## Physics 131 Midterm I (Group Problem)

(11:50-12:18pm)

(No paper or calculator allowed. Explain your work to receive full credit: 20 points) (Assume g = 10 m/s<sup>2</sup>, sin 30<sup>°</sup> = 0.5, sin 45<sup>°</sup> =  $\frac{1}{1.4}$ , sin 60<sup>°</sup> = 0.87)

 $(x = x_0 + v_0 t + \frac{1}{2}at^2 \quad v = v_0 + at \quad v^2 = v_0^2 + 2a(x - x_0))$ 

Name:

Rec. Instr.: \_\_\_\_\_

1. In a movie you are planning to make, a smuggler in a ship, which is moored at 1.0 km from shore, throws a package into the sea and flee. At that instant, a Coast Guard battery on shore sees it and fires a shell toward the ship. The Coast Guard captain in the movie will know that shells leave his cannon with a muzzle velocity of 140m/s. He will also know the maximum acceleration of the smuggler's ship. He will do a quick calculation and choose the angle at which to fire the shell so that it will hit the ship. At the instant when shell is fired, a Coast Guard cutter will take off from shore at a constant speed of 50 m/s. The cutter reach the package when the shell hits the ship.

(a) At what angle will the shell be fired?

(12pts)

(b) What acceleration will the ship have to have?

(8pts)

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## Physics 131

(Spring 98)

## **Midterm I**

(11:30-12:18pm)

(No paper or calculator allowed. Explain your work to receive full credit: 80 points)

(Assume g = 10 m/s<sup>2</sup>, cos 45<sup>°</sup> = sin 45<sup>°</sup> = 
$$\frac{1}{\sqrt{2}} = \frac{1}{1.4}$$
)  
(x = x<sub>0</sub> + v<sub>0</sub>t +  $\frac{1}{2}at^2$  v = v<sub>0</sub> + at v<sup>2</sup> = v<sub>0</sub><sup>2</sup> + 2a(x - x<sub>0</sub>))

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

Rec. Instr.: \_\_\_\_\_

1. A postman drove a car that could accelerate or decelerate at 5 m/s<sup>2</sup>. He turned into a straight dead-end street to deliver a mail. After making the turn, he started from rest and accelerated for 4 s to reach the cruising speed. He then drove for 80 m before decelerating for 4 s to come to a stop. After taking 16 s to deliver the mail and turn around, he once again accelerated for 4 s to reach the cruising speed. He cruised along and then decelerated for 4 s to reach the stop sign at the junction.

(a) What is the total length of the dead-end street?

(10pts)

(b) What is the average speed for the trip?

(c) What is the average velocity for the trip?

(d) Sketch the graphs of x vs t and v vs t on the graphs provided. Indicate the scale on the vertical axes. (14 pts)

(3pts)

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(3pts)



2. A student drove east for 2 miles and then headed 45 degrees south-east for 4.2 miles. He then headed 45 degrees south-west for 1.4 miles.

(a) Add the three vectors graphically and show the resultant vector.

(10pts)



(b) Construct the three displacement vectors using unit vectors. (6pts)

(c) Express the total displacement using the unit vectors. What is the length and direction of the total displacement vector? (9pts)

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Rec. Instr.: \_\_\_\_\_

3. Two blocks are attached via a massless string over a massless pulley as shown. The angle of the frictionless incline is 45 degrees.

(a) If the blocks are released from rest, what is the acceleration of the blocks? (15pts)



(b) What is the tension in the string?

(5pts)