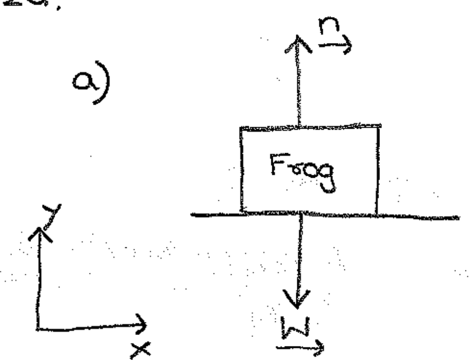
23.

a)



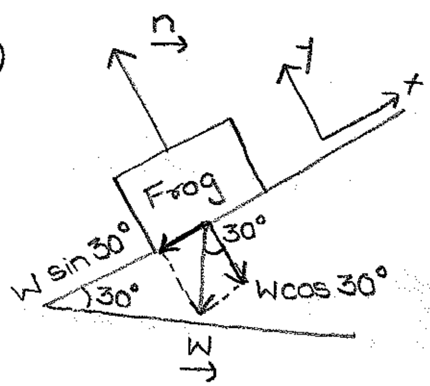
Since the frog is at rest, its acceleration $\vec{a} = 0$.

Hence, net force $= n\hat{y} + w(-\hat{y}) = m\vec{a} = 0$

or, $n = w = mg = (0.60\,\text{Kg})(9.8\,\text{m/s}^2)$
$= 5.88\,\text{N}$

$\therefore \vec{n} = 5.88\,\text{N}\,\hat{y}$

b)



As shown in figure, I choose my x and y-axis along and perpendicular to the incline.

Since the frog does not move perpendicular to the log (i.e. in the y-direction),

a_y = y-component of $\vec{a} = 0$

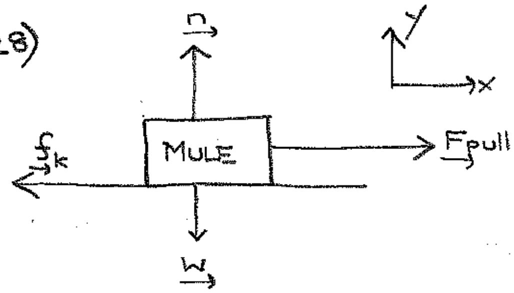
$\therefore$ Net force in y-direction

$= n\hat{y} + w\cos 30°(-\hat{y})$ [See figure]

$= 0$

or, $n = w\cos 30°$
$= mg\cos 30°$
$= 5.09\,\text{N}$

$\therefore \vec{n} = 5.09\,\hat{y}$

28) 

Since the mule has zero acceleration in the vertical direction,

net force in the vertical direction

$$= n\hat{y} + w(-\hat{y})$$
$$= ma_y\hat{y}$$
$$= 0$$

$$\therefore n = w = mg$$
$$= (120 kg)(9.8 m/s^2)$$
$$= 1176 N$$

So, maximum friction force

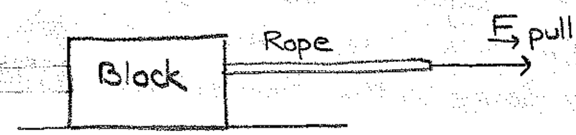
$$= \mu_s n$$
$$= (0.80)(1176 N)$$
$$= 941 N$$

Since this is greater than the maximum pull force of 800N, the pull force cannot overcome the friction force and so the farmer is not able to move the mule.

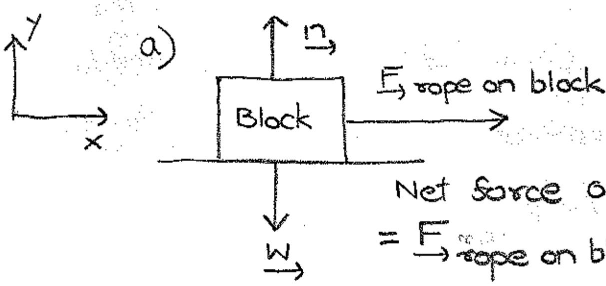
or, $\vec{n}_{2 \text{ on } 1} = -10\,\text{N}\,\hat{x}$

37.

37.



a)



Net force on block in horizontal direction

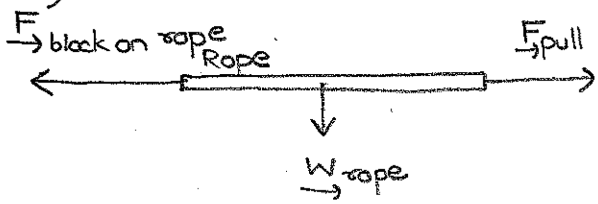
$= \vec{F}_{\text{rope on block}}$

$= \text{mass of block} \times \text{acceleration of block}$

$= (10\,\text{kg})(2.0\,\text{m/s}^2\,\hat{x})$

$= 20\,\text{N}\,\hat{x}$

b)



[Rope has a mass]

Net force on rope

$= \vec{F}_{\text{pull}} + \vec{F}_{\text{block on rope}}$

$= \vec{F}_{\text{pull}} - \vec{F}_{\text{rope on block}}$

(by Newton's 3rd law, action and reaction are equal and opposite)

$= \text{mass of rope} \times \text{acceleration of rope}$

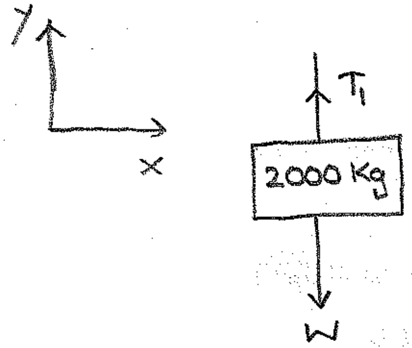
$= (0.5\,\text{kg})(2.0\,\text{m/s}^2)\,\hat{x} = 1\,\text{N}\,\hat{x}$

$\Rightarrow \vec{F}_{\text{pull}} = \vec{F}_{\text{rope on block}} + 1\,\text{N}\,\hat{x}$

$= 20\,\text{N}\,\hat{x} + 1\,\text{N}\,\hat{x}$

$= 21\,\text{N}\,\hat{x}$

63. Block:



The hanging block is in static equilibrium so $\underset{\rightarrow}{a} = 0$.

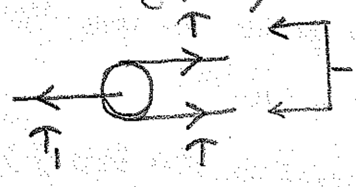
$\therefore \underset{\rightarrow}{F}_{net} = T_1\hat{y} + W(-\hat{y}) = m\underset{\rightarrow}{a} = 0$

or, $T_1 = W = mg$

$= (2000\,Kg)(9.8\,m/s^2)$

$= 19{,}600\ N$

Tensioning pulley:



Since it is the same rope (assumed massless) that goes around the pulley, the tension in both segments of the rope is assumed to be the same.

Since the pulley is also in static equilibrium,

$\underset{\rightarrow}{a} = 0$

$\therefore \underset{\rightarrow}{F}_{net} = T\hat{x} + T\hat{x} + T_1(-\hat{x}) = 0$

or, $2T - T_1 = 0$

or, $T = T_1/2 = 9800\,N$

$\underset{\rightarrow}{T} = 9800\,N\,\hat{x}$