Physics

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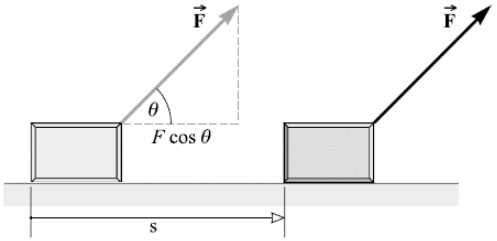
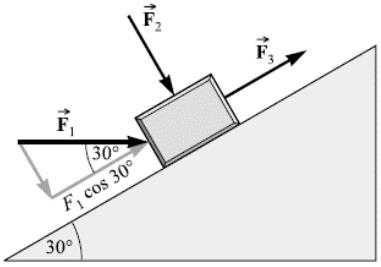
School: _____ Grade:_____

Work and Energy

1. In the figure below, assume that the object is being pulled along the ground by a 75-N force directed 28° above the horizontal. How much work does the force do in pulling the object 8.0 m?



2. A block moves up a 30° incline under the action of certain forces, three of which are shown in the figure below. F_1 is horizontal and of magnitude **40 N.** $\mathbf{F_2}$ is normal to the plane and of magnitude 20 N. $\mathbf{F_3}$ is parallel to the plane and of magnitude 30 N. Determine the combined work done by the forces as the block (and point of application of each force) moves 80 cm up the incline.



3. A 300-g object slides 80 cm along a horizontal tabletop. How much work is done in overcoming friction between the object and the table if the coefficient of kinetic friction is 0.20?

4. How much work is done against gravity in lifting a 3.0-kg object through a vertical distance of 40 cm?

5. How much work is done on an object with mass m by the force that supports it as the object is lowered through a vertical distance h? How much work does the gravitational force on it do in this same process?

6. A ladder 3.0 m long and weighing 200 N has its center of gravity 120 cm from the bottom. At its top end is a 50-N too box. Compute the work required to raise the ladder from a horizontal position on the ground to a vertical position.

7. Compute the work done against gravity by a pump that discharges 600 liters of fuel oil into a tank 20 m above the pump's intake. One cubic centimeter of fuel oil has a mass of 0.82 g. One liter is 1000 cm^3.

8. A 2.0-kg mass falls 400 cm.

   (a) How much work was done on it by the gravitational force?

   (b) How much PE_G did it lose?

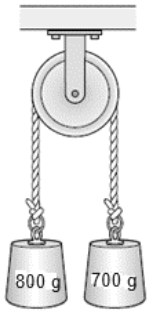
9. A force of 1.50 N acts on a 0.20-kg cart so as to accelerate it along an air track. The track and force are horizontal and in line. How fast is the cart going after acceleration from rest through 30 cm, if friction is negligible?

10. A 0.50-kg block slides across a tabletop with an initial velocity of 20 cm/s and comes to rest in a distance of 70 cm. Find the average friction force that retarded its motion.

11. A car going 15 m/s is brought to rest in a distance of 2.0 m as it strikes a pile of dirt. How large an average force is exerted by seatbelts on a 90-kg passenger as the car is stopped?

12. A projectile is shot upward from the earth with a speed of 20 m/s. How high is it when its speed is 8.0 m/s? (Ignore air friction.)

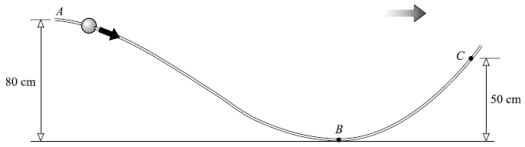
13. In an Atwood machine (as below) the two masses are 800 g and 700 g. The system is released from rest. How fast is the 800-g mass moving after it has fallen 120 cm?



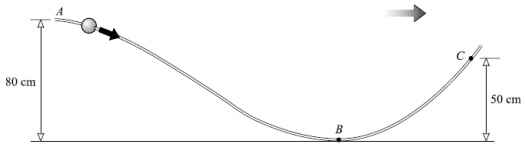
14. The figure below shows a bead sliding on a wire. If friction forces are negligible and the bead has a speed of 200 cm/s at A, what will be its speed

    (a) at point B?

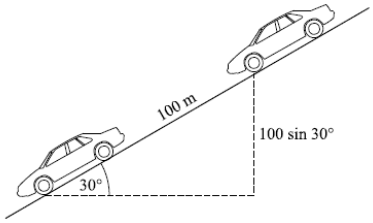
    (b) At point C?



15. Suppose the bead in has a mass of 15 g and a speed of 2.0 m/s at A, and it stops as it reaches point C. The length of the wire from A to C is 250 cm. How large an average friction force opposed the motion of the bead?



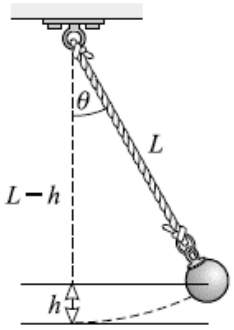
16. A 1200-kg car is coasting down a 30° hill as shown below. At a time when the car's speed is 12 m/s, the driver applies the brakes. What constant force F (parallel to the road) must result if the car is to stop after traveling 100 m?



17. A ball at the end of a 180-cm long string swings as a pendulum as shown below. The ball's speed is 400 cm/s as it passes through its lowest position.

    (a) To what height h above this position will it rise before stopping?

    (b) What angle does the pendulum then make to the vertical?

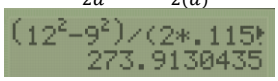


18. 500 g = 0.5 kg
200 cm/s = 2 m/s

Method I)
$a = g\sin 25° + g\cos 25°(0.15)$
$v^2 = 2as$
$s = \frac{v^2}{2a} = \frac{2^2}{2(9.8)(\sin 25+0.15\cdot\cos 25)}$ = 3.65 m

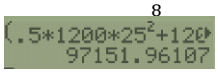
Method II)
$F = F_f + F_g = (mg\cos 25)\cdot 0.15 + mg\sin 25$
$W = F\cdot s = \frac{1}{2}mv^2$
$s = \frac{\frac{1}{2}mv^2}{F_f+F_g} = \frac{\frac{1}{2}mv^2}{(mg\cos 25)\cdot 0.15+mg\sin 25} = \frac{v^2}{2[(g\cos 25)\cdot 0.15+g\sin 25]}$ = 3.65 m

19. $a = g\frac{1}{100} + \frac{4{,}000-3{,}000}{60{,}000}$ = 0.098 + 0.017 = 0.115
$v_1^2 = v_0^2 + 2as$
$s = \frac{v_1^2-v_0^2}{2a} = \frac{12^2-9^2}{2(a)}$ = 273 m = 0.273 km



20. $\frac{KE}{t} = \frac{\frac{1}{2}mv^2}{t} = \frac{\frac{1}{2}\times 1200\times 25^2}{8}$ = 47 kJ/s = 47 kW

21. Distance = $\frac{1}{2}vt = \frac{1}{2}(25)(8)$ = 100
$\frac{KE+PE_G}{t} = \frac{\frac{1}{2}mv^2+mgh}{t} = \frac{.5(1200)25^2+1200(9.8)(100\sin 20)}{8}$ = 97 kJ/s



22. 5 cm/s = 0.05 m/s
0.25 hp = 0.25×746 watt = $mg\frac{h}{t} = m$ (9.8)(0.05)
$m = \frac{0.25\times 746}{9.8\times 0.05}$ = 380 kg

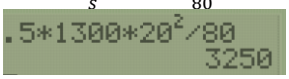
23. Power = $\frac{PE_G+KE}{time\ taken} = \frac{mgh+\frac{1}{2}mv^2}{t} = \frac{m}{t}\left(gh+\frac{1}{2}v^2\right) = 2\left(9.8\times 12+\frac{1}{2}3^2\right)$ = 244 W = 0.244 kW

24. $W = F\cdot s$ = 3×12 = 36 J

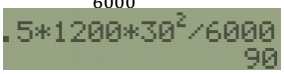
25. a) $W = W\cdot s$ = 4×9.8×1.5 = 58.8 J
b) -58.8 J

26. $W = F\cdot s$ = 180×9.8×1.7 = 3 kJ

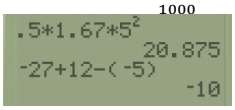
27. $W = F\cdot s = \frac{1}{2}mv^2$
$F = \frac{\frac{1}{2}mv^2}{s} = \frac{\frac{1}{2}(1300)20^2}{80}$ = 3.25 kN



28. $W = F\cdot s = \frac{1}{2}mv^2$
$s = \frac{\frac{1}{2}(1200)30^2}{6000}$ = 90 m



29. $W = F\cdot s = \frac{1}{2}mv^2$
$F = \frac{\frac{1}{2}(1.67\times 10^{-27})(5\times 10^6)^2}{\frac{0.01}{1000}}$ = 2×10^{-9} N



30. $W = F\cdot s$ = 200(9.8)(1.5) = 2.94 kJ