AVERAGE

To find average of any number of quantities of the same kind is, to add all the items together and then divide the sum by the number of items.

$$\therefore \text{Average} = \frac{\text{Sum of all the items}}{\text{No. of items}}$$

(e.g)

In a farm, 5 hectares of land yielded 29800 kg. of potatoes. Find the average yield per hectare.

Total yield in 5 hectares = 29800 kg.

Yield in 1 hectare = $\frac{29800}{5}$ = 5960 kg.

1. **A goods train, in five successive minutes, from the start runs 68 m, 127 m, 208 m, 312 m and 535 m and for the next five minutes maintains an average speed of 33 km per hour. Find the whole distance covered and the average speed of the train in km per hour.**

Solution:

[1km = 1000 m

1 hr = 60 minutes]

Average speed in the last 5 minutes

= 33km/hour

= 33000 m / 60 minutes

= 550 m/minute

∴ Distance covered in the last 5 minutes

= 550 × 5 minutes

= 2750 m

Distance covered in all the 10 minutes

= (2750 + 68 + 127 + 208 + 312 + 535) m

= 4000 m (or 4 km.)

∴ Average speed in 10 minutes

= 4000 m / 10 minutes

= 400 m/minute

= 400 × 60 m/hour

= 24000 m/hour

= 24 km/hour

2. The average salary per head of all the workers of an institution is Rs. 60. The average salary per head of 12 officers is Rs. 400. The average salary per head of the rest is Rs. 56. Find the total number of workers in the institution.

Let the total number of workers be x

∴ Total salary drawn = 60x   ...... (1)

Salary of 12 officers

= 12 × 400 = Rs. 4800

Salary of the rest = (x–12) × 56

Hence, total salary of the workers

= (x–12) 56 + 4800   ...... (2)

Equating (1) and (2)

60x = 4800 + 56x – 672

4x = 4128

x = 1032

3. On a journey across Mumbai a taxi averages 20 m.p.h. for 70% of the distance, 25 m.p.h for 10% of the distance and 8 m.p.h. for the remainder. Find the average speed of the whole journey.

Let the distance be 100 miles

Time taken for 70% journey at 20 m.p.h.

$= \frac{70}{20} = 3.5$ hours

Time taken for 10% journey at 25 m.p.h.

$= \frac{10}{25} = \frac{2}{5}$ hours = 0.4 hours

Time taken for 20% journey at 8 m.p.h.

$= \frac{20}{8} = 2.5$ hours

Total time taken

= 3.5 + 0.4 + 2.5 = 6.4 hours.

∴ Average speed $= \frac{100}{\frac{32}{5}} = \frac{100}{32} \times 5$

= 15.625 m.p.h.

4. The average temperature from 9th to the 16th of a month, both days inclusive, was 34.6° and 10th to the 17th it was 35.8°. The temperature on the 9th was 30.5°. What was it on 17th?

Average temperature from the 9th to 16th (i.e., in 8 days of a month) is = 34.6°

∴ Total temperature from the 9th to 16th

(i.e., in 8 days of a month) = 34.6° × 8

= 276.8°

But the temp. on 9th is given to be 30.5°

∴ Total temperature from 10th to 16th of a month = 276.8° – 30.5° = 246.3°

Now the average temperature from the 10th to 17th of a month is 35.8°

∴ The total temperature from the 10th to 17th of a month = 35.8° × 8 = 286.4°

∴ The temperature on 17th will be

= 286.4° – 246.3° = 40.1°

5. For five of his examination subjects not including English and History, a student's average mark is 65. For English and History, the marks are equal and when these are included his average mark is reduced to 61. Calculate his mark for English.

Average marks for the 7 subjects = 61

∴ Total marks for the 7 subjects

= 61 × 7 = 427

Average marks for 5 subjects

(other than English and History) = 65

∴ Total marks for the 5 subjects

= 65 × 5 = 325

∴ Total marks in English and History

= 427 – 325 = 102

Marks for English and History are given to be equal

∴ His marks in English = 102 ÷ 2 = 51.

6. A man spends on an average Rs. 169.47 for the first 7 months and Rs. 181.05 for the next 5 months. Find his monthly salary if he saves Rs. 308.46 during the whole year.

Average expenditure for the first 7 months

= Rs. 169.47

∴ Total expenditure in that period

= Rs. 169.47 × 7 = Rs. 1186.29

Average expenditure for the next 5 months

= Rs. 181.05

∴ Total expenditure in the period

= 181.05 × 5 = Rs. 905.25

His savings in the whole year

= Rs. 308.46

∴ Total income for the whole year

= 1186.29 + 905.25 + 308.46

= Rs. 2400.

Average income for each month

= Rs. 2400 ÷ 12 = Rs. 200

i.e., His monthly income = Rs. 200

7. An establishment is permitted an average monthly contingency expenditure of Rs. 500 per month during the financial year. When a trial check was made at the end of the first nine months of the year it was found that the average monthly contingency expenditure worked out to be Rs. 511. What average monthly expenditure for the next three months should be aimed at in order to attain the permissible average of Rs. 500 per month for the whole year?

Average monthly contingency expenditure allotted for the whole year = Rs. 500

∴ Total annual contingency expenditure
= Rs. 500 × 12 = Rs. 6000

Average monthly contingency expenditure during the first nine months = Rs. 511

∴ Total expenditure in the first nine months
= Rs. 511 × 9 = Rs. 4599

∴ As per allotment, amount left for the next three months
= Rs. (6000 – 4599) = Rs. 1401

∴ Average monthly contingency expenditure for the last 3 months = Rs. 1401 ÷ 3
= Rs. 467

8. The average of 11 numbers is 63, that of the first 6 numbers is 60 and that of the last 6 is 65. Find the sixth number.

Average for the first 6 numbers = 60

∴ Total for the first 6 numbers
= 60 × 6 = 360

Average for the last 6 numbers = 65

∴ Total for the last 6 numbers
= 65 × 6 = 390

∴ Total for the above two (sixth number included twice) = 360 + 390 = 750

Average for all the 11 numbers = 63

∴ Total for all the 11 numbers
= 63 × 11 = 693

∴ The sixth number
= 750 – 693 = 57

9. The average temperature for Monday, Tuesday, Wednesday and Thursday is 60° and the average for Tuesday, Wednesday, Thursday and Friday is 63°. If the ratio of temperature for Monday and Friday be 21:25, find these temperature.

The total temperature for Monday, Tuesday, Wednesday and Thursday = 60° × 4 = 240°

The total temperature for Tuesday, Wednesday, Thursday and Friday = 63° × 4 = 252°

Let the temperature of Monday and Friday be $21x°$ and $25x°$ (Using the given ratio).

Also, keep the total temperature for Tuesday, Wednesday and Thursday as $y°$.

Then, we get
$$25x + y = 252 \qquad \ldots (1)$$
$$21x + y = 240 \qquad \ldots (2)$$

Subtracting (2) from (1)
$$4x = 12 \qquad x = 3$$

∴ Temperature on Monday
$$= 21x = 21 × 3 = 63°$$

Temperature on Friday
$$= 25x = 25 × 3 = 75°$$

10. The average of 31 numbers is 31. When one number is added, their combined average increases by 0.5. Find the value of the new number.

Including the new number, there are 32 numbers

Presently, the average
= 31 + 0.5 = 31.5

∴ Total of all the 32 numbers
= 31.5 × 32 = 1008

Total of the first 31 numbers
= 31 × 31 = 961

∴ The new number = 1008 – 961 = 47

11. 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?

Let the average runs for 16 innings be x.

Then the average runs after 17th innings is
$$x + 3 \qquad \ldots (1)$$

Total runs for 16 innings = 16x

Total runs for 17 innings = 16x + 85

∴ Average runs for 17 innings
$$= \frac{16x + 85}{17} \qquad \ldots (2)$$

From (1) and (2), we get

$$x + 3 = \frac{16x + 85}{17}$$
$$17(x+3) = 16x + 85$$
$$17x + 51 = 16x + 85$$
$$17x - 16x = 85 - 51$$
$$x = 34$$

∴ Average runs after 17th innings
= 34 + 3 = 37

12. **The average weight of a class for 35 students is 47.5 kg. If the weight of the teacher be included, the average rises by 500 gm. What is the weight of the teacher?**

Including the teacher, there are 36 persons (35 students + 1 teacher)

And then, the average weight

= 47.5 kg + 500 gm. = 48 kg.

∴ Total weight for 36 persons

= 48 × 36 = 1728 kg.

Total weight for 35 persons

= 47.5 × 35 = 1662.5 kg.

∴ Weight of the teacher

= 1728 – 1662.5 = 65.5 kg.

13. **The average height of 25 students of a class is 1m 40 cm. Five new entrants increase the average height to 1m 45 cm. Determine the average height of the 5 new entrants. (1 metre = 100 cm)**

Including 5 new entrants the average height

= 1 m 45 cm = 145 cm

∴ Total height of these 30 students

= 145 × 30 = 4350 cm

Average height of 25 students

= 140 cm (1m 40 cm)

∴ Total height of 25 students

= 140 × 25 = 3500 cm

∴ Total height of 5 new entrants

= 4350 – 3500 = 850 cm

∴ Average height of 5 new entrants

= 850 ÷ 5 = 170 cm = 1 m 70 cm

14. **The average age of a class was 15 years, when 5 boys whose average age was 12 years, 6 months were admitted, the class average was reduced by 6 months. How many boys were there?**

Suppose there were x students in the beginning.

Their total age = $15x$

Total age of 5 new boys = (12½ years) × 5

With the inclusion of 5 boys

Average age = (15 years - 6 months)

= 14½ years

Then the total age = 14½ × $(x + 5)$

From the problem

$15x + (12½) (5) = (14½) (x + 5)$

$15x + (12½) (5) = (14½) x + (14½) (5)$

$15x – (14½) x = 5 (14½ – 12½)$

½ x = 5 × 2 = 10   ∴ x = 20

∴ There were 20 students in the beginning.

15. **The average age of 8 men is increased by 2 years, when two of them, whose ages are 20 and 24 years are replaced by two women. What is the average age of the women?**

Let the average age of 8 men be x

Replaced by two women, average age of 8 persons = x + 2

∴ After replacing, total age of 8 persons

= 8 (x+2)

Total age of 8 men = 8x

Total age of 6 men, after two men left

= 8x – (20+24) = 8x – 44

∴ Total age of 2 women

= 8 (x+2) – (8x – 44)

= 8x + 16 – 8x + 44 = 60

∴ Average age of 2 women

= 60 ÷ 2 = 30 years

16. **Average of 13 numbers is 68, the average of 1st 7 numbers is 63 and the average of last 7 numbers is 70. Find the 7th number.**

Average of 13 numbers = 68

∴ Total of 13 numbers = 13 × 68 = 884

Average of 1st 7 numbers = 63

∴ Total of 1st 7 numbers = 7 × 63 = 441

Average of last 7 numbers = 70

Total of last 7 numbers = 7 × 70 = 490

Total of 1st 6 numbers = 884 – 490 = 394

∴ 7th number = 441 – 394 = 47

17. **An officer's pension on retirement of services is equal to half the average monthly salary during the last 36 months of his service. His salary from 1.1.1954 is Rs. 380 per month with increments of Rs. 40 as from 1.10.1954, 1.10.1955 and 1.10.1956. If he retires on 1.1.1957, how much pension does he draw?**

His income from 1.1.1954 to 30.9.1954

= Rs. 380 × 9 = Rs. 3420

His income from 1.10.1954 to 30.9.1955

= Rs. (380 + 40) × 12

= 420 × 12 = Rs. 5040

His income from 1.10.1955 to 30.9.1956

= Rs. (420 + 40) × 12

= 460 × 12 = Rs. 5520

His income from 1.10.1956 to 31.12.1956

= Rs. (460 + 40) × 3

= Rs. 1500

∴ His income for the last 36 months
= 3420 + 5040 + 5520 + 1500 = Rs. 15480
∴ Average monthly salary
= Rs. 15480 ÷ 36

$= \dfrac{15480}{36} = $ Rs. 430

∴ Pension amount $= \dfrac{1}{2}$ (Rs. 430) = Rs. 215

18. **Eleven persons contributed a certain sum. Nine of them gave Rs. 2 each and the other two gave Rs. 2 and Rs. 2.50 more respectively than the average subscription of all the eleven subscribers. Find what sum the two persons subscribed.**

Let Rs. x be the average expenditure of all the 11 people

∴ Total contribution of 11 people
= Rs. 11x   ..... (i)

The first nine persons together spent
= Rs. 9 × 2 = Rs. 18

The tenth and the eleventh respectively spent
= Rs. (x+2) and Rs. (x+2.50)

∴ All the 11 persons together spent
= Rs. 18 + (x+2) + (x+2.50)
= Rs. (2x + 22.50)   .... (ii)

From (i) & (ii),

11x = 2x + 22.50
11x–2x = 22.50
9x = 22.50

$x = \dfrac{22.50}{9} = 2.50$

∴ Subscriptions of the last two persons
= Rs. (2.50 + 2) + (2.50 + 2.50) = Rs. 9.50

19. **A postman goes from a place P to another place Q, his speeds during the first one-third, second one-third and the third one-third of the distance being 4, 5 and 4½ km per hour respectively. On reaching Q he returns to P at the speed of 4 km per hour. Find his average speed throughout the journey.**

Let the distance from P to Q be x

∴ Total distance covered by postman
(P to Q) + (Q to P)
in his journey
= x + x = 2x.

Time to cover the first one-third distance
(while going from P to Q)

$= \left(\dfrac{x}{3}\right) \div 4 = \dfrac{x}{12}$

Time to cover the second one-third distance
(while going from P to Q)

$= \left(\dfrac{x}{3}\right) \div 5 = \dfrac{x}{15}$

Time to cover the third one-third distance
(while going from P to Q)

$= \left(\dfrac{x}{3}\right) \div \dfrac{9}{2} = \dfrac{x}{3} \times \dfrac{2}{9} = \dfrac{2x}{27}$

∴ Time taken for the to and fro journey

$= \dfrac{x}{12} + \dfrac{x}{15} + \dfrac{2x}{27} + \dfrac{x}{4}$

∴ His average speed throughout the journey

$= \dfrac{\text{Total distance}}{\text{Total time taken}} = \dfrac{2x}{\dfrac{x}{12} + \dfrac{x}{15} + \dfrac{2x}{27} + \dfrac{x}{4}}$

$= \dfrac{2x}{\dfrac{x}{12} + \dfrac{x}{15} + \dfrac{2x}{27} + \dfrac{1}{4}} = \dfrac{2}{\dfrac{45 + 36 + 40 + 135}{540}}$

$= \dfrac{2 \times 540}{256} = 4\dfrac{7}{32}$ km/hr

20. **The average age of a class of 23 students is 15 years. A new student joined the class and the average age increased by 6 months. Find the age of the new student.**

Total number of students including the new student = 23 + 1 = 24

Average increase in the age of 24 students

$= 6 \text{ months} = \dfrac{1}{2}$ year

∴ Total increase in the age of 24 students

$= 24 \times \dfrac{1}{2} = 12$ years

∴ The age of the new student
= 15 + 12 = 27 years.

9