

Problem

As Bailey rows her sturdy boat across the lake one sunny morning, alas a submerged log makes a small crack in the hull. Water begins to leak into the boat at 3 litres per minute. If Bailey alternates rowing and bailing, the boat travels 2 kilometres per hour, and she bails out 1.5 litres per minute. The boat will sink if it takes on 135 litres of water.

- If Bailey is 4 kilometres from the shore of the lake when the boat springs the leak, can she make it to shore before the boat sinks? Explain your reasoning.
- If your answer to part a) is 'No', how far is Bailey from shore when the boat sinks?
- Does your answer to part a) change if Bailey is only 3 kilometres from shore when she hits the log? Explain your reasoning.



Complete the table below to help discover the answers.

Time (in hours)	Distance (km) $= 2 \times \text{time}$	Water In (litres) $= 180 \times \text{time}$	Water Out (litres) $= 90 \times \text{time}$	Accumulated Water in Boat
$\frac{1}{2}$	1	90	45	45
1				
$1\frac{1}{2}$				
2				

Hints

Hint 1 - How long will it take for 135 litres of water to leak into the boat?

Hint 2 - How long would it take Bailey to reach the shore, with the boat travelling 2 km per hour?

Solution

Completing the table as suggested, with time equal to 0 when Bailey hits the log, the boat's speed at 2 kilometres per hour, water leaking in at $3 \times 60 = 180$ litres per hour, and out at $1.5 \times 60 = 90$ litres per hour, we have:

Time (in hours)	Distance (km) $2 \times \text{time}$	Water In (litres) $= 180 \times \text{time}$	Water Out (litres) $= 90 \times \text{time}$	Accumulated Water in Boat
$\frac{1}{2}$	1	90	45	45
1	2	180	90	90
$1\frac{1}{2}$	3	270	135	135
2	4	360	180	180

Thus we conclude:

- Since there are 135 litres of water in the boat when Bailey has travelled only 3 km, the boat will sink before Bailey reaches the shore.
- The boat sinks when Bailey is $4 - 3 = 1$ km from shore.
- If Bailey is only 3 km from shore when she hits the log, then she will just make it to shore as the boat sinks .. hopefully in shallow water!

Thus we conclude:

- Since there are 135 litres of water in the boat when Bailey has travelled only 3000 m (or 3 km), the boat will sink before Bailey reaches the shore.
- The boat sinks when Bailey is $4 - 3 = 1$ km from shore.
- If Bailey is only 3 km from shore when she hits the log, then she will just make it to shore as the boat sinks .. hopefully in shallow water!