1.

There are two forces on the 2.00 kg box in the overhead view of the figure shown (fig. 1), but only one is shown. For F1 = 10.0 N, *a* =12.0 m/s^2, and θ = 30.0°, find the magnitude of the second force. Give the answer in Newton (N) and give three significant figures.

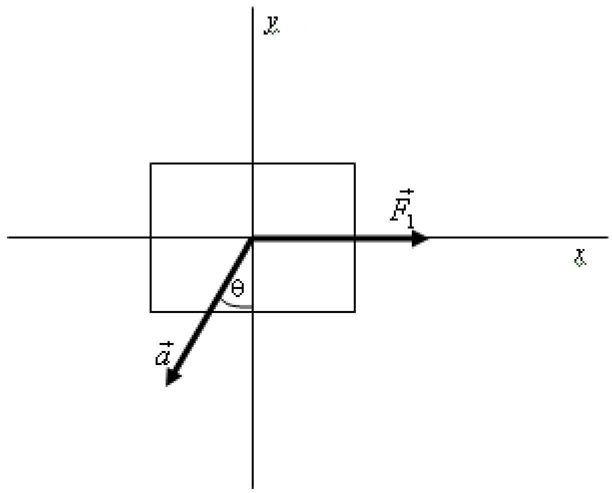


Fig1

	Student Response	Value	Correct Answer
Answer:	not answered	0%	30.3

$$\vec{F}_1 + \vec{F}_2 = m\vec{a}$$

$$\langle 10.0,\ 0\rangle + \langle F_{2,x}, F_{2,y}\rangle = 2.00 * \langle 12.0\ \mathrm{Cos}[240],\ 12.0\ \mathrm{Sin}[240]\rangle$$

Note that the angle is 240 with the positive x-direction (measured counterclockwise) NOT 30. Continuing:

$$\begin{aligned} \langle F_{2,x}, F_{2,y}\rangle &= 2.00 * \langle 12.0\ \mathrm{Cos}[240],\ 12.0\ \mathrm{Sin}[240]\rangle - \langle 10.0,\ 0\rangle \\ &= 2.00 * \langle -6.0, -10.3923\rangle - \langle 10.0,\ 0\rangle \\ &= \langle -22, -20.7846\rangle \end{aligned}$$

$$\Rightarrow F_2 = \sqrt{(-22)^2 + (-20.7846)^2} = \boxed{30.3} N$$

2.

There are two forces on the 2.00 kg box in the overhead view of the figure shown (fig. 1), but only one is shown. For F1 = 13.7 N, *a* =12.0 m/s^2, and θ = 30.0°, find the angle the second force makes with the positive direction of *x*-axis, measured counterclockwise. Give three significant figures and give the answer in degrees.

	Student Response	Value	Correct Answer
Answer:	not answered	0%	219

$$\vec{F}_1 + \vec{F}_2 = m\vec{a}$$

$$\langle 13.7,\ 0\rangle + \langle F_{2,x}, F_{2,y}\rangle = 2.00 * \langle 12.0\ \mathrm{Cos}[240],\ 12.0\ \mathrm{Sin}[240]\rangle$$

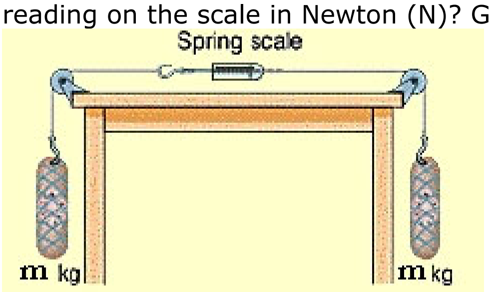
Note that the angle is 240 with the positive x-direction (measured counterclockwise) NOT 30. Continuing:

$$\begin{aligned}\langle F_{2,x}, F_{2,y}\rangle &= 2.00 * \langle 12.0\ \mathrm{Cos}[240],\ 12.0\ \mathrm{Sin}[240]\rangle - \langle 13.7,\ 0\rangle \\ &= 2.00 * \langle -6.0, -10.3923\rangle - \langle 13.7,\ 0\rangle \\ &= \langle -25.7, -20.7846\rangle\end{aligned}$$

$$\Rightarrow \theta = \tan^{-1}\left(\frac{-20.7846}{-25.7}\right) = 38.96 + 180 = \boxed{219}^{\circ}$$

3.

Two m=5.0 kg mass are hung in equilibrium as shown in the figure. What is the reading on the scale in Newton (N)? Give three significant figures.



	Student Response	Value	Correct Answer
Answer:	not answered	0%	49.0

The scale will just read the tension in the string and the tension is equal to mg = 5.0*9.8 = $\boxed{49}$ N

4.

In the figure shown (fig. 3), the mass of the block is 8.5 kg, and the angle θ is 26.7°. The tension in the cord in Newton (N) is: (Give three significant figures).

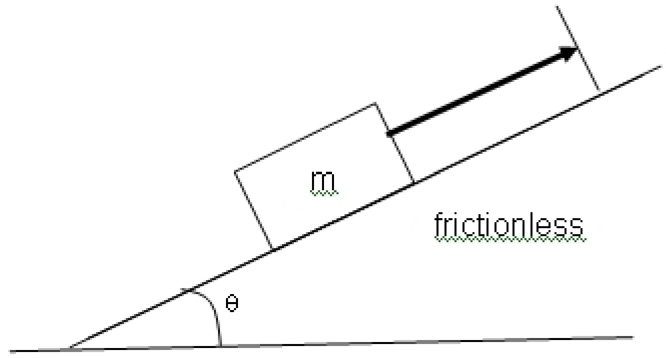


Fig. 3

	Student Response	Value	Correct Answer
Answer:	not answered	0%	37.4

The block is in equilibrium, acceleration, $\vec{a} = 0$.

$$\sum \vec{F} = m\vec{a}$$

$$\sum \vec{F} = 0$$

Taking x-axis along the incline upward:

$$\sum Fx = T - m\ g\ Sin\theta = 0$$

$$\Rightarrow T = 8.5*9.8*Sin[26.7] = \boxed{37.4}\ N$$

5.

In the figure shown (fig. 3), the mass of the block is 8.5 kg, and the angle θ is 26.3°. The normal force in Newton (N) is : (Give three significant figures)

	Student Response	Value	Correct Answer
Answer:	not answered	0%	74.7

The block is in equilibrium, acceleration, $\vec{a} = 0$.

$$\sum \vec{F} = m\vec{a}$$

$$\sum \vec{F} = 0$$

Taking x-axis along the incline upward:

$$\sum F_y = N - m\ g\ Cos\theta = 0$$

$$\Rightarrow T = 8.5*9.8*Cos[26.3] = \boxed{74.7}\ N$$

6.

In the figure shown (fig. 4), two connected blocks are pulled on a frictionless surface to the right by a force F = 28.9 N. If M_1=2.00 kg and M_2 =3.00 kg, the tension between the blocks (in Newton) is: (Give three significant figures).

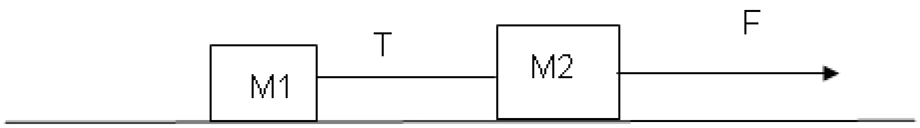


Fig. 4

	Student Response	Value	Correct Answer
Answer:	not answered	0%	11.6

Taking the two blocks as one system with mass (m1+m2) as the have the same $\vec{a}$ to the right. And choosing the x-axis along $\vec{a}$, we apply the Newton's 2nd Law in the x-direction:

$$F = (m_1 + m_2)a$$

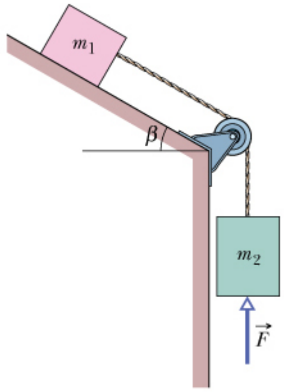
$$\Rightarrow a = \frac{F}{m_1 + m_2} = \frac{28.9}{5} = 5.78\, m/s^2$$

Now applying the N's 2nd Law for the block m1 only, in the x-direction:

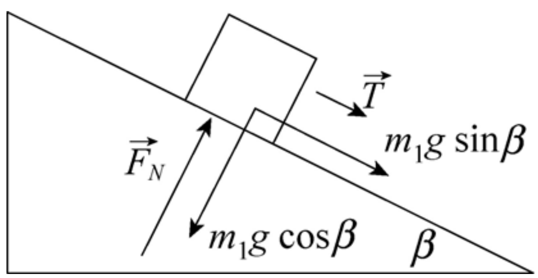
$$T = m1a = 2 * 5.72 = \boxed{11.6}\, N$$

7.

In the figure shown, a block of mass m1 = 1.0 kg on a frictionless inclined surface is connected to another block of mass m2 = 2.0 kg. The pulley is massless and frictionless. An upward force of magnitude F = 6.0 N acts on the mass m2, which has a downward acceleration of 5.5 m/s^2. What is the tension in the connecting cord? Give the answer in Newton (N) and give two significant figures.



We first analyze the forces on m_1=1.0 kg.



The +x direction is "downhill" (parallel to $\vec{T}$).

With the acceleration (5.5 m/s^2) in the positive x direction for m_1, then Newton's second law, applied to the x axis, becomes

$$T + m_1 g \sin\beta = m_1\left(5.5\,\text{m/s}^2\right)$$

This equation has tow unknowns T and β. So let's apply the N's 2nd Law on the mass m_2.
But for m_2=2.0 kg, using the more familiar vertical y axis (with *up* as the positive direction), we have the acceleration in the negative direction:

$$F + T - m_2 g = m_2\left(-5.5\,\text{m/s}^2\right)$$

where the tension comes in as an upward force (the cord can pull, not push).

From the equation for m_2, with F = 6.0 N, we find the tension T = $\boxed{2.6}$ N.