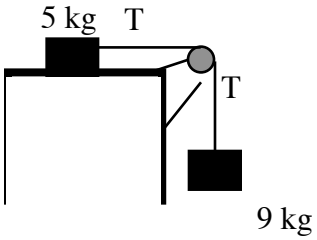
Closed book. No work needs to be shown for multiple-choice questions.

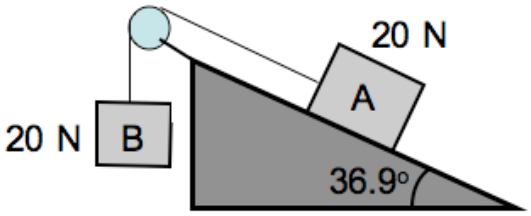
1. A 9.0-kg hanging weight is connected by a string over a pulley to a 5.0-kg block sliding on a flat table. If the coefficient of kinetic friction is 0.20, find the tension in the string.

a. 19 N
b. 24 N
c. 32 N
d. 38 N
e. 49 N



2. The system shown to the right remains at rest. Each block weighs 20 N. The force of static friction of the block on the incline is:

a. 4.0 N.
b. 8.0 N.
c. 12 N.
d. 16 N.
e. 20 N.



3. A 5.0 kg cart is moving horizontally at a speed of 6.0 m/s. In order to change its speed to 10.0 m/s, the net work done on the cart must be:

a. 400 J.
b. 90 J.
c. 40 J.
d. 160 J.
e. 550 J.

4. A skier of mass 70.0 kg is pulled up a slope by a motor-driven cable. The cable pulls her a distance of 60.0 m along a 30° frictionless slope at a constant speed of 2.00 m/s. What power must a motor have to perform this task?

a. 412 W.
b. 206 W.
c. 686 W.
d. 22.9 W.
e. 1370 W.

5. A sled of mass 20.0 kg is given a kick on a frozen pond, imparting to it an initial speed vi = 2.0 m/s. The coefficient of kinetic friction between the ice and the sled is 0.10. Use energy considerations to find the distance the sled moves before stopping.

a. 0.5 m.
b. 1 m.
c. 2 m.
d. 3 m.
e. 5 m.

6. The force acting on a particle is $F_x = (8x - 16)$ N, where x is in meters. Find the net work performed by this force if the particle moves from $x = 1.00$ to $x = 4.00$ m.

a. 0 J.
b. 12 J.
c. 24 J.
d. 32 J.
e. 64 J.

7. A roller coaster, loaded with passengers, has a mass of 2 000 kg; the radius of curvature of the track at the top point of the dip is 24 m. If the vehicle has a speed of 18 m/s at this point, what force is exerted on the vehicle by the track?

a. 2.3×10^4 N.
b. 7.4×10^3 N.
c. 4.7×10^4 N.
d. 1.0×10^4 N.
e. 2.7×10^4 N.

8. A car with mass M traveling at speed V has kinetic energy KE. What is the kinetic energy of a second car that has half the mass and twice the speed of the first car?

a. 0.5 KE
b. 2 KE
c. 4 KE
d. 8 KE
e. 0.25 KE

Equations and constants:

$$\begin{cases} x = r\cos\theta \\ y = r\sin\theta \end{cases};\quad \begin{cases} r = \sqrt{x^2 + y^2} \\ \theta = \tan^{-1}\left(\dfrac{y}{x}\right) \end{cases};\quad \begin{cases} v_x = v_{ox} + a_x t \\ \Delta x = \frac{1}{2}\left(v_{ox} + v_x\right)t \\ \Delta x = v_{ox}t + \frac{1}{2}a_x t^2 \\ v_x^2 = \left(v_{ox}\right)^2 + 2a_x\Delta x \end{cases};\quad \begin{cases} v_y = v_{oy} + a_y t \\ \Delta y = \frac{1}{2}\left(v_{oy} + v_y\right)t \\ \Delta y = v_{oy}t + \frac{1}{2}a_y t^2 \\ v_y^2 = \left(v_{oy}\right)^2 + 2a_y\Delta y \end{cases};$$

$$\begin{cases} \Delta x = x_f - x_i \\ \\ speed_{avg} = \dfrac{d}{\Delta t} \end{cases};$$

$\vec{v}_{AE} = \vec{v}_{AB} + \vec{v}_{BE}$ - relative motion

$\vec{a} = \vec{a}_r + \vec{a}_t$ where $a_r = v^2/r$ - circular motion

$$\begin{aligned} &range = v_o^{\,2}\sin(2\theta_o)/g \\ &\max - height = v_o^{\,2}\sin^2(\theta_o)/2g \end{aligned}$$ - projectile motion when initial and final height are the same

$$\begin{cases} a_{avg} = \dfrac{\Delta v}{\Delta t} \\ \\ v_{avg} = \dfrac{\Delta x}{\Delta t} \end{cases};\quad \begin{cases} a = \lim\limits_{\Delta t\to 0}\dfrac{\Delta v}{\Delta t} \\ \\ v = \lim\limits_{\Delta t\to 0}\dfrac{\Delta x}{\Delta t} \end{cases};\quad \begin{cases} \sum\vec{\mathbf{F}} = 0;\ \vec{\mathbf{a}} = 0 \\ \sum\vec{\mathbf{F}} = m\vec{\mathbf{a}} \\ \vec{\mathbf{F}}_{2on1} = -\vec{\mathbf{F}}_{1on2} \end{cases};\quad \begin{cases} F = G\dfrac{Mm}{r^2} \\ G = 6.67\times 10^{-11}\ \mathrm{N\cdot m^2/kg^2} \end{cases};;$$

$\vec{\mathrm{v}}_{\mathrm{AC}} = \vec{\mathrm{v}}_{\mathrm{AB}} + \vec{\mathrm{v}}_{\mathrm{BC}}$;

$PE_{spring} = \frac{1}{2}k\left(\Delta x\right)^2$; $W = \left|\vec{F}\right|\left|\Delta\vec{x}\right|\cos\theta$; $W_{\mathrm{net}} = W_1 + W_2 + W_3 ...$; $W_{\mathrm{nc}} = \Delta E_{mec}$; $\mathcal{P} = \vec{\mathbf{F}}\cdot\vec{\mathbf{v}} = \dfrac{W}{\Delta t}$;

$g = 9.80\ \mathrm{m/s^2}$; 100 cm = 1 m; 1,000 m = 1 km; 60 s = 1 min; 60 min = 1 hr; 2.54 cm = 1 in; 12 in = 1 ft; 5,280 ft = 1 mi; 1,609 m = 1 mi; 0.3048 m = 1 ft.