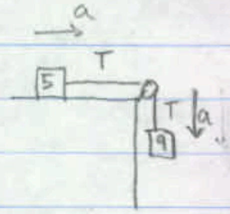
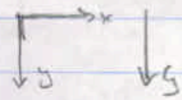
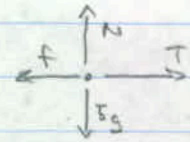
Quiz #3 Version A Solutions

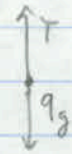
#1





Force Diagram:



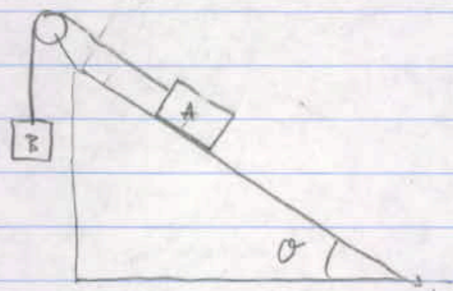


· Accelerations are equal: $5a = T - f$; $9a = 9g - T$
w/ $f = \mu_k N$ w/ $N = 5g$. Then eliminating "a" + solving for "T" we get: $a = \frac{T-f}{5}$.

$$9a = \frac{9}{5}(T-f) = 9g - T = 9/5\,T - 9/5\,f \;;\; T(9/5 + 1) = 9g + 9/5\,f \;;$$

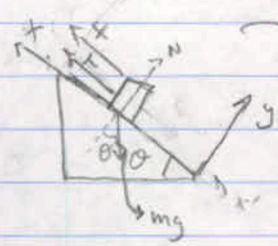
$$T = \frac{9g + 9/5\,f}{9/5 + 1} = \frac{88.2 + 17.64}{2.8} = \boxed{37.8\,N}$$

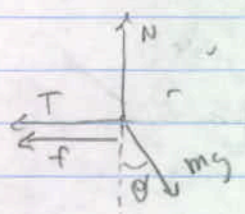
#2



Since it is not moving, we can use two different set of coordinates to determine the net force along the direction of the applied tension.

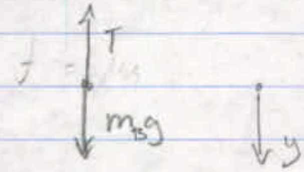
For mass A:





$F_x = T + f - m_A g \sin(\theta)$
$F_y = 0 = N - m_A g \cos(\theta)$.

For mass B:



$F_y = m_B g - T = 0$.
$T = m_B g$

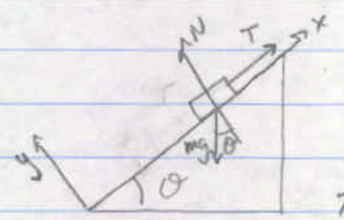
$\boxed{\#2\text{-cont.}}$ $T = m_A g \sin(\theta) - f = m_B g \Rightarrow f = m_A g \sin(\theta) - m_B g$

Thus, $|f| = |20\sin(36.9°) - 20|\,N = \boxed{8\ N = f}$

$\boxed{\#3}$ $W = \Delta KE = KE_f - KE_i = \frac{1}{2} m(v_f^2 - v_i^2)$; then,

$W = \frac{1}{2}(5)(100-36) = \boxed{160\ J = W}$

$\boxed{\#4}$



$P_{motor} = \vec{T} \cdot \vec{v} = Tv$ where

T is the applied tension by the motor. Since we are at constant speed:

$F_x = 0 = T - mg\sin(\theta)$; $T = mg\sin(\theta)$.

$P_{motor} = mg\sin(\theta) \cdot v = \boxed{686\ W}$

$\boxed{\#5}$

Friction a constant force opposing the motion, thus, $W_{fric} = -f\Delta x = \Delta KE$ (equals change in KE).

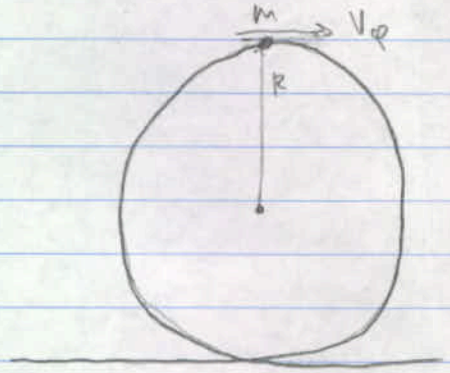
Then, $-f\Delta x = \frac{1}{2}m(v_f^2 - v_i^2) = -\frac{1}{2}mv_i^2 \Rightarrow \Delta x = \frac{\frac{1}{2}mv_i^2}{f}$.

$$\Delta x = \frac{\frac{1}{2}\cancel{m}v_i^2}{\mu \cancel{m} g} = \frac{\frac{1}{2}v_i^2}{\mu g} = \frac{\frac{1}{2}(2)^2}{(\frac{1}{10})(9.8)} = \frac{2}{0.98} \simeq \boxed{2\ m}$$

#6 $W = \int_{\vec{x}_1}^{\vec{x}_2} \vec{F}\cdot d\vec{x} = \int_1^4 (8x-16)\,dx = \frac{8x^2}{2}\Big|_1^4 - 16x\Big|_1^4 =$

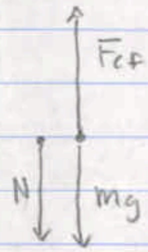
$= W = 4\cdot(16-1) - 16\cdot(4-1) = 4\cdot 15 - 16\cdot 3 = \boxed{12\ J = W}$

#7



At the top and in the reference frame of the track, there are three total forces: $\vec{N}$ (by the track), $m\vec{g}$ (gravity), & $\frac{mv^2}{r}(+\hat{r})$ (centrifugal)

Force Diagram;
In the radial direction:



$F_r = 0 = \frac{mv^2}{R} - N - mg$.

Solving for N: $N = \frac{mv^2}{R} - mg = 27{,}000 - 19{,}600 = \boxed{7400N}$

#8

$KE_1 = \frac{1}{2}MV^2$ & we are given:

$M_2 = M/2$ & $V_2 = 2V$. $KE_2 = \frac{1}{2}(M/2)(2V)^2 = \frac{1}{2}\cdot\frac{1}{2}M4V^2 =$

$= \left(\frac{1}{2}MV^2\right)\cdot 2 = \boxed{2KE = KE_2}$