

This is a 1-D problem involving relative motion.

A boat is traveling in a river in the upstream direction, at 15 km/h with respect to the water of the river. The water in the river is flowing at 7 km/h with respect to the ground.

(a) What is the velocity of the boat with respect to ground?

(b) A person on the boat walks from the front of the boat to the back of the boat at 5 km/h with respect to the boat. What is the person's velocity with respect to the ground?

Solution:

(a) Use the scalar equation: $v_p = v_B + v_{PB}$

$v_p = ?$ (velocity of the boat with respect to ground)

$v_B = +7 \text{ km/h}$ (velocity of the water with respect to ground - take this direction as positive)

$v_{PB} = -15 \text{ km/h}$ (velocity of the boat with respect to the water)

Substitute: $v_p = 7 \text{ km/h} + (-15 \text{ km/h})$

$$v_p = -8 \text{ km/h}$$

(ANS.)

The velocity of the boat is 8 km/h , opposite the (with respect to ground) flow direction.

(b) The person is walking in the downstream direction, which means that he/she is walking in the flow direction of the water, taken as positive. Therefore, we can write:

$$v_{PB} = -15 + 5 = -10 \text{ km/h} \quad (\text{velocity of the person with respect to the water})$$

$$v_B = +7 \text{ km/h} \quad (\text{same as in part (a)})$$

Use the scalar equation:

$$v_p = v_B + v_{PB} \quad (\text{same as in part (a)})$$

Substitute:

$$v_p = 7 \text{ km/h} + (-10 \text{ km/h})$$

$$v_p = -3 \text{ km/h} \quad (\text{velocity of person with respect to ground})$$

The velocity of the person with respect to ground is 3 km/h, opposite the flow direction of river