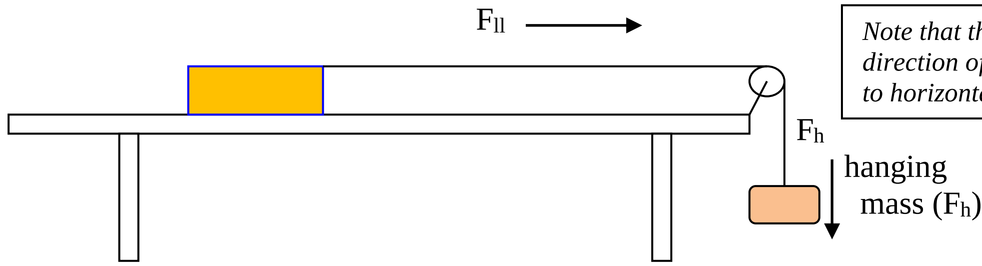
Forces and Friction

Purpose: To determine the friction between two surfaces and then find the acceleration and forces associated with various systems.

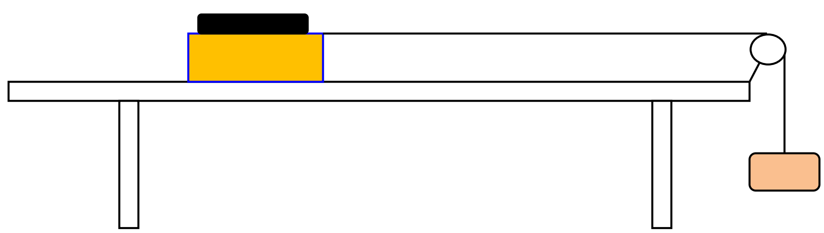
Procedure:

1) <u>Find μ</u> by setting up the ramp on the horizontal and adding enough hanging mass to get the block to move at a constant velocity; $\Sigma F = 0$ F_h refers to "weight of hanging mass"

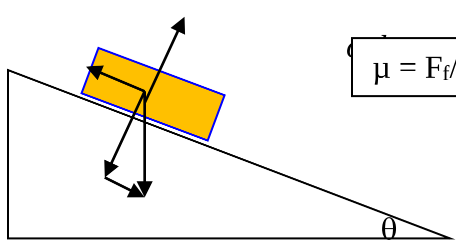


> *Note that the pulley only changes the direction of the force from vertical to horizontal, therefore, $F_w = F_h$*

2) <u>Add mass</u> to the block (object-black rectangular block) and see how much hanging mass is needed to move the block at v_c. Does this change μ?



3) Remove the mass (from object) and <u>verify μ</u> by placing the ramp at the inverse tangent of μ and seeing if the block slides down at v_c When the block slides down at a *constant velocity* then $F_f = -F_p$ ($\sum F = 0$). And in the equation "$\mu = F_f / F_N$", F_f can be replaced with F_p ($F_p = -F_f$), so the equation becomes "$\mu = F_p / F_N$", solving for $F_p = \sin\theta\, F_w$ and $F_N = \cos\theta\, Fw$. Note that the F_w's cancel and $\mu = \sin\theta / \cos\theta = \tan\theta$. Therefore, the block slides down the ramp at v_c when "$\mu = \tan\theta$"



$$\boxed{\mu = F_f/F_N = F_p/F_N = \sin\theta F_w/\cos\theta F_w = \sin\theta/\cos\theta = \tan\theta}$$

4) A) <u>Adjust the ramp to a higher angle</u> (aboutm10^0 than #3) and determine the angle. Using 2nd Law and the parallel and perpendicular forces calculate the forces acting and the acceleration the block (without additional mass).

Show all calculations!

Data table of above steps:

1) mass hanging; m_h = ________ g; _______ kg; F_{ll} = _________N, F_f = ________N
mass of block; m_b = ________ g; _______ kg; F_w = ________ N; F_N = ________N
μ =

2) mass hanging; m_h = ________ g; _______ kg; F_{ll}= _________N, F_f = ________N
mass of block; m_b = ________ g; _______ kg; F_w = ________ N; F_N = ________N
μ =

3) θ = _____^{o}, $\mu = \tan\theta$; tan ___^{0} = ______
Does the object slide down at v_c? …explain! In not, what did you have to do to get it too? … explain!

4. h = _______m; hyp = ______m; $\sin\theta$ =h/hyp; θ =______^{o}

F_p = ______N F_N’ =_______ N F_f =_________N a = _________m/s^2