

# GATE

## CRASH COURSE

**ALL BRANCH**

**Subject**

**General Aptitude**

Lec : 06

Boats Streams & Pipes Cistern

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# Topics *to be covered*

**1** Boats and Streams ✓

**2** Problem on Trains ✓

**3** Pipes and Cistern







## BOATS and STREAMS



$$\text{S. Boat} = \frac{DS + US}{2}$$

$$\text{S. Water} = \frac{DS - US}{2}$$

(US) (10 kmph) Upstream

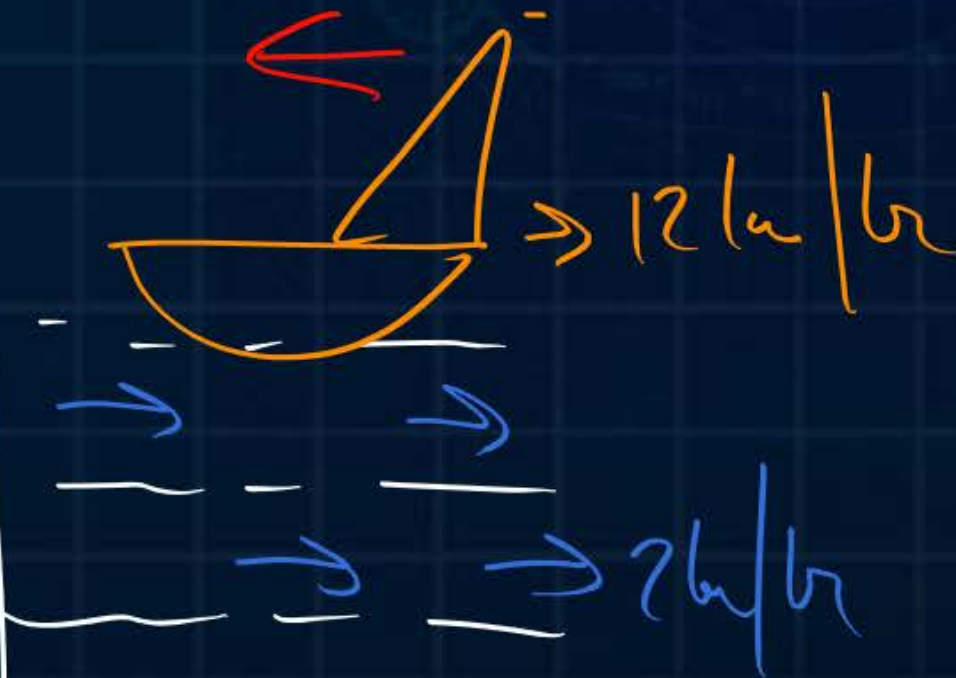
(DS) (14 kmph) Downstream

Speed of Boat  
- Speed of water

$$\text{Speed} = \underline{S.B - S.W}$$

$$\text{Speed} = \underline{S.B + S.W}$$

Speed of Boat  
+ Speed of water





## Question

$$T = \frac{D}{S}$$



A boat whose speed in still water is 15 km/hr goes 30 km downstream and comes back upstream in 4.5 hours. What is the speed of water current?

**A** 4 km/hr

**B** 10 km/hr

**C** 6 km/hr

**D** 5 km/hr

$$S.B = 15 \text{ km/hr}$$

$$\frac{30}{15+x} + \frac{30}{15-x} = 4.5$$

$$\Rightarrow \frac{450 - 30x + 450 + 30x}{225 - x^2} = 4.5$$

Speed of water  $\Rightarrow$

$$900 = 1012.5 - 4.5x^2$$

$$4.5x^2 = 112.5$$

$$x^2 = \frac{112.5}{4.5} = \frac{1125}{45}$$

$$x^2 = 25$$

$$x = \sqrt{25} = 5$$



## Question



$$\text{Distance} = x$$

A boat takes 12 hours to go downstream and 24 hours to return while covering a certain distance. What is the time taken by the boat to cover the same distance in still water?

**A** 10 hours

**C** 15 hours

$$\frac{\frac{x}{12} + \frac{x}{24}}{2} = \text{S. Boat}$$

**B** 18 hours

**D** 16 hours

$$\frac{2x + x}{24} \times \frac{1}{2} = \text{S. Boat}$$

$$\frac{3x}{48} = \text{S. Boat}$$
$$\frac{16}{16}$$

$$\frac{x}{16} = \text{Speed of Boat}$$

$$\text{Time} = \frac{D}{S}$$

$$= x \div \frac{x}{16}$$
$$= x \times \frac{16}{x} = 16 \text{ hrs}$$



## Question



Speed of man in still water is  $(28/3)$  km/hr. It takes him thrice as much time to row upstream as it takes to row downstream. What is the velocity of the stream?

**A**  $(14/3)$  km/hr

**B**  $(16/3)$  km/hr

**C** 6 km/hr

**D**  $(20/3)$  km/hr

Time

$$U.S : D.S = 3 : 1$$

Speed

$$U.S : D.S = 1 : 3$$

$$\frac{\frac{28}{3} - x}{\frac{28}{3} + x} = \frac{1}{3}$$

$$\Rightarrow 28 - 3x = \frac{28}{3} + x$$

$$\Rightarrow 3(28 - 3x) = 28 + 3x$$

$$\Rightarrow 84 - 9x = 28 + 3x$$

$$\Rightarrow 56 = 12x$$

$$\therefore x = \frac{56}{12} = \frac{14}{3}$$





# TRAINS



meters

$$\checkmark \text{ Distance} = l \text{ of Train}$$

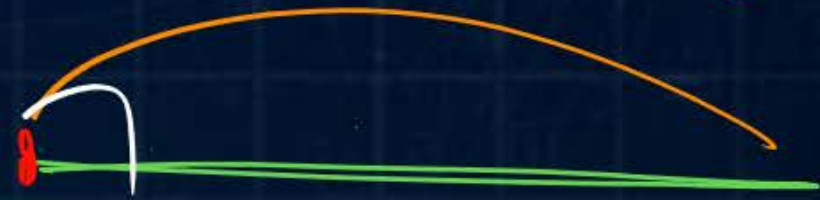
Speed km/hr



+  $l_{\text{Tunnel}}$   
+  $l_B$

$$\checkmark \text{ Distance} = l_{\text{Train}} + l \text{ of Platform}$$

R.S. = (+)

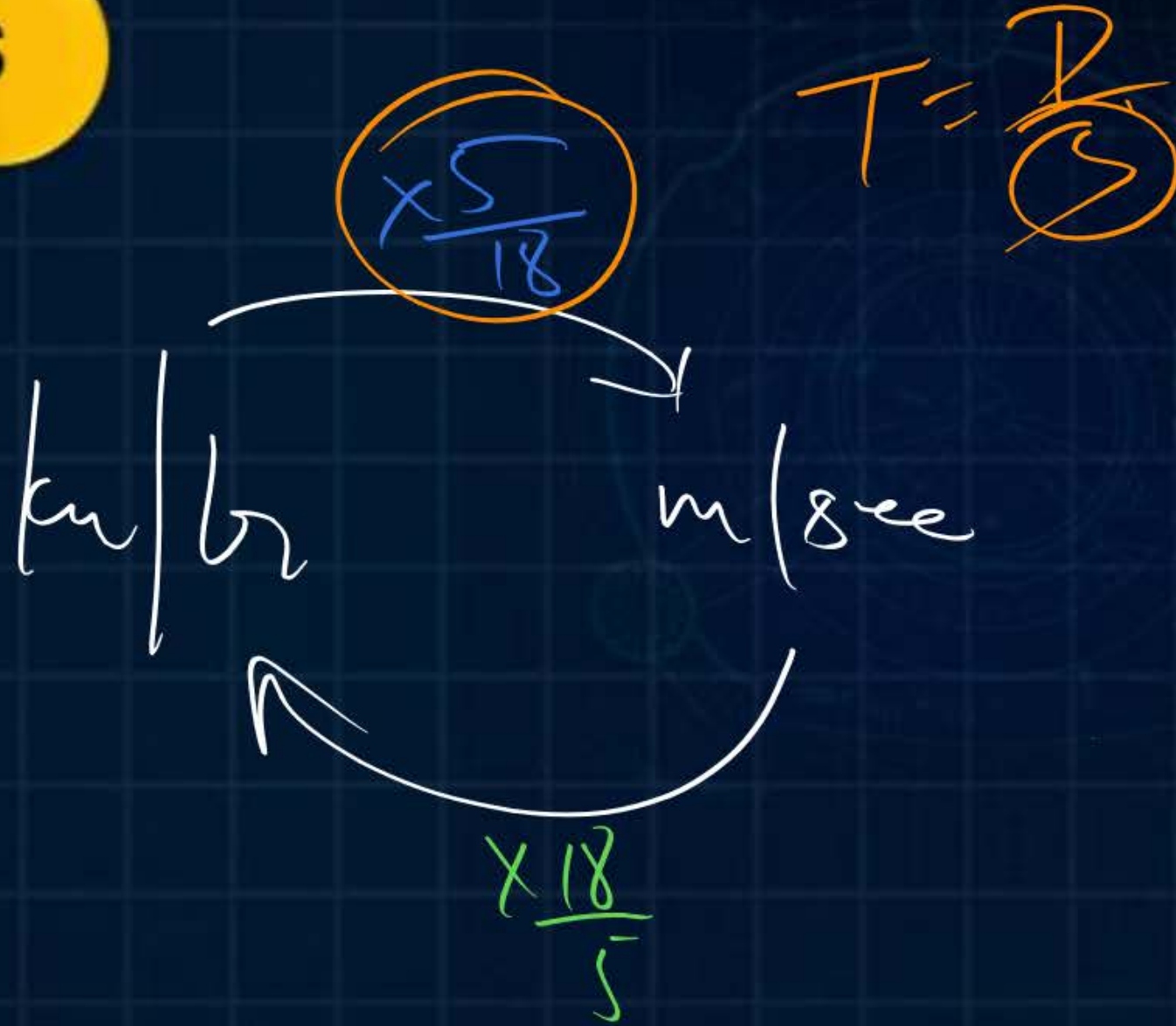


$$\checkmark \text{ Distance} = l_{T_1} + l_{T_2}$$

R.S. = (~)



## TRAINS



$$\frac{km}{hr} = \frac{\cancel{5} 1000m}{\cancel{3600} sec \times 18}$$



## Question



$$D = S \times T$$

A train running at 52 km/hr takes 36 seconds to pass a platform. Next it takes 24 seconds to cross a man walking at the platform with 10 km/hr in the same direction. Find the length of the platform. (meters)

Train Crossing Platform

$$D = 280 + l_P$$

$$\Rightarrow 280 + l_P = 52 \times \frac{5}{18} \times 36$$

$$l_P = 520 - 280 = \underline{\underline{240\text{m}}}$$

Train crossing Man

$$D = l \text{ of Train}$$

$$\Rightarrow l \text{ of Train} = \frac{42}{18} \times 5 \times 24$$

$$\therefore l \text{ of Train} = \underline{\underline{280\text{m}}}$$



## Question

A train passes a platform in 36 seconds and a man standing on the platform in 20 seconds. If the speed of the train is 54 km/hr, what is the length of the platform?

**A** 240 m

**B** 300 m

**C** 120 m

**D** 360 m

$$\begin{aligned} \text{Length of Train} &= \frac{54 \times 5}{18} \times 20 \\ &= 300 \text{ m} \end{aligned}$$

$$\begin{aligned} 300 + \text{Length of Platform} &= \frac{54 \times 5}{18} \times 36 \\ \text{Length of Platform} &= 540 - 300 \\ &= 240 \text{ m} \end{aligned}$$



## Question

$$D = S \times T$$



A train 110 meter long is running at a speed of 60 km/hr. In what time will it pass a man who is running at 6 km/hr in the direction opposite to that in which the train is going?

$$D = \text{L of Train} = 110$$

$$R.S. = 66 \times \frac{5}{18}$$

Time = ?

$$\Rightarrow 110 = 66 \times \frac{5}{18} \times T$$

**B** 10 seconds

**D** 6 seconds

$$T = 6 \text{ seconds}$$

**A** 5 seconds

**C** 7 seconds





## PIPES and CISTERN



(TIME & WORK)

$$\frac{1}{5} + \frac{1}{6} = \frac{11}{30}$$

$$\frac{30}{11} = 2\frac{8}{11} \text{ hrs}$$

A ✓  
5 hrs

B ✓  
6 hrs

Empty (-)  
filling (+)

C ✓  
4 hrs  $\frac{1}{4}$

$$\frac{1}{5} + \frac{1}{6} - \frac{1}{4} = \frac{12+10-15}{60} = \frac{7}{60} \Rightarrow \frac{60}{7} = 8\frac{4}{7}$$



## Question



$$P = \frac{1}{32} \quad Q = \frac{1}{48}$$

Two pipes P and Q can fill a tank in 32 minutes and 48 minutes respectively. Both pipes are opened and after some time pipe Q is turned off. The tank is filled in 24 minutes. When was the pipe Q closed?

**A** 15 minutes

**B** 12 minutes

**C** 10 minutes

**D** 16 minutes

'x' minutes

$$\frac{24}{32} + \frac{x}{48} = 1$$

$$36 + x = 48$$

$$\therefore x = 48 - 36$$

$$= 12$$



## Question



$$P = \frac{1}{60} \quad | \quad Q = \frac{1}{40}$$

Two pipes P and Q can individually fill a tank in 60 minutes and 40 minutes. If pipe Q alone is open for the first half an hour and then pipe P is also turned on, in how many minutes more will the tank get filled up?

**A** 8 minutes

**C** 4 minutes

**B** 10 minutes

**D** 6 minutes

$$x = \frac{30}{5} = 6 \text{ minutes}$$

$$1 = \frac{30}{40} + \frac{x}{40} + \frac{x}{60}$$

$$\Rightarrow 120 = 90 + 3x + 2x$$

$$\Rightarrow 30 = 5x$$



## Question



$$A = \frac{1}{5} \quad | \quad B = \frac{1}{6} \quad | \quad C = -\frac{1}{12}$$

Two pipes can fill a tank in 5 hours and 6 hours respectively. A third pipe will empty it in 12 hours. If all the pipes are opened, then find the time taken to either fill or empty the tank?

**A** Filled in  $60/17$  hours

**B** Filled in  $30/17$  hours

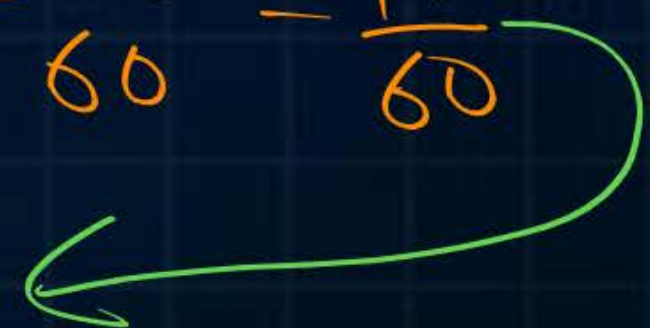
**C** Emptied in  $9/2$  hours

**D** Filled in  $30/11$  hours

$$\frac{1}{5} + \frac{1}{6} - \frac{1}{12} = \frac{12 + 10 - 5}{60}$$

$$= \frac{22 - 5}{60} = \frac{17}{60}$$

$$\frac{60}{17} \text{ hrs}$$





## Question

Pipe P is twice as fast as pipe Q, and pipe Q is twice as fast as pipe R. Find the ratio of the time taken by P, Q and R to fill a cistern.

$$P:Q:R = \underline{1:2:4}$$

Time

**A** 1:2:4

$$P:Q = 1:2$$

**B** 4:1:2

**C** 4:2:1

$$2 \times (Q:R = 1:2)$$

**D** 2:1:4

$$= 2:4$$



## Question



$$A = \frac{1}{20} \quad | \quad B = \frac{1}{24} \quad | \quad C = \frac{-1}{x}$$

40 min

Two pipes can fill a tank in 20 and 24 minutes respectively. There is an outlet in the tank that can empty it at 3 gallons per minute. If all the pipes are opened, the tank gets filled in 15 minutes. Find the capacity of the tank?

**A** 108 gallons

**B** 150 gallons

**C** 120 gallons

**D** 80 gallons

$$\frac{3}{\frac{120}{40}} = \frac{1}{x}$$

$$\therefore x = 40$$

$$\frac{1}{20} + \frac{1}{24} - \frac{1}{x} = \frac{1}{15}$$

$$\Rightarrow \frac{6+5}{120} - \frac{1}{15} = \frac{1}{x}$$

$$\Rightarrow \frac{11-8}{120} = \frac{1}{x}$$

Capacity  
 $40 \times 3$   
120 gallons



Question (PYQ GATE Exam 2019 CE)



$$X = \frac{1}{5} \quad | \quad Y = \frac{1}{4} \quad | \quad Z = -\frac{1}{20}$$

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 1.50

B 2.00

**C 2.50**

D 4.00

$$\frac{1}{5} + \frac{1}{4} - \frac{1}{20} = \frac{4+5-1}{20} = \frac{8}{20}$$

$$\frac{20}{8} = \underline{\underline{2.5 \text{ hrs}}}$$



Question (PYQ GATE Exam 2019 ME)



$$P = \frac{1}{6} \quad | \quad Q = \frac{1}{9} \quad | \quad R = -\frac{1}{12}$$

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

$$4 + 6 + 4.5 = 14.5 \text{ hr}$$

**A** 13.50

**C** 15.50

**B** 14.50

**D** 16.50

$$\frac{4}{6} - \frac{4}{12} + \frac{6}{9} - \frac{6}{12} + \frac{x}{9} = 1$$

$$24 - 12 + 24 - 18 + 4x = 36$$

$$= 48 - 30 + 4x = 36$$

$$4x = 36 - 18$$

$$x = \frac{18}{4} = \frac{9}{2}$$

$$= 4.5 \text{ hr}$$



Question (PYQ GATE Exam 2018 ME)



From the time the front of a train enters a platform, it takes 25 seconds for the back of the train to leave the platform, while travelling at constant speed of  $54 \text{ km/h}$ . At the same speed, it takes 14 seconds to pass a man running at  $9 \text{ km/h}$  in the same direction as the train. What is the length of the train and that of the platform in meters, respectively?

- A** 210 and 140
- B** 162.5 and 187.5
- C** 245 and 130
- D** 175 and 200

$$D = S \times T$$

$$\begin{aligned} \text{Length of Train} &= 45 \times \frac{5}{18} \times 14 \\ &= 175 \text{ m} \end{aligned}$$

$$\begin{aligned} 175 + \text{LP} &= 54 \times \frac{5}{18} \times 25 \\ \text{LP} &= 375 - 175 = 200 \end{aligned}$$



Question (PYQ GATE Exam 2017 EC)



$$\text{No. of Vehicles} = 720 \times 2 = 1440$$

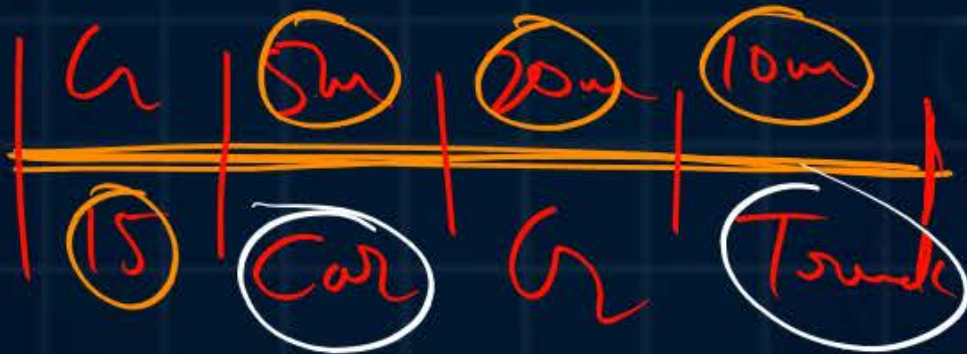
Trucks (10 m long) and cars (5 m long) go on a single lane bridge. There must be a gap of at least 20 m after each truck and a gap of at least 15 m after each car. Trucks and cars travel at a speed of 36 km/h. If cars and trucks go alternately, what is the maximum number of vehicles that can use the bridge in one hour?

**A** 1440

**C** 720

**B** 1200

**D** 600



50m

720

$$\checkmark 1 \text{ hr} \rightarrow 36 \text{ km}$$

$$\checkmark 1 \text{ hr} \rightarrow 36000 \text{ m}$$

$$\frac{36000}{50} = \text{No. of slots}$$



## Question (PYQ GATE Exam 2016 EC)

It takes 10 s and 15 s, respectively, for two trains traveling at different constant speeds to completely pass a telegraph post. The length of first train is 120 m and that of the second train is 150 m. The magnitude of the difference in speeds of the two trains (in m/s) is

**A** 2.0

**B** 10.0

**C** 12.0

**D** 22.0

$$S_{T_1} = \frac{120}{10} = 12 \text{ m/s}$$

$$S_{T_2} = \frac{150}{15} = 10 \text{ m/s}$$

$$\Rightarrow 2 \text{ m/s}$$



Question (PYQ GATE Exam 2014 EC)

(NAT)

$$T = \frac{D}{S}$$



A man can row at 8 km per hour in still water. If it takes him thrice as long to row upstream, as to row down stream, then find the stream velocity in km per hour.

$$3 \left( \frac{D}{8+x} \right) = \frac{D}{8-x}$$

$$\therefore x = \frac{16}{4}$$

$$24 - 3x = 8 + x$$

$$4x = 16$$

$$\underline{\underline{4 \text{ km/hr}}}$$



Question (PYQ GATE Exam 2014 EC)

(NAT)

$$S = \frac{D}{T}$$



✓  
A train that is 280 meters long, travelling at a uniform speed, crosses a platform in 60 seconds and passes a man standing on the platform in 20 seconds. What is the length of the platform in meters?

$$\text{Speed of Train} = \frac{280}{20} = 14 \text{ m/sec}$$

$$L_T + L_P$$

$$280 + L_P = 14 \times 60$$

$$L_P = 840 - 280 = \underline{\underline{560 \text{ m}}}$$





## Summary



Boats & Streams

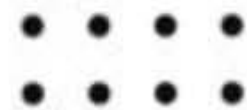
Trains

Pipes & Cistern



The word 'Thank' is written in a large, yellow, cursive script. A yellow arrow starts at the top of the 'T', extends horizontally to the right, and then curves downwards to point at the end of the word.

THANK



**Keep Hustling!**