

# HW 1, ME 240 Dynamics, Fall 2017

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Fall 2017

Compiled on December 30, 2019 at 10:11pm [public]

Your response: ✓

Do not round intermediate calculations, however for display purposes report intermediate steps rounded to four significant figures. Give your final answer(s) to three significant figures.

The position of a car traveling between two stop signs along a straight city block is given by  $r = [8t - (45/2)\sin(2t/7)]$  m, where  $t$  denotes the time and  $0 \leq t \leq 17.8$  s. Compute the displacement of the car between 2.1 and 3.6 s, as well as between 11.1 and 12.6 s. For each of these time intervals, compute the average velocity of the car.



$$\Delta r_1 = \boxed{5.432} \text{ m}$$

$$\Delta r_2 = \boxed{21.286} \text{ m}$$

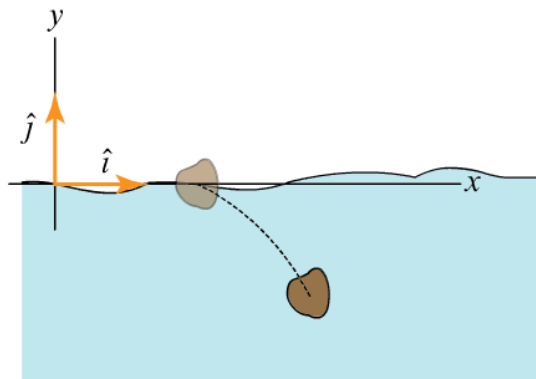
$$(v_{\text{avg}})_1 = \boxed{3.621} \text{ m/s}$$

$$(v_{\text{avg}})_2 = \boxed{14.190} \text{ m/s}$$

The motion of a stone thrown into a pond is described by

$$\vec{r}(t) = \left[ \left( 1.5 - 0.4e^{-13.5t} \right) \hat{i} + \left( 0.096e^{-13.5t} - 0.096 - 0.75t \right) \hat{j} \right] \text{ m, where } t \text{ is time}$$

expressed in s, and  $t = 0$  s is the time when the stone first hits the water. Determine the stone's velocity and acceleration. In addition, find the initial angle of impact  $\theta$  of the stone with the water, i.e., the angle formed between the stone's trajectory and the x axis at  $t = 0$  s.

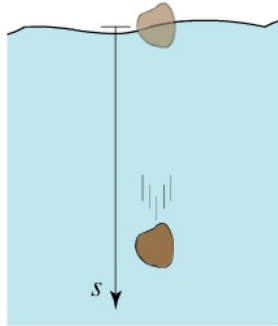


$$v(t) = \dot{r}(t) = \left[ \left( 5.4 \right) \hat{i} + \left( -0.75 \right) \hat{j} \right] \text{ m/s}$$

$$a(t) = \dot{v}(t) = \left[ \left( -72.9 \right) \hat{i} + \left( 17.496 \right) \hat{j} \right] \text{ m/s}^2$$

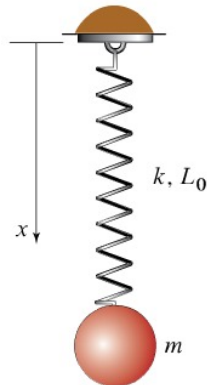
$$\theta = 20.776 \text{ } \times$$

A 1.7 kg rock is released from rest at the surface of a calm lake. If the resistance offered by the water as the rock falls is directly proportional to the rock's velocity, the rock's acceleration is  $a = g - C_d v/m$ , where  $g$  is the acceleration of gravity,  $C_d$  is a constant drag coefficient,  $v$  is the rock's velocity, and  $m$  is the rock's mass. Letting  $C_d = 4.1$  kg/s, determine the rock's velocity after 1.9 s.



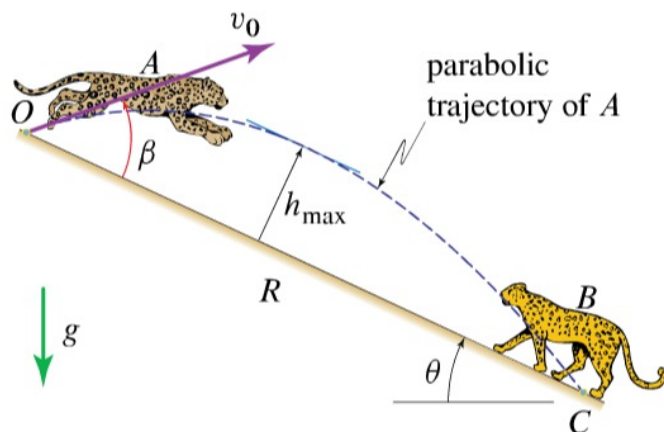
$$v_f = \boxed{4.026} \text{ m/s}$$

The acceleration of a particle of mass  $m$  suspended by a linear spring with spring constant  $k$  and unstretched length  $L_0$  (when the spring length is equal to  $L_0$ , the spring exerts no force on the particle) is given by  $\ddot{x} = g - (k/m)(x - L_0)$ . Let  $k = 101$  N/m,  $m = 0.8$  kg, and  $L_0 = 0.78$  m. If the particle is released from rest at  $x = 0$  m, determine the maximum length achieved by the spring.



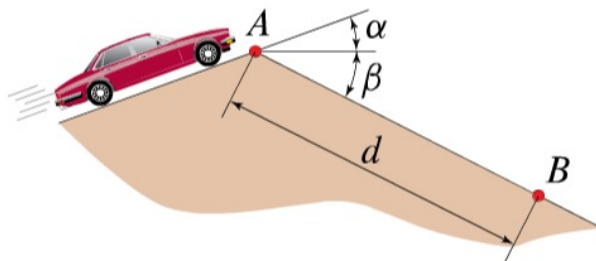
$$x_{\max} = \boxed{1.715} \text{ m}$$

The jaguar  $A$  leaps from  $O$  at speed  $v_0 = 6.4$  m/s and angle  $\beta = 38^\circ$  relative to the incline to try to intercept the panther  $B$  at  $C$ . Determine the distance  $R$  that the jaguar jumps from  $O$  to  $C$  (i.e.  $R$  is the distance between the two points of the trajectory that intersect the incline), given that the angle of the incline is  $\theta = 20^\circ$ .



$$R = \boxed{5.537} \text{ m}$$

In a movie scene involving a car chase, a car goes over the top of a ramp at  $A$  and lands at  $B$  below. Determine the speed of the car at  $A$  if the car is to cover distance  $d = 170$  ft for  $\alpha = 23^\circ$  and  $\beta = 32^\circ$ . Neglect aerodynamic effects.



$$v_0 = \boxed{51.093} \text{ ft/s}$$