

## Introduction

### General Rules:

- If a person A completes a work in n days then, work done by A in 1 day is  $(1/n)$  part of the work
- If a person A completes  $(1/n)$  part of work in one day then, A will take n days to finish the work.

### Rules for problems on pipes and cistern

**Rule1:** Suppose a pipe fills a tank in n hours. Then, a part of the tank filled in 1 hour =  $1/n$  which means that work done by the inlet in 1 hour is  $1/n$

**Rule2:** Suppose an outlet empties a full tank in m hours. Then, a part of the tank emptied in 1 hour =  $1/m$  which means that work done by the outlet in 1 hour is  $-1/m$

### Examples

**Example 1 – ‘A’ alone can finish a piece of work in 12 days and ‘B’ alone can do it in 15 days. If both of them work at it together, how much time will they take to finish it?**

Solution - Time taken by A to finish the work = 12 days

Time taken by B to finish the work = 15 days

Thus, work done by A in 1 day =  $\frac{1}{12}$

Work done by B in 1 day =  $\frac{1}{15}$

Work done by (A + B) in 1 day =  $\frac{1}{12} + \frac{1}{15} = \frac{9}{60} = \frac{3}{20}$

Therefore, time taken by (A+B) to finish the work =  $\frac{20}{3}$  days =  $6\frac{2}{3}$  days

**Example 2 – A and B together can do a piece of work in 12 days, while B alone can finish it in 30 days. In how many days can A alone finish the work?**

Solution - It is given that time taken by (A+B) to finish a work = 12 days

=> (A+B)'s 1 day work =  $\frac{1}{12}$

Time taken by B alone = 30 days

$$\Rightarrow \text{B's 1 day work} = \frac{1}{30}$$

Time taken by A alone to finish the work = ?

Work done by (A + B) in 1 day = A's 1 day work + B's 1 day work

$$\Rightarrow \frac{1}{12} = \text{A's 1 day work} + \frac{1}{30}$$

$$\Rightarrow \text{A's 1 day work} = \frac{1}{12} - \frac{1}{30} = \frac{5-2}{60} = \frac{3}{60} = \frac{1}{20}$$

Therefore, Time taken by A alone to finish the work = 20 days

**Example 3 – A can do a piece of work in 25 days and B can finish it in 20 days. They work together for 5 days and then A leaves. In how many days will B finish the remaining work?**

Solution - Given that time taken by A to finish the work = 25 days

Time taken by B to finish the work = 20 days

$$\text{Thus, work done by A in 1 day} = \frac{1}{25}$$

$$\text{Work done by B in 1 day} = \frac{1}{20}$$

$$\text{Work done by (A + B) in 1 day} = \frac{1}{25} + \frac{1}{20} = \frac{4+5}{100} = \frac{9}{100}$$

$$\text{Work done by (A + B) in 5 days} = \frac{9}{100} \times 5 = \frac{9}{20}$$

$$\text{Thus, remaining work} = 1 - \frac{9}{20} = \frac{11}{20} \text{ which is to be done by B}$$

Now, Time taken by B to finish the work = 20 days

$$\text{Time taken by B to finish } \frac{11}{20} \text{ work} = \frac{11}{20} \times 20 = 11 \text{ days}$$

Thus, remaining work is done by B in 11 days.

**Example 4 – A and B can do a piece of work in 12 days; B and C can do it in 15 days while C and A can finish it in 20 days. In how many days will A, B, C finish it, working together? In how many days will each one of them finish it, working alone?**

Solution - Given that time taken by (A+B) to finish work = 12 days

Time taken by (B+C) to finish work = 15 days

Time taken by (C+A) to finish work = 20 days

$$\text{Thus, work done by (A+B) in 1 day} = \frac{1}{12} \longrightarrow 1$$

$$\text{Work done by (B+C) in 1 day} = \frac{1}{15} \longrightarrow 2$$

$$\text{Work done by (C+A) in 1 day} = \frac{1}{20} \longrightarrow 3$$

Adding 1, 2 and 3, we get

$$\text{Work done by } 2(A+B+C) \text{ in 1 day} = \frac{1}{12} + \frac{1}{15} + \frac{1}{20} = \frac{12}{60} = \frac{1}{5}$$

$$\text{Work done by (A+B+C) in 1 day} = \frac{1}{10}$$

Time taken by (A+B+C) to finish work = 10 days

A's 1 day work = Work done by (A+B+C) in 1 day - Work done by (B+C) in 1 day

$$= \frac{1}{10} - \frac{1}{15} = \frac{1}{30}$$

Time taken by A alone to finish work = 30 days

B's 1 day work = Work done by (A+B+C) in 1 day - Work done by (A+C) in 1 day

$$= \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$$

Time taken by B alone to finish work = 20 days

C's 1 day work = Work done by (A+B+C) in 1 day - Work done by (A+B) in 1 day

$$= \frac{1}{10} - \frac{1}{12} = \frac{1}{60}$$

Time taken by C alone to finish work = 60 days

**Example 5 – A tap 'A' can fill a cistern in 8 hours while tap 'B' can fill it in 4 hours. In how much time will the cistern be filled if both 'A' and 'B' are opened together?**

Solution - Given that time taken by tap A to fill cistern = 8 hours

And, time taken by tap B to fill cistern = 4 hours

Thus, work done by tap A in 1 hour =  $\frac{1}{8}$

Work done by tap B in 1 hour =  $\frac{1}{4}$

$$\text{Work done by (A+B) in 1 hour} = \frac{1}{8} + \frac{1}{4} = \frac{3}{8}$$

Time taken by (A+B) to fill the cistern =  $\frac{8}{3}$  hours

**Example 6 – A tap ‘A’ can fill a cistern in 4 hours and the tap ‘B’ can empty the full cistern in 6 hours. If both the taps are opened together in the empty cistern, in how much time will the cistern be filled up?**

Solution - Given that time taken by tap A to fill the cistern = 4 hours

And, time taken by tap B to empty the cistern = 6 hours

Thus, work done by tap ‘A’ in 1 hour =  $\frac{1}{4}$

Also, since tap B empties the cistern

So, work done by tap B in 1 hour =  $-\frac{1}{6}$

Work done by (A+B) in 1 hour =  $\frac{1}{4} - \frac{1}{6} = \frac{1}{12}$

Therefore, time taken by (A+B) to fill cistern = 12 hours

**Example 7 – A cistern can be filled by two taps ‘A’ and ‘B’ in 12 hours and 16 hours respectively. The full cistern can be emptied by a third tap ‘C’ in 8 hours. If all the taps are turned on at the same time, in how much time will the empty cistern be filled up completely?**

Solution - Given that time taken by tap A to fill cistern = 12 hours

Time taken by tap B to fill it = 16 hours

Time taken by tap C to empty the full cistern = 8 hours

Thus, work done by A in 1 hour =  $\frac{1}{12}$

Work done by tap B in 1 hour =  $\frac{1}{16}$

Now, since tap C empties the cistern

So, Work done by tap C in 1 hour =  $-\frac{1}{8}$

Work done by (A+B+C) in 1 hour =  $\frac{1}{12} + \frac{1}{16} - \frac{1}{8} = \frac{4+3-6}{48} = \frac{1}{48}$

Time taken by (A+B+C) to fill cistern = 48 hours

### Exercise 13 A

**Question 1 – Rajan can do a piece of work in 24 days while Amit can do it in 30 days. In how many days can they complete it, if they work together?**

Solution - Time taken by Rajan to finish work = 24 days

Time taken by Amit to finish it = 30 days

Thus, work done by rajan in 1 day =  $\frac{1}{24}$

Work done by amit in 1 day =  $\frac{1}{30}$

Work done by rajan and amit together in 1 day =  $\frac{1}{24} + \frac{1}{30} = \frac{5+4}{120} = \frac{9}{120}$

Time taken by rajan and amit if working together =  $\frac{120}{9} = \frac{40}{3} = 13\frac{1}{3}$  days

**Question 2 – Ravi can do a piece of work in 15 hours while Raman can do it in 12 hours. How long will both take to do it, working together?**

Solution - Time taken by Ravi to finish work = 15 hours

Time taken by Raman to finish it = 12 hours

Thus, work done by Ravi in 1 hour =  $\frac{1}{15}$

Work done by Raman in 1 hour =  $\frac{1}{12}$

Work done by Ravi and Raman together in 1 hour =  $\frac{1}{15} + \frac{1}{12} = \frac{4+5}{60} = \frac{9}{60}$

Time taken by Ravi and Raman if working together =  $\frac{60}{9} = \frac{20}{3} = 6\frac{2}{3}$  hours = 6 hours 40 minutes

**Question 3 – A and B, working together can finish a piece of work in 6 days, while A alone can do it in 9 days. How much time will B alone take to finish it?**

Solution - It is given that time taken by (A+B) to finish a work = 6 days

$\Rightarrow$  (A+B)'s 1 day work =  $\frac{1}{6}$

Time taken by A alone = 9 days

$\Rightarrow$  A's 1 day work =  $\frac{1}{9}$

Time taken by B alone to finish the work = ?

Work done by (A + B) in 1 day = A's 1 day work + B's 1 day work

$$\Rightarrow \frac{1}{6} = \frac{1}{9} + \text{B's 1 day work}$$

$$\Rightarrow \text{B's 1 day work} = \frac{1}{6} - \frac{1}{9} = \frac{3-2}{18} = \frac{1}{18}$$

Therefore, Time taken by B alone to finish the work = 18 days

**Question 4 – Two motor mechanics, Raju and Siraj, working together can overhaul a scooter in 6 hours. Raju alone can do the job in 15 hours. In how many hours can Siraj alone do it?**

Solution - It is given that time taken by Raju and Siraj to finish the work = 6 hours

$$\Rightarrow (\text{Raju} + \text{Siraj})\text{'s 1 hour work} = \frac{1}{6}$$

Time taken by Raju alone = 15 hours

$$\Rightarrow \text{Raju's 1 hour work} = \frac{1}{15}$$

Time taken by Siraj alone to finish the work = ?

Work done by (Raju + Siraj) in 1 hour = Raju's 1 hour work + Siraj's 1 day work

$$\Rightarrow \frac{1}{6} = \frac{1}{15} + \text{Siraj's 1 hour work}$$

$$\Rightarrow \text{Siraj's 1 hour work} = \frac{1}{6} - \frac{1}{15} = \frac{5-2}{30} = \frac{3}{30} = \frac{1}{10}$$

Therefore, Time taken by Siraj alone to finish the work = 10 hours

**Question 5 – A, B and C can do a piece of work in 10 days, 12 days and 15 days respectively. How long will they take to finish it if they work together?**

Solution - Time taken by A to finish the work = 10 days

Time taken by B to finish the work = 12 days

Time taken by C to finish the work = 15 days

$$\text{Thus, work done by A in 1 day} = \frac{1}{10}$$

$$\text{Work done by B in 1 day} = \frac{1}{12}$$

$$\text{Work done by C in 1 day} = \frac{1}{15}$$

$$\text{Work done by (A + B+C) in 1 day} = \frac{1}{10} + \frac{1}{12} + \frac{1}{15} = \frac{6+5+4}{60} = \frac{15}{60} = \frac{1}{4}$$

Therefore, time taken by (A+B+C) to finish the work = 4 days

**Question 6 – A can do a piece of work in 24 hours while B can do it in 16 hours. If A, B and C working together can finish it in 8 hours, in how many hours can C alone finish the work?**

Solution - It is given that time taken by (A+B+C) to finish a work = 8 hours

$$\Rightarrow (A+B+C)\text{'s 1 hour work} = \frac{1}{8}$$

Time taken by A alone = 24 hours

$$\Rightarrow A\text{'s 1 hour work} = \frac{1}{24}$$

Time taken by B alone = 16 hours

$$\Rightarrow B\text{'s 1 hour work} = \frac{1}{16}$$

Time taken by C alone to finish the work = ?

Work done by (A + B+C) in 1 hour = A's 1 hour work + B's 1 hour work + C's 1 hour work

$$\Rightarrow \frac{1}{8} = C\text{'s 1 hour work} + \frac{1}{24} + \frac{1}{16}$$

$$\Rightarrow C\text{'s 1 hour work} = \frac{1}{8} - \left(\frac{1}{24} + \frac{1}{16}\right) = \frac{1}{8} - \frac{1}{24} - \frac{1}{16} = \frac{6-2-3}{48} = \frac{1}{48}$$

Therefore, Time taken by C alone to finish the work = 48 hours

**Question 7 – A, B and C working together can finish a piece of work in 8 hours. A alone can do it in 20 hours and B alone can do it in 24 hours. In how many hours will C alone do the same work?**

Solution - It is given that time taken by (A+B+C) to finish a work = 8 hours

$$\Rightarrow (A+B+C)\text{'s 1 hour work} = \frac{1}{8}$$

Time taken by A alone = 20 hours

$$\Rightarrow A\text{'s 1 hour work} = \frac{1}{20}$$

Time taken by B alone = 24 hours

$$\Rightarrow B\text{'s 1 hour work} = \frac{1}{24}$$

Time taken by C alone to finish the work = ?

Work done by (A + B+C) in 1 hour = A's 1 hour work + B's 1 hour work + C's 1 hour work

$$\Rightarrow \frac{1}{8} = \text{C's 1 hour work} + \frac{1}{24} + \frac{1}{20}$$

$$\Rightarrow \text{C's 1 hour work} = \frac{1}{8} - \left(\frac{1}{24} + \frac{1}{20}\right) = \frac{1}{8} - \frac{1}{24} - \frac{1}{20} = \frac{15-5-6}{120} = \frac{4}{120} = \frac{1}{30}$$

Therefore, Time taken by C alone to finish the work = 30 hours

**Question 8 – A and B can finish a piece of work in 16 days and 12 days respectively. A started the work and worked at it for 2 days. He was then joined by B. Find the total time taken to finish the work.**

Solution - Given that time taken by A to finish the work = 16 days

Time taken by B to finish the work = 12 days

Work done by A in 1 day =  $\frac{1}{16}$

Work done by B in 1 day =  $\frac{1}{12}$

$$\text{Work done by (A+B) in 1 day} = \frac{1}{16} + \frac{1}{12} = \frac{3+4}{48} = \frac{7}{48}$$

Time taken by (A+B) to finish the work =  $\frac{48}{7}$

Now, A worked for 2 days

Thus, work done by A in 2 days =  $\frac{2}{16} = \frac{1}{8}$

$$\text{Left work} = 1 - \frac{1}{8} = \frac{7}{8}$$

Remaining work is to be done by both A and B together

$$\Rightarrow \text{Time taken by (A+B) to finish } \frac{7}{8} \text{ work} = \frac{48}{7} \times \frac{7}{8} = 6 \text{ days}$$

Total time taken to finish the work =  $6+2 = 8$  days

**Question 9 – A can do a piece of work in 14 days while B can do it in 21 days. They began together and worked at it for 6 days. Then, A fell ill and B had to complete the remaining work alone. In how many days was the work completed?**

Solution - Given that time taken by A to finish the work = 14 days

Time taken by B to finish the work = 21 days

Work done by A in 1 day =  $\frac{1}{14}$



Work done by B in 1 day =  $\frac{1}{21}$

Work done by (A+B) in 1 day =  $\frac{1}{14} + \frac{1}{21} = \frac{3+2}{42} = \frac{5}{42}$

Time taken by (A+B) to finish the work =  $\frac{42}{5}$  days

Now, A and B worked together for 6 days

So, work done by (A+B) in 6 days =  $6 \times \frac{5}{42} = \frac{5}{7}$

Left work =  $1 - \frac{5}{7} = \frac{2}{7}$

Now, time taken by B to finish  $\frac{2}{7}$  work =  $21 \times \frac{2}{7} = 6$  days

Total time taken =  $6+6=10$  days

**Question 10 – A can do  $\frac{2}{3}$  of a certain work in 16 days and B can do  $\frac{1}{4}$  of the same work in 3 days. In how many days can both finish the work, working together?**

Solution - Given that Time taken by A to finish  $\frac{2}{3}$  of work = 16 days

=> Time taken by A to finish 1 work =  $16 \times \frac{3}{2} = 24$  days

So, work done by A in 1 day =  $\frac{1}{24}$

Time taken B to finish  $\frac{1}{4}$  of work = 3 days

=> Time taken by B to finish 1 work =  $3 \times 4 = 12$  days

So, work done by B in 1 day =  $\frac{1}{12}$

Work done by (A+B) in 1 day =  $\frac{1}{24} + \frac{1}{12} = \frac{1+2}{24} = \frac{3}{24} = \frac{1}{8}$

Time taken by (A+B) if working together = 8 days

**Question 11 – A, B and C can do a piece of work in 15, 12 and 20 days respectively. They started the work together, but C left after 2 days. In how many days will the remaining work be completed by A and B?**

Solution - Time taken by A to finish the work = 15 days

Time taken by B to finish the work = 12 days

Time taken by C to finish the work = 20 days

Thus, work done by A in 1 day =  $\frac{1}{15}$

Work done by B in 1 day =  $\frac{1}{12}$

Work done by C in 1 day =  $\frac{1}{20}$

Work done by (A + B+C) in 1 day =  $\frac{1}{15} + \frac{1}{12} + \frac{1}{20} = \frac{4+5+3}{60} = \frac{12}{60} = \frac{1}{5}$

Thus, time taken by (A+B+C) to finish the work = 5 days

Now, C left after 2 days

Work done by (A + B+C) in 2 days =  $\frac{2}{5}$

Remaining work =  $1 - \frac{2}{5} = \frac{3}{5}$

Remaining work is to be completed by A and B

So, work done by (A+B) in 1 day =  $\frac{1}{15} + \frac{1}{12} = \frac{4+5}{60} = \frac{9}{60} = \frac{3}{20}$

Time taken by (A+B) together to finish work =  $\frac{20}{3}$  days

Time taken by (A+B) to finish  $\frac{3}{5}$  of work =  $\frac{20}{3} \times \frac{3}{5} = 4$  days

So, remaining work is to be completed in 4 days

**Question 12 – A and B can do a piece of work in 18 days; B and C can do it in 24 days while C and A can finish it in 36 days. In how many days can A, B, C finish it, if they all work together?**

Solution - Given that time taken by (A+B) to finish work = 18 days

Time taken by (B+C) to finish work = 24 days

Time taken by (C+A) to finish work = 36 days

Thus, work done by (A+B) in 1 day =  $\frac{1}{18}$   $\longrightarrow$  1

Work done by (B+C) in 1 day =  $\frac{1}{24}$   $\longrightarrow$  2

Work done by (C+A) in 1 day =  $\frac{1}{36}$   $\longrightarrow$  3

Adding 1, 2 and 3, we get

$$\text{Work done by } 2(A+B+C) \text{ in 1 day} = \frac{1}{18} + \frac{1}{24} + \frac{1}{36} = \frac{4+3+2}{72} = \frac{9}{72} = \frac{1}{8}$$

$$\text{Work done by } (A+B+C) \text{ in 1 day} = \frac{1}{16}$$

Time taken by  $(A+B+C)$  to finish work = 16 days

**Question 13 – A and B can do a piece of work in 12 days, B and C in 15 days, and C and A in 20 days. How much time will A alone take to finish the job?**

Solution - Given that time taken by  $(A+B)$  to finish work = 12 days

Time taken by  $(B+C)$  to finish work = 15 days

Time taken by  $(C+A)$  to finish work = 20 days

$$\text{Thus, work done by } (A+B) \text{ in 1 day} = \frac{1}{12} \longrightarrow 1$$

$$\text{Work done by } (B+C) \text{ in 1 day} = \frac{1}{15} \longrightarrow 2$$

$$\text{Work done by } (C+A) \text{ in 1 day} = \frac{1}{20} \longrightarrow 3$$

Adding 1, 2 and 3, we get

$$\text{Work done by } 2(A+B+C) \text{ in 1 day} = \frac{1}{12} + \frac{1}{15} + \frac{1}{20} = \frac{12}{60} = \frac{1}{5}$$

$$\text{Work done by } (A+B+C) \text{ in 1 day} = \frac{1}{10}$$

Time taken by  $(A+B+C)$  to finish work = 10 days

A's 1 day work = Work done by  $(A+B+C)$  in 1 day - Work done by  $(B+C)$  in 1 day

$$= \frac{1}{10} - \frac{1}{15} = \frac{1}{30}$$

Time taken by A alone to finish work = 30 days

**Question 14 – Pipes A and B can fill an empty tank in 10 hours and 15 hours respectively. If both are opened together in the empty tank, how much time will they take to fill it completely?**

Solution - Given that time taken by pipe A to fill an empty tank = 10 hours

Time taken by pipe B to fill an empty tank = 15 hours

Work done by pipe A in 1 hour =  $\frac{1}{10}$

Work done by pipe B in 1 hour =  $\frac{1}{15}$

$$\text{Work done by (A+B) in 1 hour} = \frac{1}{10} + \frac{1}{15} = \frac{3+2}{30} = \frac{5}{30} = \frac{1}{6}$$

Time taken by (A+B) if opened together = 6 hours

**Question 15 – Pipe A can fill an empty tank in 5 hours while Pipe B can empty the full tank in 6 hours. If both are opened at the same time in the empty tank, how much time will they take to fill it up completely?**

Solution - Given that time taken by pipe A to fill an empty tank = 5 hours

Time taken by pipe B to empty tank = 6 hours

Work done by pipe A in 1 hour =  $\frac{1}{5}$

Now, since pipe B empties the tank

Thus, Work done by pipe B in 1 hour =  $-\frac{1}{6}$

$$\text{Work done by (A+B) in 1 hour} = \frac{1}{5} - \frac{1}{6} = \frac{6-5}{30} = \frac{1}{30}$$

Time taken by (A+B) to fill the tank = 30 hours

**Question 16 – Three taps A, B and C can fill an overhead tank in 6 hours, 8 hours and 12 hours respectively. How long would the three taps take to fill the empty tank, if all of them are opened together?**

Solution - Given that time taken by tap A to fill an empty tank = 6 hours

Time taken by tap B to fill an empty tank = 8 hours

Time taken by tap C to fill an empty tank = 12 hours

Work done by tap A in 1 hour =  $\frac{1}{6}$

Work done by tap B in 1 hour =  $\frac{1}{8}$

Work done by tap C in 1 hour =  $\frac{1}{12}$

$$\text{Work done by (A+B+C) in 1 hour} = \frac{1}{6} + \frac{1}{8} + \frac{1}{12} = \frac{4+3+2}{24} = \frac{9}{24} = \frac{3}{8}$$

Time taken by (A+B+C) if opened together =  $\frac{8}{3} = 2\frac{2}{3}$  hours = 2 hours 40 minutes

**Question 17 – A cistern has two inlets A and B which can fill it in 12 minutes and 15 minutes respectively. An outlet C can empty the full cistern in 10 minutes. If all the three pipes are opened together in the empty tank, how much time will they take to fill the tank completely?**

Solution - Time taken by inlet A to fill cistern = 12 minutes

Time taken by inlet B to fill cistern = 15 minutes

Time taken by outlet C to empty the cistern = 10 minutes

Work done by inlet A in 1 minute =  $\frac{1}{12}$

Work done by inlet B in 1 minute =  $\frac{1}{15}$

Work done by outlet C in 1 minute =  $-\frac{1}{10}$  (since outlet C empties the cistern)

Work done by (A+B+C) in 1 minute =  $\frac{1}{12} + \frac{1}{15} - \frac{1}{10} = \frac{5+4-6}{60} = \frac{3}{60} = \frac{1}{20}$

Time taken by (A+B+C) to fill the cistern = 20 minutes

**Question 18 – A pipe can fill a cistern in 3 hours. Due to a leak in its bottom, the cistern fills up in 10 hours. If the cistern is full, in how much time will it be emptied by the leak?**

Solution - Given that time taken by pipe to fill cistern = 9 hours

Let the leak empties the cistern in x hours

Work done by pipe in 1 hour =  $\frac{1}{9}$

Work done by leak in 1 hour =  $-\frac{1}{x}$  (since leak empties the cistern)

Thus, work done by pipe and leak together in 1 hour =  $\frac{1}{9} - \frac{1}{x}$

Given that total time taken to fill the cistern = 10 hours

Total work done to fill cistern in 1 hour =  $\frac{1}{10}$

Therefore,  $\frac{1}{9} - \frac{1}{x} = \frac{1}{10}$

$$\Rightarrow \frac{1}{9} - \frac{1}{10} = \frac{1}{x}$$

$$\Rightarrow \frac{1}{90} = \frac{1}{x}$$

$$\Rightarrow x = 90 \text{ hours}$$

**Question 19 – Pipe A can fill a cistern in 6 hours and pipe B can fill it in 8 hours. Both the pipes are opened and after two hours, pipe A is closed. How much time will B take to fill the remaining part of the tank?**

Solution - Given that time taken by pipe A to fill the cistern = 6 hours

Time taken by pipe B to fill it = 8 hours

Work done by pipe A in 1 hour =  $\frac{1}{6}$

Work done by pipe B in 1 hour =  $\frac{1}{8}$

Work done by (A+B) in 1 hour =  $\frac{1}{6} + \frac{1}{8} = \frac{4+3}{24} = \frac{7}{24}$

Time taken by (A+B) to fill the cistern =  $\frac{24}{7}$

Now, after 2 hours, pipe A is closed

Work done by (A+B) in 2 hours =  $2 \times \frac{7}{24} = \frac{7}{12}$

Remaining work =  $1 - \frac{7}{12} = \frac{5}{12}$

Remaining work is to be done by pipe B

Thus, time taken by pipe B to fill  $\frac{5}{12}$  of cistern =  $\frac{5}{12} \times 8 = \frac{10}{3} = 3\frac{1}{3}$  hours = 3 hours 20 min

### Exercise 13B

**Question 1 – A alone can do a piece of work in 10 days and B alone can do it in 15 days. In how many days will A and B together do the same work?**

Solution - Time taken by A to finish a work = 10 days

Time taken by B to finish it = 15 days

Work done by A in 1 day =  $\frac{1}{10}$

Work done by B in 1 day =  $\frac{1}{15}$

Work done by (A+B) in 1 day =  $\frac{1}{10} + \frac{1}{15} = \frac{3+2}{30} = \frac{5}{30} = \frac{1}{6}$

Time taken by (A+B) when working together = 6 days

**Question 2 – A man can do a piece of work in 5 days. He and his son working together can finish it in 3 days. In how many days can the son do it alone?**

Solution - Time taken by a man to finish a work = 5 days

Time taken by man and his son working together to finish it = 3 days

Work done by man in 1 day =  $\frac{1}{5}$

Work done by man and his son in 1 day =  $\frac{1}{3}$

Time taken by son alone = ?

Work done by man and his son in 1 day = man's 1 day work + son's 1 day work

$$\Rightarrow \frac{1}{3} = \frac{1}{5} + \text{son's 1 day work}$$

$$\Rightarrow \text{Son's 1 day work} = \frac{1}{3} - \frac{1}{5} = \frac{2}{15}$$

Thus, time taken by son alone to finish work =  $\frac{15}{2} = 7\frac{1}{2}$  days

**Question 3 – A can do a job in 16 days and B can do the same job in 12 days. With the help of C, they can finish the job in 6 days only. Then, C alone can finish it in?**

Solution - Time taken by A to do a job = 16 days

Time taken by B to do job = 12 days

Time taken by (A+B+C) to do a job = 6 days

Work done by A in 1 day =  $\frac{1}{16}$

Work done by B in 1 day =  $\frac{1}{12}$

Work done by (A+B+C) in 1 day =  $\frac{1}{6}$

Work done by C alone in 1 day = (A+B+C)'s 1 day – (A's 1 day work + B's 1 day work)

$$\Rightarrow \text{C's 1 day work} = \frac{1}{6} - \left(\frac{1}{16} + \frac{1}{12}\right) = \frac{8-3-4}{48} = \frac{1}{48}$$

Thus, time taken by C alone to do job = 48 days

**Question 4 – To complete a work, A takes 50% more time than B. If together they take 18 days to complete the work, how much time shall B take to do it?**

Solution - Let time taken by B to finish the work be  $x$  days

Then, time taken by A to finish it =  $x + \frac{50x}{100} = \frac{150x}{100} = 1.5x$  days

Time taken by (A+B) when working together = 18 days

Work done by A in 1 day =  $\frac{1}{1.5x}$

Work done by B in 1 day =  $1/x$

Work done by (A+B) in 1 day =  $\frac{1}{1.5x} + \frac{1}{x} = \frac{1}{x} \left( \frac{2}{3} + 1 \right) = \frac{1}{x} \left( \frac{5}{3} \right) = \frac{5}{3x}$

$$\Rightarrow \frac{1}{18} = \frac{5}{3x}$$

$$\Rightarrow 3x = 90 \Rightarrow x = 30$$

Thus, time taken by B alone = 30 days

**Question 5 – A works twice as fast as B. If both of them can together finish a piece of work in 12 days, then B alone can do it in?**

Solution - Let work done by B in 1 day be  $x$

Then work done by A in 1 day =  $2x$

Time taken by (A+B) when working together = 12 days

Work done by (A+B) in 1 day =  $1/12$

$$\text{Thus, } \frac{1}{12} = x + 2x = 3x$$

$$\Rightarrow \frac{1}{12} = 3x \Rightarrow x = \frac{1}{36}$$

So, time taken by B alone = 36 days

**Question 6 – A alone can finish a piece of work in 10 days which B alone can do in 15 days. If they work together and finish it, then out of total wages of Rs 3000, A will get?**

Solution - Time taken by A alone to finish a work = 10 days

Time taken by B alone to finish it = 15 days

Work done by A in 1 day =  $1/10$



Work done by B in 1 day =  $\frac{1}{15}$

Work done by (A+B) in 1 day =  $\frac{1}{10} + \frac{1}{15} = \frac{5}{30} = \frac{1}{6}$

Total wages = Rs 3000

A will get =  $\frac{\frac{1}{10}}{\frac{1}{6}} \times 3000$

$\Rightarrow \frac{1}{10} \times 6 \times 3000 = \text{Rs}1800$

**Question 7 – The rates of working of A and B are in the ratio 3:4. The number of days taken by them to finish the work is in the ratio?**

Solution - Given that ratio of rates of working of A and B = 3:4

We know that number of days taken by them is reciprocal of rates of working

$\Rightarrow$  Ratio of number of days taken by A and B =  $\frac{4}{3} = 4:3$

**Question 8 – A and B together can do a piece of work in 12 days; B and C can do it in 20 days while C and A can do it in 15 days. A, B and C all working together can do it in?**

Solution - Given that time taken by (A+B) to finish work = 12 days

Time taken by (B+C) to finish work = 20 days

Time taken by (C+A) to finish work = 15 days

Thus work done by (A+B) in 1 day =  $\frac{1}{12} \longrightarrow 1$

Work done by (B+C) in 1 day =  $\frac{1}{20} \longrightarrow 2$

Work done by (C+A) in 1 day =  $\frac{1}{15} \longrightarrow 3$

Adding 1, 2 and 3, we get

Work done by 2(A+B+C) in 1 day =  $\frac{1}{12} + \frac{1}{20} + \frac{1}{15} = \frac{5+3+4}{60} = \frac{12}{60} = \frac{1}{5}$

Work done by (A+B+C) in 1 day =  $\frac{1}{10}$

Time taken by (A+B+C) to finish work = 10 days

**Question 9 – 3 men or 5 women can do a work in 12 days. How long will 6 men and 5 women take to do it?**

Solution - Time taken by 3 men to do work = 12 days

Time taken by 5 women to do work = 12 days

Work done 3 men in 1 day =  $\frac{1}{12}$

Work done by 1 man in 1 day =  $\frac{1}{36}$

Work done by 6 men in 1 day =  $\frac{6}{36} = \frac{1}{6}$

Work done by 5 women in 1 day =  $\frac{1}{12}$

Work done by 1 woman in 1 day =  $\frac{1}{60}$

Work done by 5 women in 1 day =  $\frac{5}{60} = \frac{1}{12}$

Work done by 6 men and 5 women =  $\frac{1}{6} + \frac{1}{12} = \frac{3}{12} = \frac{1}{4}$

Time taken by 6 men and 5 women when working together = 4 days

**Question 10 – A can do a piece of work in 15 days. B is 50% more efficient than A. B can finish it in?**

Solution - Time taken by A to do work = 15 days

Work done by A in 1 day =  $\frac{1}{15}$

Given that B is 50% more efficient than A

$\Rightarrow$  Work done by B in 1 day =  $\frac{1}{15} \times \frac{100+50}{100} = \frac{150}{100} \times \frac{1}{15} = \frac{1}{10}$

Thus, time taken by B to finish work = 10 days

**Question 11 – A does 20% less work than B. If A can finish a piece of work in  $7\frac{1}{2}$  hours, then B can finish it in?**

Solution - Time taken by A to finish work =  $7\frac{1}{2} = \frac{15}{2}$  hours

Work done by A in 1 hour =  $\frac{2}{15}$

Let time taken by B to finish work = x hours

Then, work done by B in 1 hour =  $\frac{1}{x}$

It is given that A does 20% less work than B

$$\Rightarrow \text{Work done by A in 1 hour} = \frac{80}{100} \times \frac{1}{x} = \frac{4}{5x}$$

$$\Rightarrow \frac{4}{5x} = \frac{2}{15}$$

$$\Rightarrow 60 = 10x \Rightarrow x = 6 \text{ Hours}$$

**Question 12 – A can do a piece of work in 20 days which B alone can do in 12 days. B worked at it for 9 days. A can finish the remaining work in?**

Solution - Given that time taken by A to finish work = 20 days

Time taken by B to finish it = 12 days

$$\text{A's 1 day work} = 1/20$$

$$\text{B's 1 day work} = 1/12$$

Now B worked for 9 days

$$\text{B's 9 days' work} = 9/12 = 3/4$$

$$\text{Remaining work} = 1 - \frac{3}{4} = \frac{1}{4}$$

Remaining work is to be done by A

$$\text{So, time taken by A to finish } 1/4 \text{ of work} = 20 \times \frac{1}{4} = 5 \text{ days}$$

**Question 13 – A can do a piece of work in 25 days, which B alone can do in 20 days. A started the work and was joined by B after 10 days. The work lasted for?**

Solution - Given that time taken by A to finish work = 25 days

Time taken by B to finish it = 20 days

$$\text{A's 1 day work} = 1/25$$

$$\text{B's 1 day work} = 1/20$$

$$\text{(A+B)'s 1 day work} = \frac{1}{25} + \frac{1}{20} = \frac{9}{100}$$

Time taken by (A+B) to finish the work = 100/9

$$\text{A's 10 days' work} = 10/25 = 2/5$$

$$\text{Remaining work} = 1 - \frac{2}{5} = \frac{3}{5}$$

Remaining work is to be done by (A+B)

$$\text{So, time taken by (A+B) to finish } \frac{1}{2} \text{ of work} = \frac{3}{5} \times \frac{100}{9} = \frac{20}{3} = 16\frac{2}{3} \text{ days}$$

**Question 14 – Two pipes can fill a tank in 20 minutes and 30 minutes respectively. If both the pipes are opened simultaneously, then the tank will be filled in?**

Solution - Time taken by pipe A to fill a tank = 20 minutes

Time taken by pipe B to fill it = 30 minutes

Work done by pipe A in 1 minute =  $\frac{1}{20}$

Work done by pipe B in 1 minute =  $\frac{1}{30}$

$$\text{Work done by (A+B) in 1 minute} = \frac{1}{20} + \frac{1}{30} = \frac{5}{60} = \frac{1}{12}$$

Time taken by (A+B) to fill the tank together = 12 minutes

**Question 15 – A tap can fill a cistern in 8 hours and another tap can empty the full cistern in 16 hours. If both the taps are open, the time taken to fill the cistern is?**

Solution - Time taken by a tap to fill a cistern = 8 hours

Time taken by another tap to empty the cistern = 16 hours

Work done by tap to fill cistern in 1 hour =  $\frac{1}{8}$

Work done by tap to empty cistern in 1 hour =  $-\frac{1}{16}$  (since it empties a cistern)

$$\text{Work done by both the taps in 1 hour} = \frac{1}{8} - \frac{1}{16} = \frac{1}{16}$$

Time taken by both taps to fill the cistern = 16 hours

**Question 16 – A pump can fill a tank in 2 hours. Due to a leak in the tank it takes  $2\frac{1}{3}$  hours to fill the tank. The leak can empty the full tank in?**

Solution - Given that time taken by pipe to fill tank = 2 hours

Let the leak empties the cistern in x hours

Work done by pipe in 1 hour =  $\frac{1}{2}$

Work done by leak in 1 hour =  $-\frac{1}{x}$  (since leak empties the cistern)

Thus, work done by pipe and leak together in 1 hour =  $\frac{1}{2} - \frac{1}{x}$

Given that total time taken to fill the tank =  $2\frac{1}{3} = \frac{7}{3}$  hours

Total work done to fill tank in 1 hour =  $\frac{3}{7}$

Therefore,  $\frac{1}{2} - \frac{1}{x} = \frac{3}{7}$

$$\Rightarrow \frac{1}{2} - \frac{3}{7} = \frac{1}{x}$$

$$\Rightarrow \frac{1}{14} = \frac{1}{x}$$

$$\Rightarrow x = 14 \text{ hours}$$

**Question 17 – Two pipes can fill a tank in 10 hours and 12 hours respectively, while a third pipe empties the full tank in 20 hours. If all the three pipes operate simultaneously, in how much time will the tank be full?**

Solution - Time taken by pipe A to fill tank = 10 hours

Time taken by pipe B to fill tank = 12 hours

Time taken by pipe C to empty the tank = 20 hours

Work done by pipe A in 1 hour =  $\frac{1}{10}$

Work done by pipe B in 1 hour =  $\frac{1}{12}$

Work done by pipe C in 1 hour =  $-\frac{1}{20}$  (since pipe C empties the tank)

$$\text{Work done by (A+B+C) in 1 hour} = \frac{1}{10} + \frac{1}{12} - \frac{1}{20} = \frac{6+5-3}{60} = \frac{8}{60} = \frac{2}{15}$$

Time taken by (A+B+C) to fill the tank =  $\frac{15}{2}$  hours =  $7\frac{1}{2}$  hours 7 hours 30 minutes