Chapter - 11

Pipe and Cistern

Foundation

Solutions

1. (b); Time taken to fill the tank = 6 h.
Part of tank filled in 6 h = 1

Part of tank filled in 1 h = $\frac{1}{6}$

2. (d); Time taken to fill $\frac{1}{8}$ part of tank = 1 h

$\therefore$ Time taken to fill the empty tank = 8 h.

3. (b); Time taken to empty a cistern = 3h

Time taken to empty $\frac{2}{3}$ part of the cistern

$= 3\times\frac{2}{3} = 2$ h

4. (d); Given time taken by tap A to fill the tank = 60 min
Let Time taken by tap B to fill the tank = x min

There, $\frac{1}{60}+\frac{1}{x} = \frac{1}{40} \Rightarrow \frac{1}{x} = \frac{1}{40}-\frac{1}{60} = \frac{3-2}{120}$

$\frac{1}{x} = \frac{1}{120} \Rightarrow x = 120$ min

5. (b); Given pipe A can fill a tank = 10 h
Pipe B can empty it = 6 h

Time taken to empty the full tank = $\frac{1}{\frac{1}{6}-\frac{1}{10}}$

$= \frac{1}{\frac{5-3}{30}} = \frac{1}{\frac{5-3}{30}} = 15$ h

6. (b); Given,
Time taken by first tap to fill the tank (A) = 3 h
Time taken by second tap to fill the tank (B) = 4 h
And time taken to empty the full tank by third tap (C) = 5hr
$\therefore$ Part of the tank will be filled by all there taps in

1 hr $= \frac{1}{3}+\frac{1}{4}-\frac{1}{5} = \frac{20+15-12}{60} = \frac{23}{60}$h

Required time $= \frac{60}{23}$h $= 2\frac{14}{23}$h

7. (a); Given,
A = 30 min, B = 10 min, C = 40 min

Part of the tank filled in 1 h $= \frac{1}{30}+\frac{1}{10}-\frac{1}{40}$

$= \frac{4+12-3}{120} = \frac{13}{120}$

Required time $= \frac{120}{13} = 9\frac{3}{13}$h

8. (b); Given, $\frac{1}{a}+\frac{1}{b}+\frac{1}{c} = \frac{1}{10} \Rightarrow \frac{1}{a} = \frac{1}{30}, \frac{1}{b} = \frac{1}{40}$

$\frac{1}{c} = \frac{1}{10}-\frac{1}{30}-\frac{1}{40} \Rightarrow \frac{12-4-3}{120} = \frac{5}{120}$

c = 24 min

9. (a); Given, a = 60, b = 75

$\frac{1}{a}+\frac{1}{b}-\frac{1}{c} = \frac{1}{50} \Rightarrow \frac{1}{c} = \frac{1}{60}+\frac{1}{75}-\frac{1}{50}$

$= \frac{5+4-6}{300} \Rightarrow \frac{1}{c} = \frac{3}{300} \Rightarrow c = 100$

10. (d); Let a, b, c be the time taken to fill the tank by pipes A, B and C respectively

Given, $\frac{1}{a}+\frac{1}{b} = \frac{1}{6}, \frac{1}{b}+\frac{1}{c} = \frac{1}{10}, \frac{1}{a}+\frac{1}{c} = \frac{1}{12}$

Then, $2\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right) = \frac{1}{6}+\frac{1}{10}+\frac{1}{12} = \frac{10+6+5}{60}$

$\frac{1}{a}+\frac{1}{b}+\frac{1}{c} = \frac{21}{120}$

Required time $= \frac{120}{21} = \frac{40}{7} = 5\frac{5}{7}$h

11. (b); Let 4x is the time taken to fill the tank by inlet B
Then x will be the time taken to fill tank by inlet A
$\Rightarrow$ x = 15

Part of the tank will fill in 1 min $= \frac{4+1}{60} = \frac{1}{12}$ min

Required time = 12 min

12. (c); A = 16 h, B = 10 h

Part of the tank filled in (2h) $= \frac{1}{16}+\frac{1}{10}$

$= \frac{5+8}{80} = \frac{13}{80}$

Part of the tank filled in (12 h) $= \frac{78}{80}$

Remaining part $= 1-\frac{78}{80} = \frac{2}{80} = \frac{1}{40}$

$\frac{1}{40}$ part of the tank will be filled by inlet

$$A = \frac{\frac{1}{40}}{\frac{1}{16}} = \frac{16}{40} = \frac{8}{20} = \frac{4}{10} = \frac{2}{5} \text{ hr}$$

Required time $= 12 + \frac{2}{5} = 12\frac{2}{5}$ hr

13. (d); 1 part of cistern will be empty by pipe A = 27 h

$\frac{2}{3}$ part of cistern will be empty by pipe

$A = 27 \times \frac{2}{3} = 18$ hr.

14. (d); Given, A = 10 min, B = 6 min

Part of tank will be empty in 1 min $= \frac{1}{6} - \frac{1}{10}$

$= \frac{5-3}{30} = \frac{1}{15}$

$\therefore$ Full tank will be empty in 15 min.

$\therefore$ $\frac{2}{3}$rd part of the tank will be empty in

$= 15 \times \frac{2}{3} = 10$ minutes to empty the tank

15. (c); Part of the tank will be filled in 1 h $= \frac{1}{8} - \frac{1}{16} = \frac{1}{16}$

Required time = 16 h

16. (b); Part of the tank that will be empty in 1 h $= \frac{1}{15} + \frac{1}{10}$

$= \frac{2+3}{30} = \frac{5}{30} = \frac{1}{6} \Rightarrow$ Required time = 6 hrs

17. (c); Given, A = 20 min, B = 25 min

In 1 min, part of the tank will be filled

$= \frac{1}{20} + \frac{1}{25} = \frac{5+4}{100} = \frac{9}{100}$

In 5 min part of the tank will be filled $= \frac{45}{100}$

Remaining part $= 1 - \frac{45}{100} = \frac{55}{100} = \frac{11}{20}$

It will take pipe A to fill the $\frac{11}{20}$ part of the tank

$= \frac{\frac{11}{20}}{\frac{1}{20}} = 11$ min

18. (c); By the formula

$$\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$$

Here, $D_1 = 15$, $H_1 = 6$, $M_1 = 12$

$M_2 = ?$, $D_2 = 12$, $H_2 = 9$

$15 \times 6 \times 12 = x \times 12 \times 9$

$x = \frac{5 \times 6}{3} = 10$

19. (c); Time taken by second pipe to fill the tank

$= \frac{1}{\left(\frac{1}{8} - \frac{1}{12}\right)} = \frac{1}{\frac{3-2}{24}} = \frac{1}{\frac{1}{24}} = 24$ hrs

Capacity of tank = 24 × 60 × 6 = 8640 litres

20. (a); Given,

First tap to fill the tank (A) = 8 hr

Second tap can empty the tank (B) = 16 hr

Part of the tank wil be filled in 1 h $= \frac{1}{8} - \frac{1}{16}$

$= \frac{2-1}{16} = \frac{1}{16} \Rightarrow$ Required time = 16 hr

21. (c); Given,

First tap to fill the tank (A) = 5 hr

Second tap to empty the tank (B) = 4 hr

Part of the tank will be empty in 1 hr

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

Required time = 20 hr

22. (a); Part of the tank will be filled in 1 hr

$= \frac{1}{15} + \frac{1}{12} - \frac{1}{20} = \frac{4+5-3}{60} = \frac{6}{60} = \frac{1}{10}$

Required time = 10 hr

23. (b); Part of tank will be emptied in 1 hr by 3rd pipe

$= \frac{1}{60} + \frac{1}{70} - \frac{1}{60} = \frac{1}{70}$

Required time = 70 min

24. (d); Let after x min the pipe be closed so that the tank will be filled full in half hour

$\therefore \frac{30}{75} \times 2 + \frac{x}{45} = 1 \Rightarrow \frac{180+5x}{225} = 1$

$180 + 5x = 225 \Rightarrow 5x = 45 \Rightarrow x = 9$ min

25. (b); Let the required time = x

Part of the tank will be filled by tap (A and B)

$= \frac{1}{60} + \frac{1}{40} = \frac{5}{120} = \frac{1}{24}$

Then according to question

$$\frac{x}{2\times 40}+\frac{x}{2\times(24)}=1 \Rightarrow \frac{x}{80}+\frac{x}{48}=1 \Rightarrow x=30$$

Required time = 30 min

26. (a); Part of tank filled in 1 min $=\frac{1}{15}+\frac{1}{18}=\frac{6+5}{90}=\frac{11}{90}$

Part of the tank that will be filled in 6 min

$=\frac{66}{90}=\frac{11}{15}$

Let x be the time taken to empty the tank by third tap.

$$\frac{\frac{11}{15}}{\frac{1}{x}-\frac{11}{90}}=\frac{33}{2} \Rightarrow \frac{90-11x}{90x}=\frac{11}{15}\times\frac{2}{33}$$

$180x = 4050 - 495x \Rightarrow x = \frac{4050}{675} = 6$ min

27. (c); Part of the tank filled by all the three tap A, B, C in

1 hr $=\frac{1}{6}$

In 2 hr part of the tank will be fill $=\frac{1}{3}$

Remaining part $=1-\frac{1}{3}=\frac{2}{3}$

Let a and b be time to fill the tank tap A and B respectively.

$$7=\frac{\frac{2}{3}}{\frac{1}{a}+\frac{1}{b}} \Rightarrow \frac{1}{a}+\frac{1}{b}=\frac{2}{3}\times\frac{1}{7}=\frac{2}{21}$$

Part of the tank will be fill by the tap C 1 hr

$=\frac{1}{6}-\frac{2}{21}=\frac{7-4}{42}=\frac{3}{42}=\frac{1}{14}$

Required time = 14 hr.

28. (d); Part of the tank will be filled by all of the taps in 1 min $=\frac{3+2-4}{12}=\frac{1}{12}$

Required time = 12 hour

29. (b); Part of the tank will be empty in 1 hr $=\frac{1}{5}-\frac{1}{6}=\frac{1}{30}$

Required time = 30 hr

30. (c); By formula; $\frac{18\times 5}{1440}=\frac{x\times 8}{1920}$

$x=\frac{18\times 5\times 1920}{1440\times 8} \Rightarrow x = 15$ hour

Moderate

1. (d); Part of the cistern that can be filled in 1 hr

$=\frac{1}{14}+\frac{1}{16}=\frac{8+7}{112}=\frac{15}{112}$

Time taken to fill the cistern $=\frac{112}{15}$ hr

$=\frac{112}{15}\times 60$ min $= 448$ min

Due to leakage, time taken to fill the cistern
= 448 + 92 = 540 min = 9 hr
Time required to empty the tank

$$=\frac{1}{\frac{15}{112}-\frac{1}{9}}=\frac{112\times 9}{23}=43\frac{19}{23}\text{h}$$

2. (c); Part of the tank that will be filled when pipe P and R are opened for 1 min $=\frac{1}{12}+\frac{1}{15}=\frac{9}{60}$

$\therefore$ Part of the tank that will be filled after 5 min

$=\frac{45}{60}=\frac{3}{4}$

6 min is the time to empty the tank by tap M.

$\therefore$ Required time $=\frac{3}{4}\times\frac{1}{\left(\frac{1}{6}-\frac{9}{60}\right)}$

$=\frac{3}{4}\times\frac{60}{1}=45$ min

3. (c); Required time $=\frac{40}{4}$ min $= 10$ min

4. (a); Let first pipe fill the tank in (x) h then Second pipe will fill it in (x + 10)h

$$\frac{1}{x}+\frac{1}{x+10}=\frac{1}{12} \Rightarrow \frac{x+10+x}{x(x+10)}=\frac{1}{12}$$

$$\frac{2x+10}{x^2+10x} = \frac{1}{12} \Rightarrow 24x + 120 = x^2 + 10x$$

$x^2 - 14x - 120 = 0$

$x^2 - 20x + 6x - 120 = 0$

$x(x-20) + 6(x-20) = 0 \Rightarrow x = 20$

5. (b); Let total time = x

$$\therefore \frac{2}{15} + \frac{x}{20} = 1 \Rightarrow \frac{x}{20} = 1 - \frac{2}{15}$$

$$\frac{x}{20} = \frac{13}{15} \Rightarrow x = \frac{52}{3}\text{ min}$$

6. (d); Part of the tank that will be filled by both pipe A and B in 1 min $= \frac{1}{24} + \frac{1}{32} = \frac{4+3}{96} = \frac{7}{96}$

Let after x min, pipe B should be closed

$$\therefore x \times \frac{7}{96} + \frac{(9-x)}{24} = 1$$

$$\frac{7x + 36 - 4x}{96} = 1$$

$3x + 36 = 96 \Rightarrow 3x = 60 \Rightarrow x = 20$ min

7. (c); Part of the tank will be filled when all of the pipes A, B and C are opened alternatively, each of 1 min (3 min)

$$= \frac{1}{20} + \frac{1}{30} - \frac{1}{15} = \frac{3+2-4}{60} = \frac{1}{60}$$

$$\therefore \text{Time taken to fill } \left[1 - \left(\frac{1}{20} + \frac{1}{30}\right)\right] \text{ Or}$$

$\frac{55}{60}$ th part of the tank filled in $= 3 \times 55 = 165$ min

$$\therefore \text{Remaining part} = 1 - \frac{55}{60} = \frac{1}{12}$$

Tank A fills $\frac{1}{20}$ part in 1 min

$$\therefore \text{Remaining part} = \frac{1}{12} - \frac{1}{20} = \frac{1}{30}$$

i.e., $\frac{1}{30}$ th part is filled by B in 1 min

$\therefore$ Total time = (165 + 1 + 1) = 167 min

8. (d); When taps are not opened properly

$$\text{Tap A will fill the tank} = 25 \times \frac{6}{5} = 30 \text{ min}$$

$$\text{Tap B will fill the tank} = 20 \times \frac{3}{2} = 30 \text{ min}$$

$$\therefore \text{Part of the tank will be filled in 1 min} = \frac{1}{30} + \frac{1}{30}$$

$$= \frac{1}{15}$$

$\therefore$ Required time = 15 min

9. (b); Part of the tank will be filled in 1 min

$$= \frac{1}{20} + \frac{1}{15} + \frac{1}{12} = \frac{3+4+5}{60} = \frac{12}{60} = \frac{1}{5}$$

$$\therefore \text{Required time} = 5 \times \frac{40}{100} = 2 \text{ min}$$

10. (d); Part of the tank will be filled in 1 min by tap A and B $= \frac{1}{4} + \frac{1}{5} = \frac{5+4}{20} = \frac{9}{20}$

In 2 min. part of the tank will be filled

$$= 2 \times \frac{9}{20} = \frac{9}{10}$$

Time Required by third pipe to empty the tank

$$= \frac{9}{10} \times \frac{1}{\left(\frac{1}{2} - \frac{1}{4} - \frac{1}{5}\right)} = \frac{9}{10} \times 20 = 18 \text{ min}$$

11. (c); In 1 hr the amount of water that will be filled in the tank = 42 + 56 – 48 = 50 L

$\therefore$ Capacity of the tank = 50 × 16 = 800 L

12. (c); In 1 min the boy will pour water in tank $= \frac{4}{3}$ L

In 1 min the girl will pour water in tank $= \frac{3}{4}$ L

$$\therefore \text{Both will pour water in 1 min} = \frac{1}{\frac{4}{3} + \frac{3}{4}} = \frac{12}{25}$$

$$\therefore \text{Required time} = \frac{12}{25} \times 100 = 48 \text{ min}$$

13. (a); Let inlet pipe fill the tank in x hr

$\therefore$ Outlet pipe will empty the tank in 2x hr

$$\therefore \frac{1}{x} - \frac{1}{2x} = \frac{1}{x+36} \Rightarrow \frac{1}{2x} = \frac{1}{x+36} \Rightarrow x = 36 \text{ hr}$$

14. (a); Diameter $\Rightarrow$ 1 : 3 : 4

Efficiency $\Rightarrow$ 1 : 9 : 16 $\rightarrow 26 \rightarrow$ 16 min

$\downarrow$

$\frac{16 \times 26}{16}$

Thus, third pipe alone will fill the tank in 26 min.

15. (c); Part of the tank will be filled in 1 hr

$$=\frac{1}{36}+\frac{1}{45}=\frac{9}{180}=\frac{1}{20}$$

$\therefore$ Required time = 20 hr

16. (c); In 1 minute the pipe of 2 cm fills

$\frac{1}{61}\times\frac{1}{4}$ of the cistern

In 1 min the pipe of $1\frac{1}{3}$ cm diameter fill $\frac{1}{61}\times\frac{4}{9}$ of the cistern

In 1 min the pipe of 1 cm diameter fill $\frac{1}{61}$ of the cistern.

$$\therefore \quad \frac{1}{61\times 4}+\frac{1}{61}\times\frac{4}{9}+\frac{1}{61}=\frac{9+16+36}{9\times 4\times 61}$$

$$=\frac{61}{36\times 61}=\frac{1}{36}$$

$\therefore$ The whole is filled with 36 minutes.

17. (c); Part of the tank will be filled, by both pipe in 1 hr

$$=\frac{1}{20}+\frac{1}{30}=\frac{5}{60}=\frac{1}{12}$$

$\therefore$ In 1 hr the leak will empty the part of tank

$$=\frac{1}{12}\times\frac{1}{3}=\frac{1}{36}$$

And to fill $\frac{1}{3}$ of the tank, both pipe will take

$$=\frac{12}{3}=4 \text{ hr.}$$

to fill other $\frac{2}{3}$ part of the tank, it will take

$$=\frac{2}{3}\times\frac{1}{\frac{1}{20}+\frac{1}{30}-\frac{1}{36}}=\frac{2}{3}\times\frac{1}{\frac{9+6-5}{180}}$$

$$=\frac{2}{3}\times\frac{180}{10}=12 \text{ hr}$$

$\therefore$ Total time = (12 + 4) hr = 16 hr

18. (b); Part of tank will be full in 1 hr

$$=\frac{1}{4}+\frac{1}{6}-\frac{1}{8}=\frac{6+4-3}{24}=\frac{7}{24}$$

$\therefore$ Required time $=\frac{24}{7}=3\frac{3}{7}$ hrs.

19. (b); Let first pipe can fill the reservoir in x hr

$\therefore$ Second pipe will fill it in (x + 5) hr

$$\therefore \quad \frac{1}{x}+\frac{1}{x+5}=\frac{1}{6} \Rightarrow \frac{x+5+x}{x(x+5)}=\frac{1}{6}$$

$6(2x + 5) = x^2 + 5x \Rightarrow 12x + 30 = x^2 + 5x$

$x^2 - 7x - 30 = 0 \Rightarrow x^2 - 10x + 3x - 30 = 0$

$(x + 3)(x - 10) = 0 \Rightarrow x = 10$ hrs

20. (b); Let x, y and z be time to fill the cistern by pipes, A, B and C respectively. The part of the tank will be filled in 2 hr by all the pipe

$$=2\times\left(\frac{1}{6}\right)=\frac{1}{3}$$

Remaining part $=1-\frac{1}{3}=\frac{2}{3}$

$\therefore$ Time taken by pipe A and B together to fill the tank $=8\times\frac{3}{2}=12$ h

$\therefore$ by pipe C alone to fill the tank $=\frac{1}{6}-\frac{1}{12}=\frac{1}{12}$

$\therefore$ Required time = 12 hr

Ace SSC

$\therefore$ Mathematical Abilities

1. When beginning with the preparation for Quantitative Aptitude, you must focus on scoring topics like Data Interpretation, Simplification, Arithmetic, and Algebra.

2. Practising regularly using standard books and online mock tests enhances the speed of solving the questions from the mathematics part.

3. For this section, time management is important; therefore you must practice solving questions by setting a time.