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.

a) 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.

b) If your answer to part a) is 'No', how far is Bailey from shore when the boat sinks?

c) 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 × time	Water In (litres) = 180 × time	Water Out (litres) = 90 × 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) $2 \times$ time	Water In (litres) $= 180 \times$ time	Water Out (litres) $= 90 \times$ 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:

a) 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.

b) The boat sinks when Bailey is 4 - 3 = 1 km from shore.

c) 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:

a) 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.

b) The boat sinks when Bailey is 4 - 3 = 1 km from shore.

c) 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!