HW 1,ME 240 Dynamics, Fall 2017

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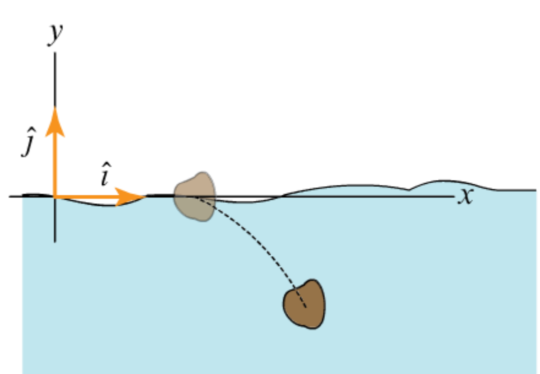
Your response: ✓

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 $0 \text{ s} \le t \le 17.8$ 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.

Δr_1 = 5.432 m ✓
Δr_2 = 21.286 m ✓
$(v_{avg})_1$ = 3.621 m/s ✓
$(v_{avg})_2$ = 14.190 m/s ✓

The motion of a stone thrown into a pond is described by $\vec{r}(t) = \left[\left(1.5 - 0.4e^{-13.5t}\right)\hat{\imath} + \left(0.096e^{-13.5t} - 0.096 - 0.75t\right)\hat{\jmath}\right]$ m, where t 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 θ of the stone with the water, i.e., the angle formed between the stone's trajectory and the x axis at $t = 0$ s.

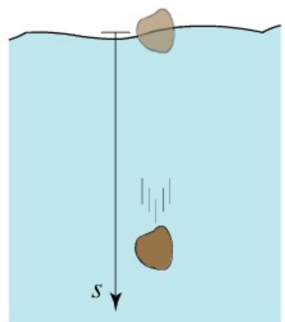


$v(t) = \dot{r}(t) = \left[\left(\boxed{5.4}\,✓\,e^{-13.5t}\right)\hat{\imath} + \left(\boxed{-0.75}\,✓\,\boxed{1.296}\,✓\,e^{-13.5t}\right)\hat{\jmath}\right]$ m/s

$a(t) = \dot{v}(t) = \left[\left(\boxed{-72.9}\,✓\,e^{-13.5t}\right)\hat{\imath} + \left(\boxed{17.496}\,✓\,e^{-13.5t}\right)\hat{\jmath}\right]$ m/s^2

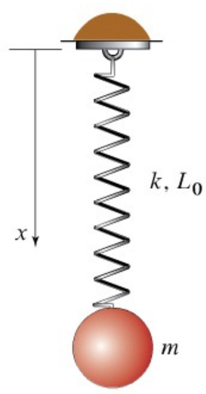
θ = 20.776 ✗

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.



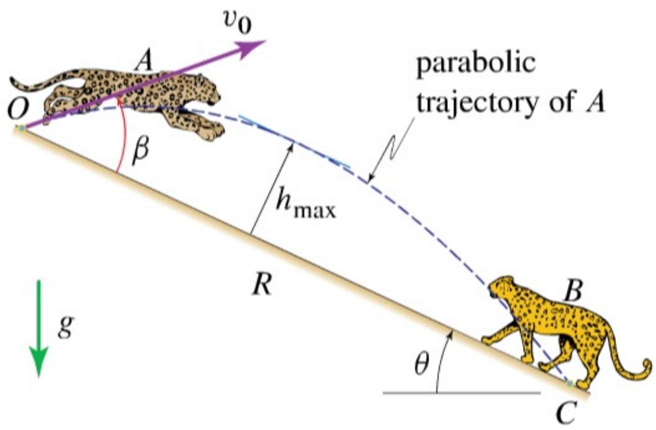
v_f = 4.026 m/s

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.



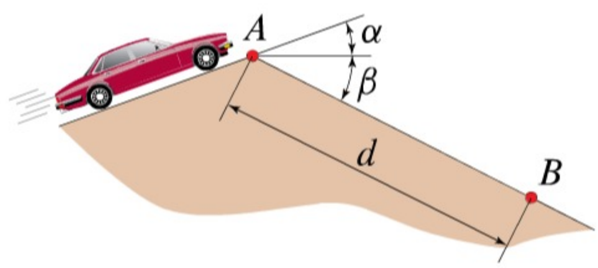
x_{max} = 1.715 m

The jaguar A leaps from O at speed v_0 = 6.4 m/s and angle β = 38° 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 isθ = 20°.



R = 5.537 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 α = 23° and β = 32°. Neglect aerodynamic effects.



v_0 = 51.093 ft/s