

Chapter 7 Homework Problems

Problem 7.1

A car with an initial velocity of 30 m/s accelerates at a constant rate of 12 m/s^2 . Find the time required for the car to reach a speed of 60 m/s and the distance traveled during this time.

(Solution: 2.5 sec, distance = 112.5 m)

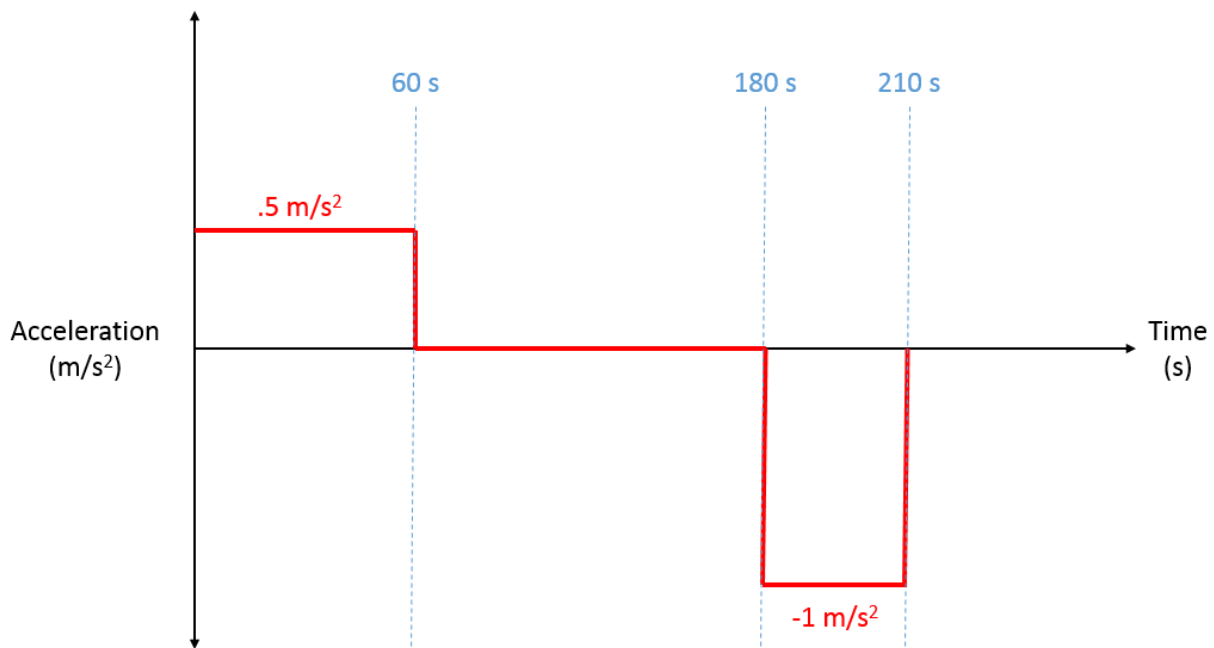
Problem 7.2

A car traveling 60 miles per hour sees a fallen log in the road 400 ft away. Assuming the driver immediately slams on the brakes, what is the required rate of deceleration needed to assure the driver does not hit the log?

(Solution: minimum acceleration = -9.68 ft/s^2)

Problem 7.3

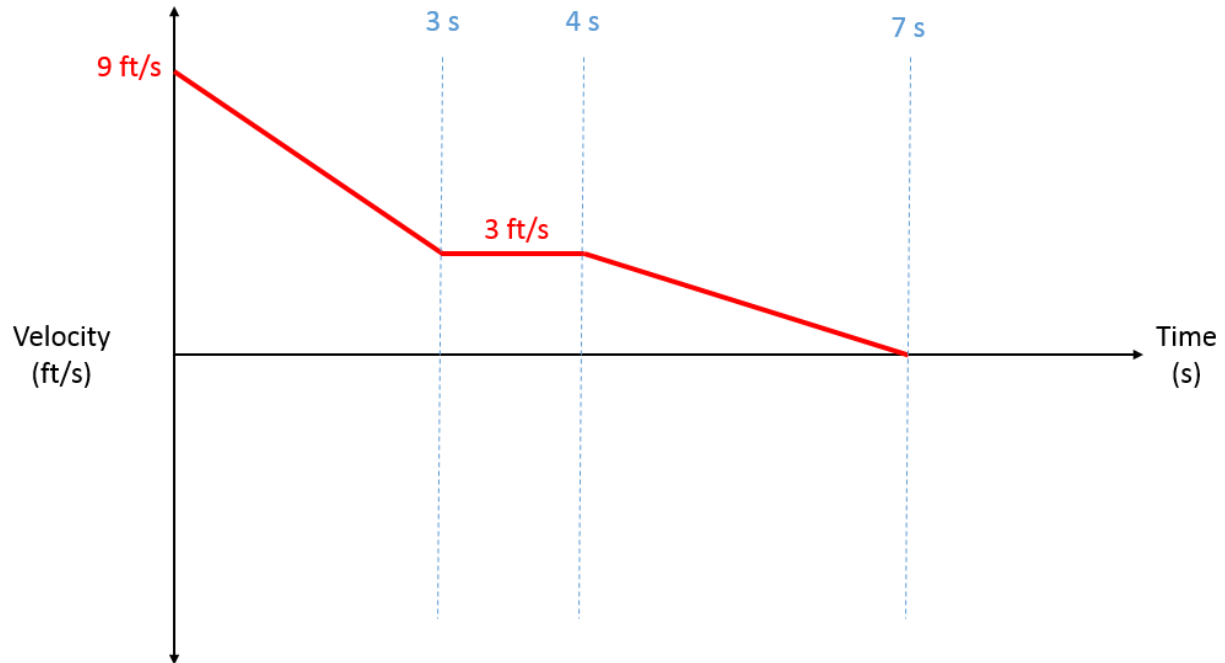
A train experiences the acceleration over time detailed below. Draw the v-t and s-t diagrams with all key points and equations labeled and determine the total distance traveled by the train.



(Solution: total distance = 4950 m + v-t and s-t diagrams)

Problem 7.4

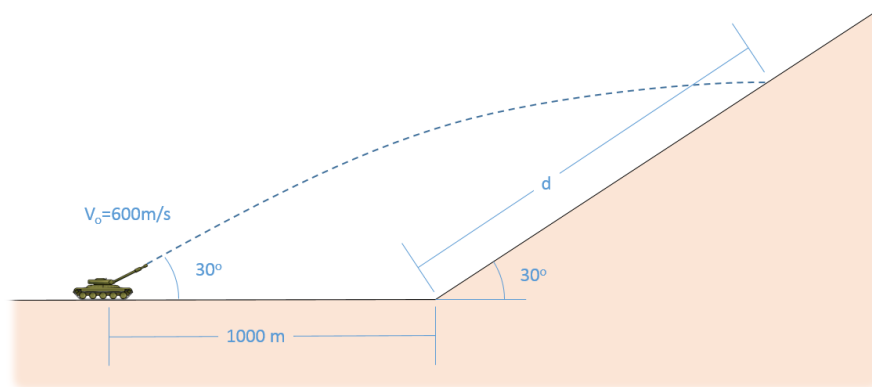
As a roller coaster cart comes into the gate at the end of the ride it goes through two sets of brakes. The velocity over time is shown in the graph below. Draw the a-t and s-t diagrams with all key points and equations labeled. Determine total distance the cart travels during this seven-second period.



(Solution: 25.5 ft + a-t and s-t diagrams)

Problem 7.5

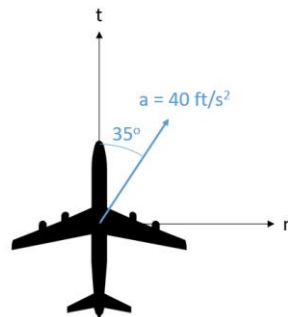
A tank fires a round at a 30° angle with a muzzle velocity of 600 m/s. The round is expected to hit a mountainside one kilometer away. The mountainside also has an average angle of 30° . How far up the mountainside will the round be expected to travel before hitting the ground (d) if we ignore air resistance?



(Solution: $d = 5.37 \text{ km}$)

Problem 7.6

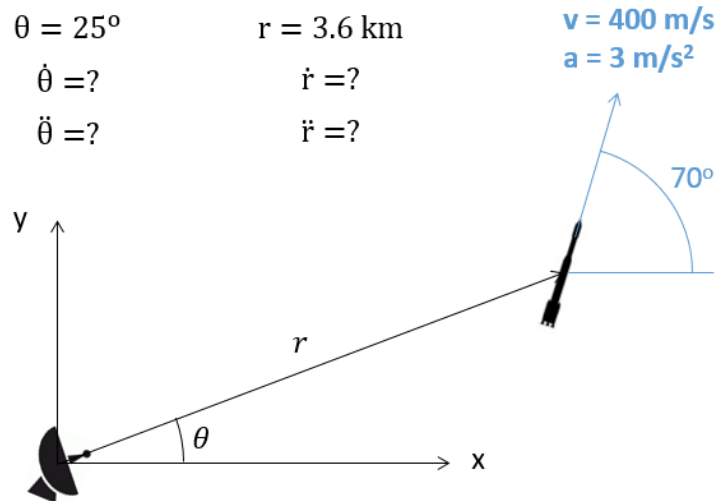
A plane with a current speed of 600 ft/s is increasing in speed while also making a turn. The acceleration is measured at 40 ft/s^2 at an angle 35° from its current heading. Based on this information, determine the rate at which the plane is increasing its speed (tangential acceleration) and the radius of the turn for the plane.



(Solution: $a_t = 32.77 \text{ ft/s}^2$ and $r = 15,690 \text{ ft}$)

Problem 7.7

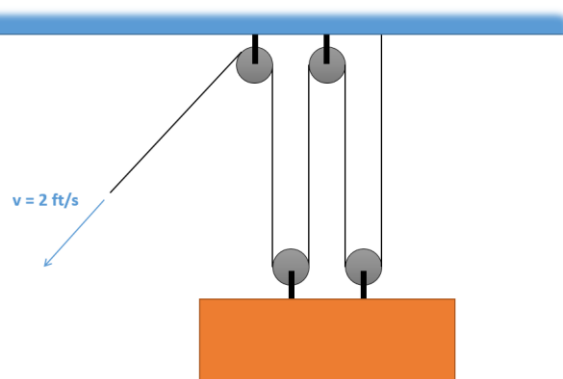
A radar station is tracking a rocket with a speed of 400 m/s and an acceleration of 3 m/s² in the direction shown below. The rocket is 3.6 km away ($r = 3600$ m) at an angle of 25°. What would you expect \dot{r} , \ddot{r} , $\dot{\theta}$, and $\ddot{\theta}$ to be?



(Solution: $\dot{r} = 282.8$ m/s, $\ddot{r} = 24.34$ m/s², $\dot{\theta} = .0786$ rad/s, $\ddot{\theta} = -.01176$ rad/s²)

Problem 7.8

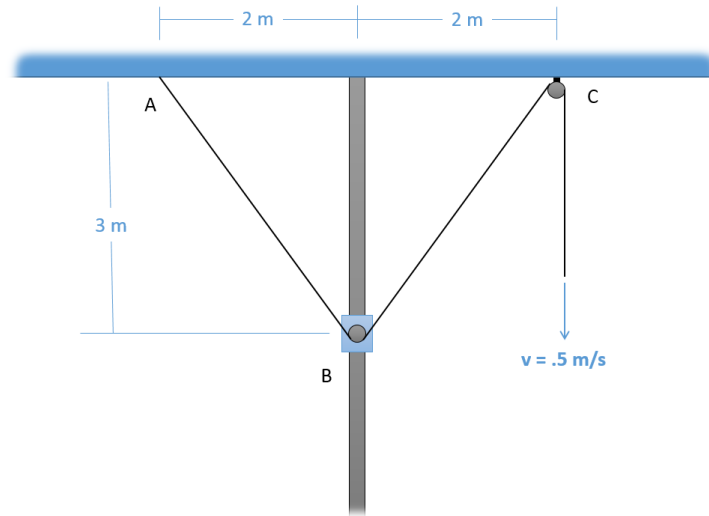
The pulley system below is being used to lift a heavy load. Assuming the end of the cable is being pulled at a velocity of 2 ft/s, what is the expected upwards velocity of the load?



(Solution: $v_L = .5$ ft/s)

Problem 7.9

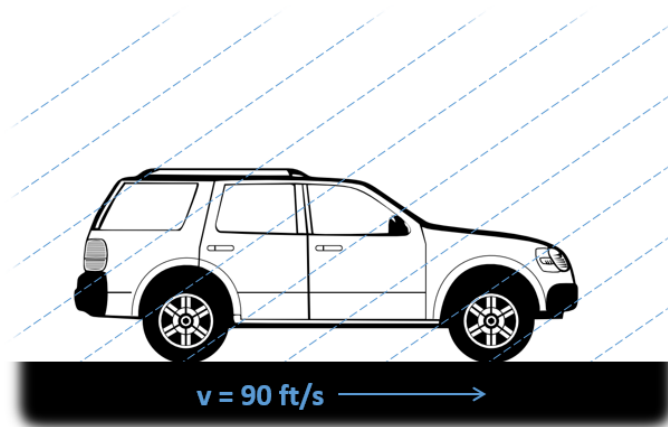
A cable is anchored at A, goes around a pulley on a movable collar at B, and finally goes around a pulley at C as shown below. If the end of the rope is pulled with a velocity of $.5 \text{ m/s}$, what is the expected velocity of the collar at this instant?



(Solution: $v_B = .3 \text{ m/s}$)

Problem 7.10

You are driving at a velocity of 90 ft/s in the rain while you notice that the rain is hitting your car at an angle 35° from vertical from your perspective. Assuming the rain is actually coming straight down (when observed by a stationary person), what is the velocity of the rain with respect to the ground?



(Solution: $v_r = 128.5 \text{ ft/s}$)