HW 3
   **FORCES at ANGLE, ELEVATOR, 2 BODIES CONNECTED WITH A ROPE, HANGING OBJECTS, INCLINE**

1. Two forces act on a 16-kg object.   The first force has a magnitude of 68 N and is directed 24° north of east.   The second force is 32 N, 48° north of west.   What is the acceleration of the object resulting from the action of these two forces?

2. Two forces act on a 4.5-kg block resting on a frictionless surface as shown.   What is the magnitude of the horizontal acceleration of the block?
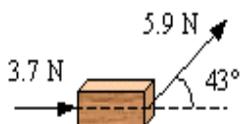
3. A 20.0-kg package is dropped from a high tower in still air and is "tracked" by a radar system. When the package is 25 m above the ground, the radar tracking indicates that its acceleration is 7.0 m/s^2. Determine the force of air resistance on the package.

4. A 1000-kg elevator is rising and its speed is increasing at 3 m/s^2. The tension in the elevator cable is:

5. A 700-kg elevator accelerates downward at 3.0 m/s^2. The tension force of the cable on the elevator is:

6. A 400-N block is dragged along a rough (μ_k = 0.4) horizontal surface by an applied force F as shown. The block moves at constant velocity. What is the magnitude of F?
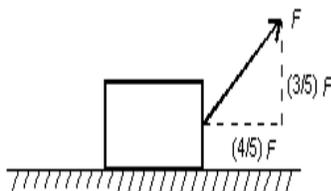
7. You pull your 18-kg suitcase at constant speed on a horizontal floor by exerting a 43-N force on the handle, which makes an angle with the horizontal. The force of friction on the suitcase is 27 N.
   a. What angle does the handle make with the horizontal?
   b. What is the normal force on the suitcase?
   c. What is the coefficient of friction?

8. A 25-kg chair is pushed across a frictionless horizontal floor with a force of 20 N, directed 20° below the horizontal. The acceleration of the chair is:

9. A 10-kg block is connected to a 40-kg block as shown in the figure.   The surface on which the blocks slide is frictionless.   A force of 50 N pulls the blocks to the right.
   a) What is the magnitude of the acceleration of the 40-kg block?
   b) What is the magnitude of the tension **T** in the rope that connects the two blocks?
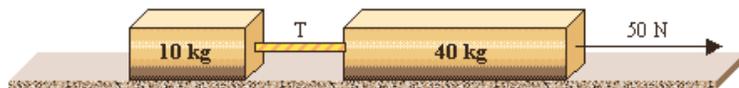
10. A 70 N block and an 35-N block are connected by a string as shown. If the pulley is massless and the surface is frictionless, the magnitude of the acceleration of the 70-N block   is:
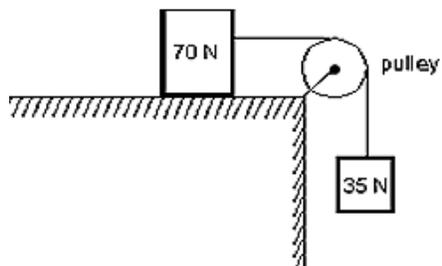
11. A 4-kg block is connected by a *massless* rope to a 2-kg block as shown in the figure. Complete the following statement: If the 4-kg block is to begin sliding, the coefficient of static friction between the 4-kg block and the surface must be

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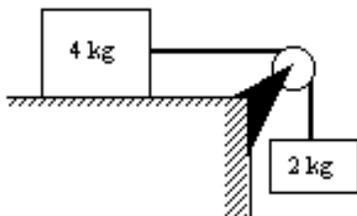
12. Block A of mass of 50 kg, is on a horizontal table top. The coefficient of static friction is 0.40. A horizontal string is attached to A and passes over a massless, frictionless pulley as shown. The mass m_B attached to the other end of the string is 30 kg.
    1. What is the tension in the string?
    2. What is acceleration of block A?
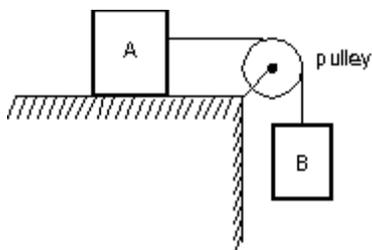
13. Two blocks weighing 250 N and 350 N respectively, are connected by a string that passes over a massless pulley as shown. The tension in the string is:

250 N

350 N
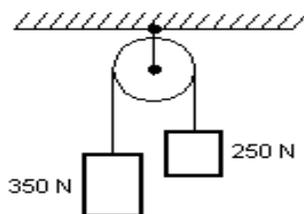
14. A block of mass M is hung by ropes as shown.   The system is in equilibrium.   The point O represents the knot, the junction of the three ropes.   Which of the following statements is true concerning the magnitudes of the three forces in equilibrium?

F_2 F_1

$30°$ O $30°$ horizontal line

F_3

M
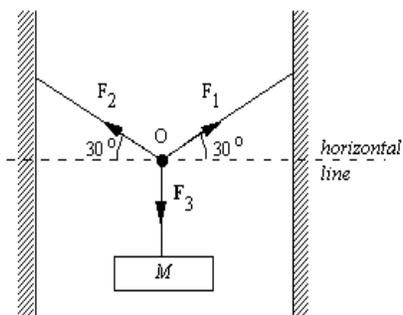
a) F1 = F2 = F3
b) F2 = 2F3
c) F2 < F3
d) F1 > F3

If M = 20 kg, find all three forces !

15. A 20-kg crate is suspended from a fixed beam by two vertical ropes.   What is the tension in each rope?
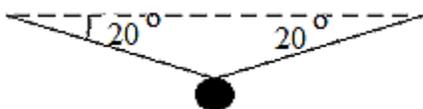
16. At an art auction, Whitney has acquired a painting that now hangs from a nail on her wall, as shown in the figure. If the painting has a mass of 12.6 kg, what is the tension in each side of the wire supporting the painting?
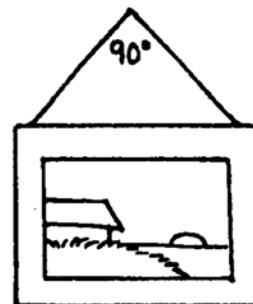
17. A 25-N crate slides down a frictionless incline that is 25° above the horizontal. The magnitude of the normal force of the incline on the crate is:

18. A block slides down a frictionless plane that makes an angle of 30° with the horizontal. The acceleration of the block   is:

19. At a playground, a child slides down a slide that makes a 42° angle with the horizontal direction.   The coefficient of kinetic friction for the child sliding on the slide is 0.20.   What is the magnitude of her acceleration during her sliding? If she starts from rest how long is the slide if it takes 4 s to slide down?

20. A crate is sliding down an incline that is 35° above the horizontal. If the coefficient of kinetic friction is 0.40, the acceleration of the crate is? If the crate starts from rest how long is the incline if it takes 3 s to slide down? What is the speed at the bottom?

21. A 32-N force, parallel to the incline, provided by a rope, is required to push a certain crate at constant velocity up a frictionless incline that is 30° above the horizontal. The mass of the crate is:

22. Linc, the 65.0- kg lifeguard, slides down a water slide that is inclined at an angle of 35.0^0 to the horizontal, into the community swimming pool. if the coefficient of friction of the slide is 0.050, what is Linc's acceleration as he slides down? The fun takes 2.2 seconds. How long is the slide? what is his speed at the bottom?

23. At Sea World, a 900.-kg polar bear slides down a wet slide inclined at an angle of 25.0° to the horizontal. The coefficient of friction between the bear and the slide is 0.0500. What frictional force impedes the bear's motion down the slide?
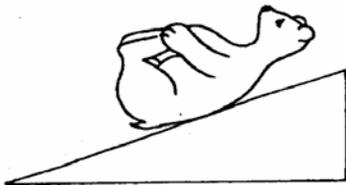
24. Block A, with a mass of 10 kg, rests on a 30° incline. The coefficient of kinetic friction is 0.20. The attached string is parallel to the incline and passes over a massless, frictionless pulley at the top. Block B, with a mass of 8.0 kg, is attached to the dangling end of the string. The acceleration of B (going down) is:
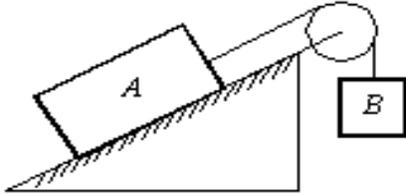
27. The system shown remains at rest. The force of friction on the upper block is:

$W = 20$ N
$a = 3$ m
$b = 4$ m

Gravitational force - both

1. Gravitational forces are the weakest forces found in nature.   Because of this

    a. the gravitational effect between a pencil and the earth cannot be seen

    b. there is no gravitational force between two 1-kg masses

    c. there is no movement between two 1-kg masses located near each other in space

    d. gravitational effects occur only when a large mass is involved

    e. gravitational forces that are easily observed involve one or more large masses

2. The reason the moon does not fall into Earth is that

    a. Earth's gravitational field at the moon is weak

    b. gravitational pull of other planets keeps the moon up

    c. the moon has a sufficiently large orbital speed

    d. the moon has less mass than the earth

    e. none of the above

3. Which is more, the gravitational force between Earth and the moon, or between Earth and the sun?

    a. Earth-sun   b. Earth-moon   c. equal

4. If the moon orbited Earth at a distance twice what it is now, would the moon be moving faster, slower, or with the same speed as today? Explain. What would happen to the length of the month?

5. By what factor would your weight be multiplied if Earth's diameter were 1/ 4 as big and Earth's mass remained unchanged?

6. By what factor would your weight be multiplied if Earth were 1/4 as massive and Earth's diameter remained unchanged?

7. What would a person who weighs 70 N on Earth weigh on a planet that has the same mass as Earth but half its radius?

8. Imagine you are standing atop a ladder so tall that you are 5 Earth radii from Earth's center. What is your weight at the top of the ladder, relative to your weight on the ground?

9. A man whose mass is 72 kg is in a spacecraft at a height equal to Earth's diameter (not radius!) above Earth's surface. What is the gravitational force between him and Earth at this distance?

10. Jupiter has a mass about 300 times that of Earth, and its radius is about 11 times that of Earth. What would be the approximate weight of a 2.5-kg rock on the surface of Jupiter?

11. Satellites often hover 640 km above Earth's surface, which is 10% of Earth's radius. What is Earth's approximate gravitational field, g, in satellite territory?

12. What is Earth's gravitational field, g,   4 Earth-diameters   from Earth's surface (9r from Earth's center)?

13. Suppose you're standing on the surface of a shrinking planet. If it shrinks to 1/ 3 its diameter (and its mass remains the same), how many times as much would you weigh on the shrunken surface?

14. Calculate the force of gravity on a 1-kg mass at Earth's surface. The mass of Earth is 6×10^{24} kg, and its radius is 6.4×10^{6} m.

15. Calculate the force of gravity on the same 1-kg mass if it were 6.4 X 10^6 m above Earth's surface (that is, if it were 2 Earth radii from Earth's center).

16. Calculate the force of gravity between Earth (mass = 6.0 x 10^{24} kg) and the moon (mass = 7.4 x 10^{22} kg). The average Earth—moon distance is 3.8 x 10^8 m.

17. By what factor would your weight change if Earth's diameter were doubled and its mass were also doubled?

18. If you stood atop a ladder that was so tall that you were twice as far from Earth's center, how would your weight compare with its present value?

19. Find the change in the force of gravity between two planets when the distance between them is reduced to one-tenth of the original distance.

20. Find the change in the force of gravity between two objects when both masses are doubled and the distance between them is also doubled.

21. Many people mistakenly believe that the astronauts that orbit Earth are "above gravity" Calculate g for space shuttle territory; 200 km above Earth's surface. Assume Earth's mass is 6.0×10^{24} kg, and its radius is 6.38×10^6 m (6380 km). Your answer is what percentage of 9.8 m/s^2?

22. On the small and good planet Ballonius in a distant solar system, suppose we find the radius of the good planet to be 200 000 m. We also drop a rock and find that it travels 1.5 m in the first second of free fail, which means it accelerates at 3 m/s^2. Estimate the mass of Ballonius.