Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block: \_\_\_\_\_\_\_

**Relative Velocity**

To measure a moving objects average velocity we need to know its change in position or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

and it’s change in time or it’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. To measure a **position** however, we first need to

know where we are measuring from or the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Up till now, we have chosen the **reference point** to be a point that doesn’t move, but this is not necessary. We are allowed to choose any reference point we want.

Imagine the following scenario: A man is standing still on the qing gui (light rail) and a woman is walking towards him. The qing gui is moving towards Dalian with a velocity of 16 m/s, and the woman is walking in the opposite direction with a velocity of -2 m/s. (These velocities are measured **relative** to the **ground**)

Depending on the **reference frame** we choose, the man and woman have different velocities.

If we choose an observer who is not on the train (you) as our reference frame, we notice the man is moving with a velocity of \_\_\_\_\_\_\_ m/s and the woman is moving with a velocity of \_\_\_\_\_\_\_ m/s.

We say they are moving with velocities “**relative to**” an outside observer or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_to the observer.

The general equation for the above scenario, objects on a moving vehicle is:

Vo = Vp + Vt Vo is the observed velocity Vp is the passenger velocity Vt is the train velocity

If we choose the man to be our **reference frame** the woman is moving with a velocity of \_\_\_\_\_\_\_\_\_ m/s, **relative to** the man.

If we choose the woman to be our **reference frame** the man is moving with a velocity of \_\_\_\_\_\_\_\_\_ m/s, **relative to** the woman.

The general equation for measuring relative velocities is: Vab = Va – Vb

This reads, the velocity of **a** **relative to b** (Vab) equals velocity of a (Va) minus velocity of b (Vb)

Practice: Do the following questions. Make sure to show all your work with general equations and draw the appropriate pictures.

1. A plane is flying East with a velocity of 245 m/s and a man on the plane is walking towards the back with a velocity of 2 m/s.
2. What is the velocity of the man relative to the plane?
3. What is the velocity of the man relative to a stationary observer on Earth?
4. What is the velocity of the plane relative to the man?
5. A man standing on top of a moving train throws a football in the direction of the train. If the train has a velocity of 25 m/s and the man can throw with a speed of 15 m/s, calculate the following.
6. What is the velocity of the football relative to the train?
7. What is the velocity of the man relative to the train?
8. What is the velocity of the football relative to a stationary observer?
9. What is the velocity of the man relative to a stationary observer?
10. The same man from question #2 runs with a velocity -3.0 m/s on top of the train and throws the football with the same speed towards the back of the train, calculate the following.
11. What is the velocity of the football relative to the train?
12. What is the velocity of the man relative to the train?
13. What is the velocity of the football relative to a stationary observer?
14. What is the velocity of the man relative to a stationary observer?