Exam #1: Basic kinematics and dynamics

Name: /30

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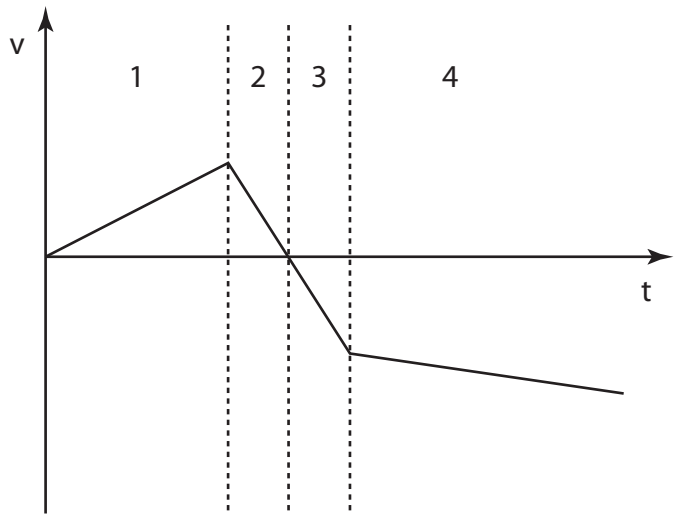
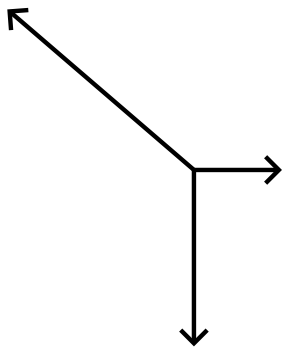
1. Conceptual problems

a. The velocity-time graph of a car is shown below. During each of the four time intervals, indicate whether the car is speeding up or slowing down. [4 pts]



b. Three forces acting on an object are indicated by the free-body diagram below. Sketch the net force acting on the object. [3 pts]



c. Draw free-body diagrams for each of the following: (i) a projectile in motion in the presence of air resistance, (ii) a rocket leaving the launch pad with its engines operating, and (iii) an athlete running along the end of a horizontal track (i.e., as their direction is changing). [3 pts]

2. A wrecking ball is hanging from a crane when the cable suddenly breaks. It takes the ball 1.2 s for the ball to travel halfway to the ground. Ignore air resistance.

a. How far does the ball fall? [3 pts]

b. What is the ball's velocity just before it hits the ground? (3 pts)

3. A Ferris wheel carries its riders in a (vertically oriented) circle with a radius of 8.0 m. The Ferris wheel makes one revolution every 9.0 s.

a. Calculate the angular velocity. [2 pts]

b. Calculate the centripetal acceleration and centripetal force acting on a 70-kg person as they travel around in a circle on the Ferris wheel. What direction does the force point? [2 pts]

c. What is the person's apparent weight (or normal force acting upward on them) as they pass the lowest point of the circle? How does this compare to their weight? [2 pts]

4. Chinook salmon are able to move upstream faster by jumping out of the water periodically; this behavior is called porpoising. Suppose a salmon swimming in still water jumps out of the water with a speed of 6.26 m/s at an angle of 45°, sails through the air a distance L before returning to the water, and then swims a distance L at a speed of 3.58 m/s before beginning another porpoising maneuver. Determine the average speed of the fish.

a. How long is the fish in the air during one "jump"? [2 pts]

b. How far does the fish travel during each "jump"? [2 pts]

c. How much time does the fish spend in the water between each "jump"? [2 pts]

d. What is the average speed of the fish? [2 pts]