King Fahd University of Petroleum & Minerals
CIVIL ENGINEERING DEPARTMENT

CE 201 STATICS (Sections 1 & 2)

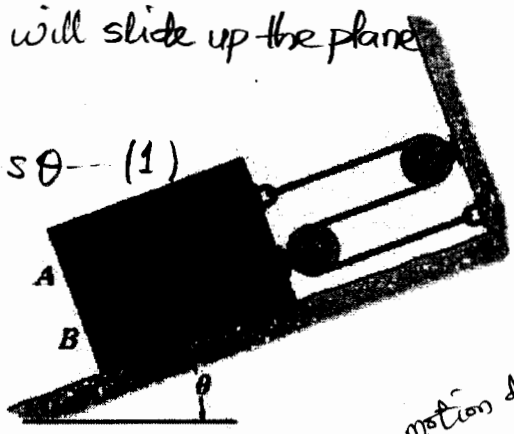
Second Semester 1432 / 2011 (102)

Name: Key
ID #: _____

Quiz # 11

Score ___ / 10

If the coefficient of static friction at all contacting surfaces is μ_s, determine the inclination θ at which the identical blocks, each of weight *W*, begin to slide.



Let's assume A will slide down and B will slide up the plane

From FBD in fig 1,

$+\uparrow \Sigma F_y = N_1 - W\cos\theta = 0 \Rightarrow N_1 = W\cos\theta$ ---- (1)

$+\rightarrow \Sigma F_x = T + F_1 - W\sin\theta = 0$

Substituting for $F_1 = \mu_s N_1 = \mu_s W\cos\theta$,

$T + \mu_s W\cos\theta - W\sin\theta = 0$

$\Rightarrow T = W\sin\theta - \mu_s W\cos\theta$ ---------- (2)

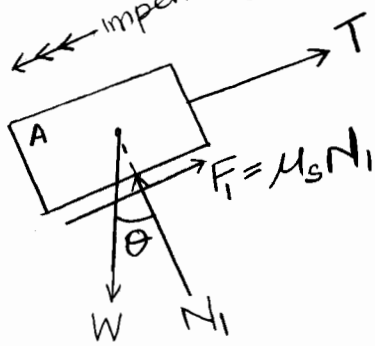


fig. 1

Also from FBD in fig 2,

$+\uparrow \Sigma F_y = N_2 - N_1 - W\cos\theta = 0$

Substituting for $N_1 = W\cos\theta$ from (1),

$N_2 - W\cos\theta - W\cos\theta = 0$

$\Rightarrow N_2 = 2W\cos\theta$ ---------- (3)

$+\rightarrow \Sigma F_x = 2T - \mu_s(N_1 + N_2) - W\sin\theta = 0$

Substituting N_1 from (1), T from (2) and N_2 from (3), we obtain

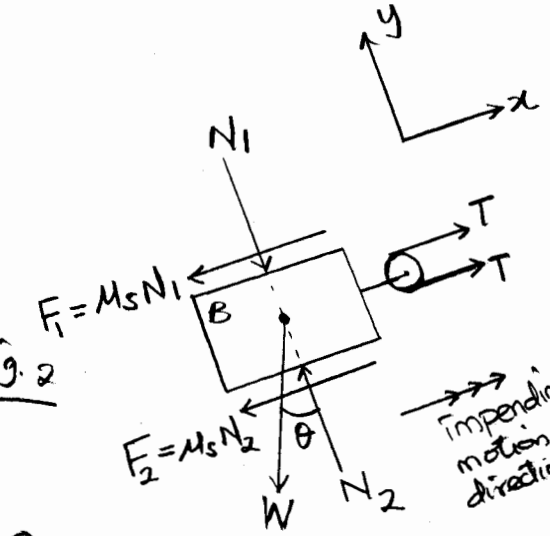


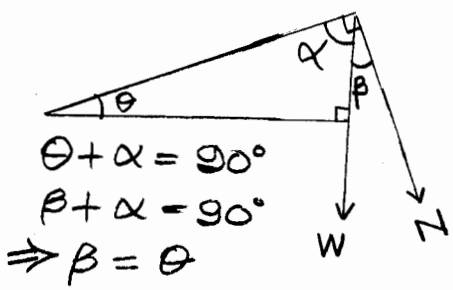
fig. 2

$2W\sin\theta - 2\mu_s W\cos\theta - 3\mu_s W\cos\theta - W\sin\theta = 0$

$W\sin\theta - 5\mu_s W\cos\theta = 0$

Dividing through by $W\cos\theta$, we get

$\tan\theta = 5\mu_s \Rightarrow \boxed{\theta = \tan^{-1} 5\mu_s}$



Thus $\theta = \tan^{-1} 5\mu_s$ at the instance the weights begin to slide. The +ve value of θ shows our assumption was right!