

LESSON 10 Rate (II)

GUIDED EXAMPLE 1

* Vertically align

When Tap A, Tap B, Tap C and Tap D are turned on at the same time, they can fill up a tank in 4 minutes.

Tap A and Tap B can fill up the tank in 14 minutes.

Tap C alone can fill up the tank in 28 minutes.

How long will Tap D to fill up the same tank alone?

4 ... 28
14 28
28

	Time (min)	Tank
A+B + C + D	4 x 7 28 ↓	1 x 7 7 ↓
A+B	14 x 2 28 ↓	1 x 2 2 ↓
C	28	1
D	28 ÷ 4 7 =	7 - 2 - 1 = 4 1 ↓ ÷ 4

Ans : 7 min

GUIDED EXAMPLE 2

A swimming pool can be filled with an inlet pipe in 5 hours.

An outlet pipe can drain it in 7 hours.

Given that the pool is empty and both pipes are fully opened at the same time, how long will it take to fill up the pool completely?

	Time (hours)	Pool
Inlet (+)	5×7 35 ↘	1×7 7 ↘
Outlet (-)	7×5 35 ↘	1×5 5 ↘
Inlet - Outlet	$35 \div 2$ $17\frac{1}{2}$ //	$7 - 5 = 2$ 1 ↘

Ans: $17\frac{1}{2}$ h

GUIDED EXAMPLE 3

There was 3.78 litres of water in the tank.

Water is leaking at the rate of 0.6 litres per minute from the tank.

At the same time, water is being added to the tank at the rate of 0.2 litres per minute.

How long would it take to empty the tank?

(Raffles Girls' Pri/P5 SA2/Q9)

	Time (min)	Vol water (l)
Leak (-)	1	0.6
Add (+)	1	0.2
Leak - Add (-)	1×9.45 \downarrow <u>9.45</u>	$0.6 - 0.2 = 0.4$ $\times 9.45$ 3.78

Ans: 9.45 min

GUIDED EXAMPLE 4

A water tank of capacity 93.6 ℓ is being filled by 2 taps.
 Water flows from Tap A at the rate of 540 m ℓ per minute.
 Water flows from Tap B at the rate of 500 m ℓ per minute.
 If both taps are turned on at the same time,
 how long does it take to fill the water tank completely?
Give your answer in hours and minutes.

(Methodist Girls' School /P5 SA2 /Q45)

$$93.6 \text{ l} = 93.6 \times 1000 \text{ ml}$$

$$= 93\,600 \text{ ml}$$

	Time (min)	Vol water (ml)
A	1	540
B	1	500
A+B	1×90 90	$540 + 500 = 1040$ $93\,600$

$$90 \text{ min} = 1 \text{ h } 30 \text{ min}$$

$$\text{Ans} = \underline{1 \text{ h } 30 \text{ min}}$$

$$3.45 \text{ h} = \underline{3} \text{ h } \underline{27} \text{ min}$$

$$0.45 \text{ h} = 0.45 \times 60 \text{ min}$$

$$= 27 \text{ min}$$

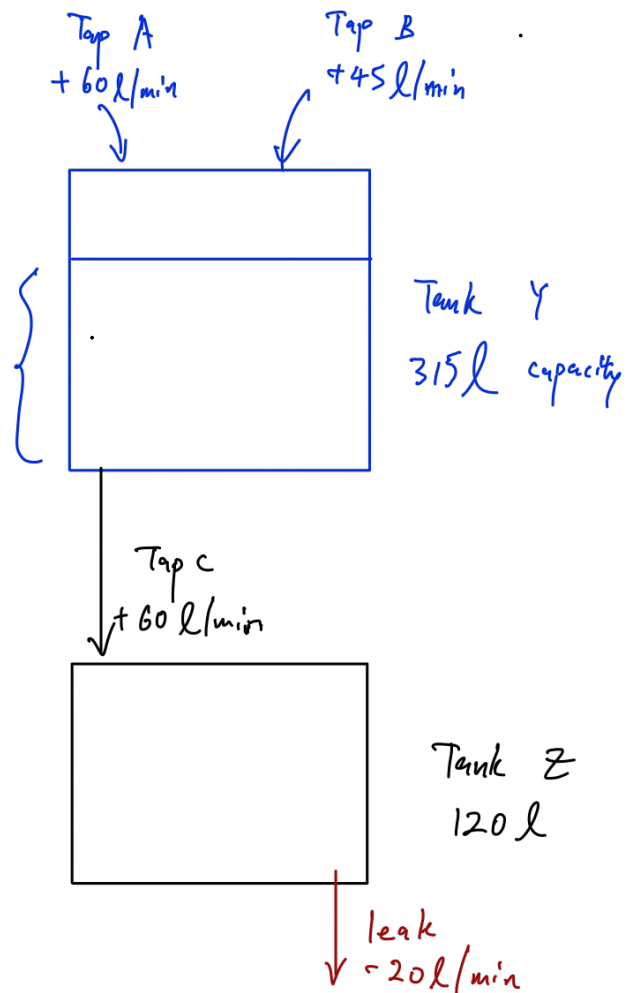
GUIDED EXAMPLE 5

Tank Y ~~have~~^{has} a capacity of 315 litres.
 Water from Tap A and Tap B is being poured into the Tank
~~is being poured into the tank~~ at a rate of 60 litres/min and 45 litres/min respectively.
 When Tank Y is $\frac{2}{3}$ full, Tap C is opened,
 draining water from Tank Y into the empty Tank Z at the rate of 60 litres/min.
 Tank Z has a capacity of 120 litres, and it leaks at 20 litres/min.
 How long does it take to fill Tank Z,
 from the time Tap A and Tap B started?

$$\frac{2}{3} \times 315 \text{ l} = 210 \text{ l}$$

	Time (min)	Vol water (l)
A	1	60
B	1	45
A+B	1 $\times 2$ 2	60 + 45 = 105 $\times 2$ 210
C	1	60
Leak	1	20
C - leak	1 $\times 3$ 3	60 - 20 = 40 $\times 3$ 120

$$2 + 3 = 5$$



Ans : 5 min

BUILD YOUR UNDERSTANDING

- Tap A and B and D can fill a tank in 9 minutes.
 Tap A and C can fill a tank in 12 minutes.
 Tap B and C and D can fill a tank in 18 minutes.
 How long will it take to fill the tank if all the ~~three~~ ^{four} taps are turned on?

9, 18, 27, 36
 12, 24, 36
 18, 36

	Time (min)	Tank
A + B + D	9 x 4 36	1 x 4 4
A + C	12 x 3 36	1 x 3 3
B + C + D	18 x 2 36	1 x 2 2
2A + 2B + 2C + 2D (2 groups of 4 taps)	36 ÷ 9 4	4 + 3 + 2 = 9 1
A + B + C + D	x 2 8	1

Ans: 8 min

P5 Heuristics Approach to Problem Solving

Rate (II)

2. Hose A can fill up a small pond in 12 minutes while Hose B can fill up the same pond in 8 minutes.
- a) What fraction of the pond can Hose A fill in 1 minute?
- b) If both hoses are turned on at the same time, how long will it take to fill up half the pond?

$$12 \quad \textcircled{24}$$

$$8 \quad 16 \quad \textcircled{24}$$

	Time (min)	Pond
A	$\begin{array}{c} 12 \\ \times 2 \downarrow \\ 1 \\ 24 \end{array}$	$\begin{array}{c} 1 \\ \times 2 \downarrow \\ \frac{1}{12} \text{ (a)} \\ 2 \end{array}$
B	$\begin{array}{c} 8 \\ \times 3 \downarrow \\ 24 \end{array}$	$\begin{array}{c} 1 \\ \times 3 \downarrow \\ 3 \end{array}$
A+B	$\begin{array}{c} 24 \div 5 \\ 4.8 \div 2 \\ 2.4 \text{ (b)} \\ \underline{\underline{=}} \end{array}$	$\begin{array}{c} 2+3 = 5 \\ 1 \div 5 \\ \frac{1}{5} \div 2 \\ \frac{1}{10} \end{array}$

Ans: a) $\frac{1}{12}$

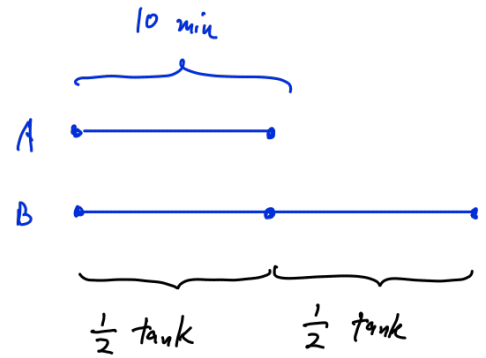
b) $\underline{\underline{2.4 \text{ min}}}$

P5 Heuristics Approach to Problem Solving

Rate (II)

3. Tap A and Tap B together can fill up a tank in 20 minutes.
 Tap A alone can fill up the same tank in 40 minutes.
 Tap A and Tap B are turned on at the same time.
 After 10 minutes, Tap A is turned off.
 How long did it take for Tap B to fill up the ^{remainder} ~~tank~~?

	Time (min)	Tank
A + B	20×2 \downarrow $\div 2$ $\left(\begin{array}{l} 40 \\ 10 \end{array} \right)$	1×2 \downarrow $\div 2$ $\left(\begin{array}{l} 2 \\ \frac{1}{2} \end{array} \right)$
A	40	1
B	$40 \div 2$ \downarrow $\underline{\underline{20}}$	$2 - 1 = 1$ \downarrow $\div 2$ $\frac{1}{2}$



Ans : 20 min

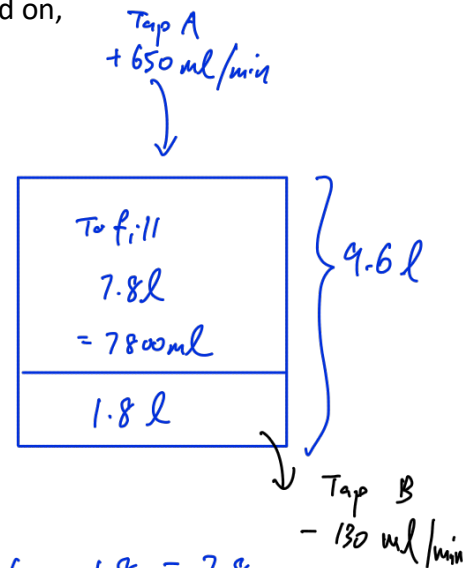
P5 Heuristics Approach to Problem Solving

Rate (II)

4. A water tank of capacity 9.6 l is filled by Tap A at the rate of 650 ml/min and out of the tank by Tap B at the rate of 130 ml/min. If there is 1.8 l of water in the tank and both taps are then turned on, how long will it take to fill the tank completely?

(Anglo Chinese School (Junior)/P5 SA2/Q44)

	Time (min)	Vol (ml)
A (+)	1	650
B (-)	1	130
A - B	1 $\times 15$ <u>15</u>	650 - 130 = 520 $\times 15$ 7800



$$9.6 - 1.8 = 7.8$$

$$7.8 \text{ l} = 7.8 \times 1000 \text{ ml} \\ = 7800 \text{ ml}$$

Ans: 15 min

P5 Heuristics Approach to Problem Solving

Rate (II)

5. Tap A takes 1 minute to fill a container.
 Tap B takes 40 seconds to fill the same container.
 When the two taps are turned on and off at the same time,
 how long do they take to fill the container?

(Fairfield Methodist Pri/P5 SA2/Q48)

when it is empty

	Time (seconds)	Container
A	60 $\times 2$ ↓ 120	1 $\times 2$ ↓ 2
B	40 $\times 3$ ↓ 120	1 $\times 3$ ↓ 3
A+B	120 $\div 5$ ↓ <u>24</u>	2 + 3 = 5 ↓ 1 $\div 5$

Ans : 24s

P5 Heuristics Approach to Problem Solving

Rate (II)

6. A tank has a capacity of 100 litres.
 Tap A can fill up the tank completely in 8 minutes while
 Tap B can fill up the same tank in 6 minutes.
 Tap C can drain the tank completely in 4 minutes.

a) If all the taps are turned on at the same time,
 how long does it take to fill $\frac{3}{5}$ of the tank?

b) How much water would have flowed out through Tap C
 when before the tank is 60% filled with water?

8
6
4

	Time (min)	Fraction of Tank
A (+)	8×3 24	1×3 3
B (+)	6×4 24	1×4 4
C (-)	4×6 24	1×6 6
A+B - C	$24 \times \frac{3}{5}$ (a) 14.4	$3 + 4 - 6 = 1$ $\frac{3}{5}$

b) For Tap C,

$$4 \text{ min} \rightarrow 100 \text{ l}$$

$$1 \text{ min} \rightarrow 100 \text{ l} \div 4$$

$$= 25 \text{ l}$$

$$14.4 \text{ min} \rightarrow 14.4 \times 25 \text{ l}$$

$$= 360 \text{ l}$$

Ans : a) 14.4 min
 b) 360 l