NCERT Solutions For Class 8 Maths

Chapter 7 - Proportional Reasoning I

1.

(i) Are the ratios 3 : 4 and 72 : 96 proportional?

(ii) What is the HCF of 72 and 96? (Page 162)

Answer:

(i) HCF of 3 and 4 is 1.

$\therefore$ Ratio $\frac{3}{4}$ is in its simplest form.

HCF of 72 and 96 is 24 (since $72 = 24 \times 3$ and $96 = 24 \times 4$).

$\therefore \frac{72}{96} = \frac{24 \times 3}{24 \times 4} = \frac{3}{4}$

$\therefore$ Ratio $\frac{72}{96}$ in its simplest form is $\frac{3}{4}$.

$\therefore$ Ratios $3 : 4$ and $72 : 96$ are proportional because both ratios in their simplest form are the same.

(ii) HCF of 72 and 96 is equal to 24.

2. Kesang wanted to make lemonade for a celebration. She made 6 glasses of lemonade in a vessel and added 10 spoons of sugar to the drink. Her father expected more people to join the celebration. So he asked her to make 18 more glasses of lemonade. To make the lemonade with the same sweetness, how many spoons of sugar should she add? How can we find the factor of change in the ratio? (Page 162)

Answer:

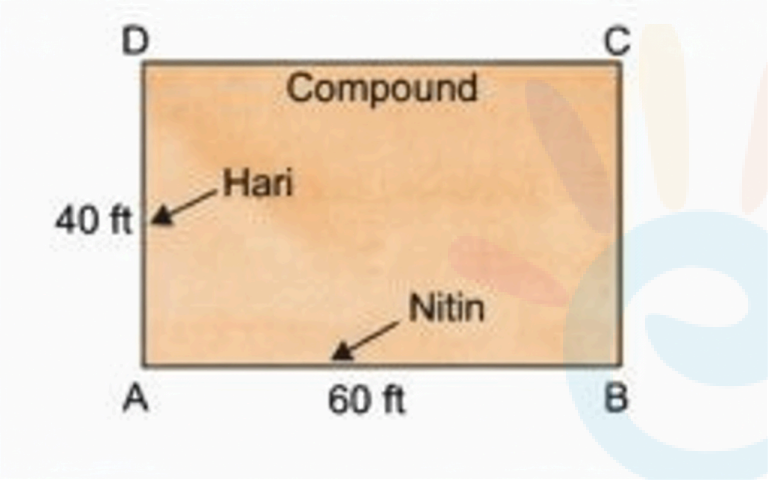
Start by writing the ratio of glasses to spoons of sugar in the first batch. For 6 glasses and 10 spoons the ratio is $\frac{6}{10}$ which simplifies to $\frac{3}{5}$ or $3:5$. When the number of glasses is 18, let the required number of spoons be x. The new ratio should match the old one to keep sweetness the same: $\frac{3}{5}=\frac{18}{x}$. Solve for x: multiply both sides by x and by 5 to get $3x=5\times 18=90$, so $x=\frac{90}{3}=30$. Thus she needs **30 spoons** of sugar.

The factor of change compares the new number of glasses with the original: $\frac{18}{6}=3$. That means the recipe is scaled up by a factor of 3, so every ingredient must be multiplied by 3.

3. Nitin and Hari were constructing a compound wall around their house. Nitin was building the longer side, 60 ft in length, and Hari was building

the shorter side, 40 ft in length. Nitin used 3 bags of cement, but Hari used only 2 bags of cement. Nitin was worried that the wall Hari built would not be as strong as the wall he built because he used less cement. Is Nitin correct in his thinking? (Page 163)

Answer:



Compare the length-to-cement ratios for both builders. For Nitin: $\frac{60}{3} = 20,$ so his ratio is $60 : 3$ which simplifies to $20 : 1$ (meaning 1 bag per 20 ft). For Hari: $\frac{40}{2} = 20,$ so his ratio is $40 : 2$ which also simplifies to $20 : 1$. Because both ratios are identical when simplified, each builder used the same amount of cement per foot of wall. Therefore the walls should be equally strong with respect to cement usage. Nitin's worry is not justified.

Note: both ratios show that one bag of cement is used for every 20 ft of wall.

4. In my school, there are 5 teachers and 170 students. The ratio of teachers to students in my school is 5 : 170. Count the number of

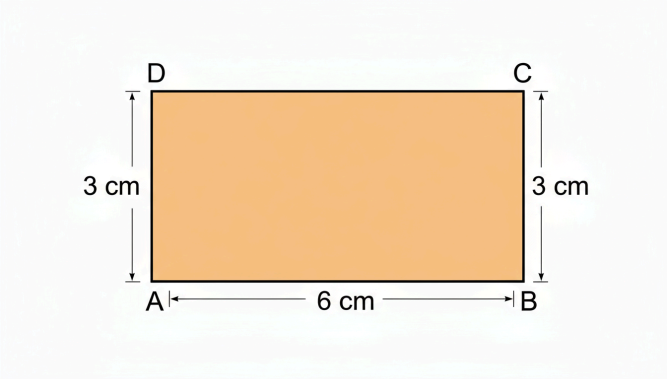
teachers and students in your school. What is the ratio of teachers to students in your school? Write it below. Is the teacher-to-student ratio in your school proportional to the one in my school? (Page 163)

Answer:

In the given school the teacher:student ratio is $5:170$. Simplify this by dividing both numbers by 5 to get $1:34$. In the other school described, there are 6 teachers and 213 students, so the ratio is $6:213$. This simplifies by dividing both terms by 6 to give $1:35.5$ (or keeping it exact, $6:213$ reduces to $2:71$ if dividing by 3, but the decimal form highlights the difference). Because $1:34$ is not equal to $1:35.5$, the two ratios are not proportional. So the teacher-to-student ratio in the second school is **not** proportional to the one in the given school.

5. Measure the width and height (to the nearest cm) of the blackboard in your classroom. What is the ratio of width to height of the blackboard? Can you draw a rectangle in your notebook whose width and height are proportional to the ratio of the blackboard? Compare the rectangle you have drawn to those drawn by your classmates. Do they all look the same? (Page 163)

Answer:



Suppose the blackboard measures 300 cm in width and 150 cm in height. The width-to-height ratio is: $\frac{300}{150} = \frac{2}{1}$ or $2:1$. To draw a rectangle with the same proportion, choose an easy width such as 6 cm and find the matching height x so that $2:1::6:x$. Writing this as an equation: $\frac{2}{1} = \frac{6}{x} \Rightarrow 2x = 6 \Rightarrow x = 3.$ So the corresponding height is 3 cm; draw AB = 6 cm and AD = 3 cm at right angles and join CD to form rectangle ABCD.

When classmates draw rectangles using the same ratio but different scale factors, the shapes are similar (same proportions) though not identical in size. Similarity means matching corresponding side ratios; size may differ depending on the scale chosen.

6. When Neelima was 3 years old, her mother was 10 times her age. What is the ratio of Neelima's age to her mother's age? What would be the ratio of their ages when Neelima is 12 years old? Would it remain the same? (Page 164)

Answer:

Initially Neelima is 3 years and her mother is $10 \times 3 = 30$ years. Their age ratio is $\frac{3}{30} = \frac{1}{10}$ or $1 : 10$. After some years, when Neelima becomes 12, that is 9 years later (since $12 - 3 = 9$). The mother's age then is $30 + 9 = 39$. The new ratio becomes $\frac{12}{39} = \frac{4}{13}$ or $4 : 13$ after simplifying by gcd 3. Because $1 : 10$ is not equal to $4 : 13$, the ratio of their ages does not remain the same as they grow older.

Remark: adding the same fixed number to each term of a ratio (here both ages increase by the same number of years) does not generally preserve the original proportion.

7. Fill in the missing numbers for the following ratios that are proportional to 14 : 21.
(i) ____ : 42
(ii) 6 : ____
(iii) 2 : ____
What factor should we multiply 14 by to get 6? Can it be an integer? Or should it be a fraction? (Page 164)

Answer:

The given ratio is $14 : 21$ which simplifies to $\frac{14}{21} = \frac{2}{3}$.

(i) Let the missing number be x in $x : 42$. Set up proportion: $\frac{14}{21} = \frac{x}{42} \Rightarrow \frac{2}{3} = \frac{x}{42}$. Solving gives $3x = 2 \times 42 = 84$ so $x = 28$. Hence the missing number is **28**.

(ii) For $6 : x$ set $\frac{14}{21} = \frac{6}{x} \Rightarrow \frac{2}{3} = \frac{6}{x}$. Solve: $2x = 18 \Rightarrow x = 9$. The missing number is **9**.

(iii) For $2 : x$ use $\frac{14}{21} = \frac{2}{x} \Rightarrow \frac{2}{3} = \frac{2}{x}$. Solve: $2x = 6 \Rightarrow x = 3$. The missing number is **3**.

To get from 14 to 6 we multiply by the factor $\frac{6}{14} = \frac{3}{7}$ which is a fraction (not an integer). Multiplying 21 by the same factor yields $21 \times \frac{3}{7} = 9$, confirming the pair $6 : 9$ as proportional to $14 : 21$.

8. Filter coffee is a beverage made by mixing coffee decoction with milk. Manjunath usually mixes 15 mL of coffee decoction with 35 mL of milk to make one cup of filter coffee in his coffee shop. In this case, we can say that the ratio of coffee decoction to milk is 15 : 35. If customers want 'stronger' filter coffee. Manjunath mixes 20 mL of the decoction with 30 mL of milk. The ratio here is 20 : 30. Why is this coffee stronger?



(i) And when they want 'lighter' filter coffee, he mixes 10 mL of coffee and 40 mL of milk, making the ratio 10 : 40. Why is this coffee lighter?



(ii) The following table shows the different ratios in which Manjunath mixes coffee decoction with milk. Write in the last column if the coffee is stronger or lighter than the regular coffee. (Pages 164-165)

Coffee Decoction (in mL)	Milk (in mL)	Regular/Strong/Light
300	600	
150	500	
200	400	
24	56	
100	300	

Answer:

In one cup of regular filter coffee:

Coffee decoction = 15 mL

Milk = 35 mL

∴ Ratio of coffee decoction to milk = $15 : 35 = 3 : 7$

Here, $3 + 7 = 10$

∴ Coffee decoction in 10 mL filter coffee = $3\,\text{mL}$

∴ Coffee decoction in 100 mL filter coffee = $\frac{3}{10} \times 100 = 30\,\text{mL}$

In one cup of stronger filter coffee:

Coffee decoction = 20 mL

Milk = 30 mL

∴ Ratio of coffee decoction to milk = $20 : 30 = 2 : 3$

Here, $2 + 3 = 5$

∴ Coffee decoction in 5 mL filter coffee = $2\,\text{mL}$

∴ Coffee decoction in 100 mL filter coffee = $\frac{2}{5} \times 100 = 40\,\text{mL}$

Since $40\,\text{mL} > 30\,\text{mL}$, the latter coffee is stronger.

(i) In a cup of lighter filter coffee:

Coffee decoction = 10 mL

Milk = 40 mL

∴ Ratio of coffee decoction to milk = $10 : 40 = 1 : 4$

Here, $1 + 4 = 5$

∴ Coffee decoction in 5 mL filter coffee = $1\,\text{mL}$

∴ Coffee decoction in 100 mL filter coffee = $\frac{1}{5} \times 100 = 20\,\text{mL}$

Since $20\,\text{mL} < 30\,\text{mL}$, this coffee is lighter.

(ii)

S. No.	Coffee Decoction (in mL)	Milk (in mL)	Regular/Stronger/Lighter
1	300	600	Stronger
2	150	500	Lighter
3	200	400	Stronger
4	24	56	Regular

5	100	300	Lighter

S.No. 1

Here $300 + 600 = 900$

∴ Coffee decoction in 900 mL filter coffee = $300\,\text{mL}$

∴ Coffee decoction in 100 mL filter coffee = $\frac{300}{900} \times 100 = \frac{100}{3} = 33\frac{1}{3}\,\text{mL}$

Since $33\frac{1}{3} > 30$, this filter coffee is stronger.

S.No. 2

Here $150 + 500 = 650$

∴ Coffee decoction in 650 mL filter coffee = $150\,\text{mL}$

∴ Coffee decoction in 100 mL filter coffee = $\frac{150}{650} \times 100 = \frac{300}{13} = 23\frac{1}{13}\,\text{mL}$

Since $23\frac{1}{13} < 30$, this filter coffee is lighter.

S.No. 3

Here $200 + 400 = 600$

∴ Coffee decoction in 600 mL filter coffee = $200\,\text{mL}$

∴ Coffee decoction in 100 mL filter coffee = $\frac{200}{600} \times 100 = \frac{100}{3} = 33\frac{1}{3}\,\text{mL}$

Since $33\frac{1}{3} > 30$, this filter coffee is stronger.

S.No. 4

Here $24 + 56 = 80$

∴ Coffee decoction in 80 mL filter coffee = $24\,\text{mL}$

∴ Coffee decoction in 100 mL filter coffee = $\frac{24}{80} \times 100 = 30\,\text{mL}$

Since $30 = 30$, this filter coffee is regular.

S.No. 5

Here $100 + 300 = 400$

∴ Coffee decoction in 400 mL filter coffee = $100\,\text{mL}$

∴ Coffee decoction in 100 mL filter coffee = $\frac{100}{400} \times 100 = 25\,\text{mL}$

Since $25 < 30$, this filter coffee is lighter.

Figure It Out (Pages 165-167)

1. Circle the following statements of proportion that are true.

(i) 4 : 7 :: 12 : 21

(ii) 8 : 3 :: 24 : 6

(iii) 7 : 12 :: 12 : 7

(iv) 21 : 6 :: 35 : 10

(v) 12 : 18 :: 28 : 12

(vi) 24 : 8 :: 9 : 3

Answer:

A proportion $a : b :: c : d$ is true when $\frac{a}{b} = \frac{c}{d}$.

(i) $\frac{4}{7} = \frac{12}{21}$ because both simplify to $\frac{4}{7}$. **True.**

(ii) $\frac{8}{3} \neq \frac{24}{6}$ because $\frac{24}{6} = 4$ while $\frac{8}{3} \approx 2.666$. **Not true.**

(iii) $\frac{7}{12} \neq \frac{12}{7}$ (reciprocal), so **Not true.**

(iv) $\frac{21}{6} = \frac{7}{2}$ and $\frac{35}{10} = \frac{7}{2}$, so they match. **True.**

(v) $\frac{12}{18} = \frac{2}{3}$ while $\frac{28}{12} = \frac{7}{3}$; they are not equal. **Not true.**

(vi) $\frac{24}{8} = 3$ and $\frac{9}{3} = 3$, so they are equal. **True.**

2. Give 3 ratios that are proportional to 4 : 9.

Answer:

Multiply both terms of $4 : 9$ by the same positive integer to get proportional ratios. For example: $4 \times 2 : 9 \times 2 = 8 : 18$, $4 \times 3 : 9 \times 3 = 12 : 27$, $4 \times 4 : 9 \times 4 = 16 : 36$. Thus three proportional ratios are **8 : 18, 12 : 27,** and **16 : 36**.

3. Fill in the missing numbers for these ratios that are proportional to 18 : 24.

(i) 3 : ____

(ii) 12 : ____
(iii) 20 : ____
(iv) 27 : ____

Answer:

The base ratio $18 : 24$ simplifies to $\frac{18}{24} = \frac{3}{4}$.

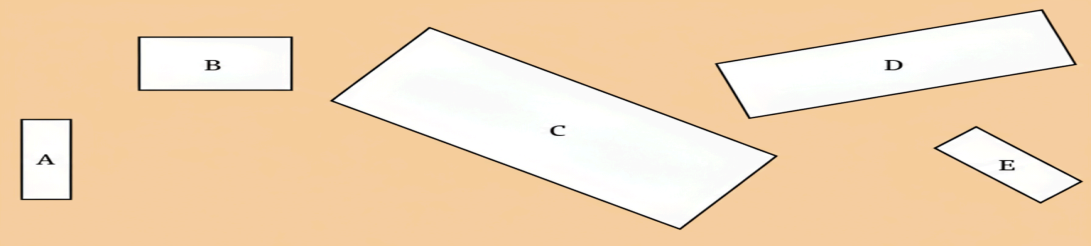
(i) For $3 : x$ set $\frac{3}{4} = \frac{3}{x}$. Solving gives $x = 4$. So the missing number is **4**.

(ii) For $12 : x$ set $\frac{3}{4} = \frac{12}{x}$. Cross-multiplying: $3x = 48 \Rightarrow x = 16$. Missing number is **16**.

(iii) For $20 : x$ set $\frac{3}{4} = \frac{20}{x}$. Then $3x = 80 \Rightarrow x = \frac{80}{3}$. Missing number is **80/3** (a fraction).

(iv) For $27 : x$ set $\frac{3}{4} = \frac{27}{x}$. Then $3x = 108 \Rightarrow x = 36$. Missing number is **36**.

4. Look at the following rectangles. Which rectangles are similar to each other? You can verify this by measuring the width and height using a scale and comparing their ratios.



Answer:

Using a scale, we measure the width and height of the given rectangles. The width-to-height ratios for rectangles A, B, C, D, and E are 1 : 3, 3 : 2, 9 : 4, 7 : 2, and 3 : 1 respectively.

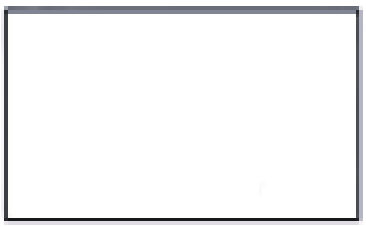
Rectangle	Width (in mm)	Height (in mm)	Ratio = Width / Height
A	5	15	5/15 = 1/3
B	15	10	15/10 = 3/2
C	45	20	45/20 = 9/4
D	35	10	35/10 = 7/2
E	15	5	15/5 = 3/1

Since all these ratios are different, we can see that rectangles A and E have ratios that are reciprocals of each other — 1 : 3 and 3 : 1.

∴ In rectangles A and E, one side is three times the other.

∴ Therefore, only rectangles A and E are similar.

5. Look at the following rectangle. Can you draw a smaller rectangle and a bigger rectangle with the same width-to-height ratio in your notebook? Compare your rectangles with your classmates' drawings. Are all of them the same? If they are different from yours, can you think why? Are they wrong?



Answer:

For the given rectangle:

Width = 32 mm and Height = 18 mm

∴ Ratio = $32 : 18$

We will draw smaller and larger rectangles similar to the given one by applying different factors of change.

Let the factor of change be $\frac{1}{2}$

∴ New width = $\frac{1}{2} \times 32 = 16\,\text{mm}$

and New height = $\frac{1}{2} \times 18 = 9\,\text{mm}$

Hence, the new rectangle obtained is similar to the given rectangle, as shown in the figure.



Let the **factor of change** be 2.

∴ New width = 2 × 32 = 64 mm

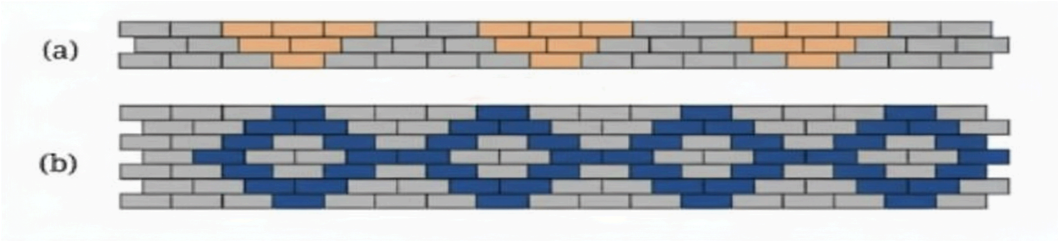
and New height = 2 × 18 = 36 mm

Thus, a new rectangle similar to the original one is obtained, as shown in the figure.



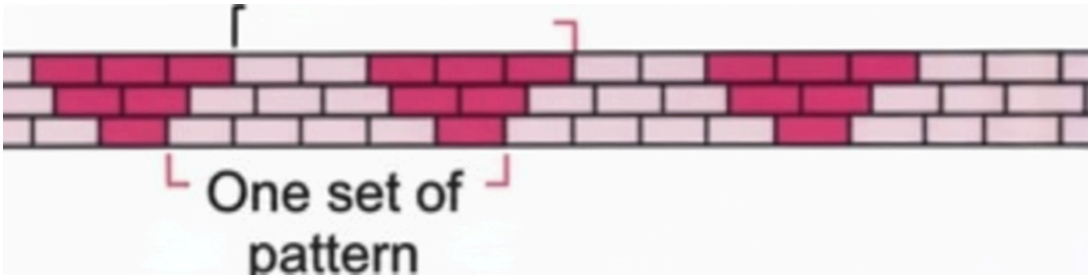
The rectangles drawn by other classmates may have different sizes, but all of them are similar to the given rectangle.

6. The following figure shows a small portion of a long brick wall with patterns made using coloured bricks. Each wall continues this pattern throughout the wall. What is the ratio of grey bricks to coloured bricks? Try to give the ratios in their simplest form.

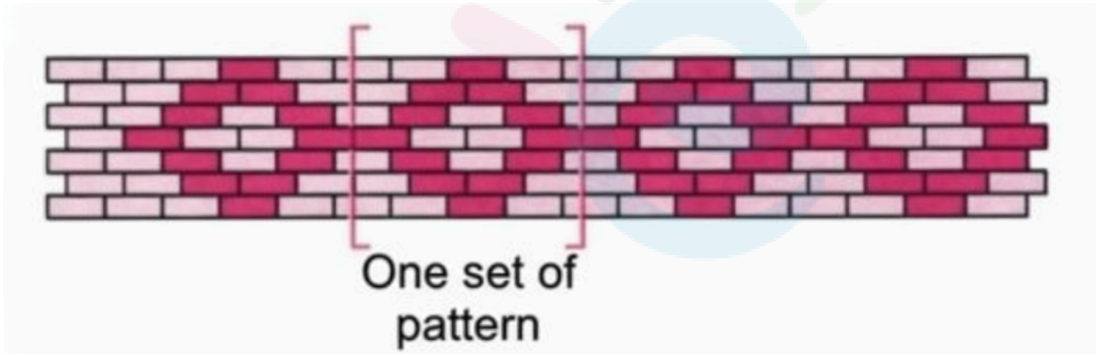


Answer:

(a) Consider one repeating pattern where grey bricks total $2+3+4=9$ and coloured bricks total $3+2+1=6$. Therefore the ratio is $9:6$ which simplifies by dividing by 3 to $3:2$.



(b) In another pattern calculation the total grey bricks sum to 16 and coloured bricks to 12, giving ratio $16 : 12$ which reduces by dividing by 4 to $4 : 3$.



Number of grey bricks in one set of pattern

$$\left(\frac{1}{2}+1+1+\frac{1}{2}\right)+(1+1)+\left(\frac{1}{2}+1+\frac{1}{2}\right)+(1+1)+\left(\frac{1}{2}+1+\frac{1}{2}\right)+(1+1)+\left(\frac{1}{2}+1+1+\frac{1}{2}\right)$$

= 3 + 2 + 2 + 2 + 2 + 2 + 3

= 16

Number of coloured bricks in one set of pattern = 1 + (1 + 1) + (1 + 1) + (1 + 1) + (1 + 1) + (1 + 1) + 1

= 1 + 2 + 2 + 2 + 2 + 2 + 1

= 12

∴ Ratio of grey bricks to coloured bricks = 16 : 12

We have 16 : 12 = 4 : 3

∴ Ratio in the simplest form = 4 : 3.

Trairasika – The Rule of Three

8. For the mid-day meal in a school with 120 students, the cook usually makes 15 kg of rice. On a rainy day, only 80 students came to school. How many kilograms of rice should the cook make so that the food is not wasted? The ratio of the number of students to the amount of rice needs to be proportional. So, 120 : 15 :: 80 : ? What is the factor of change in the first term? (Page 167)

Answer:

Let x be the kg of rice needed for 80 students. Set up proportion: $120 : 15 :: 80 : x \Rightarrow \frac{120}{15} = \frac{80}{x}$. Simplify left side: $\frac{120}{15} = 8$, so $8 = \frac{80}{x} \Rightarrow x = \frac{80}{8} = 10.$ The cook needs **10 kg** of rice.

The factor of change in the number of students is $\frac{80}{120} = \frac{2}{3}$; the rice amount must be multiplied by the same factor: $\frac{x}{15} = \frac{2}{3} \Rightarrow x = 15 \times \frac{2}{3} = 10$ confirming the result.

9.

(i) A car travels 90 km in 150 minutes. If it continues at the same speed, what distance will it cover in 4 hours?
(ii) 150 : 90 :: 4 : x — Is this the right way to formulate the question?
(iii) How can you find the distance covered in 240 minutes? (Page 169)

Answer:

(i) First convert 4 hours into minutes because the given time is in minutes: $4 \text{ hours} = 240 \text{ minutes}$. In 150 minutes the car goes 90 km. Let the distance in 240 minutes be x km. The correct proportion is: $150 : 90 :: 240 : x$.

(ii) The form $150 : 90 :: 4 : ?$ is not correct because the units differ (minutes vs hours). You must compare like units; convert 4 hours to minutes (240 minutes) first.

(iii) Solve the correct proportion: $\frac{150}{90} = \frac{240}{x} \Rightarrow \frac{5}{3} = \frac{240}{x}$. Cross-multiply: $5x = 3 \times 240 = 720 \Rightarrow x = \frac{720}{5} = 144.$ So the car covers **144 km** in 4 hours at the same speed.

10. A small farmer in Himachal Pradesh sells each 200 g packet of tea for ₹ 200. A large estate in Meghalaya sells each 1 kg packet of tea for ₹ 800. Are the weight-to-price ratios in both places proportional? Which tea is more expensive? Why? (Page 169)

Answer:

Convert to comparable units: 1 kg = 1000 g. For the Himachal seller, the ratio weight:price is $200\ \text{g} : \#\#00$ which simplifies to $1 : 1$ (i.e., ₹1 per gram in that packet context). For Meghalaya: $1000\ \text{g} : \#\#00$ reduces to $5 : 4$ when dividing by 200. As decimals or unit rates, Himachal is charging ₹200 for 200 g, which equals ₹1 per gram; Meghalaya charges ₹800 for 1000 g which equals ₹0.8 per gram. The two ratios are not proportional because $\frac{1}{1} \neq \frac{5}{4}$. Since the per-gram price in Himachal (₹1/g) is greater than in Meghalaya (₹0.8/g), tea is **more expensive in Himachal Pradesh**.

Figure It Out (Pages 170-171)

1. The Earth travels approximately 940 million kilometres around the Sun in a year. How many kilometres will it travel in a week?

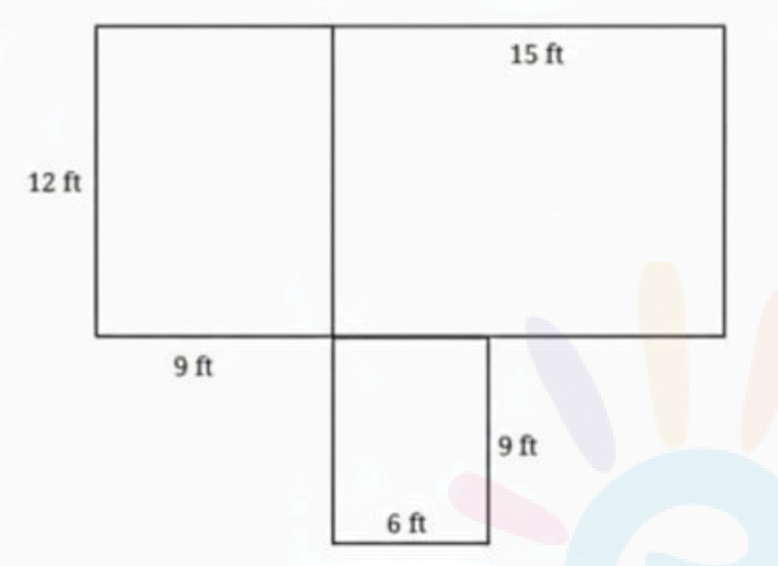
Answer:

One year has 365 days, so it has $\frac{365}{7}$ weeks. If Earth travels 940 million km in one year, then the distance per week is: $x = \frac{940 \times 10^6}{365/7} = \frac{940 \times 10^6 \times 7}{365}$.

Evaluating gives approximately **18027397 km** (about 18,027,397 km) per week. (A rounded approximate value is acceptable.)

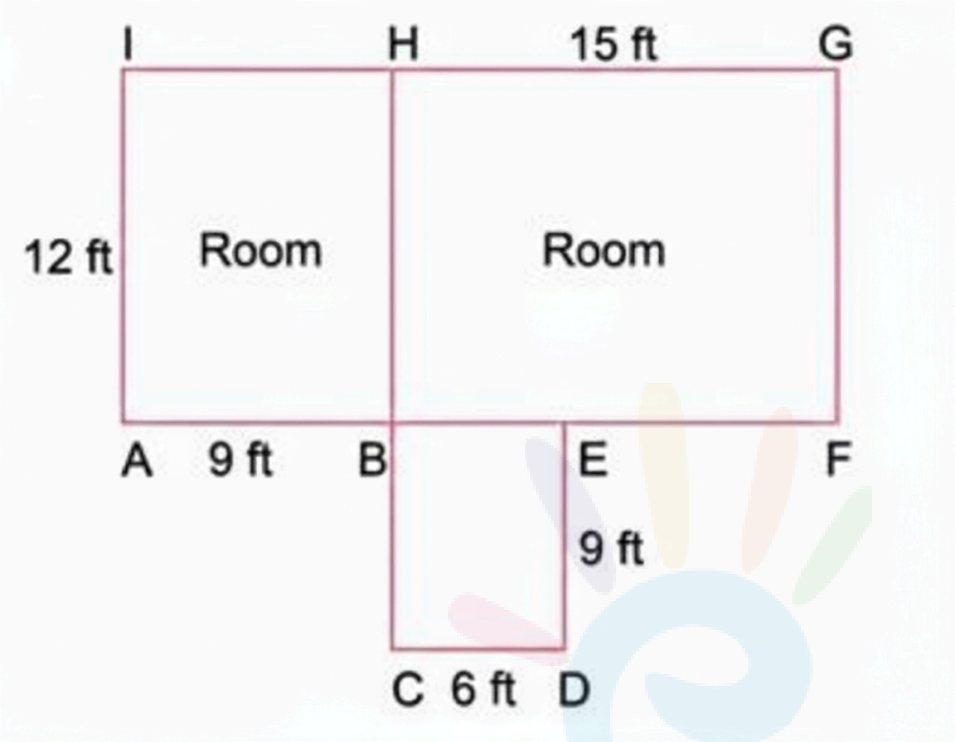
2. A mason is building a house in the shape shown in the diagram. He needs to construct both the outer walls and the inner wall that separates the two rooms. To build a wall of 10 feet, he requires approximately 1450 bricks. How many bricks would he need to build the house? Assume all

walls are of the same height and thickness.



Answer:

If 10 ft requires 1450 bricks, then use proportion. First compute total wall length given:



$\text{Total length} = 12 + (9 + 12) + 9 + 12 + (9 + 15) + (9 + 15) + 6 = 108 \text{ ft}.$ Let the number of bricks required for 108 ft be x. Set proportion: $10 : 1450 :: 108 : x \Rightarrow \frac{10}{1450} = \frac{108}{x}$.

Simplify: $\frac{1}{145} = \frac{108}{x} \Rightarrow x = 145 \times 108 = 15{,}660.$ So **15,660 bricks** are required.

3. Puneeth's father went from Lucknow to Kanpur in 2 hours by riding his motorcycle at a speed of 50 km/h. If he drives at 75 km/h, how long will it take him to reach Kanpur? Can we form this problem as a proportion 50 : 2 :: 75 : ____? Would it take Puneeth's father more time or less time to

reach Kanpur? Think about it. (Page 171)

Answer:

First find the distance: at 50 km/h for 2 hours the distance is $50 \times 2 = 100\ \text{km}$. At 75 km/h the time required is $\frac{100}{75} = \frac{4}{3}\ \text{hours}$ which equals 1 hour 20 minutes. The form $50 : 2 :: 75 : ?$ is misleading because the ratio of speed to time is not directly proportional in the way written; you must account for inverse relationship between speed and time for the same distance (higher speed gives lower time). So we cannot write $50 : 2 :: 75 : \frac{4}{3}$ as a direct proportion of the same type. Puneeth's father will take **less** time at 75 km/h (1\(\frac{1}{3}\) hours) than at 50 km/h (2 hours).

7.5 Sharing, But Not Equally

11. Prashanti and Bhuvan started a food cart business near their school. Prashanti invested ₹ 75,000 and Bhuvan invested ₹ 25,000. At the end of the first month, they gained a profit of ₹ 4,000. They decided that they would share the profit in the same ratio as their investment. What is each person's share of the profit? (Page 174)

Answer:

The investments are in ratio $75{,}000 : 25{,}000$ which simplifies to $3 : 1$. Total profit = ₹4,000. Divide the profit in the ratio 3:1: - Prashanti's share = $\frac{3}{3+1} \times 4{,}000 = \frac{3}{4} \times 4{,}000 = 3{,}000$ rupees.

- Bhuvan's share = $\frac{1}{3+1} \times 4{,}000 = \frac{1}{4} \times 4{,}000 = 1{,}000$ rupees. Check: ₹3,000 + ₹1,000 = ₹4,000, as required.

12. A mixture of 40 kg contains sand and cement in the ratio of 3 : 1. How much cement should be added to the mixture to make the ratio of sand to cement 5 : 2? (Page 174)

Answer:

For a 40 kg mixture with sand:cement = $3:1$, the sand weight is $\frac{3}{4} \times 40 = 30 \text{ kg}$ and cement is $\frac{1}{4} \times 40 = 10 \text{ kg}$. Let the final total cement be x kg so that sand:cement = $5:2$. Set proportion: $\frac{30}{x} = \frac{5}{2}$. Solve: $5x = 60 \Rightarrow x = 12 \text{ kg}$. So the final cement weight must be 12 kg. Since the mix already has 10 kg of cement, we need to add $12 - 10 = 2 \text{ kg}$ of cement.

Figure It Out (Page 175)

1. Divide ₹ 4,500 into two parts in the ratio 2 : 3.

Answer:

The sum of ratio parts is $2 + 3 = 5$. First part = $\frac{2}{5} \times 4{,}500 = 1{,}800$ rupees. Second part = $\frac{3}{5} \times 4{,}500 = 2{,}700$ rupees. So the two parts are **₹ 1,800** and **₹ 2,700**, and they add to ₹4,500.

2. In a science lab, acid and water are mixed in the ratio of 1 : 5 to make a solution. In a bottle that has 240 mL of the solution, how much acid and water does the solution contain?

Answer:

Total parts = $1 + 5 = 6$. Acid = $\frac{1}{6} \times 240 = 40 \text{ mL}$. Water = $\frac{5}{6} \times 240 = 200 \text{ mL}$.
So the bottle contains **40 mL acid** and **200 mL water**.

3. Blue and yellow paints are mixed in the ratio of 3 : 5 to produce green paint. To produce 40 mL of green paint, how much of these two colours are needed? To make the paint a lighter shade of green, I added 20 mL of yellow to the mixture. What is the new ratio of blue and yellow in the paint?

Answer:

For 40 mL total and ratio 3:5, total parts = 8. Blue = $\frac{3}{8} \times 40 = 15 \text{ mL}$, Yellow = $\frac{5}{8} \times 40 = 25 \text{ mL}$. Adding 20 mL yellow gives new totals: Blue = 15 mL, Yellow = 45 mL. Simplify ratio $15 : 45 = 1 : 3$. So the new ratio is **1 : 3**.

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4. To make soft idlis, you need to mix rice and urad dal in the ratio of 2 : 1. If you need 6 cups of this mixture to make idlis tomorrow morning, how many cups of rice and urad dal will you need?

Answer:

Total ratio parts = $2+1=3$. Rice = $\frac{2}{3}\times 6 = 4$ cups, Urad dal = $\frac{1}{3}\times 6 = 2$ cups. So use **4 cups rice** and **2 cups urad dal**.

5. I have one bucket of orange paint that I made by mixing red and yellow paints in the ratio of 3 : 5. I added another bucket of yellow paint to this mixture. What is the ratio of red paint to yellow paint in the new mixture?

Answer:

Let one bucket have volume x litres. Initially red = $\frac{3x}{8}$ and yellow = $\frac{5x}{8}$. Adding another bucket of yellow (an additional x) gives new yellow amount $\frac{5x}{8}+x=\frac{13x}{8}$. Red remains $\frac{3x}{8}$. The new ratio is: $\frac{3x/8}{13x/8}=\frac{3}{13}$. So the new red:yellow ratio is **3 : 13**.

7.6 Unit Conversions (Figure It Out Pages 176-177)

1. Anagh mixes 600 mL of orange juice with 900 mL of apple juice to make a fruit drink. Write the ratio of orange juice to apple juice in its simplest form.

Answer:

Ratio $600:900$ reduces dividing by 300 to $2:3$. So the simplest form is **2 : 3**.

2. Last year, we hired 3 buses for the school trip. We had a total of 162

students and teachers who went on that trip, and all the buses were full. This year we have 204 students. How many buses will we need? Will all the buses be full?

Answer:

If 3 buses carried 162 people when full, one bus capacity is $\frac{162}{3} = 54$ seats.

For 204 people, number of buses required = $\frac{204}{54} \approx 3.78$, so we need 4 buses to carry everyone. Total seats in 4 buses = $4 \times 54 = 216$ leaving $216 - 204 = 12$ empty seats. So we need **4 buses** and they will not be completely full (12 seats remain vacant).

3. The area of Delhi is 1,484 sq. km, and the area of Mumbai is 550 sq. km. The population of Delhi is approximately 30 million, and that of Mumbai is 20 million people. Which city is more crowded? Why do you say so?

Answer:

Crowdiness relates to population density (population per unit area). Compute area-to-population ratios or compare densities. For Delhi: $\text{density}_D = \frac{30{,}000{,}000}{1{,}484} \approx 20{,}212 \text{ people per sq.km.}$ For Mumbai: $\text{density}_M = \frac{20{,}000{,}000}{550} \approx 36{,}364 \text{ people per sq.km.}$ Because Mumbai's density is higher, **Mumbai is more crowded**. Another comparative way: if the same area-to-population ratio of Delhi were applied to Mumbai's

area, Mumbai would have far fewer people than the actual 20 million.

4. A crane of height 155 cm has its neck and the rest of its body in the ratio 4 : 6. For your height, if your neck and the rest of the body also had this ratio, how tall would your neck be?



Answer:

If total height follows neck:body = $4:6$, then the neck portion is $\frac{4}{4+6} = \frac{4}{10} = \frac{2}{5}$ of total height. For height 165 cm (given example), neck length = $\frac{2}{5} \times 165 = 66 \text{ cm}$.

5. Let us try an ancient problem from Lilavati. At that time, weights were measured in a unit named palas, and niskas was a unit of money. "If $2\frac{1}{2}$ palas of saffron costs $\frac{3}{7}$ niskas, O expert businessman! Tell me quickly, what quantity of saffron can be bought for 9 niskas?"

Answer:

Convert mixed numbers: $2\frac{1}{2} = \frac{5}{2}$ palas. Given cost ratio $\frac{5/2}{3/7}$; multiply numerator and denominator to clear fractions: $\frac{5/2}{3/7} = \frac{5}{2} \div \frac{3}{7} = \frac{5}{2} \times \frac{7}{3} = \frac{35}{6}$ in palas per niska. That means $\frac{35}{6}$ palas cost 1 niska. For 9 niskas, amount of saffron x satisfies: $\frac{35}{6} : 1 :: x : 9 \Rightarrow \frac{35}{6} = \frac{x}{9} \Rightarrow x = 9 \times \frac{35}{6} = 52.5.$ So for 9 niskas one can buy **52.5 palas** of saffron.

6. Harmain is a 1-year-old girl. Her elder brother is 5 years old. What will be Harmain's age when the ratio of her age to her brother's age is 1 : 2?

Answer:

Let after x years the ages be $1 + x$ and $5 + x$. Then $1 : 2 :: 1 + x : 5 + x \Rightarrow \frac{1}{2} = \frac{1 + x}{5 + x}.$

Cross-multiply: $2(1 + x) = 5 + x \Rightarrow 2 + 2x = 5 + x \Rightarrow x = 3.$ So in 3 years Harmain will be $1 + 3 = 4$ years old and her brother will be 8; the ratio $4 : 8$ simplifies to $1 : 2$.

7. The mass of equal volumes of gold and water is in the ratio 37 : 2. If 1 litre of water is 1 kg in mass, what is the mass of liter of gold?

Answer:

If equal volumes give masses in ratio $37 : 2$ and 1 litre of water weighs 1 kg, then for equal volume the mass of gold x satisfies: $37 : 2 :: x : 1 \Rightarrow \frac{37}{2} = \frac{x}{1} \Rightarrow x = \frac{37}{2} = 18.5 \text{ kg}.$ So one litre of gold has mass **18.5 kg**.

8. It is good farming practice to apply 10 tonnes of cow manure for 1 acre of land. A farmer is planning to grow tomatoes in a plot of size 200 ft by 500 ft. How much manure should he buy? (Please refer to the section on Unit Conversions earlier in this chapter).

Answer:

Convert units: 1 acre = 43,560 sq.ft. The recommended manure is 10 tonnes (10,000 kg) per 43,560 sq.ft. The plot area is $200 \times 500 = 100{,}000 \text{ sq.ft}$. Use proportion:

$10{,}000 : 43{,}560 :: x : 100{,}000 \Rightarrow x = \frac{10{,}000 \times 100{,}000}{43{,}560} \approx 22{,}956.84 \text{ kg}.$ That equals about **22.95684 tonnes**. Round as needed for practical purchase.

9. A tap takes 15 seconds to fill a mug of water. The volume of the mug is 500 mL. How much time does the same tap take to fill a bucket of water if the bucket has a 10-litre capacity?

Answer:

10 litres = 10,000 mL. Proportion between volume and time is: $500 : 15 :: 10{,}000 : x \Rightarrow \frac{500}{15} = \frac{10{,}000}{x}.$ Solve:

$500x = 15 \times 10{,}000 = 150{,}000 \Rightarrow x = \frac{150{,}000}{500} = 300 \text{ seconds}$ which is 5 minutes. So the bucket fills in **5 minutes**.

10. One acre of land costs ₹ 15,00,000. What is the cost of 2,400 square feet of the same land?

Answer:

1 acre = 43,560 sq.ft. Use proportion: $43{,}560 : 1{,}500{,}000 :: 2{,}400 : x \Rightarrow x = \frac{2{,}400 \times 1{,}500{,}000}{43{,}560} \approx 82{,}664.63.$ So cost ≈ **₹ 82,664.63**.

11. A tractor can plough the same area of a field 4 times faster than a pair of oxen. A farmer wants to plough his 20-acre field. A pair of oxen takes 6 hours to plough an acre of land. How much time would it take if the farmer used a pair of oxen to plough the field? How much time would it take him if he decides to use a tractor instead?

Answer:

A pair of oxen needs 6 hours per acre. For 20 acres the time is $20 \times 6 = 120 \text{ hours}$. A tractor is 4 times faster, so it takes one-fourth the time per acre: $\frac{6}{4} = 1.5 \text{ hours per acre}$. For 20 acres a tractor takes $20 \times 1.5 = 30 \text{ hours}$. Therefore using oxen requires **120 hours**, while using a tractor requires **30 hours**.

12. The ₹ 10 coin is an alloy of copper and nickel called 'cupro-nickel'. Copper and nickel are mixed in a 3 : 1 ratio to get this alloy. The mass of the coin is 7.74 grams. If the cost of copper is ₹ 906 per kg and the cost of nickel is ₹ 1,341 per kg, what is the cost of these metals in a ₹ 10 coin?

Answer:

Ratio copper:nickel = $3:1$, total parts = 4. Mass of coin = 7.74 g. - Mass of copper = $\frac{3}{4} \times 7.74 = 5.805\ \text{g}.$ - Mass of nickel = $\frac{1}{4} \times 7.74 = 1.935\ \text{g}.$ Costs per gram: copper ₹906 per 1000 g → ₹0.906 per g; nickel ₹1,341 per 1000 g → ₹1.341 per g. - Cost of 5.805 g copper = $0.906 \times 5.805 \approx \#\#.26.$ - Cost of 1.935 g nickel = $1.341 \times 1.935 \approx \#\#.59.$ So the metal value inside a ₹10 coin is approximately ₹5.26 (copper) + ₹2.59 (nickel) = **₹7.85** (rounded components as above).