Name:

Goal **Practice solving velocity vector problems.**

What To Do Answer the questions that follow

1. A canoeist is paddling at 6.5 m/s[W], relative to the shore. If there is a current of 3.5 m/s[E], what is the canoeist's velocity relative to the current?

2. A marble is rolling inside a toy wagon being pulled by a boy on the deck of a boat. The marble is rolling at 0.5 m/s[W] relative to the wagon. The wagon is being pulled at 1.5 m/s[W] relative to the surface of the boat, and the boat is moving at 4.5 m/s[S] relative to the water. The water is moving at 2.0 m/s[S] relative to the shore. What is the velocity of the marble relative to the shore?

3. Car A is travelling south at 60 km/h, while directly behind it, car B is travelling north at 40 km/h. (a) Determine the velocity of B relative to A. (b) Determine the velocity of A relative to B.

4. Relative to Earth's surface, a car is moving south at 80 km/h and a truck is moving west at 60 km/h. (a) Find the velocity of the car relative to the truck. (b) Find the velocity of the truck relative to the car.

5. Einstein's equation for the addition of velocities applies to objects moving at slow speeds and at speeds near the speed of light. For example, if a spaceship moving at velocity v_A releases a missile with velocity v_B relative to the spaceship, then the velocity of the missile relative to an observer who is at rest is given by

$$v = \frac{v_A + v_B}{1 + \frac{v_A v_B}{c^2}},$$

where c is the speed of light.

Solve for v for the following cases: (a) v_A = 350 m/s, v_B = 800 m/s (b) v_A = 10 km/s, and v_B is the speed of a laser, instead of a missile, and (c) v_A = c/2 , and v_B is the speed of a missile with speed $c/2$.