Name________________________________VID________________________________

Please circle or underline your final answers and show ALL of your work in a neat and well–organized way to recieve full credit. Also remember to write UNITS on your final answers. Good luck!

1) A block slides on a horizontal frictionless surface with an initial velocity of 3.0 m/s. A horizontal force of 100 N is applied to the block giving it an acceleration of 20.0 $m/s^2$

(a) Determine the mass of the block.

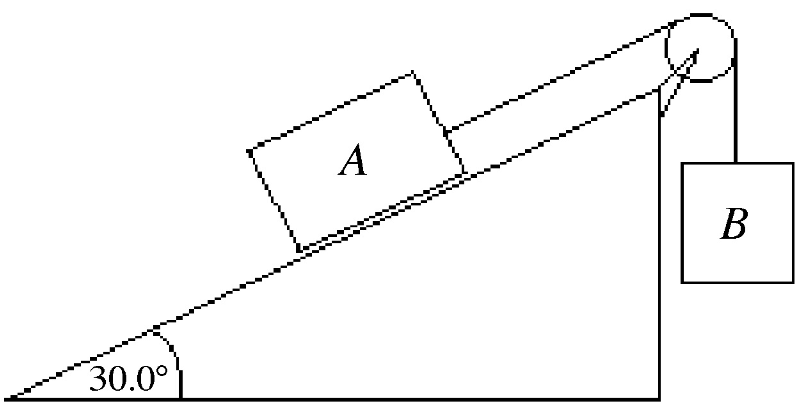
(b) Calculate the distance the block will travel if the force is applied for 7.0 s.

2) Two blocks are connected by a string that goes over an ideal pulley as shown in the figure. Block *A* has a mass of 3.00 kg and can slide over a rough plane inclined 30.0° to the horizontal. The coefficient of kinetic friction between block *A* and the plane is 0.400. Block *B* has a mass of 2.77 kg.

(a) Draw free-body diagrams of each object.

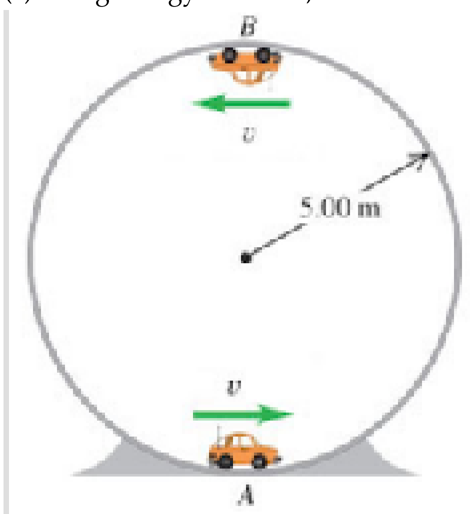
(b) Determine the magnitude of the force of *kinetic friction* on block A.

(c) Determine the tension in the string.



3) A 1500 kg rollercoaster is being pulled up a straight track inclined at an angle of 30º. The rollercoaster moves at a constant speed. Determine the *net* force on the rollercoaster.

4) A 0.65 kg toy car travels around a circular loop of radius 5.00 m. Sensors in the track show that the car pushes on the track with a force of 9.30N at the top of the track.
(a) Draw a free–body diagram depicting the forces on the car when it is at the top of the track and describe the direction of the cars acceleration vector.
(b) Determine the car's speed at the top of the track.
(c) Using energy methods, determine the car's speed at the bottom of the track.



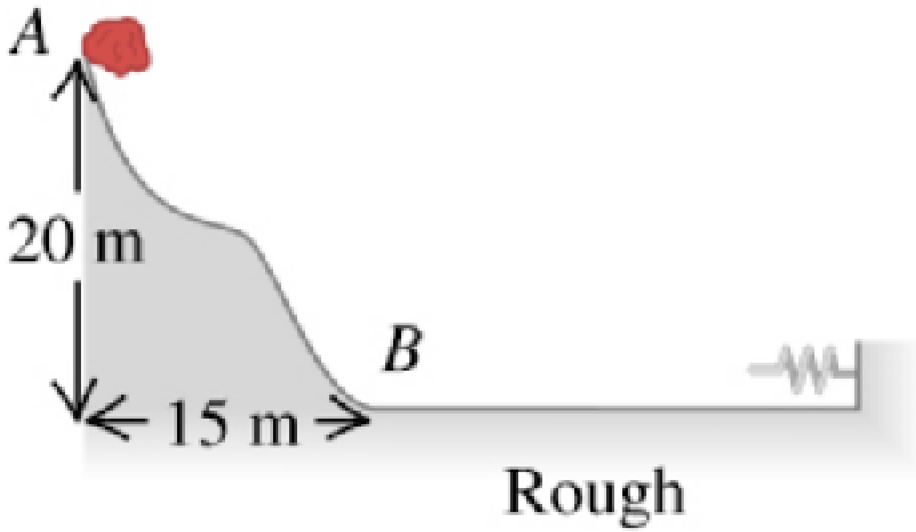

5) A force on a particle depends on position such that $F(x) = (3.00\ \text{N/m}^2)x^2 + (6.00\ \text{N/m})x$ for a particle constrained to move along the x-axis. What work is done by this force on a particle that moves from $x = 0.00$ m to $x = 2.00$ m?

6) A potential energy function in two dimensions is given by $U(x,y) = (3.00\ \text{J/m})xy + (1.00\ \text{J/m}^2)x^3$. Determine the magnitude and direction of the force at $\vec{r} = 2.0\text{m}\hat{i} - 7.0\text{m}\hat{j}$

7) An 16.0-kg stone is held in place against a spring of force constant ~~400.1N/m~~ 630,000N/m (and compressed 0.10 m) by a horizontal external force. The external force is removed, and the stone is projected across a rough surface with coefficient of kinetic friction 0.20 upon separation from the spring. The stone then ascends an ice-covered (frictionless) hill, as shown in the diagram below. The stone comes to rest at the top of the hill.

(a) Determine the speed of the stone at point B .

(b) Determine the length of the rough patch between the spring and point B.



8) A billiard ball traveling at 3.00 m/s in the +x direction collides perfectly elastically with an identical billiard ball initially at rest on the level table. The initially moving billiard ball deflects 30.0° above the x-axis from its original direction.

(a) What is the direction of the velocity of the initially stationary ball?

(b) What is the magnitude of the velocity of the initially stationary ball?

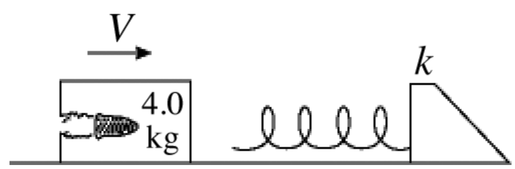
Chapter 8, We haven't covered this yet

9) An 8.0-g bullet is shot into a 4.0-kg block, at rest on a frictionless horizontal surface (see the figure). The bullet remains lodged in the block. The block moves into an ideal massless spring and compresses it by 8.7 cm. The spring constant of the spring is 2400 N/m.

(a) Determine the work done by the spring

(b) Determine the initial velocity of the bullet before it strikes the block.

for part b, just find the velocity of the block and bullet before they strike the spring. Again the initial velocity of the bullet is chapter 8.



Trigonometry

(1) $\cos(\theta) = \dfrac{adj}{hyp}, \sin(\theta) = \dfrac{opp}{hyp}, \tan(\theta) = \dfrac{opp}{adj}$

(2) $hyp^2 = adj^2 + opp^2$

Quadratic Formula:

$$Ax^2 + Bx + C = 0 \Rightarrow x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

Displacement, Velocity, Acceleration:

(1) $\Delta\vec{r} = \vec{r}_f - \vec{r}_0$

(2) $\vec{v}_{avg} = \dfrac{\Delta\vec{r}}{\Delta t}$

(3) $\vec{a}_{avg} = \dfrac{\Delta\vec{v}}{\Delta t}$

Kinematic Equations for constant acceleration:

(1) $x_f = x_0 + v_0 t + \dfrac{1}{2}at^2$

(2) $v_f = v_0 + at$

(3) $v_f^2 = v_0^2 + 2a(x_f - x_0)$

(4) $x_f - x_0 = \dfrac{1}{2}(v_f + v_0)t$

Work & Energy:

(1) $W_{net} = \dfrac{1}{2}mv_f^2 - \dfrac{1}{2}mv_0^2 = \Delta K.E.$

(2) $W = \vec{F} \cdot \vec{s} \ \ (Const.\ Force)$

(3) $W = \int_a^b \vec{F} \cdot d\vec{s} \ \ (Varying\ Force)$

(4) $\Delta K.E. + \Delta U - W_{nc} = 0 \ \ (No\ Ext.\ Forces)$

(5) $U_{Grav} = mgy \ \ U_{Spring} = \dfrac{1}{2}kx^2$

(6) $\Delta U_{ab} = -W_{ab} = -\int_a^b \vec{F} \cdot d\vec{s}$

(7) $\vec{F} = -\nabla U = -\dfrac{\partial U}{\partial x}\hat{i} - \dfrac{\partial U}{\partial y}\hat{j} - \dfrac{\partial U}{\partial z}\hat{k}$

Vector Products

(1) $\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}|\cos\phi_{AB} = A_x B_x + A_y B_y + A_z B_z$

(2) $|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}|\sin\phi_{AB}$

(3) $\vec{A} \times \vec{B} = \det\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$

(4) $\vec{v}_{inst} = \dfrac{d\vec{r}}{dt}, \vec{\omega}_{inst} = \dfrac{d\theta}{dt}$

(5) $\vec{a}_{inst} = \dfrac{d\vec{v}}{dt}, \alpha_{inst} = \dfrac{d\omega}{dt}$

(6) $|\vec{a}_{circular}| = \dfrac{v^2}{r}$

Newton's Laws:

(1) $\vec{F}_{net} = 0 \Rightarrow \vec{a} = 0$

(2) $\vec{F}_{net} = m\vec{a}$

$\vec{F}_{AB} = -\vec{F}_{BA}$

Force Laws:

(1) $\vec{F}_{fricetion} : \begin{array}{l} = \mu_k N \\ \leq \mu_s N \end{array}$

(2) $\vec{F}_{Spring} = -k\vec{x}$

(3) $\vec{F}_{Grav} = \begin{array}{l} mg \ \ (Earth's\ Surface) \\ \dfrac{Gm_1 m_2}{r^2} \ \ (Otherwise) \end{array}$

Impulse & Momentum:

(1) $\vec{F}_{net} = \frac{d\vec{p}}{dt}$ , $p = mv$

(2) $\vec{J}_{net} = F_{AVG}\Delta t = \int_0^t \vec{F}_{net}\,dt = m\vec{v}_f - m\vec{v}_i = \Delta$

(3) $\frac{d\vec{p}_{Total}}{dt} = 0$ (No Ext. Forces)

Center of Mass:

(1) $\vec{F}_{net\ EXT} = M_{Total}\vec{a}_{CM}$

(2) $\vec{r}_{CM} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2 + \ldots}{m_1 + m_2 + \ldots} = \frac{1}{M_{Total}}\int \vec{r}c$

(3) $\rho = \frac{M}{V} = \frac{dm}{dV}$

Answers (I think—I might have made mistakes):

1. (a) 5.0 kg (b) 511 m
2. (b) 10.18 N (c) 26.1 N
3. 0 N
4. (a) -y direction (b) 11m/s (c) 17.8m/s
5. 20 J
6. (a)19.8 m/s hint: work backward from the top of the hill
   (b) 1.61 m *use the new number, the old one doesn't work