Answer on Question #48625 – Physics - Mechanics | Kinematics | Dynamics

a boat takes two hours to travel 8km down and 8 km up the river when the water is till. How much time will the boat take to make the same trip when the river starts flowing at 4kmph?
1. 2 hours
2. 2 hour 40 minutes
3. 3 hours
4. 3 hour 40 minutes

Solution:
$S = 8km -$ travelled distance;
$t = 2 hours -$ time to travel distance S (when the water is till)
$v -$ velocity of the boat;
$u = 4\dfrac{km}{h} -$ velocity of the flow;

From the initial movement of the boat we can find it's velocity:
$$2S = v \cdot t \quad (1)$$
$$v = \frac{2S}{t} = \frac{2 \cdot 8km}{2\ hour} = 8\frac{km}{h}$$
Situation when the river starts to flow: time of the travel
$$T = t_{up} + t_{down}$$
Time to travel down the river:
$$t_{down} = \frac{S}{v+u} \quad (2)$$
Time to travel up the river:
$$t_{up} = \frac{S}{v-u} \quad (3)$$
$$(3) and\ (2) in\ (1):$$

$$T = \frac{S}{v+u} + \frac{S}{v-u} = S\left(\frac{1}{v+u} + \frac{1}{v-u}\right) = 8km\left(\frac{1}{8\dfrac{km}{h} + 4\dfrac{km}{h}} + \frac{1}{8\dfrac{km}{h} - 4\dfrac{km}{h}}\right)$$
$$= 2.7\ hours$$
Answer: time to travel the same distance is equal to $2.7\ hours$.