Formulas:

1) Inlet pipe: It fills a tank/cistern/reservoir.
Outlet pipe: It empties a tank/cistern/reservoir.
If a pipe can fill/empty a tank in '*n'* h, then the part of tank filled/emptied in 1 h is 1/n.

2) If a pipe can fill/empty *'1/n'* part of a tank in 1 h, then it can fill/empty the whole tank in *'m' h*.

3) If a pipe fills a tank in *m* h and an another pipe fills in *n* h. Then, part filled by both pipes in 1 h = $\frac{1}{m}+\frac{1}{n}$

4) If a pipe can fill/empty a tank in 'x' h and an another pipe can fill/empty the same tank in 'y' h then

a) If both pipes either fill or empties the tank, then the time taken to fill or empty the tank when both pipes are opened is $t=\frac{xy}{x+y}$

b) If first pipe fill the tank and second pipe **empties** the tank, then the time taken to fill the tank when both pipes are opened is $t=\frac{xy}{x-y}: x>y$

c) If first pipe fill the tank and second pipe **empties** the tank, then the time taken to fill the tank when both pipes are opened is $t=\frac{xy}{y-x}: y>x$

Example: Two pipes A and B can fill a tank in 30 minutes and 15 minutes respectively. If both the pipes are opened simultaneously, how much time will be taken to fill the tank?

Solution: x = 30, y = 15
T is the time taken to fill the tank, if both the pipes are opened simultaneously
$t=\frac{30\times15}{30+15}=10$ minutes

Example: A tap can fill a tank in 8 hours and another can empty it in 16 minutes. If both the taps are opened simultaneously, then the time (in hours) to fill the tank is:

Solution: x = 8, y = 16
T is the time taken to fill the tank, if both the pipes are opened simultaneously
$t=\frac{8\times16}{16-8}=16$ hours

5) If three pipes can fill a tank separately in x, y and z h, respectively, then part of the tank filled in 1 h by all the three pipes is given by $\frac{1}{x}+\frac{1}{y}+\frac{1}{z}$ and total time taken to fill the tank is given by $\frac{xyz}{xy+yz+zx}$ h

If any one of the three pipes is used to empty the tank, then time taken by that particular pipe will be negative (–ve). Suppose, 3rd pipe is used to empty the tank. Then, the above formulae takes the form as $\frac{1}{x}+\frac{1}{y}-\frac{1}{z}$ and $\frac{xyz}{yz+zx-xy}$

Practice Questions

Q1) There are two tanks A and B to fill up a water tank. The tank can be filled in 40 min, if both taps are on. The same tank can be filled in 60 min, if tap A alone is on. How much time will tap B alone take, to fill up the same tank? [CDS]

1) 64 min **2) 80 min** **3) 96 min** **4) 120 min**

Volume = LCM(40, 60) = 120 L
Efficiency of taps: A = a L/min, B = b L/min
a + b = 120/40 = 3 L/min; a = 120/60 = 2 L/min
b = 3 – 2 = 1 L/min
Say the tank be filled by tap B in 'n' min so, 1(n) = 120 i.e. n = 120 min

Shortcut:
x = 60, y = ?, T = 40 (time taken to fill the tank, if both the pipes are opened simultaneously)
$40 = \frac{60y}{60+y}$ i.e. y = 120 min

Q2) A pipe can fill a tank in 20 h. Due to a leak in the bottom, it if filled in 40 h. If the tank is full, how much time will the leak take to empty it? [CDS]

1) 40 h **2) 30 h** **3) 50 h** **4) 30 h**

Volume = LCM(20, 40) = 40 L
Efficiency of pipes: fill pipe = a L/min, leak pipe = b L/min
a = 40/20 = 2 L/h; a + b = 40/40 = 1 L/h
b = 1 – 2 = – 1 L/h (–ve sign indicates leak)
Say the leak empties the tank in 'n' min so, 1(n) = 40 i.e. n = 40 h

Q3) Through an inlet, a tank takes 8 h to get filled up. Due to a leak in the bottom, it takes 2 h more to get it filled completely. If the tank is full, how much time will the leak take to empty it?

[SSC]

1) 16 h **2) 20 h** **3) 32 h** **4) 40 h**

Volume = LCM(8, 10) = 40 L
Efficiency of pipes: inlet pipe = a L/min, leak pipe = b L/min
a = 40/8 = 5 L/h; a + b = 40/10 = 4 L/h
b = 4 – 5 = – 1 L/h (–ve sign indicates leak)
Say the leak empties the tank in 'n' min so, 1(n) = 40 i.e. n = 40 h

Q4) Two pipes A and B can fill a cistern in 24 minutes and 30 minutes respectively. There is also an outlet C. If all the three pipes are opened together, the tank is full in 20 minutes. How much time will be taken by C to empty the full tank.

1) 30 min **2) 40 min** **3) 45 min** **4) 60 min**

Volume = LCM(24, 30, 20) = 120 L

Efficiency of pipes: A = a L/min, B = b L/min, C = c L/min
a = 120/24 = 5 L/min; b = 120/30 = 4 L/min, a + b + c = 120/20 = 6 L/min
c = 6 – 5 – 4 = – 3 L/min (–ve sign indicates leak/exhaust pipe)
Say the cistern be emptied by tap C in 'n' min so, 3(n) = 120 i.e. n = 40 min

Q5) Two pipes A and B can fill a tank in 36 minutes and 48 minutes respectively. If both the pipes are opened simultaneously, after how much time should pipe B be closed so that the tank is full in 27 minutes?

1) 10 min **2) 12 min** **3) 14 min** **4) 16 min**

Volume = LCM(36, 48) = 144 L
Efficiency of pipes: A = a L/min, B = b L/min
a = 144/36 = 4 L/min; b = 144/48 = 3 L/min
Say the pipe B is closed after 'n' min so, 4(27) + 3n = 144 i.e. n = 12 min

Q6) Three pipes A, B and C can fill a cistern in 18 minutes. After working together for 6 minutes, C is closed and A and B fill the cistern in 24 minutes. Then find the time in which the cistern can be filled by pipe C.

1) 30 min **2) 24 min** **3) 36 min** **4) 45 min**

Volume = LCM(18, 24) = 72 L
Efficiency of pipes: A = a L/min, B = b L/min, C = c L/min
a + b + c = 72/18 = 4 L/min Equation 1
Tank filled by pipes A, B and C in 6 minutes = 4(6) = 24 L
Volume left = 72 – 24 = 48 L
a + b = 48/24 = 2 L/min Equation 2
From Equation 1, 2: c = 2 L/min
Say the pipe C is closed after 'n' min so, 2n = 72 i.e. n = 36 min

Q7) Three pipes A, B and C are connected to a leak. A and B together can fill the tank in 60 minutes, B and C together in 40 minutes, C and A together in 30 minutes. In how much time will each pipe fill the tank separately?

1) 80 min, 240 min, 48 min **2) 40 min, 120 min, 24 min**
3) 60 min, 250 min, 64 min **4) 65 min, 240 min, 64 min**

Volume = LCM(30, 40, 60) = 120 units
Efficiency of pipes: A = a L/min, B = b L/min, C = c L/min
a + b = 120/60 = 2 L/min; b + c = 120/40 = 3 L/min; c + a = 120/30 = 4 L/min
On adding the above equations, 2(a + b + c) = 9 i.e. a + b + c = 4.5 L/min
c = 2.5 L/min; b = 0.5 L/min; a = 1.5 L/min
Time taken by pipe A to fill the tank = 120/1.5 = 80 min
Time taken by pipe B to fill the tank = 120/0.5 = 240 min
Time taken by pipe C to fill the tank = 120/2.5 = 48 min

Q8) Two pipes can separately fill a tank in 30 hours and 45 hours respectively. Both the pipes are opened to fill the tank but when the tank is 2/3 full a leak develops in the tank through which 2/3 of the water supplied by both the pipes leak out. What is the total time taken to fill the tank?

1) 25 hours **2) 30 hours** **3) 35 hours** **4) 38 hours**

Volume = LCM(30, 45) = 90 L
Efficiency of pipes: A = a L/min, B = b L/min
a = 90/30 = 3 L/min; b = 90/45 = 2 L/min
Time after which the leak develops i.e. when tank contains 60 L = $\frac{60}{2+3}$ = 12 hours
Volume of the tank to be filled = 90 – 60 = 30 L
Tank is filled in 'n' hours so, $\frac{5n}{3} = 30$ i.e. n = 18 hours {As 2/3 of the water supplied by both the pipes leak out so, 1/3 of the water supplied remains in the tank i.e. 5/3 L/hour}
Total time taken to fill the tank = 12 + 18 = 30 hours

Q9) A cistern is normally filled in 4 hrs but takes 1 hr longer to fill because of leak in its bottom. If the cistern is full, the leak will empty it in ___ hr.

1) 10 hr **2) 20 hr** **3) 15 hr** **4) 12 hr**

Volume = LCM(4, 4+1) = 20 L
Efficiency of pipes: Inlet pipe = a L/hr, Leak = b L/hr
a = 20/4 = 5 L/hr; a + b = 20/5 = 4 L/hr
b = 4 – 5 = – 1 L/hr
Say the cistern be emptied by the leak in 'n' min so, 1(n) = 20 i.e. n = 20 hr

Q10) Two pipes A and B can separately fill in 30 minutes and 20 minutes respectively and waste pipe C can carry out 6 L/min. If all the pipes are opened when the cistern is full, it is emptied in 60 minutes. How many litres will the cistern hold?

1) 30 litres **2) 10 litres** **3) 45 litres** **4) 60 litres**

Here, the efficiency of pipe C (6 L/min) is given. So we cannot suppose the volume of the cistern.
Let V litres be the volume of the cistern.
$\frac{V}{30} + \frac{V}{20} - 6 = -\frac{V}{60}$ There is a – ve sign with V/60 because the cistern is being emptied.
V = 60 litres

Q11) A cistern has a leak which would empty it in 4 hrs. A tap is turned on which admits 3 litres a minute into the cistern and it is now emptied in 6 hrs. How many litres will the cistern hold?

1) 360 litres **2) 1080 litres** **3) 2160 litres** **4) 2260 litres**

Here, the efficiency of a tap (3 L/min) is given. So we cannot suppose the volume of the cistern.
Let V litres be the volume of the cistern.
$-\frac{V}{4} + 3 \times 60 = -\frac{V}{6}$ {– ve sign is used along with leak/exhaust pipe}
V = 2160 litres

Q12) One filling pipe A is 5 times faster than second filling pipe B. If B can fill a cistern in 36 minutes then find the time when the cistern will be full if both fill pipes are opened together.

1) 4 min **2) 6 min** **3) 8 min** **4) 12 min**

Efficiency of pipes: B = 1 L/min, A = 5 L/min
Volume of the cistern = 1(36) = 36 L
Time taken by both fill pipes (together) to fill the cistern = $\frac{36}{1+5}$ = 6 minutes

Q13) 8 taps are fitted to a water tank. Some of them are water taps to fill the tank and the remaining are outlet taps to empty the tank. Each water tap can fill the tank in 12 hrs and each outlet can empty it in 36 hrs. On opening all the taps the tank is filled in 3 hrs. Find the number of water taps.

1) 3 **2) 4** **3) 5** **4) 2**

Volume = LCM(12, 36) = 36 L
Efficiency of taps: Filling pipe = a L/min = 36/12 = 3 L/min, Outlet pipe = b L/min = 36/36 = –1 L/min
Let there be 'x' filling pipes and the remaining (8 – x) be outlet pipes
Volume added to the tank per hour by all the pipes working together = 3x – 1(8 – x) = 36/3 = 12
x = 5