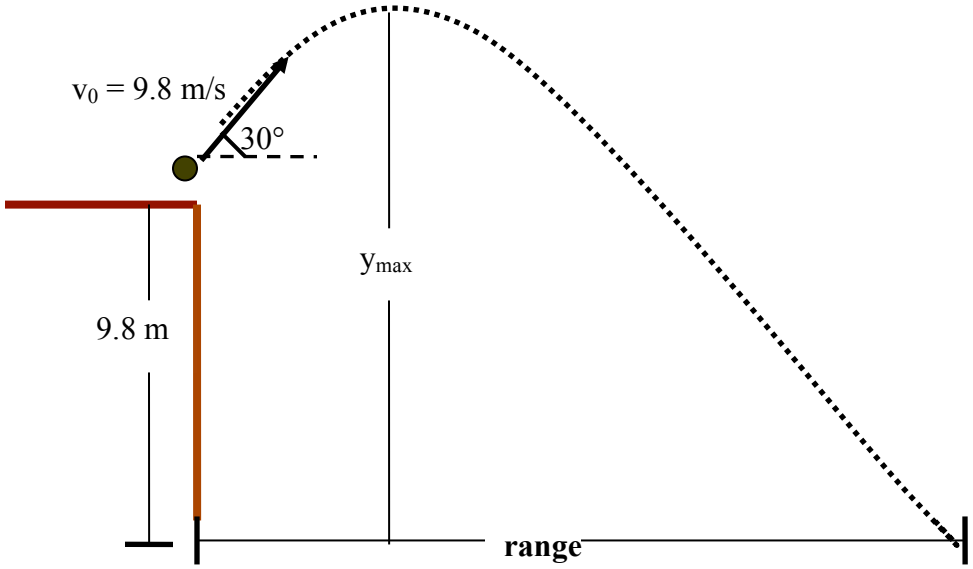
PRACTICE PROBLEMS: Final Exam, December 14 Monday, GYM, 6 to 9 PM

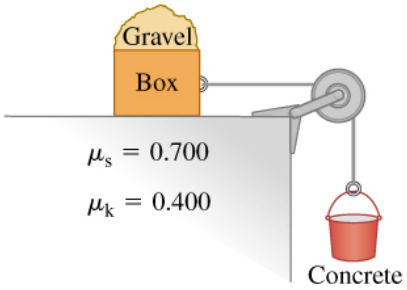
Problem 1

A ball is thrown off a 9.8 m high cliff with an initial speed of v_0 = 9.8 m/s at 30°, as shown in the diagram below.

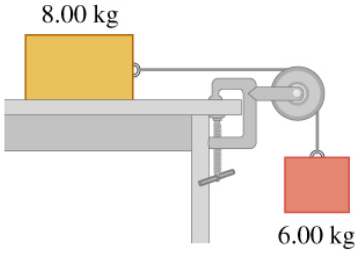


A) Find maximum height of ball. **Answer:** 11m above ground. B) Calculate the time it takes the ball to hit the ground. **Answer:** 2 seconds. C) Find range (horizontal distance traveled). **Answer:** 17m

Problem 2

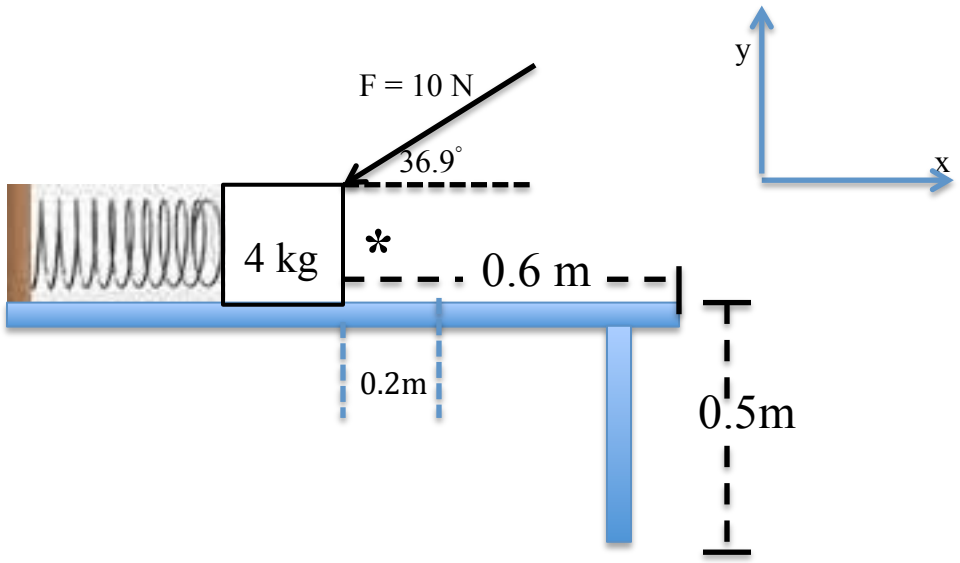


In diagram below a 65 kg bucket of concrete hangs from a cable connected to a 80 kg box with 50 kg of gravel on top. The friction between the box and the floor is as shown. A) If the system is at rest find the friction force on the box and the tension in the rope. B) If the gravel were removed the bucket will start to move down. Find the friction force and the acceleration and tension in the rope. **Answer:** A) T = 637, f_s = 637N (static Friction); B) T = 492 N, f_k = 313.6 N (Kinetic), a = 2.23 m/s^2.



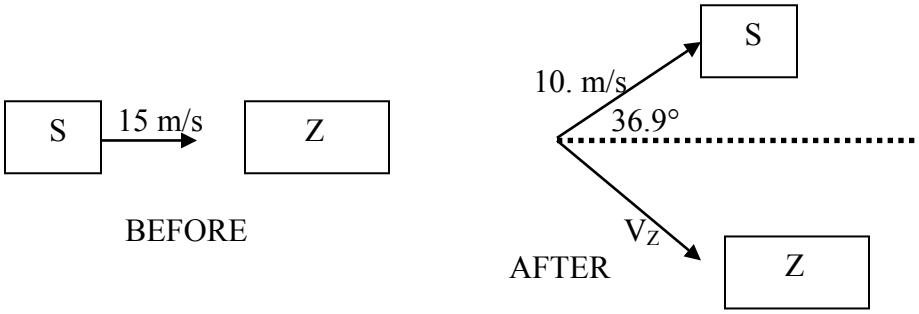
Problem 3 In the diagram below the coefficient of kinetic friction between the table and the 8kg crate is 0.250. Use the work energy theorem to calculate the speed of the 6kg block after it has fallen 1.50 m. **Answer:** assume that system starts from rest, final speed is 2.89 m/s

Problem 4 A 4-kg box compressed an ideal spring 20 cm from its equilibrium length. The box rests on a table with friction coefficients, $\mu_k = 0.15$ and $\mu_s = 0.25$, and the spring constant is $k = 800N/m$. The spring is released, and at the same time a 10-N force is applied at 36.9°, as shown below. The constant force is applied till the box falls off the edge. **A)** Show that the box will move (overcome static friction); **B)** Calculate the speed of the box at the edge of the table; **C)** Calculate the speed of the box just before it hits the ground.



Problem 5

Two skaters Sidney (m_S = 80 .0 kg) and Zdeno (m_Z = 100.0 kg) are practicing. Sidney skates at Zdeno with a speed of 15 m/s, while Zdeno doesn't move. They collide and after the collision Sidney has a velocity of 10. m/s, 36.9° from his initial direction.

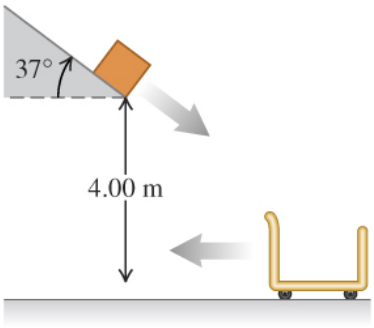


A)Find the x and y component of the final velocity (after collision) of Zdeno. Hence find Zdeno final speed, V_Z. **Answer:** 7.38 m/s.

B) Calculate the **total kinetic energy** before and after the collision. Find the change in the kinetic energy, ΔK. Is this an **elastic collision**? Why? **Answer:** ΔK = –2280J

Problem 6

In the diagram below a 50 kg cart rolls to the left at 5 m/s and a 15 kg box slides down an incline and leaves the edge at 3 m/s, 4 m above the bottom of the cart. A) What is the speed of the package just before it lands in the cart? B) What is the speed of the cart-package after the collision? **Answer: A)** 9.35 m/s; **B)** 2.39 m/s

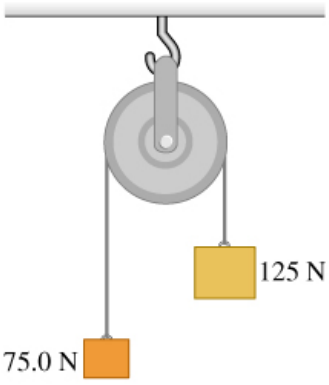


Problem 7

A computer disk starts rotating from rest at constant angular acceleration. If it takes 0.750 s to complete its second revolution: a) How long does it take to complete the first complete revolution; b) What is the angular acceleration? **Answer:** A) 1.81 s; **B)** 3.84 s^{-2}.

Problem 8

In the diagram below, two weights are connected by a very light string, which is passed over a 50 N solid-disk cylinder of radius 0.3 m. The 125 N accelerates downward, without the rope slipping. What force does the ceiling exerts on the pulley?



ANSWER: Using second law for linear and rotational motion, tension on the right rope is T_{125} = 153N; tension in the left hand side rope is T_{75} = 91.7N; acceleration a = 2.18 m•s^{-2}. Angular acceleration is α = 7.26 rad•s^{-2} clockwise (cw). Since the pulley does not fall down the vertical forces must add to zero, so that the **force** that the **ceiling exerts** on the **pulley** is 445 N.