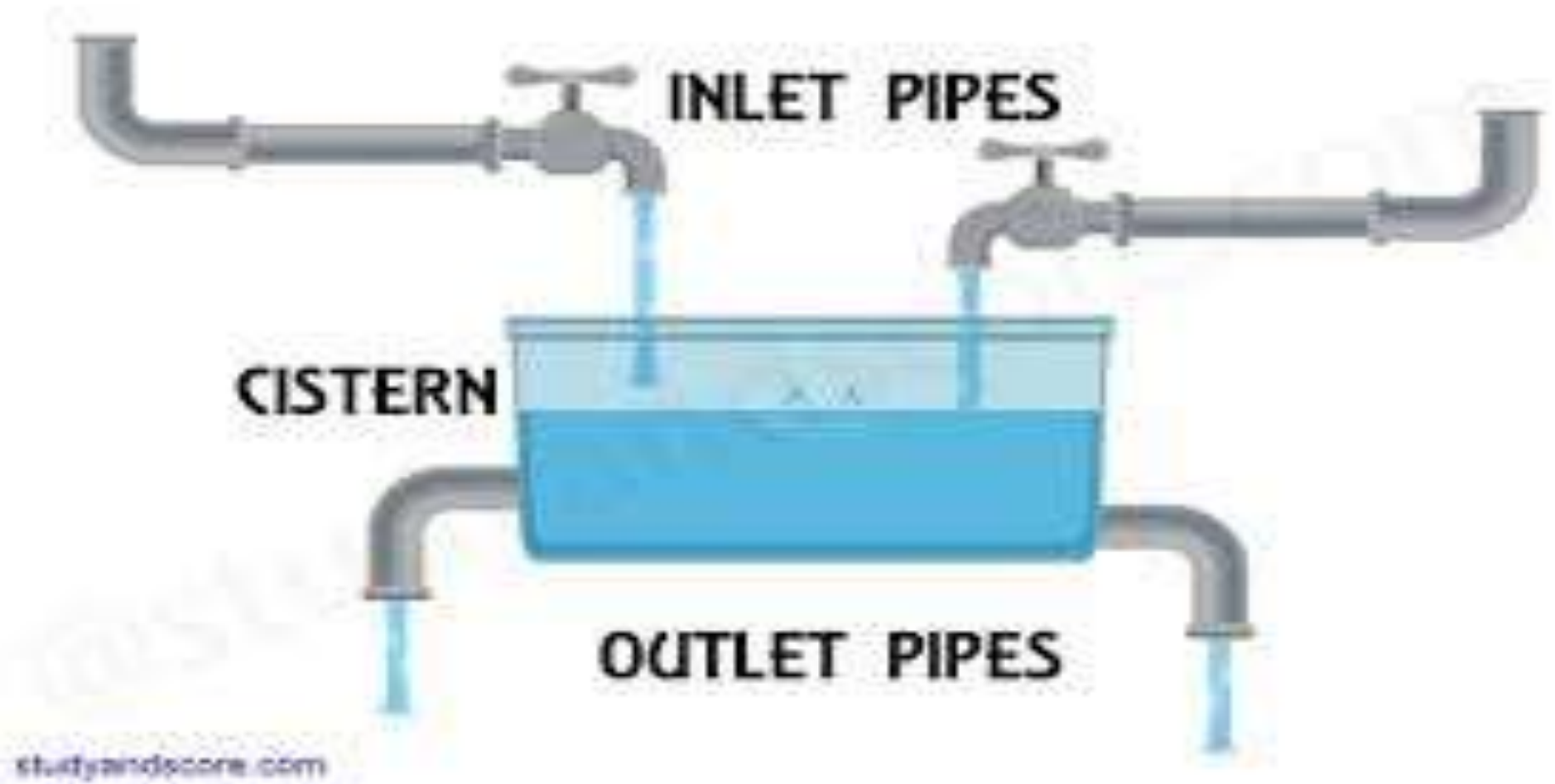


PIPE AND CISTERN



BY-RAHUL AGRAHARI

Inlet: A pipe connected with a tank or cistern or a reservoir, that fills it, is known as an inlet.

Outlet: A pipe connected with a tank or cistern or reservoir, emptying it is known as an outlet.

Important Concepts

If a pipe can fill a tank in x hours, part filled in 1 hour = $1/x$.

If a pipe can fill a tank in y hours, part filled in 1 hour = $1/y$.

Therefore, Time taken to fill the tank by both the pipes when opened simultaneously = $xy/(x+y)$

If a pipe can empty a tank in " y " hours, then tank emptied in 1 hour = $1/y$

If a pipe can empty a tank in y hours and another pipe in x hours, part of tank emptied in 1 hour when both the pipes are opened simultaneously = $(1/x + 1/y) = (x+y)/xy$

Therefore, Time taken to empty the tank by both the pipes when opened simultaneously = $xy/(x+y)$

If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours (where $y > x$), then on opening both the pipes, the net part filled in 1 hour = $1/x - 1/y = (y - x)/xy$

Therefore, When both the pipes are opened simultaneously, time taken to fill the tank fully = $xy/(y - x)$ hours.

If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours (where $x > y$), then on opening both the pipes, the net part emptied in 1 hour = $1/y - 1/x = (x - y)/xy$

Therefore, When both the pipes are open simultaneously, time taken to empty the tank fully = $xy/(x - y)$ hours.

If a pipe can fill a tank in x hours and another pipe in y hours, part of tank filled in 1 hour when both the pipes are opened simultaneously = $(1/x + 1/y) = (x+y)/xy$

QUESTION

A alone can filled a tank in 8 hr. B alone can empty the tank in 16 hr. If both the pipe open simultaneously in how much time the tank can completely filled or empty?

EXPLANATION

$$A = 8 \text{ hr (+)}$$

$$B = 16 \text{ hr (-)}$$

$$[(1/8) - (1/16)] X = 1$$

$$X = 16$$

UP-PCS

A alone can filled a tank in 12 min. B alone can empty a half tank in 4 min.

If both the pipe are open simultaneously in how much time the tank will get completely fill or empty?

EXPLANATION

$$A = 12 \text{ min (+)}$$

$$B = 8 \text{ min (-)}$$

$$[(1/12) - (1/8)] X = -1$$

$$X = 24 \text{ min}$$

AFCAT

Q. A cistern have two pipe A and B who can fill and empty in 10 and 6 min respectively. If both the pipe are open simultaneously in how much time the tank will get completely fill or empty if the tank is already fill with 40% of water?

EXPLANATION

$$A = 10 \text{ min (+)}$$

$$B = 6 \text{ min (-)}$$

$$[(1/10) - (1/6)] X = - 0.4$$

$$X = 6 \text{ min}$$

SAIL

Q. A tank is normally filled by a pipe in 8 hr but now it is taking 2 hr more to get filled because of a leak working simultaneously. How much time the leak pipe alone empty the system completely.

EXPLANATION

$$A = 8 \text{ hr (+)}$$

$$B = X \text{ hr (-)}$$

$$[(1/8) - (1/X)] (8 + 2) = 1$$

$$X = 40 \text{ hr}$$

ONGC-2010

Q. A system has two pipe A and B who can filled in 12 and 15 min respectively. There is also a leak pipe C at the bottom of the system. If all the 3 pipe are open simultaneously the system got completely filled 20 min. In how much time the leak pipe C alone can empty the system completely?

EXPLANATION

$$A = 12 \text{ min (+)}$$

$$B = 15 \text{ min (+)}$$

$$C = X \text{ min (-) [Let]}$$

$$[(1/12) + (1/15) - (1/X)] 20 = 1$$

$$X = 10 \text{ min}$$

CAT

Q. Pipe A is 5 times faster than pipe B and therefore it can filled a tank in 48 min less than B. In how much time A and B together can filled tank simultaneously?

EXPLANATION

$$A = 5 B$$

$$A = X \text{ min}$$

$$B = 5X \text{ min}$$

$$5X - X = 48$$

$$X = 12 \text{ min}$$

$$A = 12 \text{ min}$$

$$B = 60 \text{ min}$$

$$[(1/12) + (1/60)] Y = 1$$

$$Y = 10 \text{ min}$$

IB

Q.24 Two pipes can fill a tank in 20 minutes and 30 minutes respectively. Both pipes are opened simultaneously. When the tank should have been full, it is found that the waste pipe was open. Then the waste pipe was closed and in another 4 minutes, the tank was full. In what time (in Minutes) would the waste pipe empty it

(a) 36

(b) 75

(c) 45

(d) 35

EXPLANATION

The first two pipes together can fill the tank in $20 \times 30 / (20 + 30) = 12$ minutes.

Therefore, quantity filled by first pipe and second pipe together in 4 minutes is equal to quantity emptied by waste pipe in 12 minutes.

i.e., quantity filled by first pipe and second pipe together in 12 minutes is equal to quantity emptied by waste pipe in 36 minutes.

i.e., waste pipe can empty the tank in 36 minutes.

SECOND METHOD :-

The first two pipes together can fill the tank in $20 \times 30 / (20 + 30) = 12$ minutes.

Suppose the waste pipe can empty the tank in x minutes.

Part filled by first pipe and second pipe in 1 min $= 1/12$

Part filled by waste pipe in 1 min $= 1/x$

$$16/12 - 12/x = 1$$

$$X = 36$$

IAS

Q. A cistern has a leak which can empty in 8hr. A tap is turn on which admit 6L of water per min into the system. If both the pipe open simultaneously the cistern got completely empty in 12 hr. How many litres of water can the system hold?(Maximum storage capacity of the system in litres?

EXPLANATION

$$L = 8 \text{ hr}$$

$$F = X \text{ hr}$$

$$[(1/X) - (1/8)] 12 = -1$$

$$X = 24 \text{ hr}$$

$$1 \text{ min} = 6 \text{ L}$$

$$24 \text{ hr} = 6 \times 24 \times 60 = 8640 \text{ L}$$

ACCENTURE

Q. Two pipes A and B can fill a tank in 2 hours and 3 hours respectively . If they will be opened together in an empty tank then how much time will it take to fill the tank.

EXPLANATION

$$A = 2 \text{ hr (+)}$$

$$B = 3 \text{ hr (+)}$$

$$[(1/2) + (1/3)] X = 1$$

$$X = 1 \text{ hr } 12 \text{ min}$$

$$X = 72 \text{ min}$$

CAPGEMINI

Q. Pipe A can fill a tank in 8 hours while another pipe B can fill it in 16 hours. A third pipe C can empty the full tank in 32 hours. All three pipes are opened simultaneously. In what time will an empty tank be filled ?

EXPLANATION

$$A = 8 \text{ hr (+)}$$

$$B = 16 \text{ hr (+)}$$

$$C = 32 \text{ hr (-)}$$

$$[(1/8) + (1/16) - (1/32)] X = 1$$

$$X = 6.4 \text{ hr}$$

TCS

Two pipes 'P' AND 'Q' can fill a water tank in 12 and 15 minutes respectively. They were opened together but after 3 minutes tap 'P' was closed . How much more time pipe 'Q' will take to fill the tank?

EXPLANATION

$$P = 12 \text{ min (+)}$$

$$Q = 15 \text{ min (+)}$$

$$[(3/12) + (X/15)] = 1$$

$$X = 33/4 \text{ min}$$

UPSC

Q. Two pipes can fill a tank in 20 and 24 minutes respectively and a waste pipe can empty 5 gallons per minute. All the three pipes working together can fill a tank in 15 minutes. Find the capacity of the tank ?

EXPLANATION

A = 20 min (+)

B = 24 min (+)

C = X min (-)

$[(1/20) + (1/24) - (1/X)] 15 = 1$

X = 40 min

1 min = 5 gallons

40 min = 5 X 40 = 200 gallons

GATE-2014

It takes 30 minutes to empty a half – full tank by draining it at a constant rate. It is decided to simultaneously pump water into the half-full tank while draining it. What is the rate at which water has to be pumped in so that it gets fully filled in 10 minutes?

- (a) 4 times the draining rate**
- (b) 3 times the draining rate**
- (c) 2.5 times the draining rate**
- (d) 2 times the draining rate**

EXPLANATION

$E = 30 \text{ min (Half), } E = 60 \text{ min (full)}$

$$\left[\left(\frac{1}{X} \right) - \left(\frac{1}{60} \right) \right] 10 = \frac{1}{2}$$

$$X = 15 \text{ min}$$

Ans:- 4 times the draining rate

GATE-2019

An oil tank can be filled by pipe X in 5 hours and pipe Y in 4 hours, each pump working on its own. When the oil tank is full and the drainage hole is open, the oil is drained in 20 hours. If initially the tank was empty and someone started the two pumps together but left the drainage hole open, how many hours will it take for the tank to be filled? (Assume that the rate of drainage is independent of the Head)

(a) 4.00

(b) 1.50

(c) 2.00

(d) 2.50

EXPLANATION

$$X = 5 \text{ hr (+)}$$

$$Y = 4 \text{ hr (+)}$$

$$D = 20 \text{ hr (-)}$$

$$[(1/5) + (1/4) - (1/20)] T = 1$$

$$T = 2.5 \text{ hr}$$

GATE-2019

Two pipes P and Q can fill a tank in 6 hours and 9 hours respectively, while a third pipe R can empty the tank in 12 hours. Initially, P and R are open for 4 hours. Then P is closed and Q is opened. After 6 more hours R is closed. The total time taken to fill the tank (in hours) is _____

(a) 16.50

(b) 15.50

(c) 14.50

(d) 13.50

EXPLANATION

$$P = 6 \text{ hr (+)}$$

$$Q = 9 \text{ hr (+)}$$

$$R = 12 \text{ hr (-)}$$

$$[(4/6) + (X/9) - (4+6/12)] = 1$$

$$X = 10.5 \text{ hr}$$

Total time taken to fill the tank $10.5 + 4 = 14.5 \text{ hr}$

GOLDMAN SACHS - 2020

Three pipe A,B and C take 12 min, 20 min, and 15 min more than an hour respectively to fill a tank. All the three pipes are opened together for 12 min to try to fill the same tank. Then C is closed. After another 16 min, there occurs a leakage in A and the tank is fully filled after 4 min 20 sec. What percentage of A throughput is lost due to the leakage?

- (a) 25%**
- (b) 22%**
- (c) 18%**
- (d) 20%**

EXPLANATION

$$A = 72 \text{ min} , 1 \text{ Min} = 1/72$$

$$B = 80 \text{ min} , 1 \text{ Min} = 1/80$$

$$C = 75 \text{ min} , 1 \text{ Min} = 1/75$$

$$(12+16+4.33)/72 + (12+16+4.33)/80 + 12/75 - 4.33/X = 1$$

$$X = 329.2 \text{ min}$$

$$(4.33/329.2)/(4.33/72) \times 100 = 22\%$$