SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution

Coimbatore-35

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF CIVIL ENGINEERING

23GET276 – VQAR II

II YEAR/ IV SEMESTER

UNIT 1 – QUANTITATIVE ABILITY III

TOPIC – PIPES AND CISTERNS

PIPES AND CISTERNS

1. **Inlet:**

   A pipe connected with a tank or a 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.

2. If a pipe can fill a tank in x hours, then:

   part filled in 1 hour = $\frac{1}{x}$.

3. If a pipe can empty a tank in y hours, then:

   part emptied in 1 hour = $\frac{1}{y}$.

PIPES AND CISTERNS

4. 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, then

the net part filled in 1 hour = $\left(\frac{1}{x} - \frac{1}{y}\right)$.

5. 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, then

the net part emptied in 1 hour = $\left(\frac{1}{y} - \frac{1}{x}\right)$.

PIPES AND CISTERNS

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. $\frac{5}{11}$

B. $\frac{6}{11}$

C. $\frac{7}{11}$

D. $\frac{8}{11}$

Answer: Option **B**

Explanation:

Part filled by (A + B + C) in 3 minutes = $3\left(\frac{1}{30}+\frac{1}{20}+\frac{1}{10}\right)=\left(3 \times \frac{11}{60}\right)=\frac{11}{20}$.

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

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

PIPES AND CISTERNS

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. $1\frac{13}{17}$ hours

B. $2\frac{8}{11}$ hours

C. $3\frac{9}{17}$ hours

D. $4\frac{1}{2}$ hours

Answer: Option **C**

Explanation:

Net part filled in 1 hour $\left(\frac{1}{5}+\frac{1}{6}-\frac{1}{12}\right)=\frac{17}{60}$.

$\therefore$ The tank will be full in $\frac{60}{17}$ hours *i.e.*, $3\frac{9}{17}$ hours.

PIPES AND CISTERNS

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

A. $4\frac{1}{3}$ hours

B. 7 hours

C. 8 hours

D. 14 hours

Answer: Option **D**

Explanation:

Work done by the leak in 1 hour = $\left(\frac{1}{2} - \frac{3}{7}\right) = \frac{1}{14}$.

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

PIPES AND CISTERNS

Two pipes can fill a tank in 20 and 24 minutes respectively and a waste pipe can empty 3 gallons per minute. All the three pipes working together can fill the tank in 15 minutes. The capacity of the tank is:

A. 60 gallons

B. 100 gallons

C. 120 gallons

D. 180 gallons

Answer: Option **C**

Explanation:

Work done by the waste pipe in 1 minute = $\frac{1}{15} - \left(\frac{1}{20} + \frac{1}{24}\right)$

$= \left(\frac{1}{15} - \frac{11}{120}\right)$

$= -\frac{1}{40}$. [-ve sign means emptying]

$\therefore$ Volume of $\frac{1}{40}$ part = 3 gallons.

Volume of whole = (3 x 40) gallons = 120 gallons.

PIPES AND CISTERNS

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. 35 hours

D. Cannot be determined

E. None of these

Answer: Option **C**

Explanation:

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.

$$\therefore \quad \frac{1}{x} + \frac{2}{x} + \frac{4}{x} = \frac{1}{5}$$

$$\Rightarrow \frac{7}{x} = \frac{1}{5}$$

$$\Rightarrow x = 35 \text{ hrs.}$$

PIPES AND CISTERNS

Two pipes A and B can fill a tank in 20 and 30 minutes respectively. If both the pipes are used together, then how long will it take to fill the tank?

A. 12 min

B. 15 min

C. 25 min

D. 50 min

Answer: Option **A**

Explanation:

Part filled by A in 1 min = $\frac{1}{20}$.

Part filled by B in 1 min = $\frac{1}{30}$.

Part filled by (A + B) in 1 min = $\left(\frac{1}{20} + \frac{1}{30}\right) = \frac{1}{12}$.

∴ Both pipes can fill the tank in 12 minutes.

PIPES AND CISTERNS

Two pipes A and B together can fill a cistern in 4 hours. Had they been opened separately, then B would have taken 6 hours more than A to fill the cistern. How much time will be taken by A to fill the cistern separately?

A. 1 hour

B. 2 hours

C. 6 hours

D. 8 hours

Answer: Option **C**

Explanation:

Let the cistern be filled by pipe A alone in x hours.

Then, pipe B will fill it in $(x + 6)$ hours.

$$\therefore \quad \frac{1}{x} + \frac{1}{(x+6)} = \frac{1}{4}$$

$$\Rightarrow \frac{x + 6 + x}{x(x+6)} = \frac{1}{4}$$

$$\Rightarrow x^2 - 2x - 24 = 0$$

$$\Rightarrow (x - 6)(x + 4) = 0$$

$$\Rightarrow x = 6. \quad \text{[neglecting the negative value of } x\text{]}$$

PIPES AND CISTERNS

One pipe can fill a tank three times as fast as another pipe. If together the two pipes can fill the tank in 36 minutes, then the slower pipe alone will be able to fill the tank in:

A. 81 min.

B. 108 min.

C. 144 min.

D. 192 min.

Answer: Option **C**

Explanation:

Let the slower pipe alone fill the tank in x minutes.

Then, faster pipe will fill it in $\frac{x}{3}$ minutes.

$$\therefore \quad \frac{1}{x} + \frac{3}{x} = \frac{1}{36}$$

$$\Rightarrow \frac{4}{x} = \frac{1}{36}$$

$$\Rightarrow x = 144 \text{ min.}$$

PIPES AND CISTERNS

A large tanker can be filled by two pipes A and B in 60 minutes and 40 minutes respectively. How many minutes will it take to fill the tanker from empty state if B is used for half the time and A and B fill it together for the other half?

A. 15 min

B. 20 min

C. 27.5 min

D. 30 min

Answer: Option **D**

Explanation:

Part filled by (A + B) in 1 minute = $\left(\frac{1}{60} + \frac{1}{40}\right) = \frac{1}{24}$.

Suppose the tank is filled in x minutes.

Then, $\frac{x}{2}\left(\frac{1}{24} + \frac{1}{40}\right) = 1$

$\Rightarrow \frac{x}{2} \times \frac{1}{15} = 1$

$\Rightarrow x = 30$ min.

PIPES AND CISTERNS

A tap can fill a tank in 6 hours. After half the tank is filled, three more similar taps are opened. What is the total time taken to fill the tank completely?

A. 3 hrs 15 min

B. 3 hrs 45 min

C. 4 hrs

D. 4 hrs 15 min

Answer: Option **B**

Explanation:

Time taken by one tap to fill half of the tank = 3 hrs.

Part filled by the four taps in 1 hour = $\left(4 \times \frac{1}{6}\right) = \frac{2}{3}$.

Remaining part = $\left(1 - \frac{1}{2}\right) = \frac{1}{2}$.

$\therefore \frac{2}{3} : \frac{1}{2} :: 1 : x$

$\Rightarrow x = \left(\frac{1}{2} \times 1 \times \frac{3}{2}\right) = \frac{3}{4}$ hours *i.e.*, 45 mins.

So, total time taken = 3 hrs. 45 mins.

PIPES AND CISTERNS

Three pipes A, B and C can fill a tank in 6 hours. After working at it together for 2 hours, C is closed and A and B can fill the remaining part in 7 hours. The number of hours taken by C alone to fill the tank is:

A. 10

B. 12

C. 14

D. 16

Answer: Option **C**

Explanation:

Part filled in 2 hours = $\frac{2}{6} = \frac{1}{3}$

Remaining part = $\left(1 - \frac{1}{3}\right) = \frac{2}{3}$

$\therefore$ (A + B)'s 7 hour's work = $\frac{2}{3}$

(A + B)'s 1 hour's work = $\frac{2}{21}$

$\therefore$ C's 1 hour's work = { (A + B + C)'s 1 hour's work } - { (A + B)'s 1 hour's work }

$= \left(\frac{1}{6} - \frac{2}{21}\right) = \frac{1}{14}$

$\therefore$ C alone can fill the tank in 14 hours.

THANK YOU