Physics 1210/1310

Mechanics
&
Thermodynamics

Lecture 7-10, chapter 4 & 5

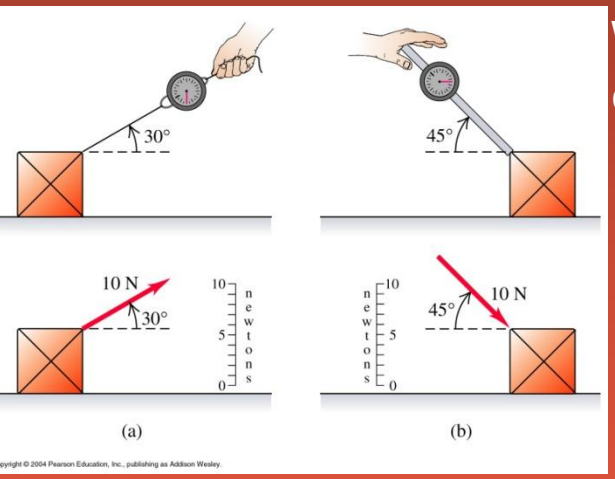
Dynamics – the causes of change of motion

The cause of a change of motion is called a force.

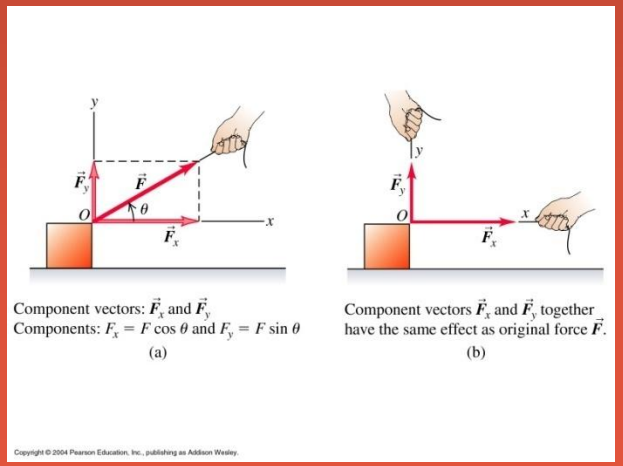
Forces can vary dramatically in magnitude.

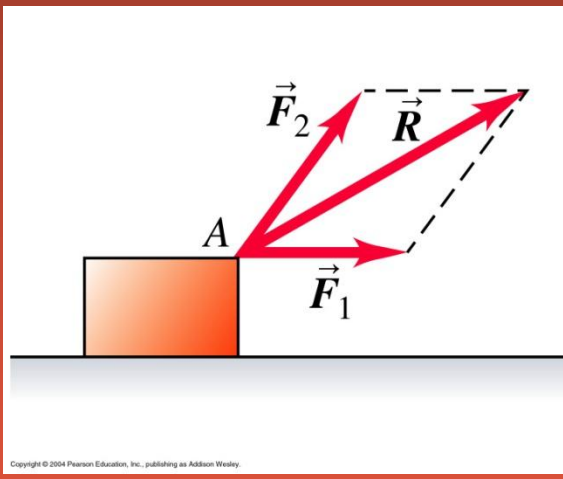
Force is a vector quantity.

The unit of force is the Newton [N] = [kg m / s^2]



We can analyze the components of a force.





A force can be exerted as a push or a pull and at any angle.

If more than one force acts on an object, we may add the vectors to find the resultant force R.

The three Newton Laws :

(11) for systems in equilibrium:

$$\Sigma F = 0$$

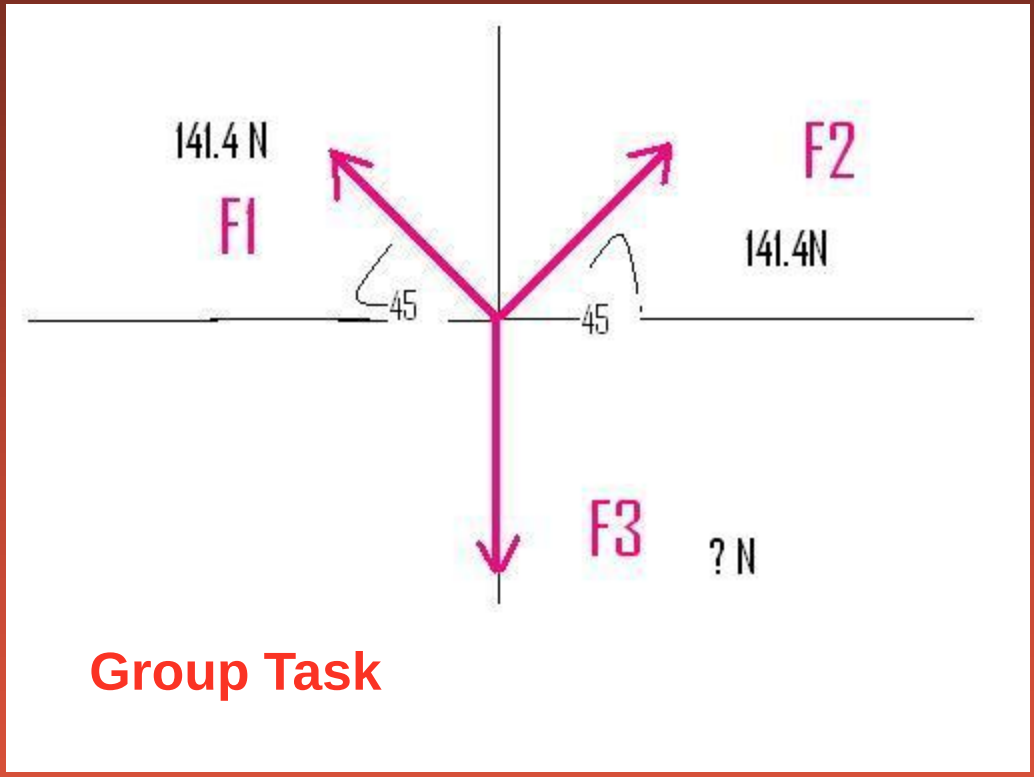
(12) for other systems:

$$\Sigma F = m\,a$$

(13) when two bodies interact through forces
for every action there is an
equal reaction

$$F_{AB} = -F_{BA}$$

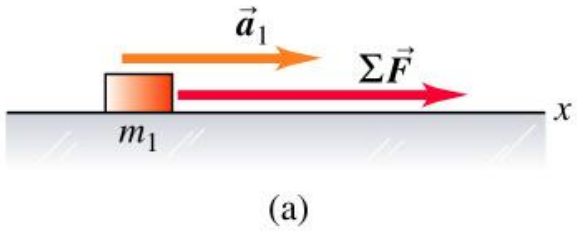
How big does F3 have to be to have a net force of zero?



$F_{1y} + F_{2y} = 2 * 141.4\ [N]\ (\sin(45)) = +200[N]$

$\rightarrow F_3 = F_{3y} = -200\ [N]$

Force in x: $F_{1x} + F_{2x} = -141.4 \cos(45)\ [N] + 100\ [N] = 0$



(a)

(b)

$$\sum F_x = ma_x \qquad \sum F_y = ma_y \qquad \sum F_z = ma_z \tag{4.8}$$

(Newton's Second Law)

$$w = mg \qquad \text{(magnitude of the weight of a body of mass } m\text{)} \tag{4.9}$$

'inertia' of mass

-

A tendency that a mass resists motion

Component formulation of Newton 2

Special case of gravity: weight is a force

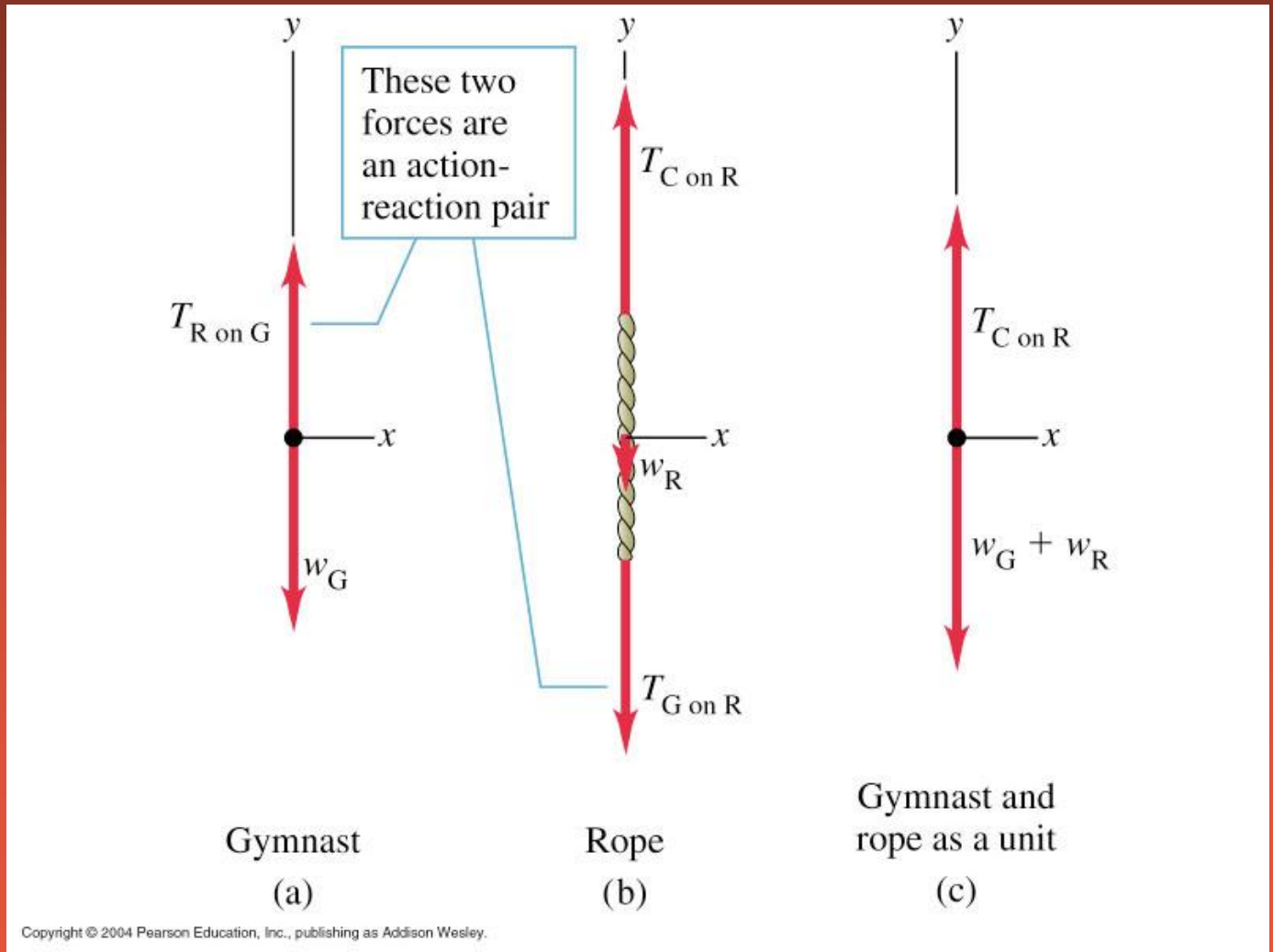
! Careful contrary to common use of term!

Overview concepts chapter 5

$$\sum F_x = 0 \qquad \sum F_y = 0 \qquad (5.2)$$

article in equilibrium, component form)

Tension and N3



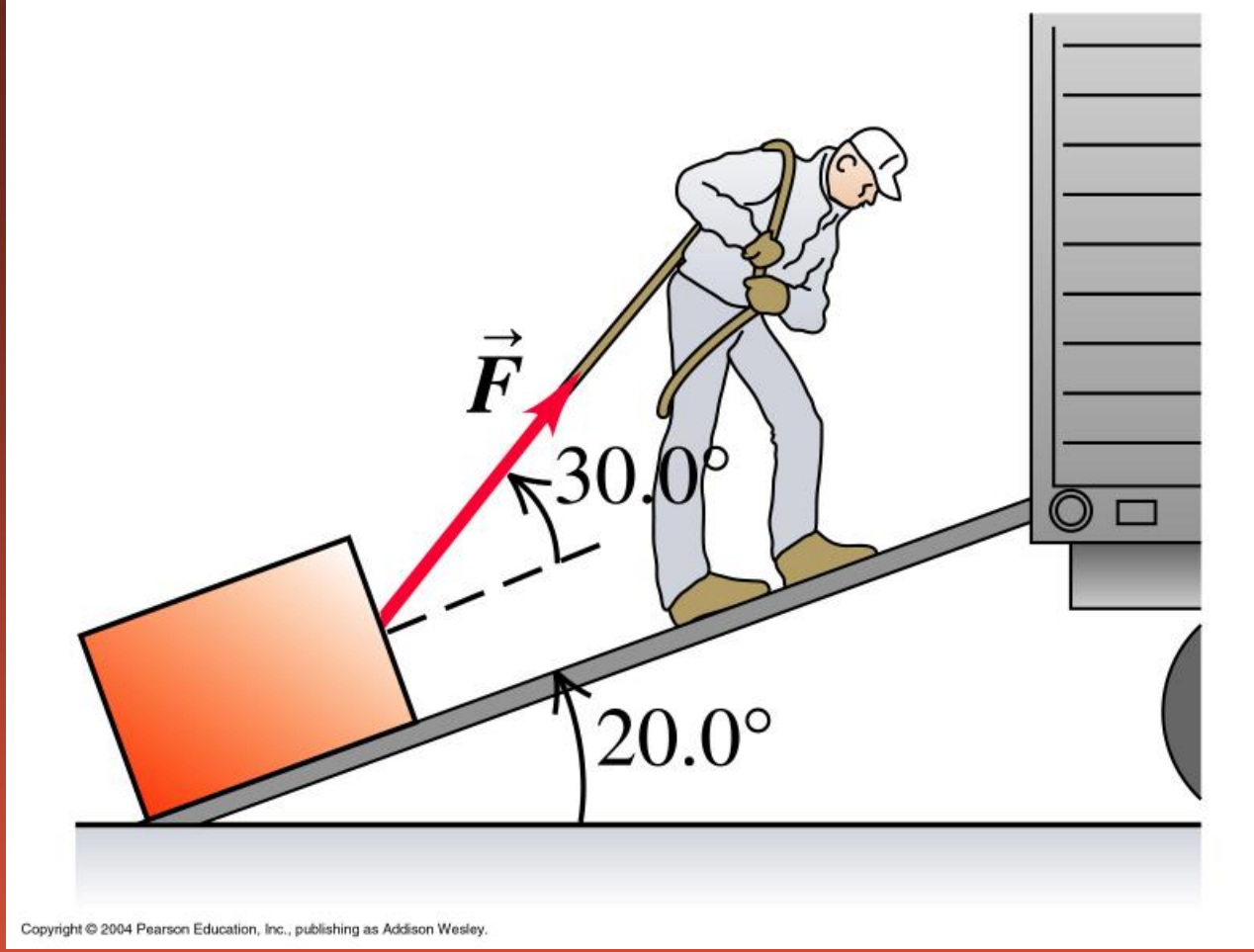
Problem 4.4

How large *F*
For F_x to be 60[N]
How large is F_y ?

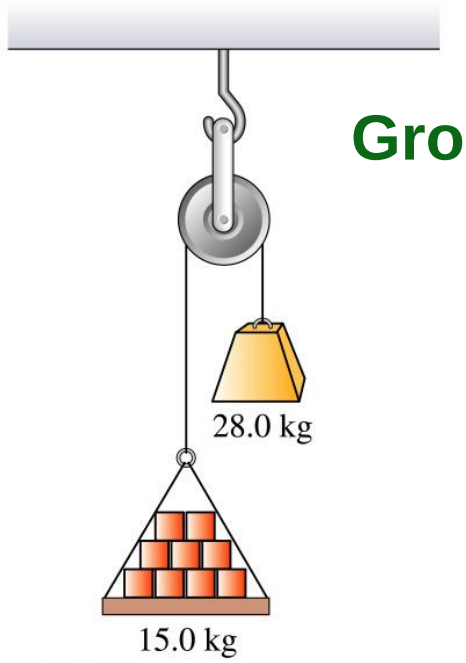
Trick:

Analyze x/y with respect to plane of motion.

$$F_x = F\cos\theta,$$
$$\theta = 30°$$

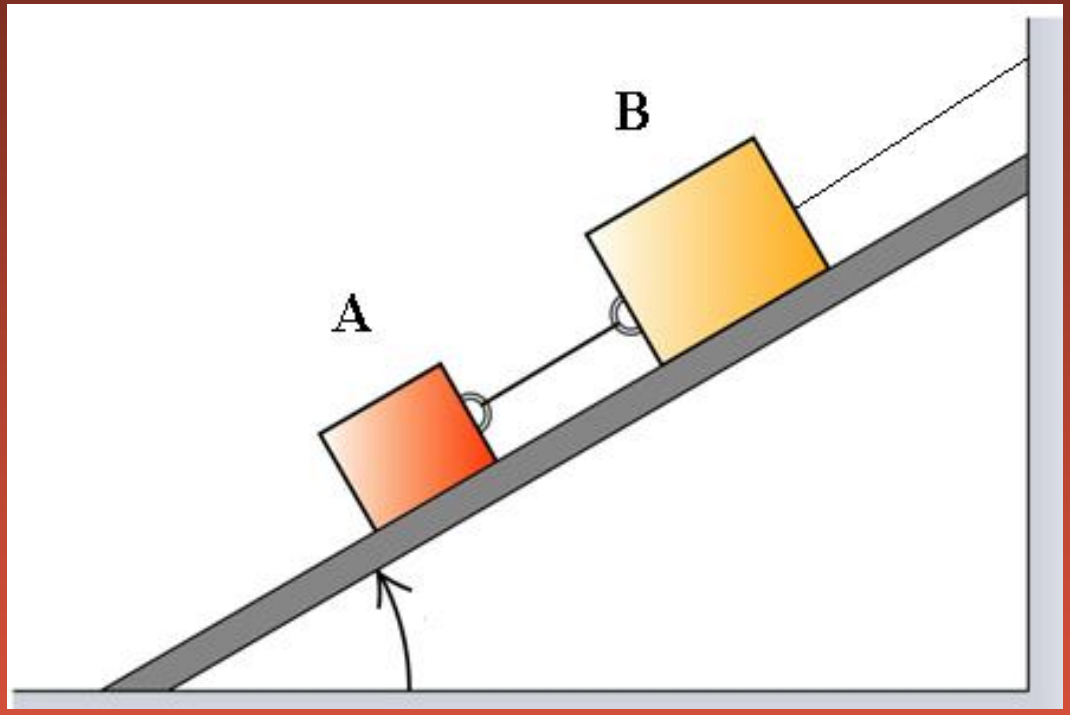


5.15 GroupTask



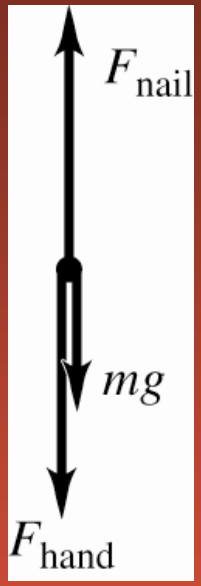
(1)
(2)

5.14



4.52

$$v_x^2 = v_{0x}^2 + 2a_x(x - x_0) \qquad \text{(constant acceleration only)} \qquad (2.13)$$



Acceleration hammer can be found from 2.13 above with v_y=0 and v_{0y}= -3.2[m/s] and y-y_0 = - 0.0045[m]

Thus the net force on the hammer head is

This total force on the hammer is shown in the force diagram.

Hammer and nail are an action-reaction pair, thus, /F_{AB}/= /F_{BA}/

Newton's Second Law – Motion and Friction

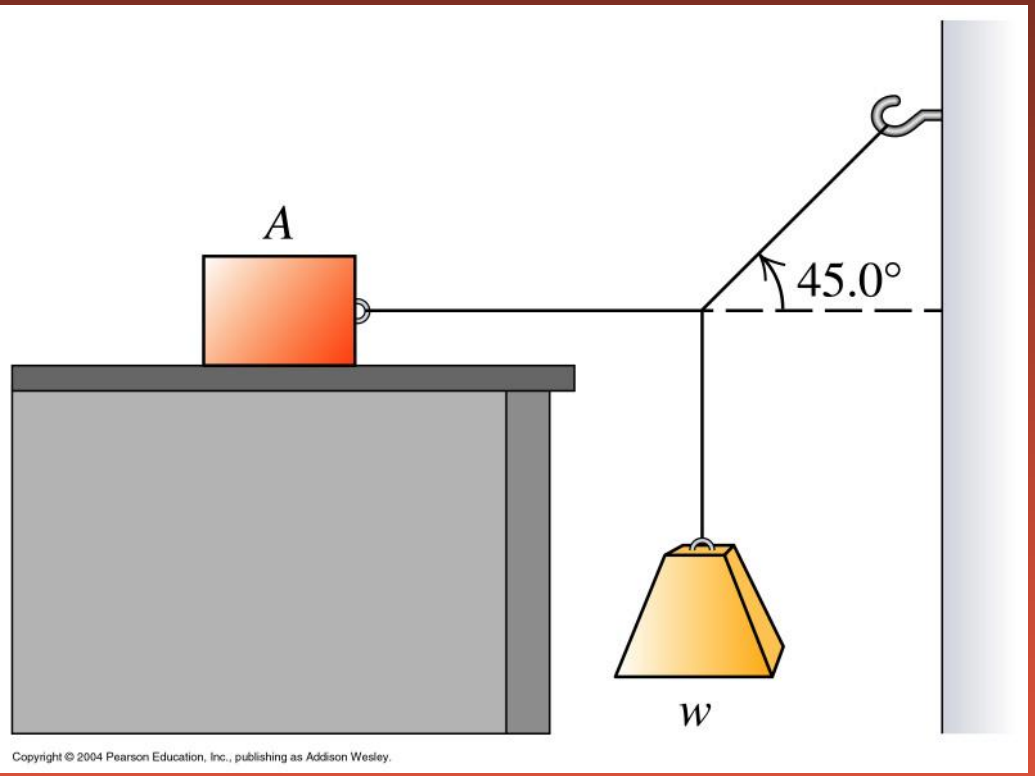
Generally, when two bodies slide along each other there is a force opposing the motion. This force is called friction. It is related to the texture of the two bodies and thus to *n*.

$$f_k = \mu_k n \qquad \text{(magnitude of kinetic friction force)} \qquad (5.5)$$

$$f_s \leq \mu_s n \qquad \text{(magnitude of static friction force)} \qquad (5.6)$$

Friction has two aspects:
To get a motion started and
To maintain an existing motion

5.66



5.92