

CH 2 PIPES AND CISTERNS

ANSWERS AND EXPLANATIONS

EXERCISE 1

1. (c) Part of the tank filled in one hour

$$= \frac{1}{8} - \frac{1}{16} = \frac{1}{16}$$

Hence, the tank will be filled in 16 hours.

2. (d) Let the exhaust tap empties the tank in x minutes.

$$\text{Then, } \frac{1}{12} + \frac{1}{15} - \frac{1}{x} = \frac{1}{20}$$

$$\text{or } \frac{1}{x} = \frac{1}{12} + \frac{1}{15} - \frac{1}{20}$$

$$\text{or } \frac{1}{x} = \frac{5+4-3}{60} = \frac{6}{60} = \frac{1}{10} \quad \text{or } x = 10 \text{ min}$$

3. (c) Let the leak empties the tank in x hours.

$$\text{Now, } \frac{1}{5} - \frac{1}{x} = \frac{1}{6}$$

$$\text{or } \frac{1}{x} = \frac{1}{5} - \frac{1}{6} = \frac{1}{30}$$

$$\text{or } x = 30 \text{ hrs.}$$

4. (c) Let pipe A fills the cistern in x minutes.

Therefore, pipe B will fill the cistern in $(x + 5)$ minutes.

$$\text{Now, } \frac{1}{x} + \frac{1}{x+5} = \frac{1}{6}$$

$$\Rightarrow x = 10$$

Thus, the pipes A and B can fill the cistern respectively in 10 minutes and 15 minutes,

5. (a) Portion of the tank filled by all the pipes together

$$\text{in 1 hour} = \frac{1}{10} + \frac{1}{12} - \frac{1}{20}$$

$$= \frac{6+5-3}{60} = \frac{8}{60} = \frac{2}{15}$$

Hence, the tank will be filled in $\frac{15}{2}$ hours

or $7\frac{1}{2}$ hours.

6. (a) Part of the capacity of the cistern emptied by the leak in one hour

$$= \left(\frac{1}{6} - \frac{1}{7} \right) = \frac{1}{42} \text{ of the cistern.}$$

The whole cistern will be emptied in 42 hours.

7. (b) Work of both tap for 1 hour

$$= \frac{1}{2} - \frac{1}{3} = \frac{1}{6}$$

Hence, both tap will fill the cistern in 6 hours.

8. (c) Part filled by $(A + B + C)$ in 1 hour

$$= \left(\frac{1}{5} + \frac{1}{10} + \frac{1}{30} \right) = \frac{1}{3}$$

\therefore All the three pipes together will fill the tank in 3 hours.

9. (c) 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 = (3×40) gallons = 120 gallons.

10. (d) Capacity of the tank = (12×13.5) litres = 162 litres.

Capacity of each bucket = 9 litres.

Number of buckets needed



$$= \left(\frac{162}{9}\right) = 18.$$

11. (d) Tank filled in 1 minute

$$= \frac{1}{25} + \frac{1}{40} - \frac{1}{30} \text{ part}$$

$$= \frac{24+15-20}{600} = \frac{19}{600} \text{ part}$$

\therefore tank will be filled complete in minutes

$$= \frac{600}{19} = 31\frac{11}{19}$$

12. (a) Here ratio of efficiencies of pipes A, B and C are as follows:

C	B	A
2	1	
<hr style="width: 100%; border: 0.5px solid black;"/>		
4	2	1

Suppose the efficiencies of pipes C, B and A are $4K$, $2K$ and K .

Since, the tank is filled in 5 hours by the three pipes having combined efficiency equal to $7K$, the time required to fill the tank by A alone

$$= \frac{7K \times 5}{K} = 35 \text{ hours}$$

13. (a)

\therefore Pipe A in 1 minute fills $1/10$ part and Pipe B in

1 min. empties $\frac{1}{6}$ part

$$\therefore \text{ Pipe A + B in 1 min} = \frac{1}{10} - \frac{1}{6} = \frac{-1}{15}$$

$\therefore \frac{1}{15}$ part gets emptied in 1 min

$$\therefore \frac{2}{5} \text{ part is emptied in } 15 \times \frac{2}{5} \text{ min} = 6 \text{ min}$$

EXERCISE 2

1. (d) Capacity of water throwing pump

$$= \frac{12}{60} \times 5.5 = 1.1 \text{ tonnes per 5.5 minutes}$$

Capacity of the leak to admit water

$$= 2.25 \text{ tonnes per 5.5 minutes}$$

In 5.5 minutes, net water accumulated by the leak

$$= (2.25 - 1.1) = 1.15 \text{ tonnes}$$

Thus, to admit 92 tonnes of water, it will take

$$\frac{5.5}{1.15} \times 92$$

$$= 440 \text{ min} = \frac{440}{60} \text{ hrs}$$

Speed required for the ship to sail through safely

$$= \frac{77 \times 60}{440} = 10.5 \text{ km/h}$$

2. (c) If both the pumps are opened together, then the tank will be emptied because the working efficiency of pump emptying is more than that of the pump filling it. Thus in 1 min net work done

$$= \left(\frac{1}{8} - \frac{1}{16}\right) = \frac{1}{16} \text{ parts}$$

or the tank will be emptied in 16 min

$$\Rightarrow \frac{1}{2} \text{ tank will be emptied in 8 min.}$$

3. (c) Proportion of the volume of the tank filled by both the pipes in 4 min

$$= 4 \left(\frac{1}{15} + \frac{1}{10}\right) = \frac{2}{3} \text{ rd of the tank.}$$

Volume of the tank filled by all the pipes working together

$$= \frac{1}{15} + \frac{1}{10} - \frac{1}{5} = \frac{-1}{30}$$

i.e. $\frac{1}{30}$ tank is emptied in 1 min.



4. (d) A + B fill in 6 hrs.

B + C fill in 10 hrs.

A + C fill in $7\frac{1}{2} = \frac{15}{2}$ hrs

∴ 2(A + B + C) fill in

$$\frac{6 \times 10 \times \frac{15}{2}}{6 \times 10 + 6 \times \frac{15}{2} + 10 \times \frac{15}{2}}$$

$$= \frac{6 \times 5 \times 15}{180} = \frac{5}{2}$$

∴ A + B + C filled the tank in 5 hrs.

Now, A [= (A + B + C) - (B + C)] fill in

$$\frac{10 \times 5}{10 - 5} = 10 \text{ hrs.}$$

Similarly, B fill in

$$\frac{\frac{15}{2} \times 5}{\frac{15}{2} - 5} = 15 \text{ hrs and}$$

C fill in $\frac{5 \times 6}{6 - 5} = 30$ hrs.

5. (c) Net part filled in 1 hour

$$= \left(\frac{1}{5} + \frac{1}{6} - \frac{1}{12} \right) = \frac{17}{60}$$

∴ The tank will be full in

$$\frac{60}{17} \text{ hrs i.e., } 3\frac{9}{17} \text{ hrs.}$$

6. (d) Part filled by first tap in one min = $\frac{1}{12}$ th

Part filled by second tap in one min = $\frac{1}{18}$ th

$$\text{Now, } 2 \left[\frac{1}{12} + \frac{1}{18} \right] + \text{unfilled part} = 1$$

$$\Rightarrow \text{unfilled part} = \frac{13}{18} \text{th}$$

∴ $\frac{1}{18}$ th part of tank is filled by second tap in

1 min.

∴ $\frac{13}{18}$ th part of tank is filled by second tap in 1

min.

$$= 18 \times \frac{13}{18} \text{ min} = 13 \text{ min.}$$

7. (b) In one min, (A + B) fill the cistern

$$= \frac{1}{10} + \frac{1}{15} = \frac{1}{6} \text{th}$$

In 3 min, (A + B) fill the cistern = $\frac{3}{6} = \frac{1}{2}$ th

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

∴ $\frac{1}{10}$ th part filled by A in one min.

∴ $\frac{1}{2}$ nd part filled by A in $10 \times \frac{1}{2} = 5$ min.

∴ Total time = 3 + 5 = 8 min.

8. (c) 1 minute's work of each of the three pipes

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

i.e., work of 3 pipes for 3 minutes = $\frac{1}{60}$

∴ Work of 3 pipes for 55 minutes each

$$= \frac{1}{60} \times 55 = \frac{11}{12}$$

∴ Remaining part to be filled

$$= 1 - \frac{11}{12} = \frac{1}{12}$$

Now, pipe A will fill $\frac{1}{20}$ of the cistern in next 1 minute.



