98.1$

100 – 98.1 = 2% decrease

19. (c) Let number of children be x

$\therefore$ No. of sweets received by each child $= \frac{405}{x}$

$$\Rightarrow \quad \frac{405}{x} = 20\% \text{ of } x$$

$$\Rightarrow \quad \frac{405}{x} = \frac{x}{5}$$

$$\Rightarrow \quad x^2 = 405 \times 5$$

$$\Rightarrow \quad x = \sqrt{405\times5} = \sqrt{81\times5\times5} = 9\times5 = 45$$

$\therefore$ Required no. of sweets received by each child

$$= \frac{405}{45} = 9$$

20. (b) Let salary of Mr. Sarang = x

ATQ, 6% of salary = 2100

$$\Rightarrow \quad \frac{6}{100}\times x = 2100 \quad \Rightarrow \quad x = 35{,}000$$

Total investment = 6% + 8% + 9% = 23%

Total Annual amount invested

$$= 12 \times \frac{23}{100}\times35000 = ₹96600$$

21. (c) Let Ms. Pooja Pushpan's monthly salary = ₹ x

According to the question, 13% of the x = ₹ 8554

$$\Rightarrow x = ₹\left(\frac{8554\times100}{13}\right) = ₹\ 65800$$

Total monthly investment in percentage

= 13 + 23 + 8 = 44%

$\therefore$ Total monthly investment

$$= 44\% \text{ of } ₹\ 65800 = ₹\left(\frac{44\times65800}{100}\right) = ₹\ 28952$$

$\therefore$ Total annual investment

$= ₹\ (12 \times 28952) = ₹\ 347424$

22. (b) In 30 litres of mixture.

$$\text{Milk} = \frac{30\times85}{100} = 25.5 \text{ litres}$$

Water = 30 – 25.5 = 4.5 litres

On adding 12.5 litres of water total quantity of water

= 4.5 + 12.5 = 17 litres

$\therefore$ Required ratio of milk and water

= 25.5 : 17 = 1.5 : 1 = 3 : 2

23. (e) Remaining mixture = 90 – 18 = 72 litres

$$\text{Milk} = \frac{70}{100}\times72 = 50.4$$

Water = 72 – 50.4 = 21.6 litres

On adding 18 litres of water. Required percentage of milk

$$= \frac{50.4}{90}\times 100 = \frac{504}{9} = 56\%$$

24. (b) Mrs. Sharma's monthly salary = ₹ x.

$\therefore$ 15% of x = 4428

$$\Rightarrow \frac{x\times 15}{100} = 4428$$

$$\Rightarrow x = \frac{4428\times 100}{15} = ₹\ 29520$$

$\therefore$ Total investment = (15 + 18 + 9)% of 29520

$$= \frac{29520\times 42}{100} = ₹\ 12398.40$$

25. (d) Let the number be x

According to the questions,

$8x - 153 = 153 - x$

$\Rightarrow 8x + x = 153 + 153$

$\Rightarrow 9x = 306$

$$\Rightarrow x = \frac{306}{9} = 34$$

$$\therefore \text{25\% of } 34 = \frac{34\times 25}{100} = 8.5$$

26. (e) Let the original number be x.

According to the questions,

$6x - 168 = 168 - x \quad \Rightarrow \quad 7x = 168 + 168 = 336$

$$\Rightarrow x = \frac{336}{7} = 48$$

$$\therefore \text{15\% of } 48 = \frac{48\times 15}{100} = 7.2$$

27. (b) If total maximum marks be x, then,

$$\frac{x\times 64}{100} = 2240 - 128 = 2112$$

$$\Rightarrow x = \frac{2112\times 100}{64} = 3300$$

Marks obtained by Meena = 2240 – 907 = 1333

$$\therefore \text{Required percentage} = \frac{1333}{3300}\times 100 = 40\%$$

28. (c) Let the number of recognised voters in the village be x.

For candidates B,

$\because$ 40% = 300

$$\therefore 100\% = \frac{300}{40}\times 100 = 750$$

$\therefore$ Votes got by A = 750 + 660 = 1350

According to the question,

$$\frac{60x}{100} = 1350 + 750 = 2100$$

$$\Rightarrow x = \frac{2100\times 100}{60} = 3500$$

29. (d) Percentage decrease

$$= \frac{20}{100+20}\times 100 = \frac{50}{3} = 16\frac{2}{3}\% \approx 17\%$$

30. (d) According to the question,

First subject = 60%

Second subject = 80%

Aggregate in all subject = 3 × 70 = 210

$\therefore$ First + Second + Third = 210

60 + 80 + Third = 210

Third = 210 – 140 = 70