GREEN

QUIZ 5 Blue, PHY 191 B, Friday, Oct 7, 2016 (15 pts)

RED

[see both sides of sheet!]

SHOW WORK CLEARLY OTHERWISE ZERO CREDIT!!

Question 1:

A 1.5 kg wood block is pressed against a vertical wood wall by the 40N force shown in the figure.

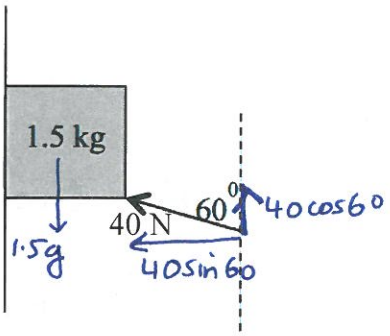
If the block is initially at rest, will

a) the block move upward?

b) the block move downward?

c) the block stay at rest?

The coefficients of static and kinetic friction for wood on wood are 0.2 and 0.1 respectively.



GREEN: BLOCK MOVES UP

(1) ANSWER: (c) (1 pt)

REASONING: (6 pts) RED: BLOCK MOVES DOWN

(3)

Force up = $40 \cos 60^\circ = 20$ N

Force down = $1.5g = 14.7$ N (11.8 N) (28.4 N)

$\Rightarrow$ net force is ↑, i.e. "impending" motion is up / upward / down

$\therefore f_s$ = force of static friction is ↓ ↑

(1)

The maximum force of static friction $(f_s)_{max}$ is

$(f_s)_{max} = \mu_s n = 0.2(40 \sin 60) = 6.9$ N

(2)

$\therefore$ maximum force ↓ is $14.7 + 6.9 = 21.6$ N (11.8; 18.7; 20; 26.9)

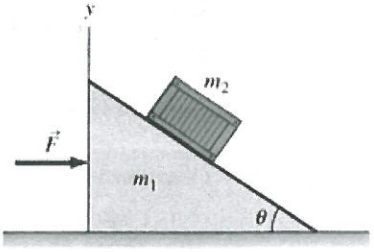
which exceeds / is less than the upward 20 N force. (20; downward 28.4; is less than)

$\therefore$ THE BLOCK STAYS! (moves up / moves down)

TURN SHEET OVER

Question 2:

In the diagram on the right, a block of mass $m_2 = 2\text{kg}$ is placed on a wedge of mass $m_1 = 3\text{kg}$, and a horizontal force $F = 10\text{N}$ is applied to m_1 as shown. It is observed that m_2 does not slip either up or down along the wedge, as the wedge + block system moves forward.

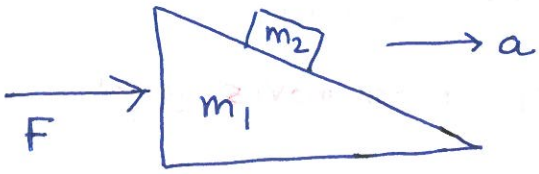


Find the normal force between the wedge and the block. (8 pts)

For the "$m_1 + m_2$" system: In the x-direction,

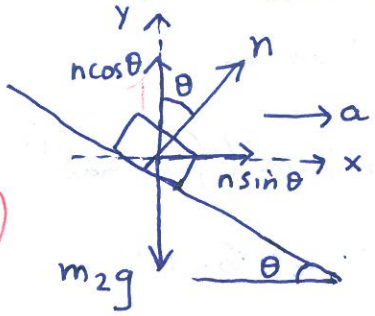
$$F_{net_x} = ma_x$$

$$\Rightarrow F = (m_1 + m_2)a \quad \text{—— (i)}$$



$$\therefore a = \frac{10}{2+3} = 2\,m/s^2 \quad (1)$$

To find the normal force, draw the f.b.d. for the block: (or the wedge, whichever...)



(1)

In the x-direction: $F_{net_x} = ma_x$

$$n\sin\theta = ma \quad (2)$$

$$\text{i.e. } n\sin\theta = 2(2) = 4 \quad \text{—— (ii)}$$

In the y-direction: $F_{net_y} = ma_y$

$$n\cos\theta - m_2g = 0 \quad (2)$$

$$\text{i.e. } n\cos\theta = 2(9.8) = 19.6 \quad \text{—— (iii)}$$

From equations (ii) & (iii) [NOTE! 2 EQUATIONS & 2 UNKNOWNS!]

Solve for 'n' from eqn (iii) & plonk into eqn (ii):

From eqn. (iii), $n = \frac{19.6}{\cos\theta}$, plonk into (ii), $\frac{19.6}{\cos\theta}\cdot\sin\theta = 4$ (2)

$\Rightarrow \theta = \tan^{-1}(4/19.6) = 11.5^\circ \rightarrow$ SUBSTITUTE IN Eqn. (ii) or (iii) to obtain $\boxed{n = 20\,N}$

GREEN: $n = 27\,N$

RED: $n = 31\,N$