



Motion Practice Problems

1. Kaitlyn runs the 100-meter dash in a time of 13.7 seconds. What is the magnitude of her average velocity?
2. A rabbit hops 30 yards across a field with a constant speed of 6 yards per second. How long did this take?
3. An elevator goes from the 1st floor to the 10th floor with an average velocity of 1.2 m/s in a time of 35 seconds. How high up did the elevator go?
4. A cat falls from a tree and hits the ground 0.9 seconds later. While it's falling, the cat spreads out its legs, causing it to have an acceleration of 8 m/s^2 directed downward. What is the cat's speed when it hits the ground?
5. A car accelerates from 0 to 50 mph in a time of 6 seconds. What is the average acceleration in miles per hour squared (mi/hr^2)?
6. A truck heading 60 mph East passes a car heading 45 mph West. What is the speed of the truck relative to the car?
7. A car passes a man on a bike. Both are going the same direction. The cyclist is traveling at 10 m/s. If the cyclist sees the car pass him at a speed of 13 m/s, what was the speed of the car?
8. Salmon can swim at a rate of 2.2 mph in calm waters. In order to swim upstream, they need to overcome the 0.8 mph current. If someone stands on the shore and watches the fish swim upstream, how fast will the salmon appear to be swimming?
9. Jerry paddles his canoe down a 3 km section of river. The water's current has a speed of 4 km/hr. Jerry paddles with the current, and reaches the end of the river in half an hour. How fast was Jerry paddling?
10. A boat attempts to travel straight across a 30-meter-wide river with a speed of 4 m/s. However, the 3 m/s current causes the boat to head slightly down stream instead of straight across. What is the velocity of the boat relative to land? How long will it take to reach the other side? How far down stream will the boat end up?
11. Learning their lesson from the last boat, a second boat attempts to cross the same river by steering their boat so that it goes straight across. If this boat has a maximum velocity of 6.5 m/s, what angle should the boat take to go straight across? How long will it take to cross the river?

Physics Mechanics



1.

$$V_{avg} = \frac{\Delta x}{t} = \frac{100}{13.7} = 7.3 \frac{m}{s}$$

↑
displacement
time

2.

$$v = \frac{d}{t}$$

↑
velocity = $\frac{\text{distance}}{\text{time}}$

$$6 = \frac{30}{t}$$
$$6t = 30$$
$$t = 5s$$

5 seconds

3.

~~1.2 = \frac{d}{t}~~ $v = \frac{d}{t}$

$$1.2 = \frac{d}{35}$$
$$d = 1.2(35)$$
$$d = 42 m$$

4.

$$a = \frac{\Delta v}{t}$$

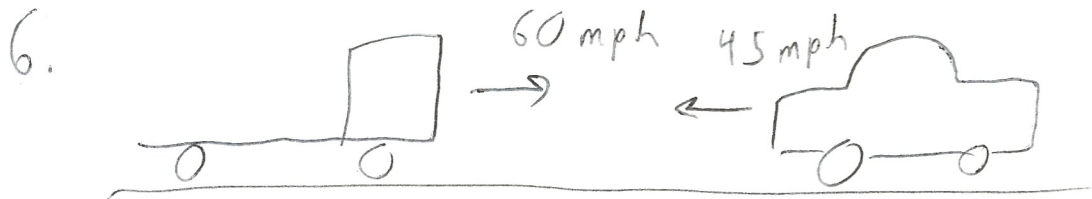
acceleration = $\frac{\text{change in velocity}}{\text{time}}$

$$8 = \frac{v_f - 0}{.9}$$
$$v_f - 0 = 8(.9)$$
$$v_f = 7.2 \frac{m}{s}$$

Physics Mechanics

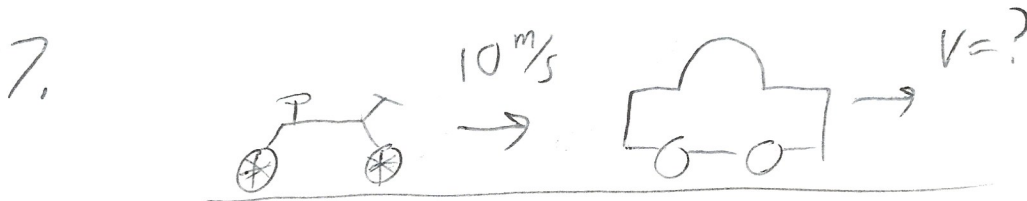


5.
$$a_{avg} = \frac{\Delta V}{t} = \frac{50-0}{6} = 8.33 \frac{mi}{hr^2}$$



Heading towards each other \Rightarrow add velocities

$$60 + 45 = 105 \text{ mph}$$



If the bike sees the car pass it at 13 m/s ,
then the speed of the car = $13 + 10$
 $= 23 \text{ m/s}$

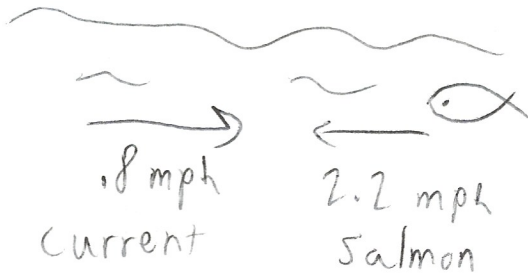
Physics Mechanics

Dan the Tutor



Learn by Doing

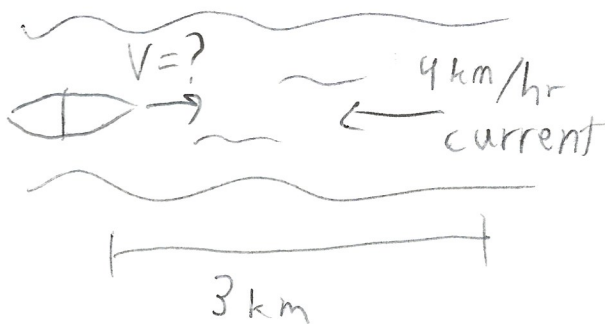
8.



Salmon appears to be moving $2.2 - 0.8$ mph

1.4 mph

9.



$$V = \frac{\Delta x}{t}$$

↑

$$\text{Jerry's speed} - 4 = \frac{\Delta x}{t}$$

(V_J)

$$V_J - 4 = \frac{3}{.5} \leftarrow \text{half an hour}$$

$$V_J = 4 + \frac{3}{.5}$$

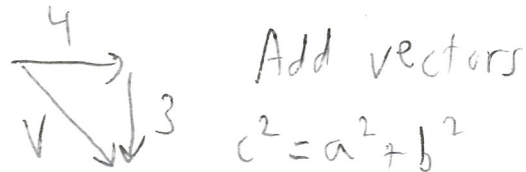
$$V_J = 10 \text{ km/hr}$$



10.



Velocity of boat relative to land



Add vectors

$$c^2 = a^2 + b^2$$

$$V^2 = 3^2 + 4^2$$

$$V = \sqrt{9 + 16}$$

$V = 5 \text{ m/s}$ relative to land

How long to reach other side

x-axis only

$$V = \frac{\Delta x}{t}$$

velocity
in x
direction

$$4 = \frac{30}{t}$$

$$4t = 30$$

$$t = 7.5 \text{ s}$$

How far down stream

y-axis only

$$\text{velocity in y direction } V = \frac{\Delta y}{t}$$

velocity
in y
direction

$$3 = \frac{\Delta y}{7.5}$$

$$\Delta y = 3(7.5)$$

$$= 22.5 \text{ m}$$

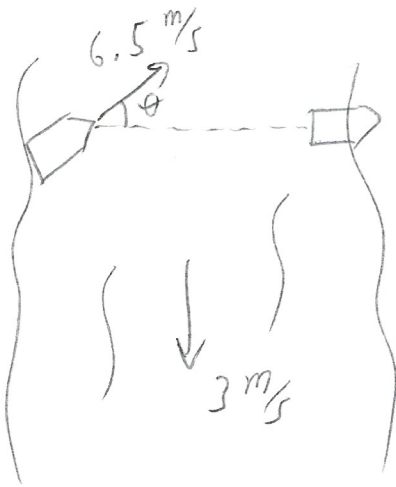
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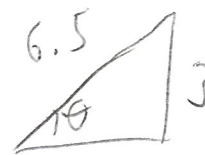


Learn by Doing

11.



To go straight across, we need the boat's y-component of velocity to cancel out the 3 m/s current.



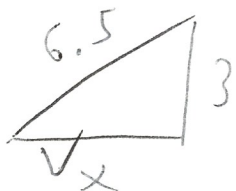
$$\sin \theta = \frac{3}{6.5}$$

$$\sin \theta = .462$$

$$\theta = 27.5^\circ$$

How long will it take to cross

x-axis only



$$a^2 + b^2 = c^2$$

$$V_x^2 + 3^2 = 6.5^2$$

$$V_x^2 + 9 = 42.25$$

$$V_x = \sqrt{42.25 - 9}$$

$$V_x = 5.77 \text{ m/s}$$

$$V_x = \frac{\Delta x}{t}$$

$$5.77 = \frac{30}{t}$$

$$5.77t = 30$$

$$t = \frac{30}{5.77}$$

$$t = 5.20 \text{ seconds}$$