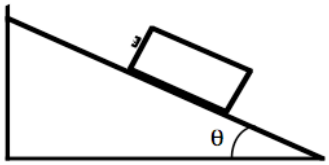
Closed book. No work needs to be shown for multiple-choice questions.

1. A 50 N block, on a 30° incline, is being held motionless by friction. The coefficient of static friction between the block and the plane is 0.83. The force due to static friction acting on the block in this case is:



a. 0 N.
b. 13 N.
c. 25 N.
d. 36 N.
e. 43 N.

2. A worker pushes a wheelbarrow with a horizontal force of 40 N over a level distance of 6.0 m. If a frictional force of 24 N acts on the wheelbarrow in a direction opposite to that of the worker, what net work is done on the wheelbarrow?

a. 240 J
b. 216 J
c. 144 J
d. 96 J
e. 72 J

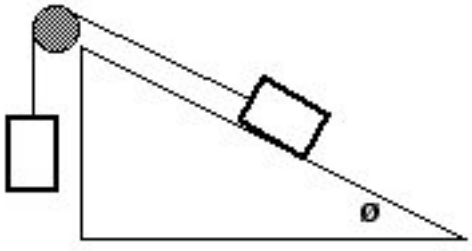
3. Yuri, a Russian weightlifter, is able to lift 250 kg to a height of 2.00 m in 2.00 s. What is his power output?

a. 500 W
b. 2.45 kW
c. 4.90 kW
d. 9.80 kW
e. 1.23 kW

4. A 1200-N crate rests on the floor. How much work is required to move it at a constant speed 4.0-m along the floor against a friction force of 230-N?

a. 230 J
b. 460 J
c. 920 J
d. 1200 J
e. 4800 J

5. A 5.0kg mass is accelerated up from rest at the bottom of the 4.0 m long ramp by a falling 20.0kg mass suspended over a frictionless pulley. The ramp is inclined 30° ramp from the horizontal, and the coefficient of kinetic friction is 0.26. Determine the acceleration of the 5.0 kg mass along the ramp.



a. 4.9 m/s^2.
b. 5.9 m/s^2.
c. 6.4 m/s^2.
d. 7.8 m/s^2.
e. 9.8 m/s^2.

6. A force $\vec{F} = 4x^2\hat{i} + 3y^3\hat{j}$ N acts on an object as the object moves in the x direction from the origin to $x = 3.00$ m. Find the work $W = \int \mathbf{F} \cdot d\mathbf{r}$ done on the object by the force.

a. 18 J
b. 243 J
c. 36 J
d. 81 J
e. 108 J

7. A roller coaster, loaded with passengers, has a mass of 2 000 kg; the radius of curvature of the track at the bottom 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 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.

Equations and constants:

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

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

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

$range = v_o^{\,2}\sin(2\theta_o)/g$

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

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

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

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

$g = 9.80\ \mathrm{m/s^2};\ 100\ \mathrm{cm} = 1\ \mathrm{m};\ 1{,}000\ \mathrm{m} = 1\ \mathrm{km};\ 60\ \mathrm{s} = 1\ \mathrm{min};\ 60\ \mathrm{min} = 1\ \mathrm{hr};\ 2.54\ \mathrm{cm} = 1\ \mathrm{in};$

$12\ \mathrm{in} = 1\ \mathrm{ft};\ 5{,}280\ \mathrm{ft} = 1\ \mathrm{mi};\ 1{,}609\ \mathrm{m} = 1\ \mathrm{mi};\ 0.3048\ \mathrm{m} = 1\ \mathrm{ft}.$