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Average

Average

The average of a given number of quantities of the same kind is expressed as

$$\text{Average} = \frac{\text{Sum of the quantities}}{\text{Number of the quantities}}$$

Average is also called the Arithmetic Mean.

Also, Sum of the quantities = Average × Number of the quantities

$$\text{Number of quantities} = \frac{\text{Sum of the quantities}}{\text{Average}}$$

- If all the given quantities have the same value, then the number itself is the average.
- If all the given quantities are not all the same, then the average of the given quantities is always greater, then the smallest number and always less than the largest number. Equivalently, atleast one of the numbers is less than the average and atleast one is greater then the average.
- If each of the given quantities is increased by a constant p, then their average is also increased by p.
- If each of the given quantities is decreased by a constant p, then their average is also decreased by p.
- If each of the given quantities is multiplied by a constant p, then their average is also multiplied by p.
- Whenever the given quantities form an arithmetic sequence and if the given quantities has odd terms, then the average is the middle term in the sequence and if the given quantities has even terms, then the average of the sequence is the average of the middle two terms.
- In order to calculate the weighted average of a set of numbers, multiply each number in the set by the number of times it appears, add all the products and divide by the total number of numbers in the set.
- If the speed of an object from A to B is x km/h and from B to A is y km/h,then the average speed during the whole journey is $\frac{2xy}{x+y}$ km/h .
- If the average of N_1 quantities is x and N_2 quantities is y then the average of total $(N_1 + N_2)$ quantities is given by $\frac{(N_1x + N_2y)}{N_1 + N_2}$

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Example 1: What is the average of first five even numbers.

Solution. The first prime even numbers are 2, 4, 6, 8, 10

$$\text{Average} = \frac{2+4+6+8+10}{5} = \frac{30}{5} = 6$$

Example 2: The average of five consecutive even numbers is 50. What is the largest of these numbers?

Solution. Let the numbers be $x - 4$, $x - 2$, x, $x + 2$, $x + 4$.

$$\text{Average} = \frac{\text{Sum of the quantities}}{\text{Number of the quantities}}$$

$$= \frac{x-4+x-2+x+x+2+x+4}{5} = 50$$

$$\Rightarrow \quad \frac{5x}{5} = 50$$

$$\Rightarrow \quad x = 50$$

So, the numbers are 46, 48, 50, 52, 54.

The largest of these numbers is 54.

Example 3: Average weight of 32 students of a class is 30.5 kg. If weight of a teacher is also included then average weight is increased by 500 g. What is the weight of the teacher?

Solution. Total weight of 32 students = 30.5 × 32 = 976 kg

Average weigth of (32 students + 1 teacher) = (30.5 + 0.5) = 31 kg

∴ Total weight of (32 students + 1 teacher) = 31 × 33 = 1023 kg

∴ Weight of teacher = (1023 – 976) kg = 47 kg

Example 4: The average salary per head of all the employees of an institution is Rs 60. The average salary per head of 12 officers is ` 400 and average salary per head of the rest is ` 56. Find the total number of employees in the institution.

Solution. Let the total number of employees be x.

Then,
$$60 = \frac{\text{Total salary of all employees}}{x}$$

$$60 = \frac{12\times400+(x-12)\times56}{x}$$

$$\Rightarrow \quad 60x = 12 \times 400 + (x - 12) \times 56 = 4800 + 56x - 672$$

$$\Rightarrow \quad 60x - 56x = 4800 - 672$$

$$\Rightarrow \quad 4x = 4128 \Rightarrow x = 1032$$

Hence, the total number of employees is 1032.

Example 5: If the average of p and q is 58 and the average of q and 5 is 64, what is the value of $s - p$?

Solution. Given,
$$\frac{p+q}{2} = 58 \Rightarrow \quad p + q = 116 \qquad \text{...(i)}$$

Also,
$$\frac{q+s}{2} = 64 \Rightarrow \quad q + s = 128 \qquad \text{...(ii)}$$

Subtracting Eq. (i) from (ii), we get

$$(q + s) - (p + q) = 128 - 116 \Rightarrow s - p = 12$$

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Example 6: 12 men went to a restaurant. 11 of them spent ` 5 each and the 12th person spent ` 11 more than the average expenditure of all. Find the total money spent by them?

Solution. Let the average money spent by the 12 men = ` x

Money spent by the 12th man = ` $(x + 11)$

Money spent by the other 11 men = ` $(11 \times 5)$ = ` 55

Total money spent by the 12 men = ` $(55 + x + 11)$ = ` $(x + 66)$

$$\therefore x = \frac{x+66}{12} \Rightarrow 12x = x + 66 \Rightarrow 11x = 66 \Rightarrow x = ` 6$$

Total money spent by the 12 men = 6×12 = ` 72.

EXERCISE

1. The average weight of 8 persons increases by 2.5 kg when a new person comes in place of one of them weighing 65 kg. What might be the weight of the new person?
(a) 82 kg (b) 85 kg
(c) 76.5 kg (d) 80 kg

2. Sumitra has an average of 56% on her first 7 examinations. How much she should make on her eighth examination to obtain an average of 60% on 8 examinations?
(a) 88% (b) 78%
(c) 92% (d) 68%

3. Ages of '*A*' and '*B*' are in the ratio of 2 : 3 respectively. Six years hence the ratio of their ages will become 8 : 11 respectively. What is B's present age?
(a) 18 years (b) 28 years
(c) 27 years (d) 25 years

4. The total age of *A* and *B* is 12 years more than that of total age of *B* and *C*. *C* is how many years younger than A?
(a) C is elder than *A* (b) 26
(c) 12 (d) 25

5. The average marks fetched by Mohan in History, Geography, Science and Mathematics is 10 more than the marks fetched in Mathematics. If he has got 110 marks aggregate in History and Geography, what will be the aggregate marks fetched in Science and Mathematics?
(a) 90 (b) 70 (c) 75 (d) 85

6. The average of first three of five odd numbers arranged in ascending order is 10 less than the average of the last three of these numbers. If the sum of the last two of these numbers is 42, what is the sum of the first two of these numbers?
(a) 23 (b) 18
(c) 16
(d) can't be determined

7. Jayesh is twice as old as Vijay and half as old as Suresh. If sum of Suresh's and Vijay's ages is 85 years what is Jayesh's age in years?
(a) 34 (b) 39
(c) 68 (d) 35

8. Six years ago Jaganath was twice as old as Badri if the ratio of their present age is 9 : 5 respectively, what is the difference between their present ages?
(a) 24 (b) 30
(c) 52 (d) 27

9. Jitu scores 60, 80, 40, 50 and 90 per cent marks in the subjects *A*, *B*, *C*, *D* and *E* respectively. However, the weights attached to those subjects are 5, 4, 3, 2 and 1 respectively. Which of the following represents the weighted average of marks scored by Jitu in these five subjects
(a) 75 (b) 78
(c) 62 (d) 79

10. Jayesh is as much younger than Anil as he is older than Prashant. If the sum of the ages of Anil and Prashant is 48 years, what is Jayesh's age in years?
(a) 29 (b) 30
(c) 24 (d) 25

11. The average weight of a group of 150 students in a class is 60 kg. If the mean of weights of all the 50 male students in the class is 70 kg, then the average weight of 100 girls in the class is:
(a) 85 kg (b) 40 kg
(c) 60 kg (d) 55 kg

12. In a journey of 160 km, a train covers the distance 120 km at a speed of 80 km/h and the remaining

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distance at 40 km/h. The average speed of the train for the whole journey is:
(a) 50 km/h (b) 64 km/h
(c) 68 km/h (d) 74 km/h

13. The average of 10 numbers is 7. If each number is multiplied by 12, then the average of new set of numbers is
(a) 72 (b) 86
(c) 79 (d) 84

14. A school has only three classes which contain 40, 50 and 60 students,4/ respectively. The pass percentage of these classes are 10, 20 and 35 respectively. The pass percentage of the school is
(a) $23\frac{1}{3}\%$ (b) 15% (c) $26\frac{2}{3}\%$ (d) 30%

15. A batsman has a certain average of runs for 16 innings. In the 17th innings, he makes a score of 85 runs, thereby increasing his average by 3. What is the average after the 17th innings?
(a) 60 (b) 37
(c) 38 (d) 27

16. In Aran's opinion his weight is greater than 65 kg but less than 72 kg. His brother does not agree with Arun and he thinks that Aran's weight is greater than 60 kg but less than 70 kg. His mother's view is that his weight cannot be greater than 68 kg. If all of them are correct in their estimation, what is the average of different probable weights of Arun?
(a) 71 kg (b) 67 kg
(c) 73 kg (d) 58 kg

ANSWERS

1. (b)	**2**. (a)	**3**. (c)	**4**. (c)	**5**. (d)	**6**. (d)	**7**. (a)	**8**. (a)	**9**. (c)	**10**. (c)
11. (d)	**12**. (b)	**13**. (d)	**14**. (a)	**15**. (a)	**16**. (b)				

EXPLANATIONS

1. **By short cut:** The weight of the new person = 8 × 2.5 + 65 = 85 kg

2. By given condition,
$56 \times 7 + x = 60 \times 8$
$\Rightarrow x = 480 - 392 = 88\%$

4. By given condition, $A + B$
$= 12 + B + C \Rightarrow A - C = 12$
$\therefore$ C is 12 years younger than A.

5. By givern condition,
$$\frac{\text{History + Geography + Science + Maths}}{4} = 10 + \text{Maths}$$
$\Rightarrow$(History + Geography) + Science – 3 = 40
$\Rightarrow$ 110 + Science – 3 Maths = 40
$\Rightarrow$ 3 Maths – Science = 70
Since there is no relation given between Maths and Science therefore the question cannot be solved.

6. Let the numbers be x, $x + 2$, $x + 4$, $x + 6$ and $x + 8$.
$$\frac{x+x+2+x+4}{3} = \frac{x+4+x+6+x+8}{3} - 10$$
$\Rightarrow x + 2 = x + 6 - 10$
$\Rightarrow 2 = -4$ which can't be possible.

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7. Jayesh = 2 Vijay = $\frac{1}{2}$Suresh

Suresh + Vijay = 85 ⇒ 5 Vijay = 85

⇒ Vijay = 17 years

∴ Jayesh = 34 years.

8. Let their present ages be 9x and 5x. Six years ago,

(9x – 6) = 2 (5x – 6) ⇒ x = 6

∴ The difference between their present ages = 9x – 5x = 4 × 6 = 24 years

9. Weighted average

$$= \frac{(60\times5)+(80\times4)+(40\times3)+(50\times2)+(90\times1)}{5+4+3+2+1}$$

$$= \frac{930}{15} = 62 \text{ marks}$$

10. Jayesh's age = $\frac{\text{Anil's age + Prashant's age}}{2}$

= 24 years.

11. Total weight = 150 × 60 = 9000 kg

Total male students weight = 50 × 70

= 3500 kg

Rest weight = 9000 – 3500 = 5500 kg

Then girls average weight is = $\frac{5500}{100}$ = 55 kg

14. Total number of students passed in I class

$$= \frac{10}{100}\times40 = 4$$

Total number of students passed in II class

$$= \frac{20}{100}\times50 = 10$$

Total number of students passed in class III

$$= \frac{35}{100}\times60 = 21$$

∴ Total number of students passed in the school = 35

Thus, pass percentage of the school

$$= \frac{35}{150}\times100 = \frac{70}{3} = 23\frac{1}{3}\%$$

15. Let the average score be x runs, then by given condition total score of 16 innings = 16x.

$$\frac{16x+85}{17} = (x+3) \Rightarrow x = 34$$

∴ Average after 17th innings

= 34 + 3 = 37.

16. According to Arun, his weight x kg is such that

65 < x < 72 ...(i)

According to his brother,

60 < x < 70 ...(ii)

According to his mother, x £ 68 ...(iii)

From (i), (ii) and (iii), we get

65 < x ≤ 68 i.e., x = 66, 67 or 68

$$\text{Average} = \frac{66+67+68}{3} = 67 \text{ kg}$$

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