Show all Work!! Circle your answer(s).

A block of mass $m = 2.00 \text{ kg}$ is on a plane inclined at an angle $\theta = 20.0^\circ$ from the horizontal. The coefficient of kinetic friction between the block and the incline is $\mu_k = 0.500$. A force $F$ is applied on the block along the incline, as shown in the figure, and the mass moves down the incline at constant speed $v = 3.00 \text{ m/s}$.

(a) [2 pts.] Calculate the net work done on the block (the work done by all forces), when it moves 0.400 m.
(b) [6 pts.] Calculate the work done by the force of gravity when the block moves 0.400 m.
(c) [6 pts.] Calculate the work done by the force of kinetic friction when the block moves 0.400 m.
(d) [4 pts.] Calculate the work done by the force $F$ when the block moves 0.400 m.
(e) [2 pts.] Calculate the magnitude of the force $F$.

\[
\begin{align*}
\text{a)} \quad W_{\text{net}} &= \Delta K = 0.00 \\
\text{b)} \quad W_g &= mgd \sin \theta \\
&= 2 \times 9.8 \times 0.4 \times \sin 20^\circ = 2.68 \text{J} \\
\text{c)} \quad W_f &= -F \cdot d = -\mu_k mg \cos \theta \cdot d \\
&= -0.5 \times 2 \times 9.8 \times \cos 20 \times 0.4 = -3.68 \text{J} \\
\text{d)} \quad W_{\text{net}} = 0 &\quad \Rightarrow \quad W_g + W_f + W_F = 0 \\
&\quad \Rightarrow \quad W_F = -W_g -W_f \\
&= -2.68 + 3.68 = 1 \text{J} \\
\text{e)} \quad W_F &= Fd \quad \Rightarrow \quad F = \frac{W_F}{d} = \frac{1}{0.4} = 2.5 \text{N}
\end{align*}
\]
A block of mass \( m_1 = 50.0 \, \text{kg} \) and a block of mass \( m_2 = 75.0 \, \text{kg} \) are connected by a string that goes over a frictionless pulley of negligible mass as shown in the figure. The inclined surface is frictionless and the angle of the incline \( \theta = 60.0^\circ \). The system is released from rest.

(a) \([12 \text{ pts.}]\) Use energy methods to calculate the speed of the blocks as the 50.0 kg block rises a distance of 0.350 m.

(b) \([2 \text{ pts.}]\) Calculate the acceleration of the blocks? (Hint: use kinematics.)

(c) \([6 \text{ pts.}]\) What is the smallest coefficient of static friction between the incline and the block \( m_2 \) that would prevent the system from moving?

\[
\Delta E = E_f - E_i = 0
\]

Take ref. points for \( U_g \) at initial

\[
E_i = k_{i1} + k_{i2} + U_{g1} + U_{g2} = 0 + 0 + 0 + 0 = 0
\]

\[
E_f = k_{f1} + k_{f2} + U_{gf1} + U_{gf2}
\]

\[
= \left( m_1 v^2 + \frac{1}{2} m_2 v^2 + m_1 g d - m_2 g d \sin \theta \right)
\]

\[
E_i = E_f \Rightarrow \frac{1}{2} (m_1 + m_2) v^2 + m_1 g d - m_2 g d \sin \theta = 0
\]

\[
v^2 = \frac{2g d}{m_1 + m_2} \left( m_2 \sin \theta - m_1 \right) \Rightarrow \boxed{v = 0.9058 \, \text{m/s}}
\]

(b) All forces are constant:

\[
v^2 - v_0^2 = 2ad \Rightarrow a = \frac{v^2}{2d}
\]

(c) \( m_1 \):

\[\Sigma F_y = 0 \Rightarrow T = m_1 g\]

\[\Sigma F_y = 0 \Rightarrow T = m_1 g \cos \theta - f_s = 0\]

\[f_{\text{max}} = \mu_s N = \mu_s m_1 g \cos \theta\]

\[\Sigma F_y = 0 \Rightarrow m_2 g \sin \theta - T = \frac{m_2 g \sin \theta}{\mu_s} = 0\]

\[a = \frac{1}{2} \, \text{m/s}^2\]
\[ m_2 g \sin \theta - m_1 g - \mu_s m_2 g \cos \theta = 0 \]

\[ \mu_s = \frac{m_2 \sin \theta - m_1}{m_2 \cos \theta} \]

\[ \Rightarrow \mu_s = 0.391 \]
Show all Work!! Circle your answer(s).

A skier of mass \( m = 70.0 \text{ kg} \) races down a ski run that has a circular shape of radius \( R = 150 \text{ m} \). Assume that the ski run exerts a frictional force of constant magnitude \( f_k = 30.0 \text{ N} \) on the skier. The skier starts from rest at point A located at an angle of \( \theta = 50.0^\circ \) from the vertical as shown.

(a) [14 pts.] Calculate the speed of the skier at the bottom of the ski run, point B.

(b) [6 pts.] Calculate the normal force exerted on the skier by the ski run at point B?

(a)

\[
\Delta E = E_f - E_i = -f_k d
\]

\[
E_i = K_i + U_i = 0 + mg h = mgR(1 - \cos \theta)
\]

\[
E_f = K_f + U_f = \frac{1}{2}mv^2 + 0 = \frac{1}{2}mv^2
\]

\[
\frac{1}{2}mv^2 - mgR(1 - \cos \theta) = -f_k d
\]

\[
\frac{1}{2}mv^2 = mgR(1 - \cos \theta) - f_k d = 32,930
\]

\[
v = \sqrt{\frac{2(32,930)}{70}} = [30.6 \text{ m/s}]
\]

(b)

\[
\sum F_y = ma_y = \frac{mv^2}{R}
\]

\[
N - mg = \frac{mv^2}{R}
\]

\[
N = mg + \frac{mv^2}{R} = [1,124 \text{ N}]
\]