

Higher Order Thinking Skills

Primary 5

Lesson 7:
Volume (II)

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LESSON 7 Volume of Liquids**Formula:**

Volume of cuboid = $\ell \times b \times h$

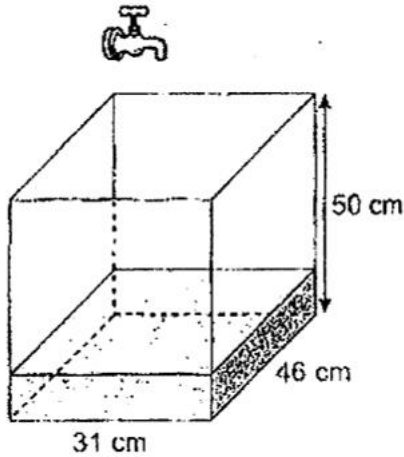
Base area = $\ell \times b$

Height = $V \div (\ell \times b)$
or
 $V \div (\text{Base area})$



GUIDED EXAMPLE 1

A rectangular tank 31 cm long, 46 cm wide and 50 cm high contained 6.8 ℓ of water at first.



a) What is the capacity of the rectangular tank?

$$31 \times 46 \times 50 = 71300$$

Ans : 71 300 cm³

b) The tap is turned on.
 Water flowed from the tap into the tank at a rate of 3 ℓ per minute.
 At this rate, how long did it take to fill the tank?

$$71\,300 \text{ cm}^3 = 71.3 \text{ ℓ}$$

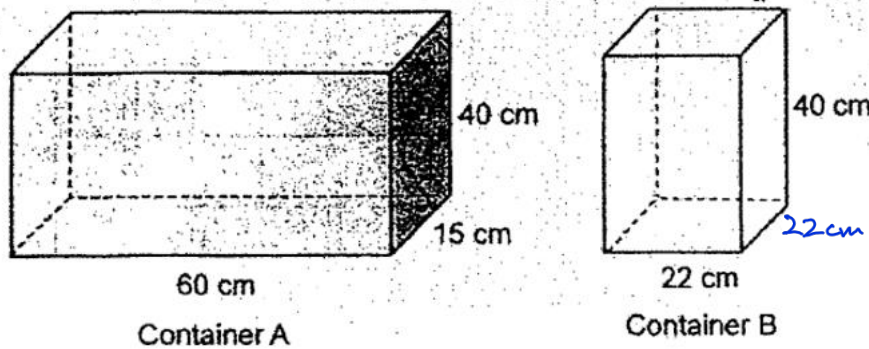
$$71.3 - 6.8 = 64.5$$

$$64.5 \div 3 = 21.5$$

Ans : 21.5 min

GUIDED EXAMPLE 2

Container A measures 60 cm by 15 cm by 40 cm.
 It is filled with water to the brim as shown below.
 The base of the container B is a square of side 22 cm. Its height is 40 cm.
 Container B is empty at first.
 Water in container A is then poured into container B, without spilling.
 After container B is filled to the brim,
 there is still some water left in container A.



- a) What is the capacity of container B?
 Leave your answer in cm^3 .

$$22 \times 22 \times 40 = 19\,360$$

Ans : 19 360 cm^3

- b) How much water is left in container A after container B is filled to the brim?
 Leave your answer in litres.

$$60 \times 15 \times 40 = 36\,000$$

$$36\,000 - 19\,360 = 16\,640$$

$$16\,640 \text{ cm}^3 = 16.64 \text{ l}$$

Ans : 16.64 l

GUIDED EXAMPLE 3

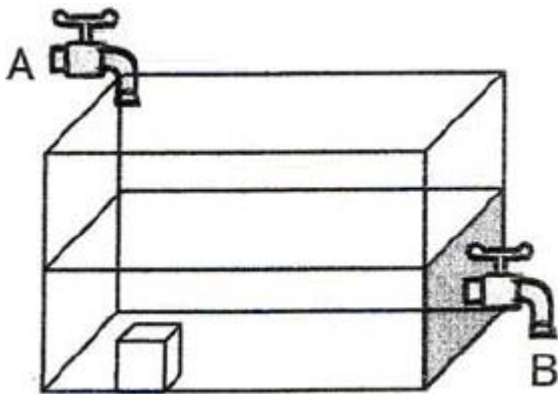
Tap A can fill an empty tank completely in 6 hours while Tap B can empty the same tank completely in 4 hours. Bobby placed a cube of side 20cm into the empty tank before filling $\frac{1}{2}$ of the tank with water.

The volume of the cube is $\frac{1}{12}$ of the capacity of the tank.

Bobby then turned on both taps at the same time.

How long will it take to empty the tank?

(Fengshan Pri / Prelim/Q43)



* make time the same

$$\frac{1}{2} - \frac{1}{12} = \frac{6}{12} - \frac{1}{12} = \frac{5}{12}$$

Need to drain $\frac{5}{12}$ of tank.

	Time (h)	Tank
A (Fill)	6 1	1 $\frac{1}{6}$
B (Drain)	4 1	1 $\frac{1}{4}$
B - A	1 $\times 5$ 5	$\frac{1}{4} - \frac{1}{6} = \frac{1}{12}$ $\frac{5}{12}$

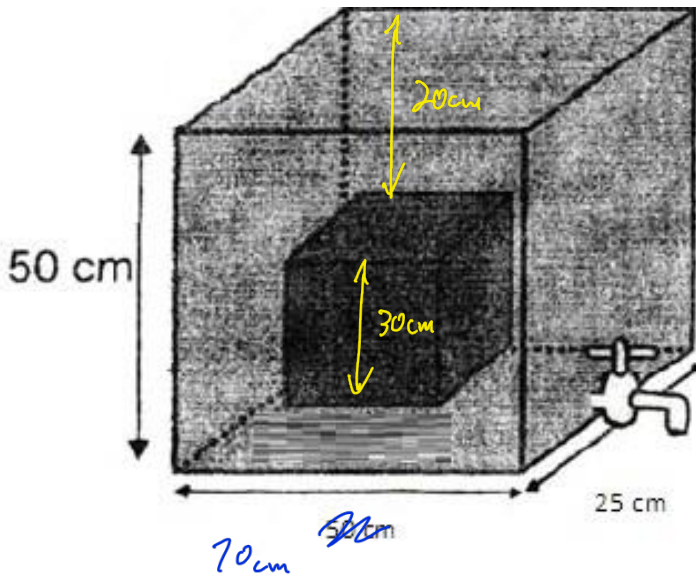
Ans: 5h

GUIDED EXAMPLE 4

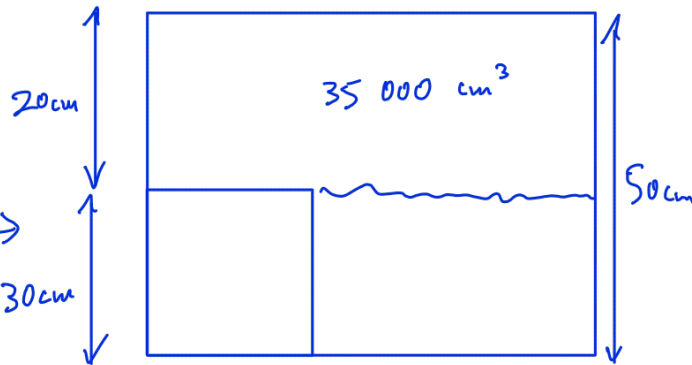
filled to the brim and

A tank measuring 70 cm by 25 cm by 50 cm contains some water [^] a cube.
 Water is allowed to escape from a tap at the side of the tank at a rate of 500 cm³ per minute.

[It took 70 min for the height of water level to drop to the top of the cube.]
 Find the volume of the cube.



consider front view



$$\begin{aligned}
 &1) \text{ Vol of water drained} \\
 &= 70 \times 500 \\
 &= 35\,000
 \end{aligned}$$

$$\begin{aligned}
 &2) \text{ Height of water drained} \\
 &= \frac{35\,000}{70 \times 25} \\
 &= 20
 \end{aligned}$$

$$\begin{aligned}
 &3) \text{ Length of cube} \\
 &= 50 - 20 \\
 &= 30
 \end{aligned}$$

$$\begin{aligned}
 &4) \text{ Vol of cube} \\
 &= 30 \times 30 \times 30 \\
 &= 27\,000
 \end{aligned}$$

$$2) \text{ Height} = \frac{\text{Volume}}{\text{Base Area}}$$

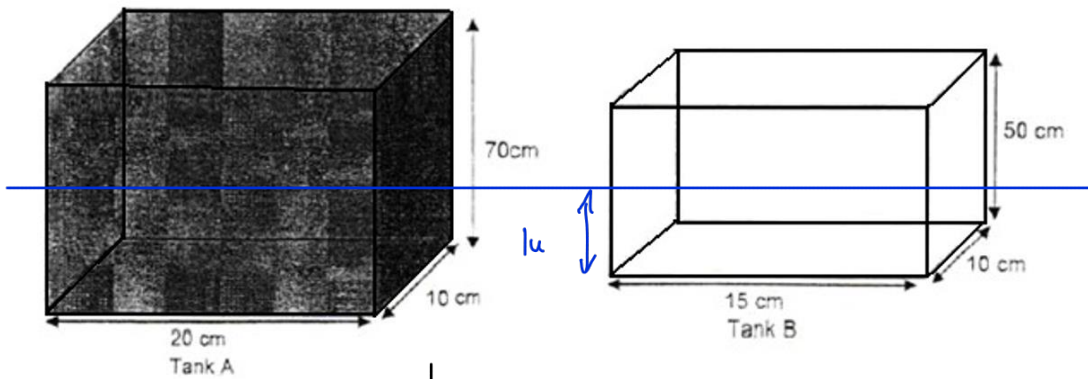
Ans : 27 000 cm³

GUIDED EXAMPLE 5

Tank A is filled with water to its brim and Tank B is empty. Without spilling any water, water is poured from Tank A to Tank B until the water levels in both tanks are the same.

What is the height of the water level?

* Internal transfer of water → total volume of water unchanged.



1) Total volume of water
 $= 20 \times 10 \times 70$
 $= 14\ 000$

2) Base area of A
 $= 20 \times 10$
 $= 200$
 Base area of B
 $= 15 \times 10$
 $= 150$

3) After	Base area (cm ²)	Height (cm)	Volume (cm ³)
Tank A	200	u	200u
Tank B	150	u	150u
		Total	350u

comparing total vol,

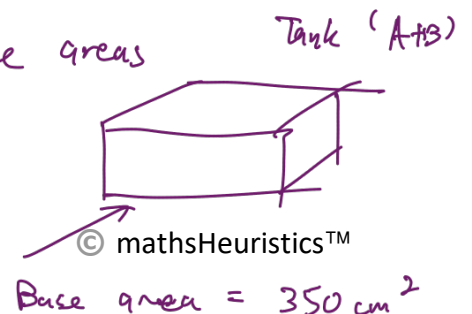
$350u = 14\ 000$
 $u = 14\ 000 \div 350$
 $= 40$

Ans: 40 cm

method 2: Combining containers and their base areas

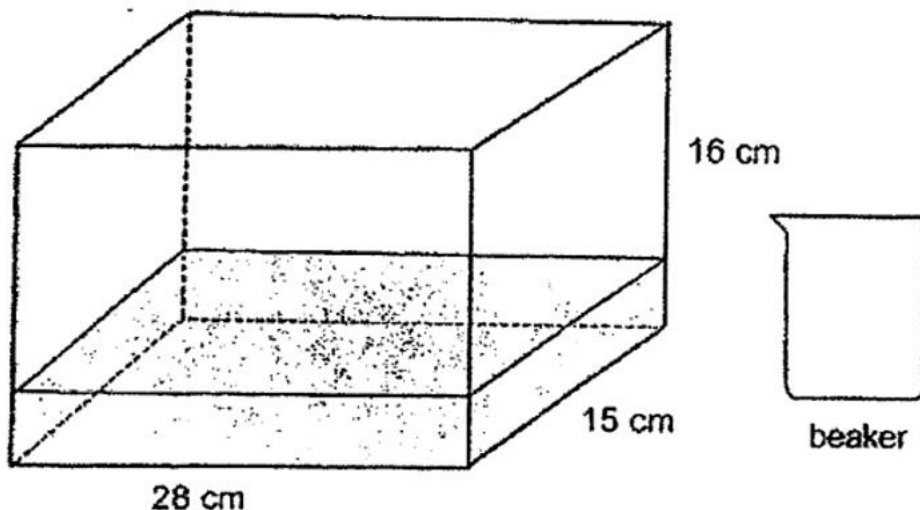
$200 + 150 = 350$

7 Height = $\frac{\text{vol}}{\text{BA}} = \frac{14000}{350} = 40$



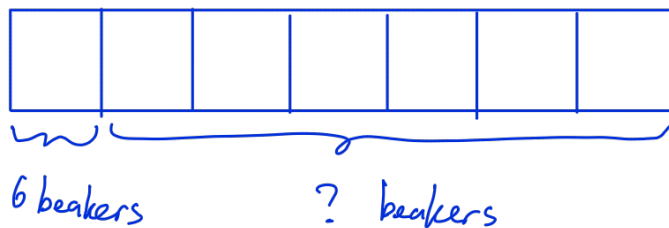
BUILD YOUR UNDERSTANDING

Mr Tan wanted to fill the tank with water to the brim.
 He used 6 beakers of water to fill $\frac{1}{7}$ of the tank.



a) How many more beakers of water would he need to fill the tank to the brim?

$$6 \times 6 = 36$$



b) Find the volume of 1 beaker.

$$36 + 6 = 42$$

$$28 \times 15 \times 16 = 6720$$

$$6720 \div 42 = 160$$

Ans : a) 36

b) 160 ml

2. Two taps fill a water tank with a capacity of 250 l.
 Tap A alone can fill the tank in 5 minutes.
 Tap B alone can fill the tank in 7 minutes.
 Tap C alone can completely drain the tank in 3 minutes.

* make time the same.

- a) How long will it take to fill $\frac{3}{7}$ of the tank when all three taps are turned on together?
 b) How many litres of water will have flowed out through Tap C when the tank is $\frac{3}{7}$ filled with water?

	Time (min)	Fraction of Tank filled
A (fill)	5 $\xrightarrow{\times 21}$ 105	1 $\xrightarrow{\times 21}$ 21
B (fill)	7 $\xrightarrow{\times 15}$ 105	1 $\xrightarrow{\times 15}$ 15
C (Drain)	3 $\xrightarrow{\times 35}$ 105	1 $\xrightarrow{\times 35}$ 35
A+B-C	105 $\xrightarrow{\times \frac{3}{7}}$ (a) 45	$21 + 15 - 35 = 1$ $\frac{3}{7}$

b) Tap C has been turned on for 45 min.

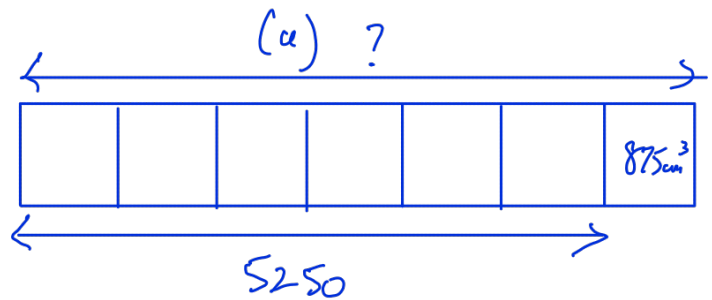
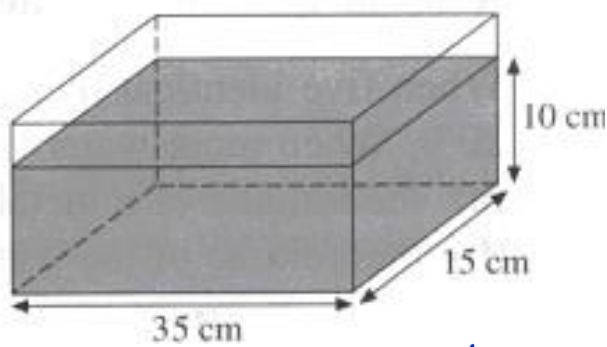
In 45 min, tap C has drained $45 \div 3 = 15$ whole tanks.

Required volume = $15 \times 250\text{l}$
 = 3750l

Ans : a) 45 min

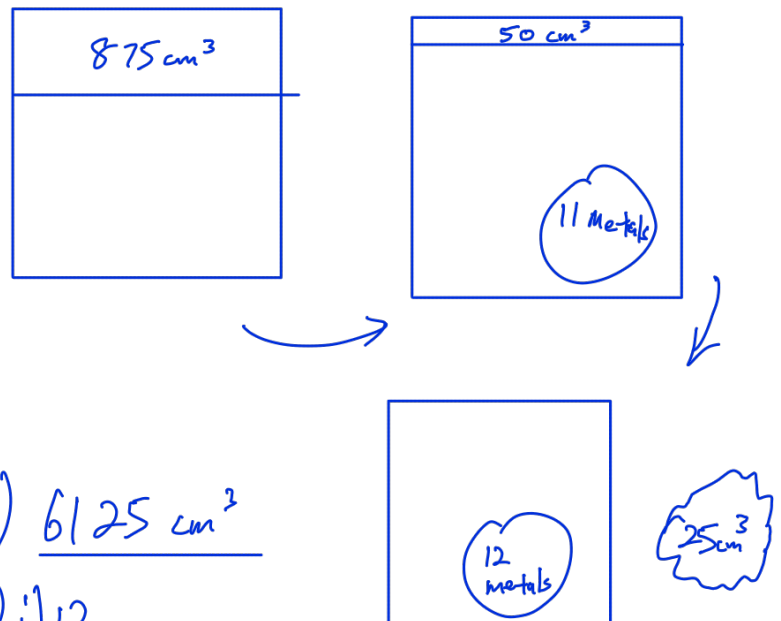
b) 3750l

3. The tank shown below is $\frac{6}{7}$ filled with water.
- (a) What is the volume of the tank?
- (b) Some identical metals, each of volume 75 cm^3 was put one at a time into the tank until the water just overflows.
- (i) How many metal balls had been put into the tank?
- (ii) What is the volume of water that overflows from the tank?



a) $35 \times 15 \times 10 = 5250$
 $5250 \div 7 = 875$
 $7 \times 875 = 6125$

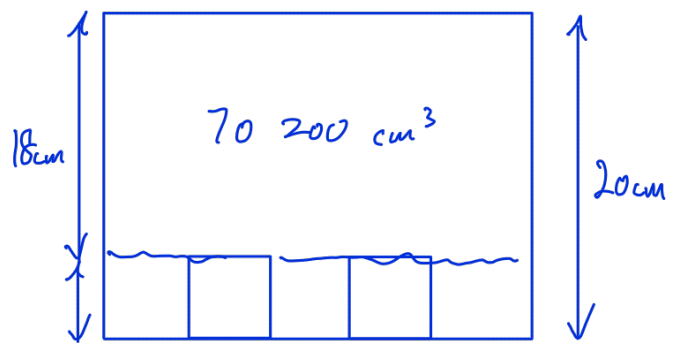
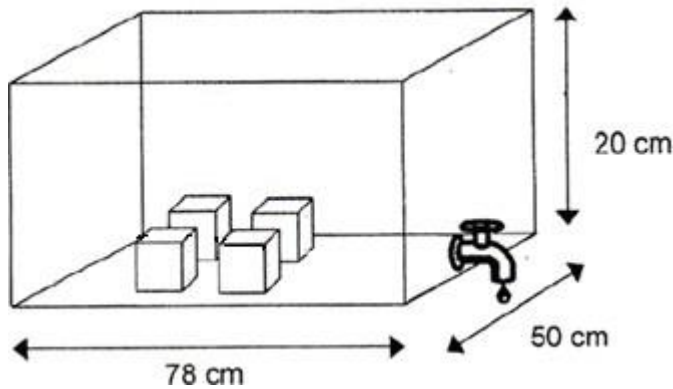
b) $875 \div 75 = 11 \text{ R } 50$
 i) $11 + 1 = 12$
 ii) $75 - 50 = 25$



Ans: a) 6125 cm³
 b) i) 12
 ii) 25 cm³

4. A rectangular tank with 4 solid metal cubes inside was filled with water to its brim. When the tap was turned on, water flowed out of the tank at a rate of 1.8 litres per minute. It took 39 minutes for the height of the water to drop to the top of the solid metal cube. Find the volume of all the metal cubes.

(Raffles Girls' Pri / P6/ Prelim /Q45)



$$1.8\text{ l} = 1800\text{ cm}^3$$

$$\begin{aligned} 1) \text{ Vol of water drained} \\ &= 39 \times 1800 \\ &= 70\ 200 \end{aligned}$$

$$\begin{aligned} 2) \text{ Decrease in water level} \\ &= \frac{70\ 200}{78 \times 50} \\ &= 18 \end{aligned}$$

$$\text{Vol} = \text{BA} \times \text{H}$$

$$\Leftrightarrow \text{H} = \frac{\text{Vol}}{\text{BA}}$$

$$\begin{aligned} 3) \text{ Length of 1 cube} \\ &= 20 - 18 \\ &= 2 \end{aligned}$$

$$\begin{aligned} 4) \text{ Vol of 4 cubes} \\ &= 4 \times 2 \times 2 \times 2 \\ &= 32 \end{aligned}$$

Ans : 32 cm³

5. A container measuring 40 cm by 25 cm by 12 cm is being filled with water by Tap A at a rate of 3.25 l per min. The water is drained from a container by Tap B at a rate of 1.25 l per min. If Tap A is turned on to fill the empty container 2 min before Tap B is turned on, how long will it take for the container to be filled completely after Tap B is turned on?

$$3.25\text{l} = 3250 \text{ cm}^3, \quad 1.25\text{l} = 1250 \text{ cm}^3$$

(Ngee Ann Pri / P6 / Prelim / Q46)

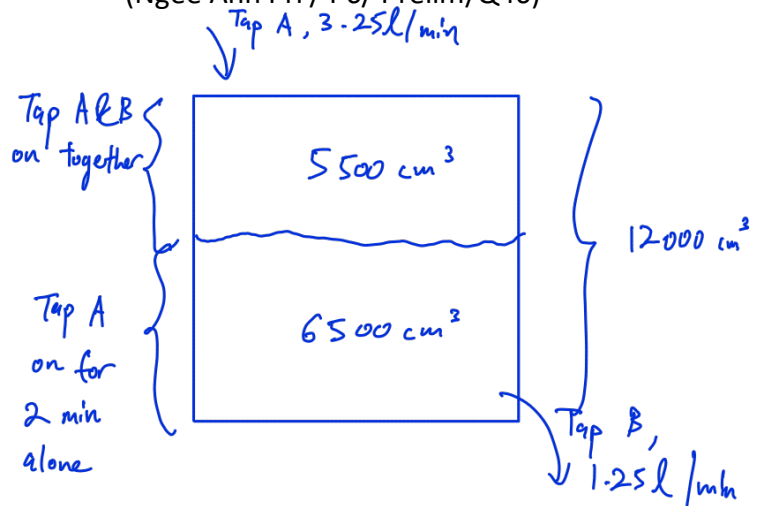
1) Vol of tank
 $= 40 \times 25 \times 12$
 $= 12000$

2) Vol filled by tap A
 $= 2 \times 3250$
 $= 6500$

3) Vol filled by tap A and drained by B
 $= 12000 - 6500$
 $= 5500$

4) Effective rate with Taps A and B on
 $= 3250 - 1250$
 $= 2000$

5) Time taken
 $= 5500 \div 2000$
 $= 2.75$

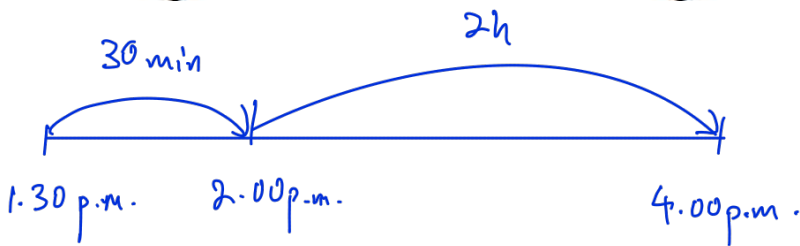
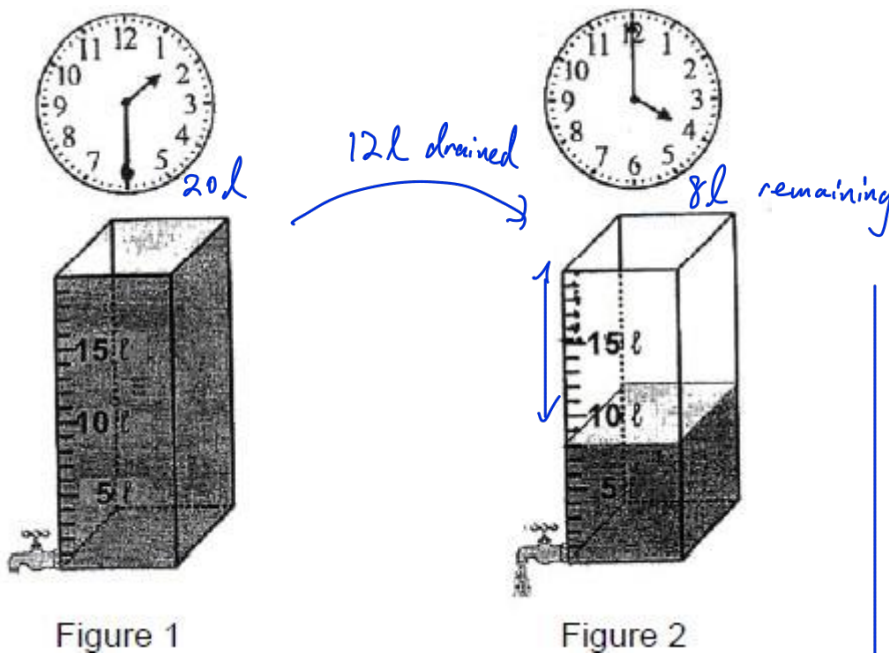


Ans : 2.75 min

6. A 20-litre tank was completely filled with water at the time shown on the clock in the afternoon in Figure 1. The tap was then turned on to drain the water out of the tank. The amount of water left in the tank after some time was shown in Figure 2.

- (a) What time was it when the tank was half full?
- (b) How long did it take to drain the 20 litres of water from the tank completely?

(Maris Stella High School/Prelim/Q43)



$2\text{h } 30\text{ min} = 150\text{ min}$

$12\text{L} \rightarrow 150\text{ min}$

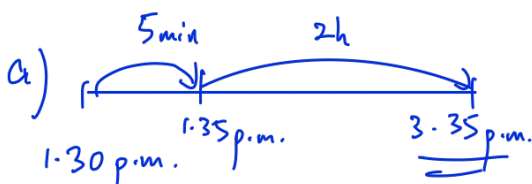
$1\text{L} \rightarrow 150\text{ min} \div 12 = 12.5\text{ min}$

$10\text{L} \rightarrow 10 \times 12.5\text{ min} = 125\text{ min}$
 $= 2\text{h } 5\text{ min}$

b) $20\text{L} \rightarrow 20 \times 12.5\text{ min}$
 $= 250\text{ min}$
 $= 4\text{h } 10\text{ min}$

Ans: a) 3:35 p.m.

b) 4h 10 min



7. Tank X measuring 40 cm by 30 cm by 15 cm is filled with water to the brim. Tank Y is an empty rectangular container with base area of 80 cm by 30 cm. Find the volume of water that must be poured ~~into~~ Tank X to Tank Y such that they both have the same height in the end. ^{to} ~~from~~

* Internal transfer of water → total vol unchanged

$$40 \times 30 \times 15 = 18000$$

$$40 \times 30 = 1200$$

$$80 \times 30 = 2400$$

After	BA (cm ²)	Ht (cm)	Vol (cm ³)
Tank X	1200	1u	1200u
Tank Y	2400	1u	2400u //
		Total	3600u

$$3600u = 18000$$

$$1u = 18000 \div 3600$$

$$= 5$$

$$2400u = 2400 \times 5$$

$$= 12000$$

Ans: 12 000 cm³