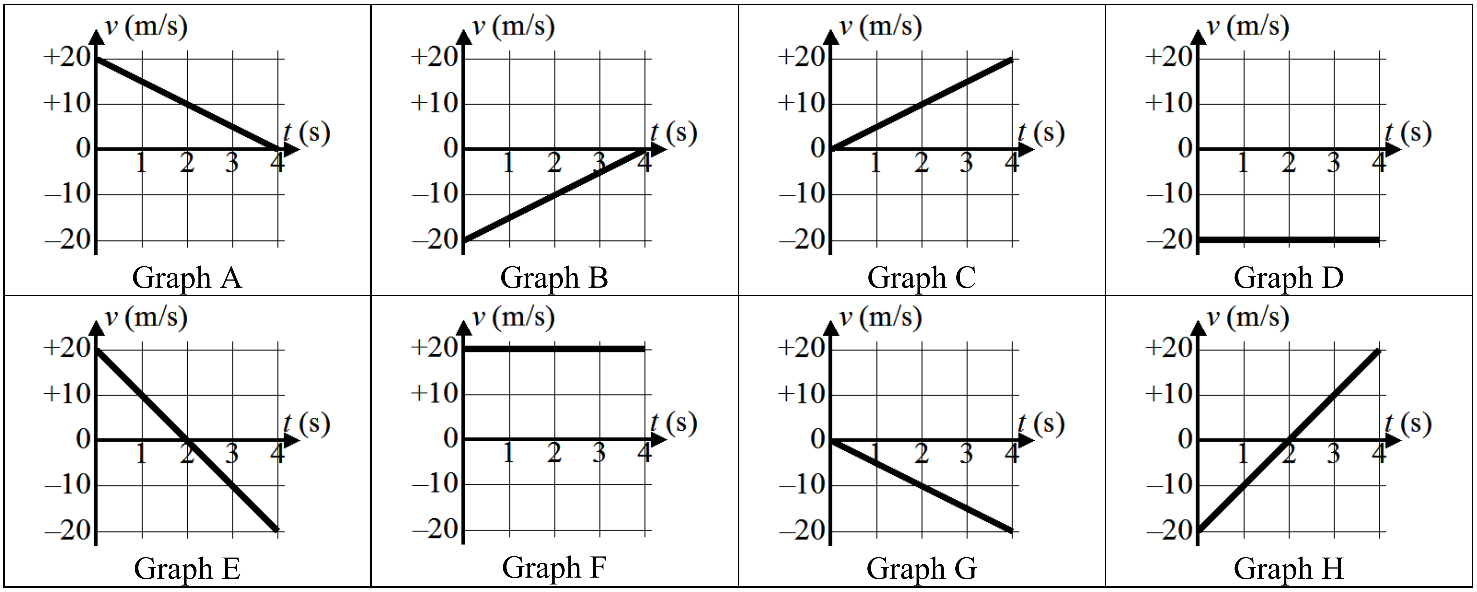
Due On: ________________ Name: ___________________________

AP Physics 1: Review Packet 01

Problem 1: Consider the following eight velocity vs. time graphs. Positive velocity is “forward” velocity.



(a) Rank the objects based on their acceleration from “most forward” to “most backward”. (If any two graphs show the same acceleration, put an equal sign between those letters.)

_________ _________ _________ _________ _________ _________ _________ _________

Most “forward” acceleration Most “backward” acceleration

Briefly explain how you determined the accelerations.

(b) Rank the objects based on their **displacement** over the 4-second interval.

_________ _________ _________ _________ _________ _________ _________ _________

Most “forward” displacement Most “backward” displacement

(c) Rank the objects based on their **distance traveled** over the 4-second interval. Remember that distance is a scalar that can never be less than zero.

_________ _________ _________ _________ _________ _________ _________ _________

Longest distance Shortest distance

Briefly explain how you determined the displacements and distances. Make sure you explain the difference between distance and displacement.

(d) If you were asked to rank average velocity, then the ranking would look like which ranking above (part a, b, or c)? Explain why.

(e) Explain in words what the object is doing in each of the following graphs. Use words like "moving forward", "moving backward", "standing still", "speeding up", "slowing down", and "constant speed".

(i) In Graph A, the object is ____.

(ii) In Graph B, the object is ____.

(iii) In Graph C, the object is ____.

(iv) In Graph D, the object is ____.

(v) In Graph F, the object is ____.

(vi) In Graph G, the object is ____.

(f) Positive net work is done on an object if it gains kinetic energy. Negative net work is done on an object if it loses kinetic energy.

(i) For which two objects was positive net work done during the 4-second interval? _____ _____

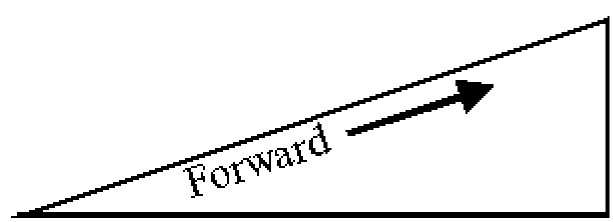
(ii) For which two objects was negative net work done during the 4-second interval? _____ _____

(iii) For which four objects was zero net work done during the interval? _____ _____ _____ _____

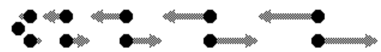
Explain your answer for Graph G (why does it have positive/negative/zero net work)?

Explain your answer for Graph E (why does it have positive/negative/zero net work)?

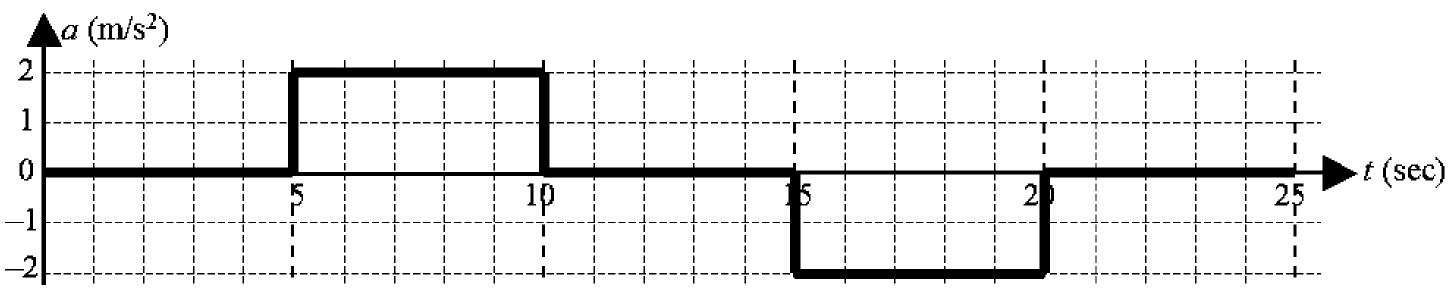
(g) Which three graphs could represent a cart with frictionless bearings on this incline? Explain your reasoning.



(h) For each motion map, state which graph describes the same motion. Motion to the right is forward.

 Graph _____	 Graph _____
 Graph _____	 Graph _____
 Graph _____	 Graph _____
 Graph _____	 Graph _____

Problem 2: An elevator starts at rest on the ground floor. The elevator moves so that its acceleration is shown as a function of time below.



(a) Is the elevator moving upward, moving downward, or at rest at time $t = 12$ seconds? If the elevator is moving, state its speed. In any case, explain your reasoning.

(b) Is the elevator moving upward, moving downward, or at rest at time $t = 22$ seconds? If the elevator is moving, state its speed. In any case, explain your reasoning.

(c) At time $t = 25$ seconds, is the elevator above or below its initial position, or has it returned to its initial position? Justify your answer.

Problem 3: A world-class runner can complete a 100 m dash in about 10 s. Past studies have shown that runners in such a race accelerate uniformly for a time t_u and then run at constant speed for the remainder of the race. A world-class runner is visiting your physics class. You are to develop a procedure that will allow you to determine the uniform acceleration a_u and an approximate value of t_u for the runner in a 100 m dash. By necessity your experiment will be done on a straight track and include your whole class of eleven students.

(a) By checking the line next to each appropriate item in the list below, select the equipment, other than the runner and the track, that your class will need to do the experiment.

____ Stopwatches	____ Tape measures	____ Rulers	____ Masking tape
____ Metersticks	____ Starter's pistol	____ String	____ Chalk

(b) Outline the procedure that you would use to determine a_u and t_u, including a labeled diagram of the experimental setup. Use symbols to identify carefully what measurements you would make and include in your procedure how you would use each piece of the equipment you checked in part (a).

(c) Outline the process of data analysis, including how you will identify the portion of the race that has uniform acceleration, and how you would calculate the uniform acceleration.

One-Dimensional Motion Review

IMPORTANT QUANTITIES

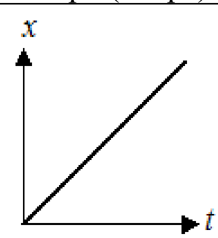
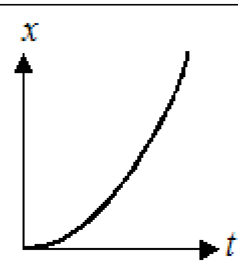
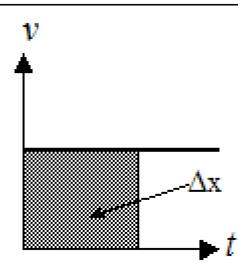
Name	Symbol	Units	Basic Equation
Time	t	Seconds	
Position	$\mathbf{x}$	Meters	
Length Distance	ℓ d	Meters	

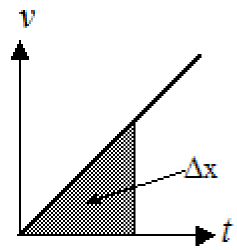
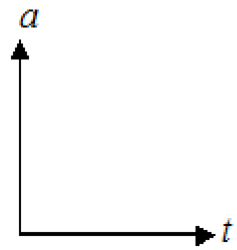
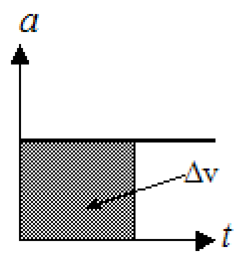
Name	Symbol	Units	Basic Equation
Velocity	$\mathbf{v}$	m/s	$\mathbf{v} = \dfrac{\Delta \mathbf{x}}{\Delta t}$
Speed	v	m/s	$v = \dfrac{\Delta \ell}{\Delta t}$
Acceleration	$\mathbf{a}$	m/s^2	$\mathbf{a} = \dfrac{\Delta \mathbf{v}}{\Delta t}$
Gravity on Earth	$\mathbf{g}$	m/s^2	$\mathbf{g} = 9.8\ m/s^2$ (Down)

IMPORTANT EQUATIONS

Name	Equation	Given?	Notes
Position as a function of time, constant velocity.	$\mathbf{x} = \overline{\mathbf{v}}t + \mathbf{x}_0$	No	Use if there is the velocity is constant or if you know initial and final velocity (the average of those is $\overline{\mathbf{v}}$).
Position as a function of time, constant acceleration.	$\mathbf{x} = \frac{1}{2}\mathbf{a}t^2 + \mathbf{v}_0 t + \mathbf{x}_0$	Yes	Use if there is acceleration, and time is involved in the problem, but no mention is made of final velocity.
Velocity as a function of time, constant acceleration.	$\mathbf{v} = \mathbf{a}t + \mathbf{v}_0$	Yes	Use if there is an acceleration and time in involved in the problem, no mention is made of position.
Velocity in terms of position and acceleration.	$v^2 = 2a(x - x_0) + {v_0}^2$	Yes	Use to relate initial and final position and velocity to acceleration, but **<u>no mention is made of time</u>**.

IMPORTANT GRAPHS

Name	Graph (Shape)	Notes
Position vs. Time (Constant Velocity)		**THE SLOPE OF A POSITION VS. TIME GRAPH IS VELOCITY.** Because velocity is constant, the slope is constant. This makes the graph a straight line.
Position vs. Time (Constant Acceleration)		**THE SLOPE OF A POSITION VS. TIME GRAPH IS VELOCITY.** Because the slope increases, the velocity increases. The shape of a position vs. time graph is a **<u>parabola</u>** for constant acceleration.
Velocity vs. Time (Constant Velocity)		**THE SLOPE OF A VELOCITY VS. TIME GRAPH IS ACCELERATION.** Because the slope is zero, acceleration is zero if velocity is constant. Constant velocity means constant *y*-value, so velocity vs. time for constant velocity is a flat line. **THE AREA UNDER A VELOCITY VS. TIME GRAPH REPRESENTS A *<u>CHANGE</u>* IN POSITION.**

Velocity vs. Time (Constant Acceleration)		**THE SLOPE OF A VELOCITY VS. TIME GRAPH IS ACCELERATION.** Because the acceleration is constant, the slope is constant. Constant slope means a straight line. **THE AREA UNDER A VELOCITY VS. TIME GRAPH REPRESENTS A *<u>CHANGE</u>* IN POSITION.**
Acceleration vs. Time (Constant Velocity)		**THE AREA UNDER AN ACCELERATION VS. TIME GRAPH REPRESENTS A *<u>CHANGE</u>* IN VELOCITY.** Since velocity is constant, there is no acceleration. The graph of zero is a horizontal line at $y = 0$, which means there is no area which means that there is no change in velocity.
Acceleration vs. Time (Constant Acceleration)		**THE AREA UNDER AN ACCELERATION VS. TIME GRAPH REPRESENTS A *<u>CHANGE</u>* IN VELOCITY.** Since acceleration is constant, the y-value of the graph is a constant, which makes a flat line.

IMPORTANT CONCEPTS

- Speed is the <u>magnitude</u> of velocity. Two cars, one traveling 60 mph north and the other 60 mph south, have the <u>same speed</u> but <u>different velocities</u>.
- Acceleration is a change in velocity. Since velocity is a vector, an object experiences an acceleration if <u>either its speed or its direction changes</u>.
- Only use the equation $v = \frac{\Delta x}{\Delta t}$ if speed is constant or you are asked for <u>average speed</u>!
- Only use the equation $a = \frac{\Delta v}{\Delta t}$ if acceleration is constant or you are asked for <u>average acceleration</u>! Note that this equation can never be used at the same time as $v = \frac{\Delta x}{\Delta t}$.
- Any object is considered to be in free-fall if gravity is the only force acting on it.

Big concept: Use kinematics whenever you have two of the following and are asked for a third: position, velocity, time, and acceleration.

Make sure that acceleration is constant before using the constant acceleration equations (hint: simple harmonic motion is not const. accel. because a spring exerts a varying force; circular motion is not const. accel. because the **a** keeps changing direction)