SPME430
SAMPLE EXAM (II)

1. A baseball player throws a baseball vertically upward in a gymnasium so that the baseball just reaches the ceiling. The height of the ceiling in the gymnasium is 8 m above the level that he releases the baseball (i.e, the vertical range of motion of the ball is 8 m). The mass of the baseball is 0.24 kg.

   a. With what initial vertical velocity does he throw the baseball?

   b. How long does it take the baseball to reach the ceiling?

At the instant that the baseball just touches the ceiling, the baseball player throws a tennis ball into the air with the same initial vertical velocity that the baseball had at the instant of release. However, the tennis ball also has a horizontal velocity of 3 m/s to the left at the instant of release. The release height of the baseball and the tennis ball were the same. The mass of the tennis ball is 0.16 kg.

   c. When the baseball and tennis ball are at the same vertical height, how far are they above the level from which they were released?

   d. How long after the tennis ball is thrown do the baseball and tennis ball reach the same vertical height?

   e. What is the vertical acceleration of the baseball when it is in the air?

   f. What is the vertical acceleration of the tennis ball when it is in the air?

   g. What is the horizontal location of the tennis ball when it is at the same height as the baseball? Assume that the horizontal location of the tennis ball at the instant of release was 0 m.

2. According to studies by Stevenson (1985), a diver (mass = 58 kg) entering the water from a 10 m tower has a vertical velocity of 16.8 m/s downward at the instant that they first touch the water. At an instant 0.133 s later, the velocity of the diver has decreased to 5.2 m/s downward.

   a. What was the change in the linear momentum of the diver over the 0.133 s interval after contact with the water?

   b. What was the average net impulse exerted on the diver over the 0.133 s interval after contact with the water?

   c. What was the average net force exerted on the diver during the 0.133 s interval after contact with the water?

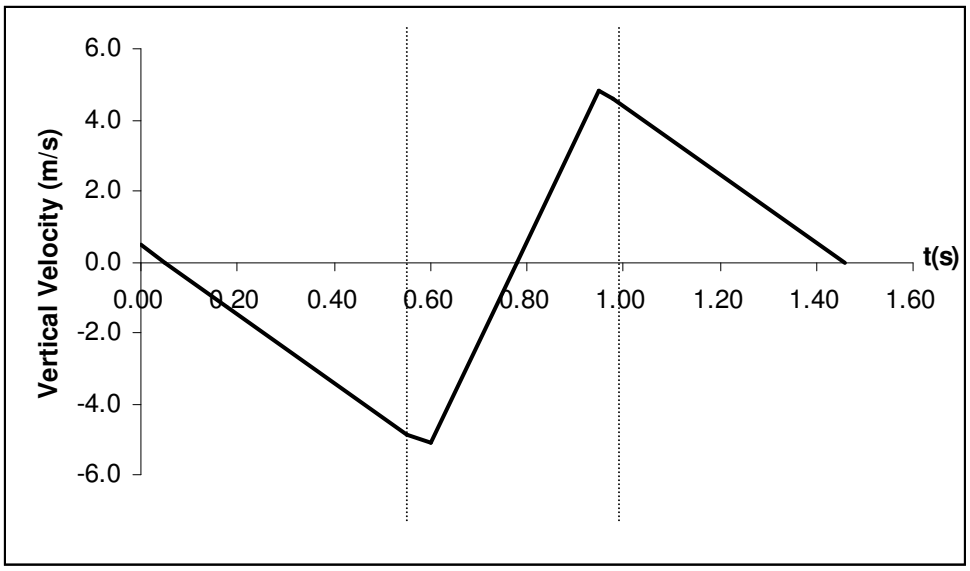
   d. Draw a free-body diagram of the diver at t=0.100 s.

   e. What was the average acceleration of the diver during the initial 0.133 s interval after contact with the water?

f. What was the average force exerted by the water on the diver during the 0.133 s interval after contact with the water?

g. Assuming that the linear acceleration of the diver remains constant during the entire time that he/she is submerged, how deep must the pool be so that the diver does not make contact with the bottom of the pool?

3. Depicted in the graph below is a slightly modified plot of the vertical velocity of the center of gravity of a person bouncing on a trampoline. The instants of touchdown (TD) and takeoff (TO) of the individual with the trampoline are indicated by dashed vertical lines at the times t=0.55 s and t=0.98 s, respectively. The mass of the trampoline is 80 kg and the mass of the subject is 60 kg. For this problem only, you can assume that g = -10.0 m/s^2.



Time (s)	Vertical Velocity (m/s)
0.00	0.5
0.05	0.0
0.55	-4.9
0.60	-5.1
0.78	0.0
0.95	4.8
0.98	4.6
1.46	0.0

a. Using the graph of v_V versus time, sketch the graph of a_V versus time.

Make the following graphs:

b. $\sum F$ versus time.

c. The weight of the subject (W) versus time.

d. The force made by the trampoline on the subject (F_{tramp}) versus time.

For the plots described in 3a, 3b, 3c and 3d, I don't want you to calculate the values of the parameters. Estimate the shapes of the curves based on the slopes/shapes of the appropriate graph.

Using the information provided on the plot of v_V versus time, determine the change in displacement in the following intervals. **For 3e - 3l, I want the correct numerical values (i.e., you will have to perform the calculations).**

e. 0.00 - 0.05 s
f. 0.05 - 0.55 s
g. 0.55 - 0.60 s
h. 0.60 - 0.78 s
i. 0.78 - 0.95 s
j. 0.95 – 0.98 s
k. 0.98 - 1.46 s

l. If the location of the center of gravity of the subject at t = 0.00 s was 2.80 m in the vertical direction, plot a displacement versus time graph for the subject.