# Conservation Energy

Phys109

December 11, 2019

1. Calculate the speed of the totally frictionless rollercoaster shown in Figure, when it reaches the ground if it starts at rest 20m above the ground. (answer 20 m/s)

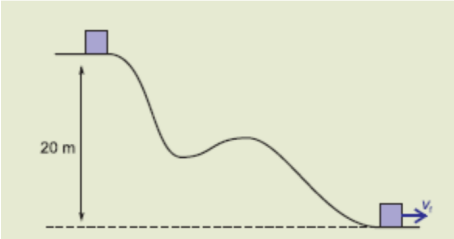


Figure 1: Problem no.1

2. A very small bus, with a mass of 500 kg, travels down a slope as shown in Figure, and arrives at the bottom of the slope travelling at a speed of $v = 15\ m/s$. The slope is 87.5 m long and starts at 20 m above the end point. Calculate the average force of friction on the bus. (answer: 500N)

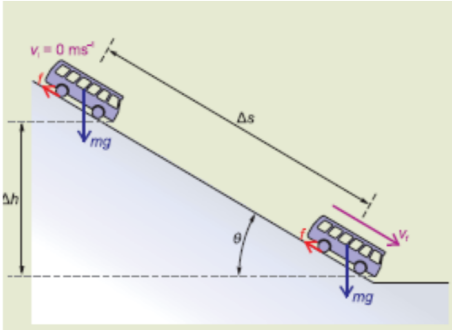


Figure 2: Problem no.2

3. A 2kg block situated on a rough incline is connected to a spring of negligible mass having a spring constant of 100 N/m. The pulley is frictionless. The block is released from rest when the spring is unstreched. The block moves 20!" down the incline before coming to rest. Find the coefficient of kinetic friction between block and incline. (answer: $\mu = 0.112$)

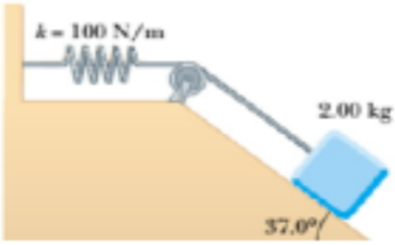


Figure 3: Problem no.3

4. A spring is hung vertically and an object of mass 2kg is attached to its lower end when the system is at equilibrium. If the spring is stretched by 10cm under the suspended object, find the spring's constant. (answer:196N/m)

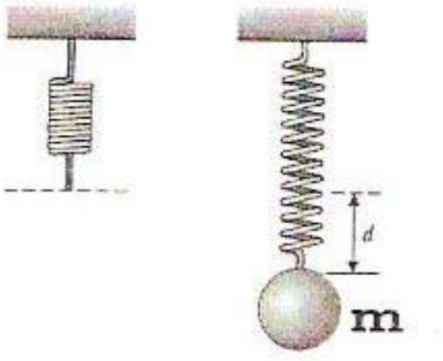


Figure 4: Problem no.4

5. A 3kg block is moving on a horizontal surface with an initial velocity of $\overrightarrow{v_0} = 2\hat{i}\ m/s$. The coefficient of kinetic friction between the block and the surface is 0.2. The mass hits the spring, located at distance of 1.9 m and stops. If the maximum compression of the spring is 0.1m, calculate (a) the spring constant k,(answer: 24N/m) (b) the change in the kinetic energy of the object. (answer: -6J)

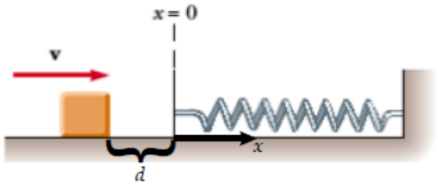


Figure 5: Problem no.5

6. A 60 kg skier starts from rest at $H = 20$ m above the end of a ski-jump ramp and leaves the ramp at angle 28°. Neglect the effects of air resistance and assume the ramp is frictionless. (a) What is the maximum height of his jump above the end of the ramp in which his speed is 17.5 m/s? (Answer: 4.4 m)
(b) If he increased his weight by putting on a backpack, would h then be greater, less, or the same?

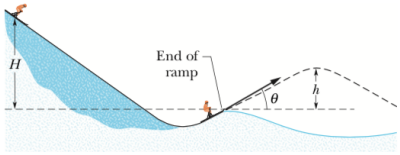


Figure 6: Problem no.6

7. Considering the Hook's law and answer the following questions?
   (a) What is the spring constant of a spring that stores 25 J of elastic potential energy when compressed by 7.5 cm?(Answer: 8889 N/m)
   (b) What is the maximum compression length of a spring stores 100 J of elastic energy with force constant $k = 1000\ N/m$? (Answer: 0.44 m)
   (c) What is the maximum stretch length of a spring which is streched by 100 N force with the spring constant of 250 $N/m$?(Answer: 0.4 m)

8. A horizontally moving block can take three friction-less routes, differing only in elevation, to reach the dashed finish line.
a) What is the height $h_1$ if the initial speed is 10 $m/s$ and it stops when it reaches to the $h_1$? (Answer: 5.1 m)
b) What is the final speed of this block when it passes through path 3 with $h_3 = 5$m? (Answer: 12 m/s)

9. A particle of mass 5 kg is released from point A and slides on the friction-less surface as shown in the figure.

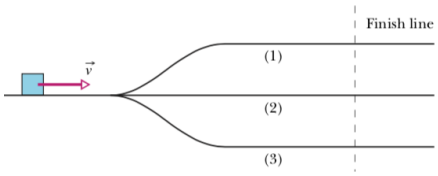


Figure 7: Problem no.8

(a) Determine the particle's speed at points B and C.(Answer: 5.9 m/s, 7.66 m/s)

(b) Determine the work done by the gravitational force in moving from A to C? (Answer: 147 J )

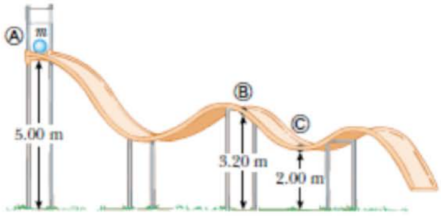


Figure 8: Problem no.9

10. A snowboarder with a mass of 57 kg starts from rest at the top of a frictionless slop at a height of45 m. She follows the frictionless path shown in figure. Calculate her speed at the second peak? (Answer: 19.8 m/s)

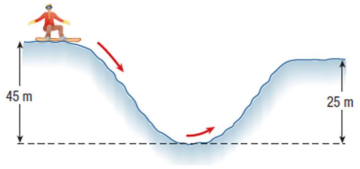


Figure 9: Problem no.10