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 **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 **= 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 **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

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

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

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

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 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

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

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 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 Y hours, and all of them are opened together, then

Net part filled in 1 hour = $1/X + 1/Y - 1/Z$

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 = 1/3 – 1/4 = 1/12

So leak will empty the tank in 12 hours.

By formula

Let's say x = 3 and y = 4

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

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

$$\left\{\frac{XYZ}{Z-X}\right\}$$ 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

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

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:

Here, K = 4 and X = 15

$= (4/ 4 + 1)\ 15$

= 12 minutes.

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

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

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

2. Two pipes A & B can fill a Cistern in 8 and 24 minutes respectively. If both pipes opened together, but pipe A is closed 4 minutes before theCistern will full. In what time the Cistern will full?

a) 9 1/7 min

b) 7 1/7 min

c) 8min

d) 9 min

3. Two taps A & B can fill a tank in 48 and 36 minutes respectively. If both taps are opened together then after how much time pipe A is closed so that the tank is filled in 25 minutes 30 seconds?

a) 14 min

b) 25 min

c) 22 min

d)None of these

4. A Boy and a Girl together fill a Cistern with water. The Boy pours 4 liters water in every 3 minutes and Girl pours 3 liters water in every 4 minutes. In how much time they will fill 100 liters of water in Cistern?

a) 32 minutes

b) 1 hour

c) 48 minutes

d) 2 hours

5. Two pipes A & B can fill a Cistern in 1 hour & 75 minutes respectively. There is also an outlet pipe C. If all three pipes are opened together, the Cistern is full in 50 minutes. How much time will be taken by C to empty the full Cistern?

A. 60 min.

B. 44 min.

C. 52 min.

D. 100 min.

6. Two pipes A & B can fill a tank in 5 hour & 20 hours respectively. There is a third pipe to empty it, but the operator did not notice it. Due to which it caused a delay of 1 hour in filling of tank. Find the time in which the third pipe would empty the filled tank?

a) 34 hours

b) 18 hours

c) 20 hours

d) 80 hours

7. Two pipes A & B can fill a Cistern in 30 hour &20hours respectively. A third pipe C can leaks out 45 liters of water per minute. If all the pipes are opened together, the Cistern will fill in 15 hours. Find capacity of the Cistern?

a) 162000 liters

b) 820000 liters

c) 14000 liters

d) 28000 liters

8. 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

9. A leak in bottom of a tank can empty it in 6 hours. A tap fill the tank @ 4 liters/minutes. If both taps are opened, then the tank will empty in 8 hours. Find capacity of the tank?

a) 6720 liters

b) 8100 liters

c) 5760 liters

d) 4750 liters

10. If tap A & B can fill a tank in 10 & 15 hour respectively. An outlet pipe C can empty it in 20 hours. Initially tap A & B are opened and when the tank was supposed to fill it was found that tap C was open by mistake. Now, the tap C being closed, after how much time the tank will fill?

a) 2 h

b) 1 h 48 min

c) 1 h

d) 2h 20 min

11. A, B & C are pipes attached to a Cistern. A & B can fill it in 20 and 30 minutes respectively. While, C can empty it in 15 minutes. If A, B, & C are kept open successively for 1 minute each. How seen will Cistern be filled?

a) 520 min

b) 167 min

c) 120 min

d) 620 min

12. 3/4 part of a tank is full of water. When 30 litres of water is taken out, the tank becomes empty. The capacity of the tank is

(1) 36 litres

(2) 42 litres

(3) 40 litres

(4) 38 litres

13. If 3/5 th of a cistern is filled in 1 minute, the time needed to fill the rest is

(1) 40 sec

(2) 30 sec

(3) 36 sec

(4) 24 sec

14. There are two pumps to fill a tank with water. First pump can fill the empty tank in 8 hours, while the second in 10 hours. If both the pumps are opened at the same time and kept open for 4 hours, the part of tank that will be filled up is :

(1) 9/10

(2) 1/10

(3) 2/5

(4) 1/5

Advance Questions

12. In what time a Cistern be filled by 3 pipes of diameter 1 cm, 1.33 cm and 2 cm running together, while the largest can fill alone in 61 minutes?The amount of water flowing in by each pipe being proportional to square of its diameter.

a) 36 min

b) 24 min

c) 45 min

d) 40 min

13. In what time a Cistern be filled by 3 pipes whose diameters are 1 cm, 2 cm and 4 cm, running together, when largest alone fill it in 1 1/20 hours?The amount of water flowing in by each pipe being proportional to square of its diameter.

a) 60 min

b) 48 min

c) 25 min

d) 30 min