

# Compound Proportion & Work Rate Problems

**Difficulty:** Easy → Challenging

## 1. Simple Compound Proportion

**Q:** If 5 workers can build 3 houses in 30 days, how many days will 10 workers take to build 6 houses?

**Solution:**

$$\frac{5 \text{ workers}}{10 \text{ workers}} = \frac{3 \text{ houses}}{6 \text{ houses}} \times \frac{30 \text{ days}}{x \text{ days}}$$

$$\frac{1}{2} = \frac{1}{2} \times \frac{30}{x} \Rightarrow x = \boxed{30 \text{ days}}$$

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## 2. Inverse Proportion (Work Rate)

**Q:** 8 machines can produce 200 toys in 5 days. How many machines are needed to produce 200 toys in 2 days?

**Solution:**

More machines = Less time (Inverse proportion)

$$8 \times 5 = x \times 2 \Rightarrow x = \boxed{20 \text{ machines}}$$

### 3. Combined Proportion

**Q:** If 4 farmers can harvest 8 acres in 6 days, how many farmers are needed to harvest 12 acres in 4 days?

**Solution:**

$$\text{Farmers} \propto \text{Acres} \quad \text{and} \quad \text{Farmers} \propto \frac{1}{\text{Days}}$$

$$\frac{4}{x} = \frac{8}{12} \times \frac{6}{4} \Rightarrow x = \boxed{4 \text{ farmers}}$$

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### 4. Work Rate (People + Days)

**Q:** 6 painters can paint a house in 10 days. How long will 15 painters take?

**Solution:**

More painters = Less time (Inverse)

$$6 \times 10 = 15 \times x \Rightarrow x = \boxed{4 \text{ days}}$$

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## 5. Compound Proportion (Food Supply)

**Q:** A camp has food for 60 students for 30 days. If 20 more students join, how long will the food last?

**Solution:**

More students = Less time (Inverse)

$$60 \times 30 = 80 \times x \Rightarrow x = \boxed{22.5 \text{ days}}$$

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## 6. Work Rate (Combined Effort)

**Q:** Alice can complete a task in 6 hours, Bob in 3 hours. How long if they work together?

**Solution:**

$$\text{Alice's rate} = \frac{1}{6}, \quad \text{Bob's rate} = \frac{1}{3}$$

$$\frac{1}{6} + \frac{1}{3} = \frac{1}{2} \Rightarrow \boxed{2 \text{ hours}}$$

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## 7. Complex Proportion (Work + Time)

**Q:** 3 pumps fill a tank in 8 hours. How many pumps are needed to fill it in 6 hours?

**Solution:**

$$3 \times 8 = x \times 6 \Rightarrow x =$$

4 pumps

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## 8. Rate of Work (Partial Completion)

**Q:** A team builds 40% of a road in 12 days. How many days to build the remaining 60%?

**Solution:**

$$\frac{40\%}{12 \text{ days}} = \frac{60\%}{x \text{ days}} \Rightarrow x =$$

18 days

## 9. Group Work Rate

**Q:** 5 adults can complete a task in 4 days, while 10 children can do it in 6 days. How long if all work together?

**Solution:**

$$\text{Adults' rate} = \frac{1}{20} \text{ per day,}$$

$$\frac{1}{20} + \frac{1}{60} = \frac{4}{60} = \frac{1}{15} \Rightarrow \boxed{15 \text{ days}}$$

## 10. Real-World Application (Water Tank)

**Q:** Pipe A fills a tank in 4 hours, Pipe B empties it in 6 hours. How long to fill if both are open?

**Solution:**

$$\text{Net rate} = \frac{1}{4} - \frac{1}{6} = \frac{1}{12} \Rightarrow \boxed{12 \text{ hours}}$$

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### Key Concepts

- 1. Direct Proportion:** If  $A \propto B$ , then  $\frac{A_1}{A_2} = \frac{B_1}{B_2}$ .
- 2. Inverse Proportion:** If  $A \propto \frac{1}{B}$ , then  $A_1 \times B_1 = A_2 \times B_2$ .
- 3. Work Rate:** Time =  $\frac{1}{\text{Rate}}$ .