Physics 2010
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EXAM 3

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A. A 2.00×10^2 N force is applied to a full Costco shopping cart and pushes the cart (m = 55.0 kg) down one of the aisles of the store. The force is is directed toward the floor at an angle of 28.0° below the horizontal. The coefficient of kinetic friction is $\mu_k = 0.120$ and the cart travels down the aisle a distance of 24.0 m. Note: This pushing force is large enough to cause the cart to accelerate.

1. *[6 pts.]* Find the work done on the cart by the pushing force.

$W_{\vec{F}} = F \Delta x \cos 28° = (200\text{N})(24\text{m}) \cos 28°$

$W_{\vec{F}} = \boxed{4.24 \times 10^3 \text{ J}}$

2. *[10 pts.]* Find the work done on the cart by the force of kinetic friction.

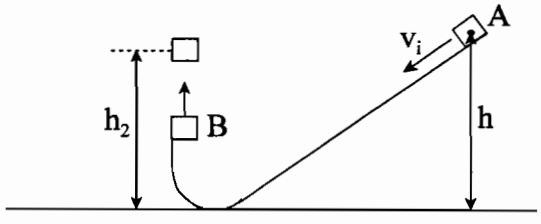
$W_{fk} = (\mu_k F_N) \Delta x \cos 180°$ $\quad F_N = F \sin 28° + mg$

$= (200\text{N}) \sin 28° + (55\text{kg})(9.8\text{m/s}^2)$

$F_N = 633\text{N}$

$W_{fk} = (.12)(633\text{N})(24\text{m}) = \boxed{-1.82 \times 10^3 \text{ J}}$

B. *[20 pts.]* A small block of mass m = 1.65 kg is projected from point A down a curved runway at an initial speed of $v_i = 4.00$ m/s (see drawing). At the initial instant, the center of mass of the block is 3.80 m (h) above the bottom of the runway. The block leaves the runway at point B traveling vertically upward. While the block is on the runway, nonconservative forces do 35.0 J of <u>negative work</u> while the block is on the runway. Determine the maximum height, h_2, above the bottom of the runway the block attains after leaving the runway.



$W_{NCR} = E - E_0$

$W_{NCR} = -35\text{ J}$

$E_0 = \frac{1}{2} m v_i^2 + mgh$

$E = mgh_2$

$-35 = mgh_2 - \left(\frac{1}{2} m v_i^2 + mgh\right)$

$= mgh_2 - \left((.5)(1.65\text{kg})(4\text{m/s})^2 + (1.65\text{kg})(9.8\text{m/s}^2)(3.8\text{m})\right)$

$mgh_2 = -35\text{ J} + 74.6\text{ J}$

$h_2 = \dfrac{39.6\text{ J}}{(1.65\text{kg})(9.80\text{m/s}^2)}$

$\boxed{h_2 = 2.45\text{m}}$