PIPES AND CISTERNS

- A pipe is connected to a tank or cistern. It is used to fill or empty the tank; accordingly, it is called an inlet or an outlet.

- **Inlet:** A pipe which is connected to fill a tank is known as an inlet.

- **Outlet:** A pipe which is connected to empty a tank is known as an outlet.

- Problems on pipes and cisterns are similar to problems on time and work. In pipes and cistern problems, the amount of work done is the part of the tank of filled or emptied. And, the time taken to do a piece of work is the time take to fill or empty a tank completely or to a desired level.

Points to remember:

1) If an inlet connected to a tank fills it in X hours, part of the tank filled in one hour is = 1/X

2) If an outlet connected to a tank empties it in Y hours, part of the tank emptied in one hour is = 1/Y

3) An inlet can fill a tank in X hours and an outlet can empty the same tank in Y hours. If both the pipes are opened at the same time and Y > X, the net part of the tank filled in one hour is given by$= (\frac{1}{X} - \frac{1}{Y})$

Therefore, when both the pipes are open the time taken to fill the whole tank is given by$= \frac{XY}{Y-X}$ hours

If X is greater than Y, more water is flowing out of the tank than flowing into the tank. And, the net part of the tank emptied in one hour is given by$= (\frac{1}{Y} - \frac{1}{X})$

Therefore, when both the pipes are open the time taken to empty the full tank is given by $= \frac{YX}{X-Y}$ hours

4) An inlet can fill a tank in X hours and another inlet can fill the same tank in Y hours. If both the inlets are opened at the same time, the net part of the tank filled in one hour is given by$= \frac{1}{X} + \frac{1}{Y}$

Therefore, the time taken to fill the whole tank is given by$= \frac{XY}{X+Y}$

In a similar way, If an outlet can empty a tank in X hours and another outlet can empty the same tank in Y hours, the part of the tank emptied in one hour when both the pipes start working together is given by $= \frac{1}{X} + \frac{1}{Y}$

Therefore, the time taken to empty the full tank is given by $= \frac{XY}{X+Y}$

5) Three inlets A, B, and C can fill a tank in X, Y and Z hours respectively. If all the inlets are opened together, the time taken to fill the tank is given by$= \frac{X+Y+Z}{XY+YZ+ZX}\ hours$

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6) Two pipes can fill a tank in X and Y hours respectively and an outlet can empty the same tank in Z hours. If all the pipes are opened together, part of the tank filled in one hour is given by$= \frac{1}{X} + \frac{1}{Y} - \frac{1}{Z}$

∴ Time taken to fill the tank completely when all the pipes are working is given by$= \frac{XYZ}{YZ+XZ-XY}$

7) A pipe can fill a tank in X hours but due to a leak in the bottom, it can be filled in Y hours.

The time taken by the leak to empty the tank is given by$= \frac{XY}{Y-X}$

PROBLEMS

1) A pipe can fill a tank in 6 hours and another pipe can empty the tank in 12 hours. If both the pipes are opened at the same time, the tank can be filled in

A. 10 hours

B. 12 hours

C. 14 hours

D. 16 hours

- Answer: B

- Sol: Part of the tank filled in one hour $= \frac{1}{6}$

  Part of the tank emptied in one hour$= \frac{1}{12}$

  Net part of the tank filled in one hour $= \frac{1}{6} - \frac{1}{12} = \frac{1}{12}$

  $\frac{1}{12}$ Part of the tank can be filled in one hour.

  $\therefore$ The tank will be filled completely in 12 hours.

Another Sol: Apply formula $= \frac{XY}{Y-X} = \frac{(6)(12)}{12-6} = 12\ hours$

2) Three pipes A, B and C can fill a cistern in 8 minutes,12 minutes and 16 minutes respectively. What is the time taken by three pipes to fill the cistern when they are opened together?

A. 3.7 minutes

B. 4 minutes

C. 4.5 minutes

D. 5 minutes

- Answer: A

- Sol: Part of the tank filled by A in one minute $= \frac{1}{8}$

  Part of the tank filled by B in one minute $= \frac{1}{12}$

  Part of the tank filled by C in one minute $= \frac{1}{16}$

  Net part of the tank filled by A+B+C in one minute

$$= \frac{1}{8} + \frac{1}{12} + \frac{1}{16} = \frac{13}{48}$$

  $\frac{13}{48}$ Part of the cistern is filled in one minute.

$\therefore$ The whole tank will be filled in $\frac{48}{13} = 3.7\ min$

3) Two pipes can fill a tank in 6 hours and 8 hours respectively. A third pipe can empty the same tank in 12 hours. If all the pipes start working together, how long it will take to fill the tank?

A. 4 hours

B. 4.5 hours

C. 4.8 hours

D. 5.2 hours

- Answer: C

- Sol: Part of the tank filled by two pipes in one hour $= \frac{1}{6} + \frac{1}{8}$

  Part of the tank emptied by the third pipe in one hour $= \frac{1}{12}$

  $\therefore$ Net part of the tank filled in one hour $= \frac{1}{6} + \frac{1}{8} - \frac{1}{12} = \frac{5}{24}$

  $\frac{5}{24}$ Part of tank can be filled in one hour

  $\therefore$ The whole tank will be filled in $\frac{24}{5} = 4.8\ hours$

4) A tank can be filled in 10 hours. After a leak in its bottom, it takes 12 hours to fill the tank. Find the time taken by the leak to empty the full tank?

A. 45 hours

B. 60 hours

C. 50 hours

D. 55 hours

- Answer: B

- Sol: Part of the tank filled in one hour before the leak$= \frac{1}{10}$

  Part of the tank filled in one hour after the leak $= \frac{1}{12}$

  Part of the tank emptied in one hour by the leak $= \frac{1}{10} - \frac{1}{12} = \frac{1}{60}$

  $\frac{1}{60}$ part of tank will be emptied in one hour by the leak

  $\therefore$ The full tank will be emptied by the leak in 60 hours.

5) Two pipes can fill a tank in 10 and 14 minutes respectively. A third pipe can empty the tank at the rate of10 liters/minute. If all the pipes working together can fill the empty tank in 8 minutes, what is the capacity of the tank?

A. 210 liters

B. 215.4 liters

C. 220 liters

D. 225.4 liters

- Answer: B

- Sol: Let the capacity of the tank is X liters.

  Part of the tank filled by two pipes in one minute = 1/10 + 1/14

  10 liters is emptied in 1 minute

  X liters will be emptied in X/10 minutes

  In X/10 minutes the whole tank will be emptied.

  In one minute 10/X part of the tank will be emptied.

  As per question $\frac{1}{10} + \frac{1}{14} - \frac{10}{X} = \frac{1}{8} \Rightarrow X = 215.4\ liters$

6) A cistern can be filled by an inlet in 6 hours and can be emptied by an outlet in 8 hours. If the inlet and outlet are opened together, in what time the cistern can be filled?

A. 24 hours

B. 26 hours

C. 20 hours

D. 18 hours

- Answer: A

- Sol: Part of the tank filled by the inlet in one hour $= \frac{1}{6}$

  Part of the tank emptied by the outlet in one hour $= \frac{1}{8}$

  Net part of the tank filled in one hour $= \frac{1}{6} - \frac{1}{8} = \frac{1}{24}$

  $\frac{1}{24}$ part of the tank is filled in one hour

  $\therefore$ The whole tank will be filled in 24 hours.

Another Sol: Apply formula $= \frac{XY}{Y-X} = \frac{(6)(8)}{8-6} = 24\ hours$

7) 20 buckets can fill a tank when the capacity of each bucket is 12 liters. If the capacity of each bucket is 10 liters, find the number of buckets required to fill the tank.

A. 30 buckets

B. 34 buckets

C. 24 buckets

D. 27 buckets

- Answer: C

- Sol: Capacity of each bucket = 12 liters

  20 buckets can fill the tank.

  So, capacity of tank = 20 * 12= 240 liters

  New capacity of bucket = 10 liters

  So, 10 liters can be poured into the tank by one bucket

  240 liters will be poured by $\frac{1}{10} \times 240 = 24$ buckets

8) Two pipes working together can fill a fish tank in 12 minutes. If one pipe fills the fish tank 10 minutes faster than the second pipe, in what time the second pipe alone can fill the fish tank?

A. 20 minutes

B. 25 minutes

C. 30 minutes

D. 35 minutes

- Answer: C

- Sol: Let the first pipe fill the fish tank in X minutes

  So, the second pipe will fill the fish tank in (X+10) minutes

  As per question $\frac{1}{X} + \frac{1}{X+10} = \frac{1}{12} \Rightarrow X^2 - 14X - 120 = 0 \Rightarrow$X=20

  ∴Second pipe will fill the fish tank in 20 + 10= 30 minutes

9) Pipes A and B can fill a tank in 5 and 6 hours respectively. Pipe C can empty it in 12 hours. If all the three pipes are opened together, then the tank will be filled in:

A. 30/17 hours

B. 30/11 hours

C. 60/17 hours

D. 9/2 hours

- Answer: C

- Sol: Net part filled in 1 hour $= \frac{1}{5} + \frac{1}{6} - \frac{1}{12} = \frac{17}{60}$

  $\therefore$ The tank will be full in $\frac{60}{17}$ hours

10) A pump can fill a tank with water in 2 hours. Because of a leak, it took 7/3 hours to fill the tank. The leak can drain all the water of the tank in:

A. 13 hours

B. 7 hours

C. 8 hours

D. 14 hours

- Answer: D

- Sol: Work done by the leak in 1 hour$= \frac{1}{2} - \frac{3}{7} = \frac{1}{14}$

  $\therefore$ Leak will empty the tank in 14 hrs

11) 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. 5/11
B. 6/11
C. 7/11
D. 8/11

- Answer: B

- Sol: Part filled by (A + B + C) in 3 minutes$= 3\left(\frac{1}{30}+\frac{1}{20}+\frac{1}{10}\right)=\frac{11}{20}$

  Part filled by C in 3 minutes$=\frac{3}{10}$

  $\therefore$Required ratio$=\left(\frac{3}{10}\times\frac{20}{11}\right)=\frac{6}{11}$

12) A tank is filled in 5 hours by three pipes A, B and C. The pipe C is twice as fast as B and B is twice as fast as A. How much time will pipe A alone take to fill the tank?

A. 20 hours
B. 25 hours
C. 30 hours
D. 35 hours

- Answer: D

- Sol: Suppose pipe A alone takes X hours to fill the tank.

Then, pipes B and C will take $\frac{X}{2}\ and\ \frac{X}{4}$ hours respectively to fill the tank.

$\therefore \frac{1}{X}+\frac{2}{X}+\frac{4}{X}=\frac{1}{5} \Rightarrow \mathrm{X}=35\ \mathrm{hrs}$

THANK YOU