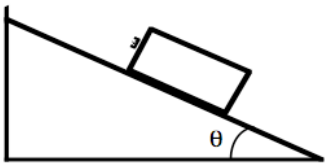
Closed book. No work needs to be shown for multiple-choice questions.

1. The coefficient of static friction between the tires of a car and the street is $\mu_s = 0.77$. Of the following, what is the steepest inclination angle of a street on which a car can be parked (with wheels locked) without slipping?



a. 22°.
b. 30°.
c. 38°.
d. 45°.
e. 50°.

2. A sled is dragged 8.0 m along a horizontal path at a constant speed of 0.30 m/s by a rope that is inclined at an angle of 25° above the horizontal. The tension in the rope is 450 N. What was the magnitude of the work done by the rope on the sled?

a. 20 J.
b. 1.9×10^2 J.
c. 3.3×10^3 J.
d. 3.6×10^3 J.
e. 1.6×10^2 J.

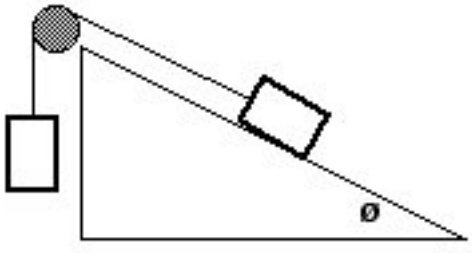
3. A crate of eggs is located in the middle of the flatbed of a pickup truck as the truck negotiates a flat curve on the road. The curve may be regarded as an arc of a circle of radius 35.0 m. If the coefficient of static friction between the truck and crate is 0.600, what is the fastest possible speed for the truck to be moving without the crate sliding?

a. 7.2 m/s.
b. 10.6 m/s.
c. 14.3 m/s.
d. 21.5 m/s.
e. 28.6 m/s.

4. 4.00×10^5 J of total work are done on a 1416 kg car while it accelerates from 10.0 m/s to some final velocity. Find this final velocity.

a. 20.6 m/s.
b. 23.8 m/s.
c. 25.8 m/s.
d. 28.4 m/s.
e. 21.6 m/s.

5. A 10.0kg 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 30º ramp from the horizontal, and the coefficient of kinetic friction is 0.3. Determine the acceleration of the 5.0 kg mass along the ramp.



a. 4.1 m/s^2.
b. 4.9 m/s^2.
c. 6.4 m/s^2.
d. 7.8 m/s^2.
e. 9.8 m/s^2.

6. A 60-kg woman runs up a flight of stairs having a rise of 4.0 m in a time of 4.2 s. What average power did she supply?

a. 380 W.
b. 560 W.
c. 620 W.
d. 670 W.
e. 57 W.

7. A sled of mass 30.0 kg is given a kick on a frozen pond, imparting to it an initial speed vi = 4.0 m/s. The coefficient of kinetic friction between the ice and the sled is 0.20. Use energy considerations to find the distance the sled moves before reaching a speed of 2.0 m/s.

a. 6 m.
b. 1 m.
c. 2 m.
d. 3 m.
e. 5 m.

8. A force $\vec{F} = 4x^3\hat{i} + 3y^2\hat{j}$ N acts on an object as the object moves in the x direction from x = 1.00 m and y = 2.00 m to x = 3.00 m and y = 4.00 m . Find the work $W = \int \mathbf{F} \cdot d\mathbf{r}$ done on the object by the force.

a. 80 J
b. 32 J
c. 56 J
d. 136 J
e. 228 J

Equations and constants:

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

$$\left\{\begin{array}{l} \Delta x = x_f - x_i \\ \\ speed_{avg} = \dfrac{d}{\Delta t} \end{array}\right\};$$

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

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

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

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

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

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