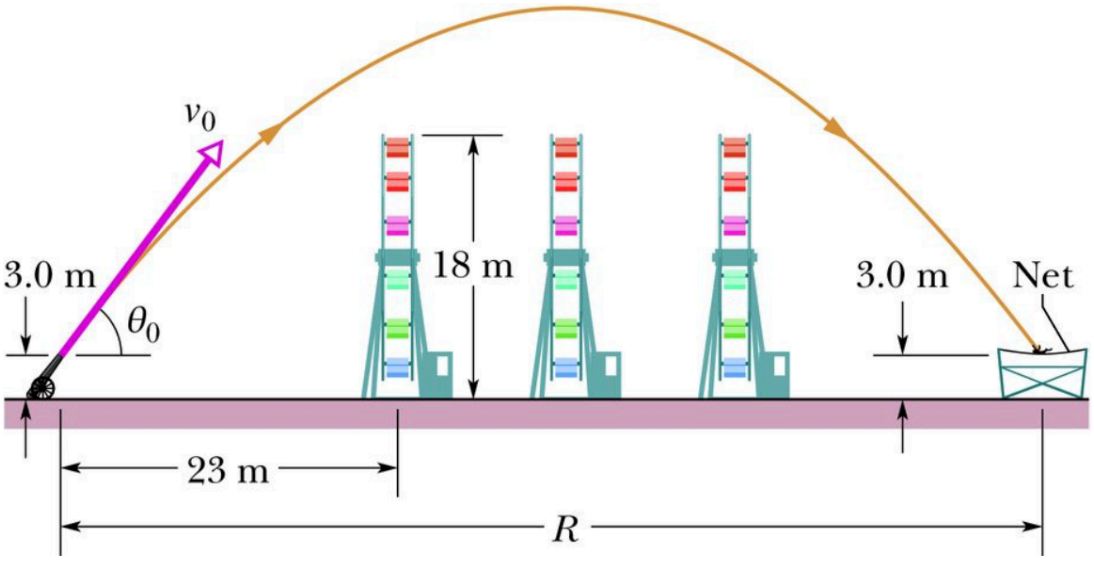
P1211 F2018, Problem-Solving Session (December 5, 2018)

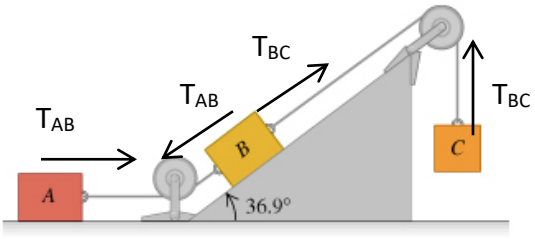
Projectile: Chapter 4

••42 In 1939 or 1940, Emanuel Zacchini took his human-cannonball act to an extreme: After being shot from a cannon, he soared over three Ferris wheels and into a net (Fig. 4-39). Assume that he is launched with a speed of 26.5 m/s and at an angle of 53.0°. (a) Treating him as a particle, calculate his clearance over the first wheel. (b) If he reached maximum height over the middle wheel, by how much did he clear it? (c) How far from the cannon should the net's center have been positioned (neglect air drag)?



Newton's Law: Chapter 5 and 6

Below **Box A**, M_A = 2 kg, is on a floor with **kinetic friction coefficient**, $\mu_k = 0.15$, and **static coefficient of friction**, $\mu_s = 0.25$. **Box A** is connect to a frictionless pulley system to **Box B**, M_B = 3 kg, resting on a 36.9°, with **no friction**. **Box B**, is connected by a frictionless pulley system, to **Box C**, M_C = 10 kg, as shown.

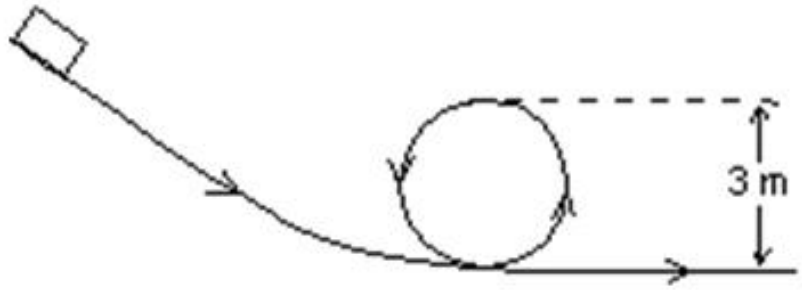


Draw FBD of all forces on the boxes. Use Newton's law to calculate the acceleration and tensions.

Energy: Chapter 7 and 8

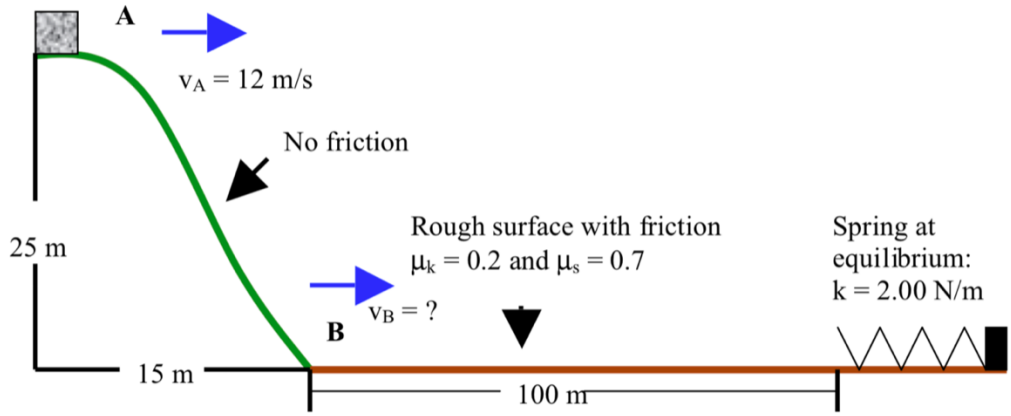
Multiple-Choice

A small object slides along the frictionless loop-the-loop with a diameter of 3 m. What minimum speed must it have at the top of the loop in order to remain in contact with the loop?



A) 1.9 m/s B) 3.8 m/s C) 5.4 m/s D) 15 m/s E) 29 m/s

In figure below a 14 kg stone slides down a snow covered hill, leaving point A with a speed of 12 m/s. There's no friction between point A and B, but there's friction after point B, where it reaches the spring and compresses it till it comes to a stop. A) Find the speed at the bottom of the hill (point B). B) Find the maximum compression of the spring.

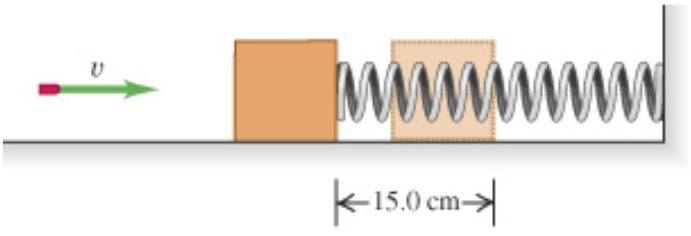


ANSWER: A) $v_B = 25.2 m \cdot s^{-1}$; B) x = 29.7 m.

Impulse and Momentum: Chapter 9

A bullet with a mass of 8.00×10^{-3} kg strikes and embeds itself in a block with mass 1.25 kg that rests on a **frictionless surface** and is attached to a coil spring with a **force constant** of $315 \frac{N}{m}$.

The impact compresses the spring 15.0 cm.



A) Find the **speed** of the block + bullet **just after** the **impact**. B) What was the **initial speed** (v) of the bullet **just before** it **hits** the block? C) Calculate the **impulse (magnitude and direction)** on the **box** due to its collision with the bullet.
ANSWER: A) 2.38 m/s; B) 373 m/s;
C) $J_x = P_2 - P_1 = Mv_F - 0 = (1.25kg)\left(2.38\frac{m}{s}\right) = 2.975\frac{kg \bullet m}{s}$ to the right.

Chapter 11: Rolling up Hill

In figure below Ball rolls up a hill without slipping. Assume that the ball is a solid sphere with moment of inertia, $I = \frac{2}{5}MR^2$. Find the linear, v_T, and angular, ω_T, speed of the ball at the top of the hill. Find the linear, v_B, and angular, ω_B, speed of the ball at the top of the hill. Calculate the change in kinetic energy from when it starts to climb the hill at 25 m/s to when it falls to the bottom of the hill. Why is the **energy not conserved**?