PHYS 105 Spring 2018

Quiz 1

Walking across a bridge, I find myself 60 m above the water. If I throw a stone straight down as hard as I can, I find it hits the water 2 seconds later. What is the speed of my throw? (g =9.8 m/s^2)

$V_0 = ?$, $t = 2s$, $a = +9.8\ m/s^2$, $\Delta y = +60\ m$

↓ + positive down

$\Delta y = V_0 t + \frac{1}{2} a t^2$

$60 = V_0 \cdot 2 + \frac{1}{2} 9.8 \cdot 2^2$

$\frac{60 - \frac{1}{2} 9.8\, 2^2}{2} = V_0 = 20.2\ m/s$

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Quiz 2

An eagle is flying horizontally at a speed of 3 m/s when the fish in her talons wiggles loose and falls into the lake 5 m below. Calculate the velocity (magnitude and direction) of the fish relative to the water when it hits the water.

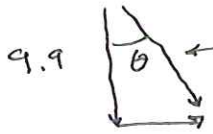
$v_x = v_{0x} = 3\ m/s$ always

$v_{0y} = 0$ $\quad a = +9.8\ m/s^2$ $\quad v_y^2 - v_{0y}^2 = 2a\Delta y$

$v_y = ?$ $\quad \Delta y = +5\ m$ $\quad v_y^2 - 0^2 = 2 \cdot 9.8 \cdot 5$

$v_y = \sqrt{2 \cdot 9.8 \cdot 5} = 9.90\ m/s$

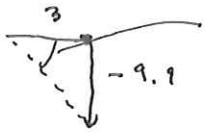
↓ + positive down



magnitude $= \sqrt{9.9^2 + 3^2} = 10.3\ m/s$

$\tan\theta = \frac{3}{9.9} \Rightarrow \theta = 16.9°$

Note in terms of "standard angle"



$\theta = -73.1°$

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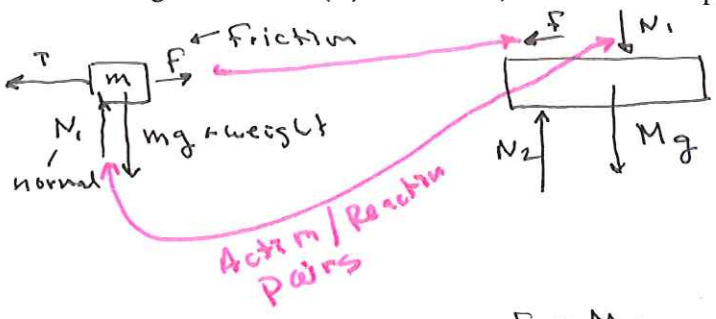
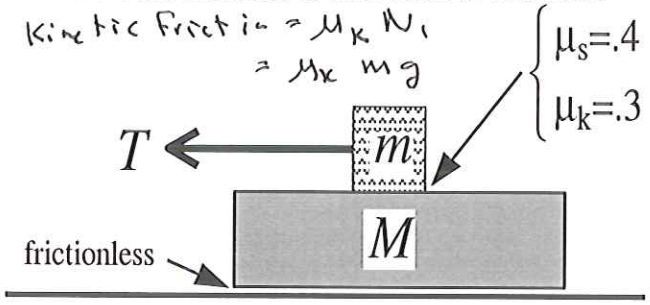
Quiz 3

A large slab (M=10 kg) floats frictionlessly on a flat surface. A block (m=1 kg) rests on top of the slab. The surface between the slab and the block has a coefficient of static friction of μ_s=0.4 and a coefficient of kinetic friction μ_k=0.3. The block is pulled with a horizontal force T. If T is sufficiently small the block+slab will move together as one object; if T is larger, there will be slippage and the block will accelerate faster than the slab (and will eventually be pulled off the slab). (A) Draw free body diagrams for each mass separately. Show and name all forces acting each mass. (B) If T=15 N, there will be slippage. Find the acceleration of each mass in this case.





Kinetic Friction $= \mu_k N_1$
$= \mu_k mg$

$T - f = ma_1$

$N_1 - mg = 0$

so $N_1 = mg$

& $f = \mu_k N_1 = \mu_k mg$

$f = Ma_2$

$N_2 - N_1 - Mg = 0$

$\mu_k mg = Ma_2$

$\frac{m}{M}\mu_k g = a_2 = .294\ m/s^2$

$T - \mu_k mg = ma_1$

$\frac{T}{m} - \mu_k g = a_1 = 12.1\ m/s^2$

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