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Aptitude Made Simple

Pipes and Cisterns

Various competitive examinations ask questions regularly based on Pipes and Cisterns.

If you have gone through my Work and Time document then solving Pipes and Cistern would definitely very easy for you to solve.

I would recommend you to go through work and time topic document once, before reading this. Work and Time, Pipes and Cisterns topics are almost similar to each other only the difference is that in Pipes and Cisterns, we need to look at negative work as well.

What are Pipes and Cisterns???

Let us look at 1 real life example to understand concept of Pipes and Cisterns.

Consider you have water storage tank of 1000 Liters on your terrace at 3rd floor.
You utilize same water in your Kitchen, daily activities etc. through different pipes
Assume you get water supply from Corporation at ground floor and you don't have facility of electric motor to transfer that water to Terrace tank.
So you fill water in bucket and go upstairs to fill tank. During this activity some water gets wasted due to leakage in bucket.
Someday magic happened and you got new Pipe in Tank itself which gets water from Corporation directly but your Tank also starts leaking at terrace itself.

Now let us summarize things in terms of Pipes and Cisterns Problem

Terrace water Tank: **Tank / Cisterns**
Magic Pipe : **Inlet Pipe/Tap**
Water supply in Bath, Kitchen etc: **Outlet Pipe/Tap**
Bucket/Tank leakage: **Leakage in Tank**

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Simple Method to solve Pipes and Cisterns:

We will be using simple LCM method to solve Work and Time problems. This is different from conventional method which we generally study in our academics.

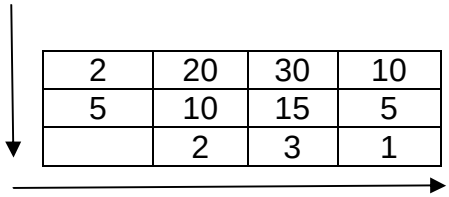
If we calculate LCM of numbers, we are almost 70% completion of problem.

Let us look at simple LCM examples first before looking at actual problems:

Example 1: Calculate LCM of 20, 30,10

Method 1: Divisional Method

This is conventional method and we will keep dividing numbers till we get either 1 or all prime numbers.



2	20	30	10
5	10	15	5
	2	3	1

LCM = 2 * 5 * 2* 3* 1= **60**

Method 2: Orally by table method.

Find greatest number from list for which LCM is to be identified.

Now look at table of this number and keep checking whether that number is divisible by other numbers in list.

Here largest number is 30. So we will write tables of 30 and table of 20, 10 as well.

We will write 30 table till we get the number which is completely divisible by 10 and 20

20	30	10
40	**60**	20
60		30
		40
		50
		60

As you can see 30 is divisible by 10 but not by 20.

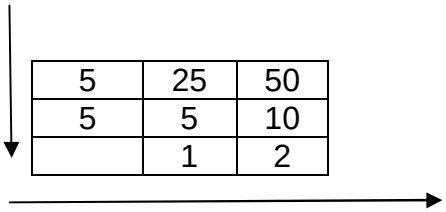
However 60 is divisible by 10 and 20 both.

So 60 is LCM [you can do this calculation orally in fraction of seconds if tables are learned 1 to 30]

Example 2: Calculate LCM of 25, 50

Method 1: Divisional Method

This is conventional method and we will keep dividing numbers till we get either 1 or all prime numbers.



5	25	50
5	5	10
	1	2

LCM = 5 * 5 * 2 * 1 * 2= **50**

Method 2: Orally by table method.

Find greatest number from list for which LCM is to be identified.

Now look at table of this number and keep checking whether that number is divisible by other numbers in list.

Here largest number is 50. So we will write tables of 50 and table of 25 as well.

We will write 50 table till we get the number which is completely divisible by 25.

25	**50**
50	

As you can see 50 is divisible by 25

So **50 is LCM**

Types of Problems:

Type	Given	To Find
Type 1	Pipe A fills tank in x hours Pipe B fills tanks n y hours	Together A & B will fill tank in how much time
Type 2	Pipe A fills tank in x hours Pipe B empties tank n y hours	Together A & B will fill tank in how much time tank will be filled
Type 3	Pipe A fills tank in x hours Due to leak it takes more time	How much time will be required to empty tank completely
Type 4	Miscellaneous	

Type1:

Problem 1:

Pipe A fills tank in 10 hours and Pipe B fills tank in 15 hours. In how much time tank will fill completely if both pipes are opened together?

Solution :

Pipe A takes 10 hours to fill tank.

Pipe B takes 15 hours to fill tank

First we will try to calculate what is capacity of tank in liters: which is nothing but LCM.

Calculate LCM of 10,15 -> LCM of 10 and 15 is 30.

Pipe	Tank Capacity	Time to fill tank(hours)	Speed for 1hour
A	30	10	30/10 = 3 liters
B	30	15	30/15 = 2 liters

So A fills 3 liters in 1 hour and 2 liters in 1 hour.

In order to fill complete tank [30 Liters]:

1 hr Speed for Pipe A + B = 3 + 2 = 5

Time required to fill complete tank = 30 / 5 =6 Hours

Answer is 6 Hours

Problem 2:

Pipe A fills tank in 10 hours. Pipe B fills tank in 30 hours. Pipe C fills tank in 60 hours. How much time required to fill tank completely if A, B and C worked together?

Solution :

Pipe A takes 10 hours to fill tank.

Pipe B takes 30 hours to fill tank.

Pipe C takes 60 hours to fill tank.

Calculate LCM of 10, 30, 60 -> LCM of 10, 30,60 is 60.

Total tank capacity : 60 Liters

Pipe	Tank Capacity	Time to fill tank(hours)	1 Hour speed
A	60	10	60/10 = 6
B	60	30	60/30 = 2
C	60	60	60/60= 1
A+B+C	60	60/9	6+2+1= 9

A+B+C will require 60/9 hours to fill tank completely

60/9 = $6\frac{6}{9}$

Answer is $6\frac{6}{9}$ Hours

Problem 3:

Pipe A fills tank in 20 minutes and Pipe B fills tank in 30 minutes. In how much time tank will fill completely if both pipes are opened together?

Solution :

Pipe A takes 20 hours to fill tank.

Pipe B takes 30 hours to fill tank

Calculate LCM of 20, 30 -> LCM of 20 and 30 is 60.

Tank capacity :

Pipe	Tank Capacity	Time to fill tank(minutes)	Speed for 1minute
A	60	20	60/20 = 3
B	60	30	60/30 = 2
A + B	60	60/5 =12	3 + 2 = 5

Answer is 12 Minutes

Type2:

Problem 1:

A Cistern can be filled by tap in 4 hours while it can be emptied by another tap in 9 hours. If both the taps are opened simultaneously then after how much time will cistern get filled?

Solution :

Pipe A takes 4 hours to fill tank.

Pipe B takes 9 hours to fill tank

We need to use minus sign in spped of B as it is outlet pipe.

Calculate LCM of 4, 9 -> LCM of 4, 9 is 36.

So Cistern capacity is 36 Liters.

Pipe	Cistern Capacity	Time to fill/empty(hours)	1 hour speed
A	36	4	36/4 = 9
B	36	9	36/9 = **-4**
A+B	36	?	9 + (-4) =5

As you can see 1st pipe is filling tank and 2nd pipe is outlet pipe so we are using minus sign for 2nd pipe

In 1 hr total speed is 5

To fill complete tank that is 36 Litres.

$\frac{36}{5} = 7\frac{1}{5}$

1/5 means 60/5 = 12 Minutes

Answer is 7.2 Hours or 7 Hours 12 minutes

Problem 2:

Two pipes can fill tank in 10 hours and 12 hours respectively, while 3rd pipe empties the full tank in 20 hours. If all three pipes are operated simultaneously then in how much time tank will be filled completely?

Solution :

Pipe A takes 10 hours to fill tank.

Pipe B takes 12 hours to fill tank

Pipe C takes 20 hours to fill tank

We need to use minus sign in speed of C as it is outlet pipe.

Calculate LCM of 10, 12 , 20 -> LCM of 10, 12, 20 is 60.

So Tank capacity is 60 Liters.

Pipe	Cistern Capacity	Time to fill/empty(in hours)	1 hour speed
A	60	10	60/10 = 6
B	60	12	60/12 = 5
C	60	20	60/20 = **-3**
A+B+C	60	?	6 + 5 + (-3) = 8

As C pipe empties pies we have used minus sign

In 1 hr if all opened together : 8 liters water would be filled.

In order to fill complete tank that is 60Liters:

$\frac{60}{8} = \frac{15}{2} = 7\frac{1}{2}$

½ means 60/2 = 30 minutes

Answer is 7.5 Hours or 7 Hours 30 minutes

Type 3:

Problem 1:

An electric pump can fill tank in 3 hours. Because of leak in the tank, it took $\mathbf{3\frac{1}{2}}$ hours to fill tank. If tank is full, how much time it wil leak take to empty it.

Solution:

Pipe A takes 3 hours to fill tank.

Pipe A with leakage (Assume leakage as B) takes $\mathbf{3\frac{1}{2}}$ hours = $\frac{7}{2}$ hours

Here we need to find how much time leakage will require to empty completely filled pipe.

Let us calculate LCM of 3 and $\mathbf{\frac{7}{2}}$

As it sometimes become challenging to find LCM of fraction, let us see simple method

Multiply both number for which LCM to be find.

After that multiplication contains fraction multiply same with denominator to get natural number

3* $\mathbf{\frac{7}{2}}$ **=** $\mathbf{\frac{21}{2}}$

Here we have denominator and we cant take it as LCM.

So

$$\mathbf{\frac{21}{2} * 2 = 21}$$

LCM of 3 and $\mathbf{\frac{7}{2}}$ is 21

Now let us use same method what we used earlier:

Please note that B is leakage pipe so it will have minus sign

Pipe	Cistern Capacity	Time to fill/empty(in hours)	1 hour speed
A	21	3	21/3 = 7
A+B	21	7/2	21/(7/2) = 6
B	21	21	7 – 6 = **-1**

Speed of A : 7

Speed of A with Leakage B : 6

So speed of Leakage B is 1.

In order to empty filled pipe leakage will need 21 /1 = 21 Hours

Answer is 21 Hours

Problem 2:

A pump can fill tank with water in 2 hours. Because of leak, it took $2\frac{1}{3}$ hours to fill the tank. The leak can drain all water in tank in how much time?

Solution:

Pipe A takes 2 hours to fill tank.

Pipe A with leakage (Assume leakage as 2) takes $\mathbf{2\frac{1}{3}}$ hours = $\frac{7}{3}$ hours

Here we need to find how much time leakage will require to empty completely filled pipe.

Let us calculate LCM of 2 and $\frac{\mathbf{7}}{\mathbf{3}}$

As it sometimes become challenging to find LCM of fraction, let us see simple method

Multiply both number for which LCM to be find.

After that multiplication contains fraction multiply same with denominator to get natural number

$2 * \frac{\mathbf{7}}{\mathbf{3}} = \frac{\mathbf{14}}{\mathbf{3}}$

Here we have denominator and we cant take it as LCM.

So

$\frac{\mathbf{14}}{\mathbf{3}} * \mathbf{3} = \mathbf{14}$

LCM of 2 and $\frac{\mathbf{7}}{\mathbf{3}}$ is 14

Now let us use same method what we used earlier:

Please note that B is leakage pipe so it will have minus sign

Pipe	Cistern Capacity	Time to fill/empty	1 hr speed
A	14	2	14/2 = 7
A+B	14	7/3	14/(7/3) = 6
B	14	14	7 – 6 = **-1**

Speed of A : 7

Speed of A with Leakage B : 6

So speed of Leakage B is 1.

In order to empty filled pipe leakage will need 14 /1 = 14 Hours

Answer is 14 Hours

Type 4:

Problem 1:

Two pipes A and B can fill a tank in 6 hours and 4 hours respectively. If they are opened on alternate hours and if Pipe A is opened first, in how many hours tank will be full?

Solution:

Pipe A takes 6 hours to fill tank.

Pipe B takes 4 hours to fill tank

Calculate LCM of 6, 4 -> LCM of 6 and 4 is 12.

Tank capacity :

Pipe	Tank Capacity	Time to fill tank(hours)	Speed for 1hour
A	12	6	12/6 = 2
B	12	4	12/4 = 3

We have calculated 1 hour speed of pipe A and B. However we cant use it directly to solve problem as pipes are opened alternatative starting form A

Hour	Tank filled (in liters)	Tank remaining (in liters)
1 [Pipe A will be open]	2	10
2 [Pipe B will be open]	2+3 = 5	7
3 [Pipe A will be open [	5+2 = 7	5
4 [Pipe B will be open]	7+3 =10	2

In 4 hours, 10 Liters will be filled and 2 Liters is remaining.

And now Pipe A will open and Pipe A speed is 2 liters per hour.

In order to fill 2 liters by pipe A:

$$\frac{2}{2} = 1$$

4 + 1 = 5 Hours

Answer is 5 Hours

Problem 2:

Two pipes A and B can fill tank in 15 hours and 20 hours respectively while third pipe C can empty full tank in 25 hours. All 3 pipes are opened in beginning. After 10 hours , C is closed. In how much time will tank be full?

Solution :

Pipe A takes 15 hours to fill tank.

Pipe B takes 20 hours to fill tank

Pipe C takes 25 hours to empty full tank

We need to use minus sign in speed of C as it is outlet pipe.

Calculate LCM of 15, 20,25 -> LCM of 15, 20, 25 is 300

Tank capacity is 300 Liters

Pipe	Tank Capacity	Time to fill/empty(in hours)	1 hour speed
A	300	15	300/15 = 20
B	300	20	300/20 = 15
C	300	25	300/25 = **-12**
A+B+C			20 + 15 + (-12) = **23**
A+B			20 + 15 = **35**

All 3 pipes initially opened:

Speed during this time **23**

For 10 hours all pipes opened:

In 1 hour speed of all 3 pipes together is 23

So in 10 hours: 23 * 10 =230 Liters filled

Post 10 hours pending tank :

300 -230 = 70 Liters

Now C pipe is closed so only A and B is opened.

Speed of A+B is 35

In order to complete pending 70 Liters:

$$\frac{\mathbf{70}}{\mathbf{35}} = \mathbf{2}$$

Total time = 10 + 2 = 12 Hours

Answer is 12 Hours

Problem 3:

Two pipes A and B can fill a tank in 24 min and 32 min respectively. If both pipes are opened simultaneously after how much time B should be closed so that tank full in 18 minutes.

Solution:

Pipe A takes 24 minutes to fill tank.

Pipe B takes 32 minutes to fill tank

We need to complete tank in 18 minutes by closing B after some interval.

Calculate LCM of 24, 32, -> LCM of 24, 32 is 96

Tank capacity is 96 Liters

Pipe	Tank Capacity	Time to fill/empty(minutes)	1 minute speed
A	96	24	96/24 = 4
B	96	32	96/32 = 3
A+B			4 + 3 = 7

A+B speed is 7

Let us assume A and B both were opened for 18 minutes.

In 18 minutes:

18 * 7 = 126 liters of water would be filled.

However our tank is of 96 Liters only.

In order to find when B should be closed we need to see what extra water filled by Pipe B.

Extra water by B = 126 – 96 = 30 Liters.

As B speed is 3 it will take (30/3 = 10) 10 minutes to do this extra water so we need to close B 10 minutes before 18 minutes.

So 18 – 10 = 8 minutes

Answer is we should close B after 8 minutes so tank will be filled in 18 minutes.