<u>Measurement of Motion Review for 2/3-term</u> Name: ____________________

1. Time dilation
   a) A spaceship is moving at 0.80c relative to Earth. How much time elapses on the spaceship's clock for every 1.0 year that passes on Earth?

   b) An observer on Earth sees a clock on a spaceship moving at 0.60c. How much time passes on Earth for every 1.0 second that is measured by the spaceship clock?

2. Length contraction
   a) A spaceship is 100. m long when at rest. How long is the spaceship when it is moving at 0.90c?

   b) A pole appears to be 5.0 m long when it is moving at 0.50c, as measured by an observer on Earth. What is the rest length of the pole?

3. Mass increase
   a) A proton has a rest mass of 1.67×10^{-27} kg. What is the proton's mass when it is moving at 0.700c?

   b) An electron has a rest mass of 9.11×10^{-31} kg. What is the speed of the electron when its mass is twice its rest mass?

4. Adding velocities
   A spaceship is moving at 0.80c away from Earth. A probe is launched from the spaceship at 0.50c relative to the spaceship, away from Earth. What is the speed of the probe as measured by an observer on Earth?

5. Applications of relativity
   a) River crossing problem: A river flows due east at 4.0 m/s. A boat is traveling across the river due north at 6.0 m/s relative to the water. What is the boat's speed and direction relative to the shore? Assume the width of the river is 100.m.

   b) Airplane navigation problem: An airplane is flying due north at an airspeed of 800.km/h. There is a wind blowing from the east at 100.km/h. What is the airplane's ground speed and direction? Assume the airplane is flying at an altitude where the wind speed is constant.

Answers:
1a) t_o = 0.60 years, 1b) t = 1.3 s
2a) L = 44 m, 2b) L_o = 5.8 m
3a) m = 2.3×10^{-27} kg, 3b) v = 0.866c
4) u = 0.93c
5a) v_{gs} = 7.2 m/s [34° E of N], 5b) v_{gs} = 806 km/h [7.13° W of N]

Measurement of Motion Review for 2/3-term Name: ______________________

1. Time dilation
   a) A spaceship is moving at 0.80c relative to Earth. How much time elapses on the spaceship's clock for every 1.0 year that passes on Earth?

   b) An observer on Earth sees a clock on a spaceship moving at 0.60c. How much time passes on Earth for every 1.0 second that is measured by the spaceship clock?

2. Length contraction
   a) A spaceship is 100. m long when at rest. How long is the spaceship when it is moving at 0.90c?

   b) A pole appears to be 5.0 m long when it is moving at 0.50c, as measured by an observer on Earth. What is the rest length of the pole?

3. Mass increase
   a) A proton has a rest mass of 1.67×10^{-27} kg. What is the proton's mass when it is moving at 0.700c?

   b) An electron has a rest mass of 9.11×10^{-31} kg. What is the speed of the electron when its mass is twice its rest mass?

4. Adding velocities
   A spaceship is moving at 0.80c away from Earth. A probe is launched from the spaceship at 0.50c relative to the spaceship, away from Earth. What is the speed of the probe as measured by an observer on Earth?

5. Applications of relativity
   a) River crossing problem: A river flows due east at 4.0 m/s. A boat is traveling across the river due north at 6.0 m/s relative to the water. What is the boat's speed and direction relative to the shore? Assume the width of the river is 100.m.

   b) Airplane navigation problem: An airplane is flying due north at an airspeed of 800.km/h. There is a wind blowing from the east at 100.km/h. What is the airplane's ground speed and direction? Assume the airplane is flying at an altitude where the wind speed is constant.

Answers:
1a) t_o = 0.60 years, 1b) t = 1.3 s
2a) L = 44 m, 2b) L_o = 5.8 m
3a) m = 2.3×10^{-27} kg, 3b) v = 0.866c
4) u = 0.93c
5a) v_{gs} = 7.2 m/s [34° E of N], 5b) v_{gs} = 806 km/h [7.13° W of N]