



# Pipes and Cistern

# 1. Basic Concepts:

1. A pipe which fills up the tank is known as inlet.
2. A pipe which empties the tank is known as outlet.
3. A pipe takes  $x$  hours to fill up the tank.  
Then  $\frac{1}{x}$  parts of the tank will be filled in **1 hour**.
4. A pipe takes  $y$  hours to empty the tank. Then part emptied in 1 hour =  $\frac{1}{y}$
5. Pipe **A** can fill a tank  $n$  times as fast as another pipe **B**. This means: If slower pipe **B** takes  $x$  min to fill up the empty tank, then faster pipe **A** takes  $\frac{x}{n}$  min to fill up the empty tank. If they operate together, then part of the tank that is filled up in **1 hour** is  $(n + 1)/x$ .

## 2. Rules and Tricks:

### Rule 1:

Two pipes A and B can fill (or empty) a cistern in X and Y hours respectively, while working alone. If both the pipes are opened together, then the time taken to fill (or empty) the cistern is given by

$$\left\{ \frac{XY}{X + Y} \right\} \text{ hours.}$$

## Example:

Two pipes A and B can fill a cistern in 20 and 30 minutes respectively. If both the pipes are opened together, how long will it take to fill the cistern?

### Solution 1:

Let's say  $x = 20$  and  $y = 30$ , then

$$\frac{20 * 30}{20 + 30} = \frac{600}{50} = 12 \text{ minutes.}$$

$$20 + 30$$

So it will take 12 minutes for both the pipes to full the cistern.

## **Solution 2: (UNITARY METHOD)**

Let the total work be assumed as  $\text{LCM}(20,30) = 60$  Units

Now to complete 60 units A takes 20 mins

To complete 60 units B takes 30 mins

Units done in 1 min by A = 3

Units done in 1 min by B = 2

Units done in 1 min by A & B = 5

To complete 60 units they will take  $60/5 = 12$  minutes.

## Rule 2:

Three pipes can fill (or empty) a cistern in X, Y and Z hours while working alone. If all the three pipes are opened together, the time taken to fill (or empty) the cistern is given by

$$\left\{ \frac{XYZ}{XY + YZ + XZ} \right\} \text{ hours.}$$

## Example:

Three pipes A,B and C can fill a tank in 20 minutes, 30 minutes and 40 minutes respectively while working alone. If, all the pipes are opened together, how long will it take to fill the tank full?

### Solution 1:

Let's say X = 20 minutes, Y = 30 minutes, Z = 40 minutes, then

$$= \frac{20 * 30 * 40}{(20*30) + (30*40) + (20*40)} = 9.23 \text{ mins}$$

So it will take 9.23 minutes to fill the tank full.

## Solution 2:(UNITARY METHOD)

Let the total work be assumed as  $\text{LCM}(20,30,40) = 120$  Units

Now to complete 120 units A takes 20 mins

To complete 120 units B takes 30 mins

To complete 120 units C takes 40 mins

Units done in 1 min by A = 6

Units done in 1 min by B = 4

Units done in 1 min by C = 3

Units done in 1 min by A+B+C = 13

To complete 120 units they will take  $120/13 = 9.23$  minutes.



### Rule 3:

If a pipe can fill a cistern in X hours and another can fill the same cistern in Y hours, but a third one can empty the full tank in Z hours, and all of them are opened together, then

Net part filled in 1 hour =  $\frac{1}{X} + \frac{1}{Y} - \frac{1}{Z}$

Time taken to fill the full cistern =

$$\frac{XYZ}{YZ + XZ - XY} \text{ hours.}$$

## Example:

Two pipes can fill a cistern in 20 minutes and 30 minutes respectively. Third pipe can empty the tank in 40 minutes. If all the three pipes are opened together, how long it will take to fill the tank full?

## Solution:

Let's say  $x = 20$ ,  $y = 30$  and  $z = 40$

$$= \frac{20 * 30 * 40}{(30*40) + (20*40) - (20*30)} = 17.14 \text{ min}$$

So it will take 17.14 minutes to fill the tank full.

## Rule 4:

A pipe can fill a cistern in  $x$  hours. Because of a leak in the bottom, it is filled in  $y$  hours. If it is full, the time taken by the leak to empty the cistern is

$$\frac{XY}{Y - X} \text{ hours.}$$

## Example:

A pipe can fill a tank in 3 hours. Because of leak in the bottom, it is filled in 4 hours. If the tank is full, how much time will the leak take to empty it?

## Solution:

Work done by leak in one hour =  $\frac{1}{3} - \frac{1}{4} = \frac{1}{12}$

So leak will empty the tank in 12 hours.

## By formula

Let's say  $x = 3$  and  $y = 4$

$$= \frac{3*4}{4-3} = 12 \text{ hours.}$$

$$4-3$$

## Rule 5:

A cistern has a leak which can empty it in  $X$  hours. A pipe which admits  $Y$  litres of water per hour into the cistern is turned on and now the cistern is emptied in  $Z$  hours. The capacity of the cistern is

$$\left\{ \frac{XYZ}{Z-X} \right\} \text{ litres.}$$

## Example:

A leak in the bottom of a tank can empty the full tank in 6 hours. An inlet pipe fills water at the rate of 4 litres per minute. When the tank is full, the inlet is opened and due to leak, the tank is empty in 8 hours. Find the capacity of the tank.

## Solution:

Here,  $X=6$ ,  $Y = 4 * 60 = 240$  and  $Z = 8$ .

The capacity of the tank is

$$= \frac{6 * 240 * 8}{8 - 6} = 5760 \text{ litres.}$$

## Rule 6:

One fill pipe A is K times faster than the other fill pipe B. If B can fill a cistern in X hours, then the time in which the cistern will be full, if both the fill pipes are opened together, is

$$\left\{ \frac{X}{K + 1} \right\} \text{ hours.}$$

## Example:

One fill pipe A is 10 times faster than second fill pipe B. If B can fill a cistern in 55 minutes, then find the time when the cistern will be full if both fill pipes are opened together.

## Solution:

Here,  $K = 10$  and  $X = 55$

$$= \frac{55}{10 + 1} = 5 \text{ mins.}$$



## Rule 7:

One fill pipe A is K times faster than the other fill pipe B. If A can fill a cistern in X hours, then the time in which the cistern will be full, if both the fill pipes are opened together, is

$$\left\{ \frac{K}{K + 1} \right\} X \text{ hours.}$$

## Example:

One fill pipe A is 4 times faster than second fill pipe B. If A can fill a cistern in 15 minutes, then find the time when the cistern will be full if both fill pipes are opened together.

## Solution:

$$\begin{aligned}\text{Here, } K &= 4 \text{ and } X = 15 \\ &= (4/4 + 1) 15 \\ &= 12 \text{ minutes.}\end{aligned}$$

## Rule 8:

If one fill pipe A is K times faster and takes X minutes less time than the other fill pipe B, then the time taken to fill a cistern, if both the pipes are opened together is

$$\left\{ \frac{KX}{(K - 1)^2} \right\} \text{ minutes.}$$

## Example:

One fill pipe A is 5 times faster than second fill pipe B and takes 32 minutes less than the fill pipe B. When will the cistern be full if both fill pipes are opened together?

## Solution:

Here,  $K = 5$  and  $X = 32$

$$= \frac{5 * 32}{(5 - 1)^2} = 10 \text{ minutes}$$

## Rule 9:

If one fill pipe A is K times faster and takes X minutes less time than the other fill pipe B, then

(a) A will fill the cistern in

$$\frac{X}{K - 1} \text{ minutes.}$$

(b) B will fill the cistern in

$$\frac{KX}{K - 1} \text{ minutes.}$$



# Practice Questions

1. Pipe A can fill a tank in 36 minutes and pipe B can fill it in 45 minutes. If both the pipes are opened to fill an empty tank, in how many minutes will it be full?

- a) 15
- b) 18
- c) 20
- d) 25

Ans: C

2. 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 filled?

- a) 7hrs 30min
- b) 7hrs 45min
- c) 8hrs 45min
- d) 9hrs 30min

Ans: A



3. A tap can fill a tank in 25 minutes and another can empty it in 50 minutes. Find whether the tank will be filled up or emptied and in how many minutes if both working together?

- a) Tank is filled up in 50 minutes
- b) Tank is emptied in 25 minutes
- c) Tank is filled up in 25 minutes
- d) None of these

Ans: A

4. Two pipes A & B can separately fill a cistern in 220 minutes and 330 minutes. Together, they can fill the cistern in
- a) 1 hour 32 minutes
  - b) 1 hour
  - c) 2 hour 12 minutes
  - d) 2 hours

Ans: C

5. A cistern has three taps in all. Two taps are used for filling the cistern and the third one is used to empty the cistern. The first two taps fill the cistern in 13 minutes and 11 minutes respectively. When all the three taps are open, the empty cistern is filled in 30 minutes. How long will the third tap (waste pipe) take to empty the cistern completely?

- a) 6.28 minutes
- b) 6.43 minutes
- c) 7.63 minutes
- d) 7.43 minutes

Ans: D

6. A pipe can fill a tank in 12 hours and another can empty it in 24 hours. If both the pipes are used, with the first pipe running for 2 hours and second pipe running for 1 hour alternatively, how long will it take to fill the tank? (Consider starting with the first pipe)

- a) 22 hrs 30 min
- b) 21 hrs
- c) 22 hrs
- d) 23 hrs

Ans: A

7. Two pipes A and B can separately fill a tank in 12 minutes and 15 minutes respectively. Both the pipes are opened together but 4 minutes after the start the pipe A is turned off. How much time will it take to fill the tank?

- a) 9 min
- b) 10 min
- c) 11 min
- d) 12 min

Ans: B

8. A cistern has a leak which would empty the cistern in 20 minutes. A tap is turned on which admits 4 liters a minute into the cistern, and it is emptied in 24 minutes. How many liters does the cistern hold?

- a) 480 liters
- b) 600 liters
- c) 720 liters
- d) 800 liters

Ans: A

9. A cistern is filled by a tap in  $3 \frac{1}{2}$  hours. Due to leak in the bottom of the cistern, it takes half an hour longer to fill the cistern. If the cistern is full how long will it take the leak to empty it?

- a) 7 hours
- b) 8 hours
- c) 14 hours
- d) 28 hours

Ans: D

10. A cistern is normally filled in 8 hours but takes two hours longer to fill because of a leak in its bottom. If the cistern is full, the leak will empty it in?

- a) 16 hrs
- b) 20 hrs
- c) 40 hrs
- d) 25 hrs

Ans: C



11. Two pipes A and B can fill a cistern in  $37\frac{1}{2}$  minutes and 45 minutes respectively. Both pipes are opened. The cistern will be filled in just half an hour, if pipe B is turned off after

- a) 5 min
- b) 9 min
- c) 10 min
- d) 15 min

Ans: B

12. A pump can fill a tank with water in 2 hours. Because of a leak, it took  $2\frac{2}{3}$  hours to fill the tank. The leak can drain all the water of the tank in

- a) 6 hours
- b) 8 hours
- c) 9 hours
- d) 10 hours

Ans: B

13. Three pipes A, B and C can fill a tank from empty to full in 30 minutes, 20 minutes, and 10 minutes respectively. When the tank is empty, all the three pipes are opened. A, B and C discharge chemical solutions P, Q and R respectively. What is the proportion of the solution R in the liquid in the tank after 3 minutes?

- a)  $6/11$
- b)  $5/11$
- c)  $7/11$
- d)  $8/11$

Ans:A

14. An inlet pipe can fill a tank in 5 hours and an outlet pipe can empty the same tank in 36 hours working individually. How many additional number of outlet pipes of the same capacity are required to be opened, so that the tank never over flows?

- a) 3
- b) 6
- c) 8
- d) 7

Ans: D



15. A tank is filled by three pipes with uniform flow. The first two pipes operating simultaneously fill the tank in the same time during which the tank is filled by the third pipe alone. The second pipe fills the tank 5 hours faster than the first pipe and 4 hours slower than the third pipe. Time required by the first pipe to fill the tank is

- a) 30 hours
- b) 15 hours
- c) 10 hours
- d) 6 hours

Ans: B

16. A tap can fill a tank in 4 hours. After half the tank is filled, two more similar taps are opened. What is the total time taken to fill the tank completely?

- a) 1 hr 20 min
- b) 4 hr
- c) 3 hr
- d) 2 hr 40 min

Ans: D

17. A large tanker can be filled by two pipes A and B in 60 minutes and 40 minutes respectively. How many minutes will it take to fill the tanker from empty state if B is used for half the time and A and B fill it together for the other half?

- a) 15 min
- b) 20 min
- c) 27.5 min
- d) 30 min

Ans: D

18. A leak in the bottom of a tank can empty the full tank in 6 hours. An inlet pipe fills water at the rate of 4 liters a minute. When the tank is full, the inlet is opened and due to the leak, the tank is empty in 24 hours. How many liters does the tank hold?

- a) 4010 litre
- b) 2220 litre
- c) 1920 litre
- d) 2020 litre

Ans: C





19. Two pipes can fill a tank in 10 and 14 minutes respectively and a waste pipe can empty 4 gallons per minute. If all the pipes working together can fill the tank in 6 minutes, what is the capacity of the tank?

- a) 120 gallons
- b) 240 gallons
- c) 450 gallons
- d) 840 gallons

Ans: D



21. If two pipes function simultaneously, the reservoir will be filled in 24 hrs. One pipe fills the reservoir 20 hours faster than the other. How many hours does it take for the second pipe to fill the reservoir?

- a) 12 hrs
- b) 30 hrs
- c) 44 hrs
- d) 60 hrs

Ans: D

22. A water tank is two-fifth full. Pipe A can fill a tank in 10 minutes and pipe B can empty in 6 minutes. If both the pipes are open, how long will it take to empty or fill the tank completely ?

- a) 6 min to empty
- b) 7 min to full
- c) 6 min to full
- d) 7 min to empty

Ans: A

23. There are 12 pipes attached to a tank. Some of them are fill pipes and some are drain pipes. Each of the fill pipes can fill the tank in 12 hours, while each of the drain pipes will take 24 hours to drain a full tank completely. If all the pipes are kept open when the tank was empty, it takes 2 hours for the tank to overflow. How many of these pipes are drain pipes?

- a) 6
- b) 11
- c) 4
- d) 7

Ans: C

24. A bath can be filled by the cold water pipe in 10 min and by hot water pipe in 15 min (independently each). A person leaves the bathroom after turning on both pipes simultaneously and returns at the moments when the bath should be full. Finding, however, that the waste pipe has been open he now closes it. In 4 min more, bath is full. In what time would be the waste pipe empty it?

- a) 9 min
- b) 12 min
- c) 15 min
- d) 14 min

Ans: A

25. Due to hole at the bottom of the tank, a tap takes 2 more minutes to completely fill the tank. Due to leakage of water through this hole, a bucket filled completely with water gets emptied in 4 minutes. In how much time can the tap fill the tank, if there was no hole at the bottom at the tank?

- a) 8 min
- b) 2 min
- c) 4 min
- d) 6 min

Ans: B

26. Pipe A can fill a tank in 'a' hours. On account of a leak at the bottom of the tank it takes thrice as long to fill the tank. How long will the leak at the bottom of the tank take to empty a full tank, when pipe A is kept closed?

- a)  $3a/2$  hrs
- b)  $2a/3$  hrs
- c)  $4a/3$  hrs
- d)  $3a/4$  hrs

Ans: A

27. Two taps can fill a tank in 12 min and 18 min respectively. Both the taps are kept open for 2 min and then the tap that fills the tank in 12 min is turned off. In how many more minutes will the tank be filled?

- a) 9
- b) 12
- c) 13
- d) 10

Ans:C



28. Pipe A usually fills a tank in 2 hours. On account of a leak at the bottom of the tank, it takes 30 more minutes to fill the tank. How long will the leak take to empty a full tank if pipe A is shut?

- a) 2 hrs 30mins
- b) 5 hrs
- c) 4 hrs
- d) 10 hrs

Ans: D

29. Pavan builds an overhead tank in his house, which has three taps attached to it. While the first tap can fill the tank in 12 hours, the second one takes one and a half times than the first one to fill it completely. A third tap is attached to the tank which empties it in 36 hours.

Now one day, in order to fill the tank, Pavan opens the first tap and after two hours opens the second tap as well. However, at the end of the sixth hour, he realizes that the third tap has been kept open right from the beginning and promptly closes it.

What will be the total time required to fill the tank?

- a) 8 hours 48 minutes
- b) 9 hours 12 minutes
- c) 9 hours 36 minutes
- d) 8 hours 30 minutes

Ans: B

30. Three pipes  $A$ ,  $B$  and  $C$  are connected to a tank. These pipes can fill the tank separately in 5 hr, 10 hr and 15hr respectively. When all the three pipes were opened simultaneously, it was observed that pipes  $A$  and  $B$  were supplying water at  $(3/4)th$  of their normal rates for the 1st hour after which they supplied water at normal rate. Pipe  $C$  supplied water at  $(2/3)th$  of its normal rate for 1st 2 hours, after which it supplied at its normal rate. In how much time, tank would be filled?

- a) 1.05 hr
- b) 2.05 hr
- c) 3.05 hr
- d) None of these

Ans: C

