Physics I

Energy Conservation

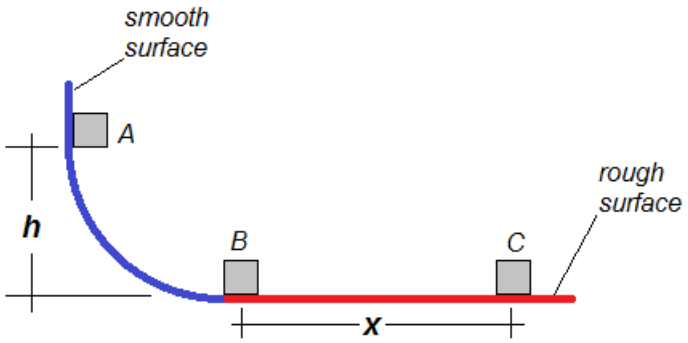
Work $W = Fd\cos\angle_F^d$

Kinetic energy linear motion $K.E. = \frac{1}{2}mv^2$

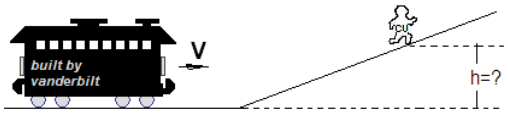
Gravitational potential energy $P.E. = mgh$

Problem 1.- A block is released from position *A* with zero initial velocity at a height $h = 4$m. It accelerates towards position *B* without friction. At point *B*, it starts to slow down due to friction and stops at *C*.
Calculate the distance *x* if $\mu = 0.4$

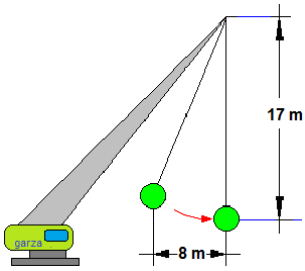
You can use the equations $F_{friction} = \mu F_{Normal}$, $F = ma$ and $v_2^2 = v_1^2 + 2ax$



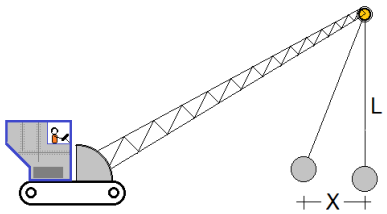
Problem 2.- A loose train car comes toward you at a speed v=12m/s on a level surface. In order to protect your life, you run up an incline. How far up do you need to go to be safe?
Assume you cannot jump to the side. Ignore friction.



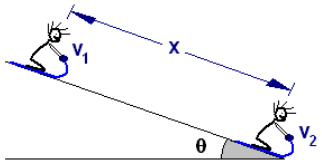
Problem 3.- A wrecking ball has a mass of 850 kg and is suspended from a crane by a 17m long cable. The ball is pulled 8 m away from the vertical and released. Calculate:
i) The velocity at the bottom of the trajectory
ii) The kinetic energy at that point.



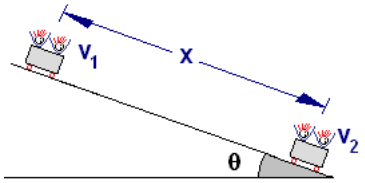
Problem 3a.- A wrecking ball of mass 250 kg is suspended from a crane with a cable of length L= 13m. The ball is pulled a distance X= 5m away from the vertical and released. Calculate the kinetic energy of the ball when it reaches the bottom of the trajectory.



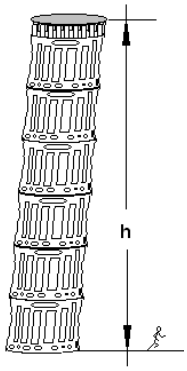
Problem 4.- A sled starts down a slope with an initial velocity $\mathbf{v_1=4m/s}$. Calculate its final velocity after sliding **x=10m** if the angle of the incline is $\mathbf{\theta=30^o}$ and we neglect friction.



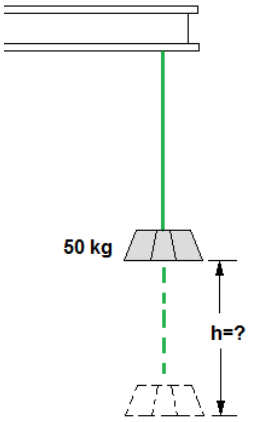
Problem 4a: A rollercoaster car starts down a slope with an initial velocity $\boldsymbol{v_1=4m/s}$. Calculate its final velocity after a distance $\boldsymbol{x=5m}$ along the slope if the angle of the incline is $\mathbf{\theta=37^o}$ and we neglect friction.



Problem 5.- A leaning tower of height h=34 m finally falls. Calculate the speed of the tip of the tower when it hits the ground.
To solve the problem, ignore the initial leaning angle, assume that the mass of the tower is uniformly distributed, ignore any external torque and approximate the moment of inertia to the one of a rod rotated about one end $I = \frac{1}{3}ML^2$



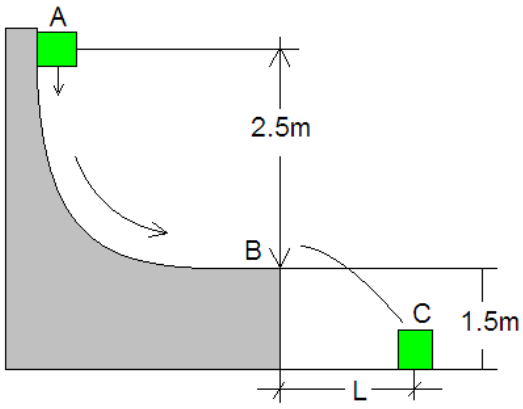
Problem 6.- Certain bungee cord behaves like a spring with constant k=800 N/m.
Suppose you attach a 50-kg mass to the end of the un-stretched cord that is hanging from a beam and release it (with initial v=0). How far down will the mass go?



Problem 7.- A 4g projectile traveling at 450 m/s hits a thick window and its stops after traveling 0.076m in the material. Find the average force on the projectile and how much kinetic energy was lost.

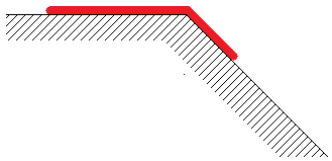
Problem 8.- A horizontal force of 230 N is applied to move a 68-kg cart (initially at rest) across a 13m-long level surface. What is the final speed of the cart?
Ignore friction in this problem.

Problem 9.- A solid block is released from point A. It slides without friction towards point B and finally lands at C. Assume the block is released from A with zero initial velocity, and its velocity at point B is horizontal. How much is the velocity at point B?



Problem 10.- Calculate the distance L in the problem above.

Problem 11.- Consider a uniform chain in the position shown in the figure. The length on the 45º inclined plane is 10 m and 20 m on the leveled surface. Its initial velocity is zero.
Calculate the velocity of the chain when the last link is on the inclined plane. Ignore friction and assume that all the links always stay in contact with the surface (this could be assured by using an elbow at the corner or some other way).



Problem 12.- A small object slides on a semicircular surface without friction. If it starts at point A with an initial velocity of 7m/s. What is its speed at point B?