Lecture 11
(Mass and Weight, Newton's 3rd Law)

Physics 160-01 Fall 2012

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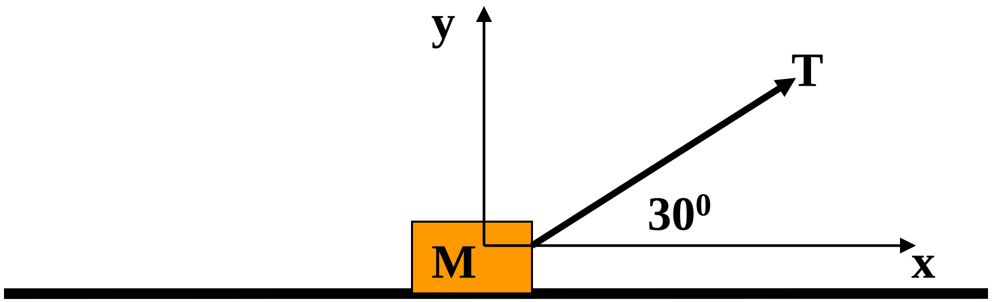
Weight and Mass

- Weight is a FORCE given by w=mg.
- Mass is a property of an object.
- An object of mass 10kg, and weight $mg=(10kg)(9.8m/s^2)=98N$, will still have mass 10kg on the moon, but will have a lower weight on the moon (since the pull of the moon's gravity on an object is less than that of the earth's).

CPS Question 10-1

- **A block of mass M sits on a horizontal plane. A rope pulls on the block to the right with a force T at an angle of 30^o with the horizontal. What is the best way to describe the normal force N of the table on the block?**



A) Mg in the + y-direction.

B) Mg + T sin(30) in the + y-direction.

C) Mg - T cos(30) in the + y-direction.

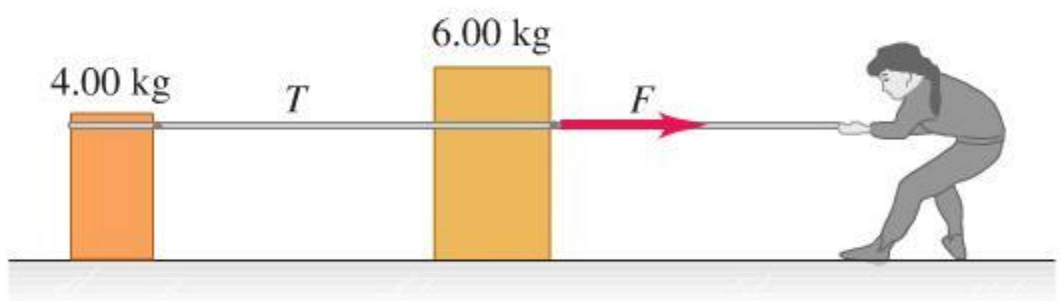
D) Mg - T sin(30) in the + y-direction.

E) Mg in a direction 30^o to the left of the block.

Problem 4.43

4.43. Two crates, one with mass 4.00 kg and the other with mass 6.00 kg, sit on the frictionless surface of a frozen pond, connected by a light rope (Fig. 4.38). A woman wearing golf shoes (so she can get traction on the ice) pulls horizontally on the 6.00-kg crate with a force F that gives the crate an acceleration of 2.50 m/s^2. (a) What is the acceleration of the 4.00-kg crate? (b) Draw a free-body diagram for the 4.00-kg crate. Use that diagram and Newton's second law to find the tension T in the rope that connects the two crates. (c) Draw a free-body diagram for the 6.00-kg crate. What is the direction of the net force on the 6.00-kg crate? Which is larger in magnitude, force T or force F? (d) Use part (c) and Newton's second law to calculate the magnitude of the force F.

Figure 4.38 Problem 4.43.



Newton’s Third Law

- If a body A exerts a force on body B, then body B exerts a force on body A. These two forces have the same magnitude, but are opposite in direction.

Demonstrations

Problem 4.24

4.24. The upward normal force exerted by the floor is 620 N on an elevator passenger who weighs 650 N. What are the reaction forces to these two forces? Is the passenger accelerating? If so, what are the magnitude and direction of the acceleration?

Problem 4.39

4.39. A Standing Vertical Jump. Basketball player Darrell Griffith is on record as attaining a standing vertical jump of 1.2 m (4 ft). (This means that he moved upward by 1.2 m after his feet left the floor.) Griffith weighed 890 N (200 lb). (a) What is his speed as he leaves the floor? (b) If the time of the part of the jump before his feet left the floor was 0.300 s, what was his average acceleration (magnitude and direction) while he was pushing against the floor? (c) Draw his free-body diagram (see Section 4.6). In terms of the forces on the diagram, what is the net force on him? Use Newton's laws and the results of part (b) to calculate the average force he applied to the ground.

Sun’s Pull on the Earth

- Rotation of earth around the sun takes 365 days = 3.15×10^7s.
- Distance between the center of the sun and center of earth is 1.50×10^{11}m.
- Mass of Earth is 5.97×10^{24}kg.
- With what force does the sun pull on the earth?
- 3.56×10^{22}N.

CPS Question 10-2

- **With what force does the earth pull on the sun?**

A) More than $3.56x10^{22}$N

B) Less than $3.56x10^{22}$N

C) Equal to $3.56x10^{22}$N

D) Cannot determine, insufficient information.

Problem 4.49

4.49. A gymnast of mass m climbs a vertical rope attached to the ceiling. You can ignore the weight of the rope. Draw a free-body diagram for the gymnast. Calculate the tension in the rope if the gymnast (a) climbs at a constant rate; (b) hangs motionless on the rope; (c) accelerates up the rope with an acceleration of magnitude $|\vec{a}|$; (d) slides down the rope with a downward acceleration of magnitude $|\vec{a}|$.