Physics 211 Exam 1

Name: _____

Recitation section: _____

- "Graph" means to make a precise graph on a separate sheet of graph paper. Intercepts, inflection points, slopes, the sign of concavity, and the like need to be accurate.
- "Sketch" means to make a casual graph which does not need to be on a separate page. These sketches need to illustrate only the essential features of the motion; they do not need to be perfectly to scale

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Question 1

A bucket hangs from a rope, 10m below the edge of a cliff. This rope is connected to a motor that accelerates it upward at $2\frac{\mathrm{m}}{\mathrm{s}^2}$.

At the same instant, a stone is dropped from the edge of the cliff and the motor is switched on, causing the bucket to accelerate upward.

Sketch the position vs. time of the bucket and of the stone on the same set of axes. (5 points)

How many seconds after the objects begin moving does the stone land in the bucket? (15 points)

How far does the stone fall before it lands in the bucket? (5 points)

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Question 2

Alice is standing on the street with a baseball. Bob is watching above from a window at a height of 5m above her. She throws the ball straight upward to him at a speed of 15 $\frac{\text{m}}{\text{s}}$, and he catches it as it flies upward.

How long is the ball in the air before he catches it? (15 points)

The quadratic formula gives you two roots. One of these will help you answer the preceding question. What is the physical interpretation of the other root? (5 points)

What is the ball's velocity when he catches it? (5 points)

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Question 3

A hiker on flat ground walks at a constant speed. She walks for one hour due north, walks for two hours at an angle 30^o south of west, then walks for three hours at an angle 45^o north of east.

How long must she walk to return to her starting point? (15 points)

In what direction must she walk to return to her starting point? (10 points)

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Question 4

An object has an acceleration of 5 $\frac{\text{m}}{\text{s}^2}$ eastward for 3 s, followed by an acceleration of 10 $\frac{\text{m}}{\text{s}^2}$ westward for 3s. The object then decelerates uniformly over a period of 5s until it comes to rest.

Graph (on separate graph paper) the object's acceleration vs. time (5 points), velocity vs. time (10 points), and position vs. time (10 points).

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Question 5

A ball is thrown from ground level at a speed v_0 at an angle θ above the horizontal.

Give your answers to the following in terms of g, v_0, and θ. If you run out of room, use the back of the page.

What are the horizontal and vertical components of the ball's initial velocity? (5 points)

What functions $x(t)$ and $y(t)$ give its position as a function of time? (5 points)

How long is the ball in the air before it lands? (5 points)

How far away from the starting point does the ball land? (5 points)

What is the maximum height achieved by the ball? (5 points)

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Question 6

A frog jumps horizontally off of a shelf 2 m high. It lands 1.5 m away.

What initial velocity did the frog jump with? (15 points)

What are the $x-$ and $y-$components of the frog's velocity when it lands on the ground? (5 points)

What is the frog's speed when it lands on the ground? (2 points)

What direction is the frog moving in when it lands? (3 points)