PHYS 2320 Introductory Mechanics Spring 2023
Prof. Jorge Munoz

Exam 1 (2/20/2023)

Student name: **Workshop section** (circle one)**:** Monday **/** Tuesday

This exam covers concepts of motion and kinematics. For the following problems, show all your work as partial credit will be given but correct answers without appropriate backing will not be accepted. The equations that you need are included at the end of this exam and you are encouraged to use a scientific calculator. If you have trouble with the equations, explain your reasoning in words. You can use a small cheat sheet if desired.

Section 1. Plug-and-play (3 points)

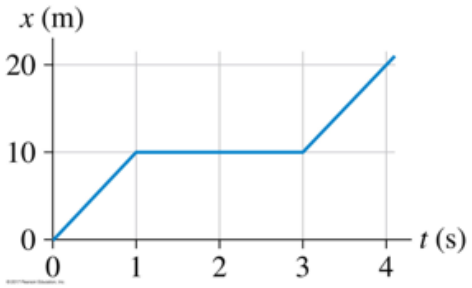
a) Alan leaves San Diego at 8:00 AM to drive to Los Angeles 120 miles north. If his average velocity is 45 miles per hour, at what time would Alan get to Los Angeles?

b) The radius of Jupiter's very nearly circular orbit around the sun is 8×10^{11} meters and the time it takes to go around the sun once is 11.86 terrestrial years. There are 365.25 days in a terrestrial year, 24 hours in a day, and 3600 seconds in one hour. What is the magnitude of the angular velocity of Jupiter in radians per second?

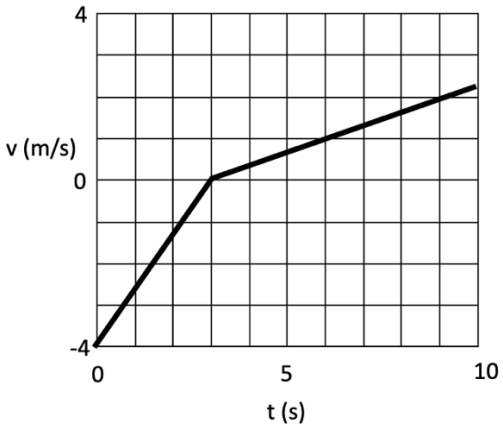
c) What is the magnitude of the velocity of Jupiter in meters per second as it travels around the sun?

Problem 2. Extracting information from graphs of particles in 1 dimension. (3 points)

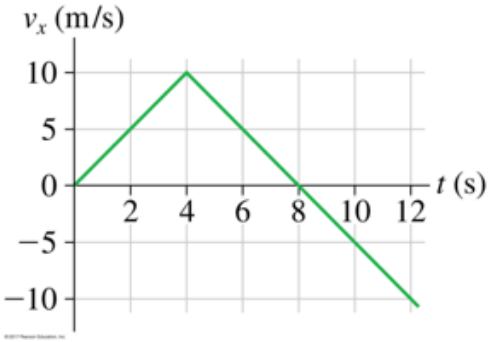
a) Write a short description of a real object for which the figure to the left would be a realistic position versus time graph. Be mindful of the units of position and time when thinking about your story.



b) The graph below represents the motion of a ball that bounces off the surface of a low-gravity planet. When does the ball return to the location it had at t = 0?



c) The figure below shows the velocity graph of a particle with initial position $x_0 = 0$ m at $t_0 = 0$ s. What is the acceleration of the particle at $t = 1$ s and at $t = 5$ s



Problem 3. Kinematics in 1-D (3 points)

On planet earth, a rock is tossed straight up from ground level, but when it returns it falls into a hole 12 m deep. The maximum height achieved by the rock is 30 meters.

a) What was the initial speed of the rock?
b) What is the velocity of the rock as it hits the bottom of the hole?
c) How long is the rock in the air, from the instant it is released until it hits the bottom of the hole?

Problem 4. Kinematics in 2-D (3 points)

A riffle is aimed horizontally at a target hit by a bullet 0.05 seconds after that bullet is fired.

a) If the initial speed of the bullet was 800 meters per second, how far away was the target?
b) On planet earth, how far below the aim point would the bullet hit?
c) Planet X has an acceleration due to gravity of 15 m/s^2, how far below the aim point would the bullet hit on this planet?

Problem 5. Easy calculus (3 points)

A car travels at constant speed for 10 seconds and then breaks for 6 seconds with constant (negative) acceleration before coming to a full stop and covering a distance of 300 meters.

a) Draw the acceleration vs time and velocity vs time graphs for the car.
b) Use the equation of the area under the curve to determine the initial speed of the car.
c) What was the magnitude of the acceleration?