Assignment: Answer all questions in a separate sheet of paper

Section A

Chapter 1: Physics and Measurements

Problem # 1, 3, 5, 9, 11, 15, 27, 35, 45, 59

Chapter 2: Motion in One Dimension

Problem # 1, 3, 5, 7, 9, 15, 19, 25, 27, 29, 37, 43, 49, 51

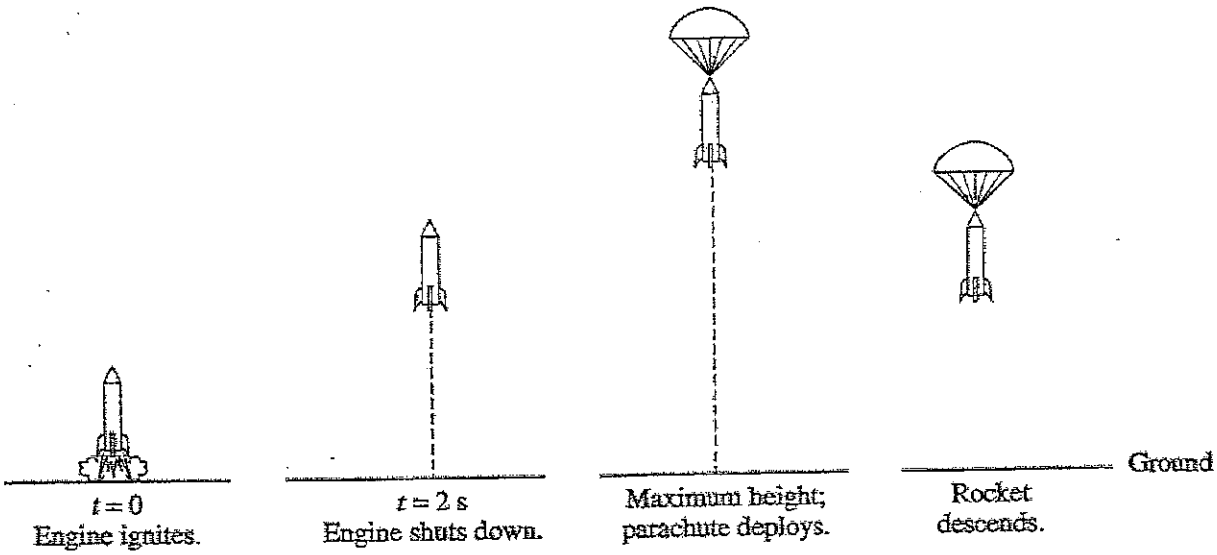
Chapter 3: Vectors

Problem # 1, 3, 5, 11, 13, 19, 23, 51

Chapter 4: Motion in Two Dimensions

Problem # 1, 3, 7, 11, 13, 15, 19, 21, 25, 29, 31, 33, 45

Section B: Show all work to get full credit



1.

Note: Figures not drawn to scale.

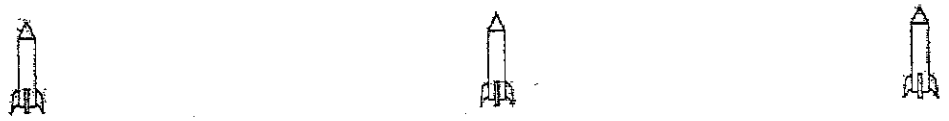
A model rocket of mass 0.250 kg is launched vertically with an engine that is ignited at time $t = 0$, as shown above. The engine provides an impulse of 20.0 N·s by firing for 2.0 s. Upon reaching its maximum height, the rocket deploys a parachute, and then descends vertically to the ground.

(a) On the figures below, draw and label a free-body diagram for the rocket during each of the following intervals.

i. While the engine is firing

ii. After the engine stops, but before the parachute is deployed

iii. After the parachute is deployed



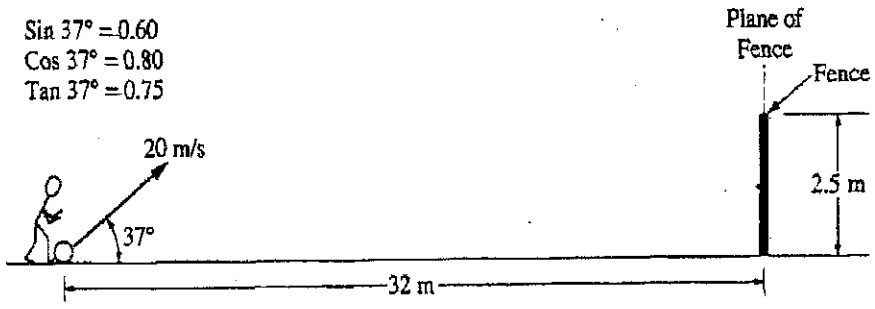
(b) Determine the magnitude of the average acceleration of the rocket during the 2 s firing of the engine.

(c) What maximum height will the rocket reach?

(d) At what time after $t = 0$ will the maximum height be reached?

Answers: b) 30 .0 m/s^2, c) 240 m d) 8.0 s

2.



Note: Diagram not drawn to scale.

A ball of mass 0.5 kilogram, initially at rest, is kicked directly toward a fence from a point 32 meters away, as shown above. The velocity of the ball as it leaves the kicker's foot is 20 meters per second at an angle of 37° above the horizontal. The top of the fence is 2.5 meters high. The kicker's foot is in contact with the ball for 0.05 second. The ball hits nothing while in flight and air resistance is negligible.

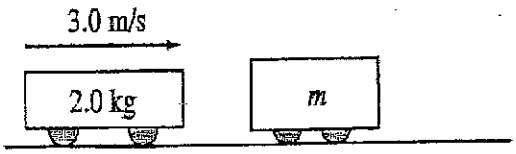
a. Determine the magnitude of the average net force exerted on the ball during the kick.

b. Determine the time it takes for the ball to reach the plane of the fence.

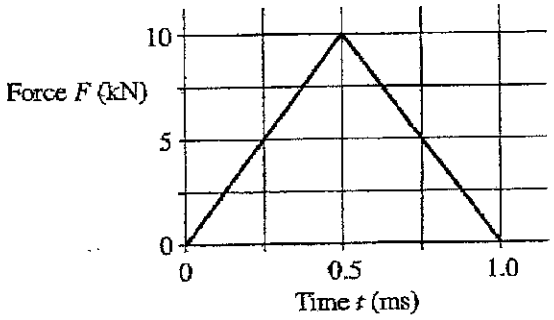
c. Will the ball hit the fence? If so, how far below the top of the fence will it hit? If not, how far above the top of the fence will it pass?

Answers: a) F= 200 N b) t= 2 sec c) yes, d= 4m

3.



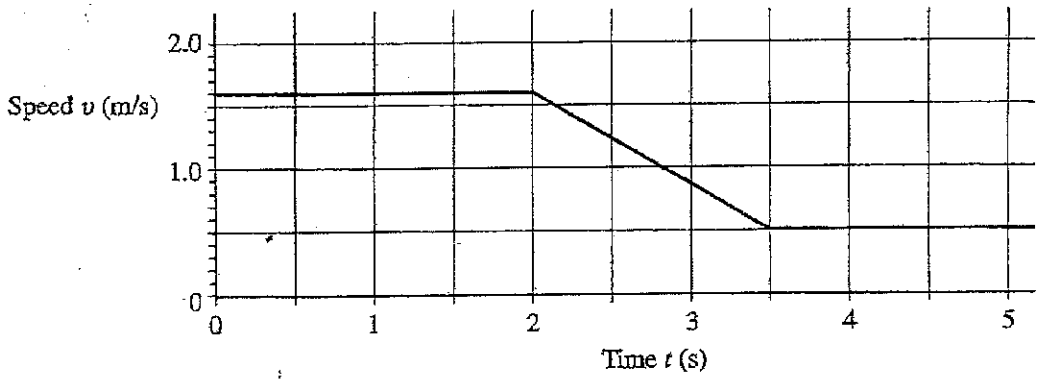
A 2.0 kg frictionless cart is moving at a constant speed of 3.0 m/s to the right on a horizontal surface, as shown above, when it collides with a second cart of undetermined mass m that is initially at rest. The force F of the collision as a function of time t is shown in the graph below, where $t = 0$ is the instant of initial contact. As a result of the collision, the second cart acquires a speed of 1.6 m/s to the right. Assume that friction is negligible before, during, and after the collision.



(a) Calculate the magnitude and direction of the velocity of the 2.0 kg cart after the collision.

(b) Calculate the mass m of the second cart.

After the collision, the second cart eventually experiences a ramp, which it traverses with no frictional losses. The graph below shows the speed v of the second cart as a function of time t for the next 5.0 s, where $t = 0$ is now the instant at which the carts separate.



(c) Calculate the acceleration of the cart at $t = 3.0$ s.

(d) Calculate the distance traveled by the second cart during the 5.0 s interval after the collision ($0 \text{ s} < t < 5.0 \text{ s}$).

(e) State whether the ramp goes up or down and calculate the maximum elevation (above or below the initial height) reached by the second cart on the ramp during the 5.0 s interval after the collision ($0 \text{ s} < t < 5.0 \text{ s}$).

Answers: a) v = 0.5 m/s to the right b) m = 3.1 kg c) a = - 0.73 m/s^2 d) d = 5.5 m e) h = 0.12 m