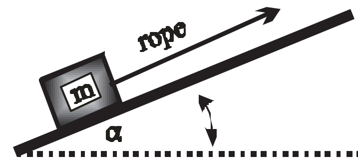
PHYSICS HOMEWORK #31 NEWTON'S LAWS
SECOND LAW $\Sigma F=ma$

<u>Newton's Second Law of Motion</u>
The acceleration of an object is directly proportional to the force applied, inversely proportional to the mass of the object and in the same direction as the accelerating force!

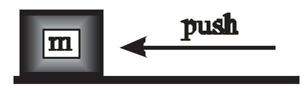
1. A crate, which has a mass of m = 45.0 kg., is being accelerated at 3.20 m/sec^2 up a frictionless inclined plane, which meets the horizontal at an angle of α = 35.0^o relative to the horizontal, by a rope as shown to the right.
   a. Complete the free body diagram showing all the forces acting on the crate as it moves up the incline at a constant speed.
   b. What will be the magnitude of the normal force acting on the crate?
   c. What will be the magnitude of the tension T in the rope?



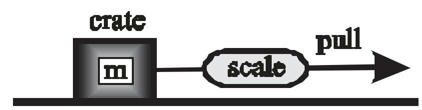
Make a freebody diagram for EVERY problem!

2. A crate, which has a mass of 55.0 kg. is being accelerated straight up by a rope at a rate of 3.80 m/sec^2. What will be the tension in the rope?

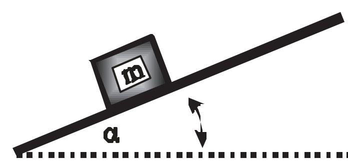
3. A crate, which has a mass of 55.0 kg., is being pushed along a horizontal surface by a force of F = 125.0 Newtons so that the crate is accelerating to the left at a constant rate of a = 1.10 m/sec^2.
   a. Complete the free body diagram showing all the forces acting on the crate.
   b. What will be the magnitude of the frictional force acting on this crate?
   c. What is the coefficient of sliding friction between the crate and the horizontal surface?



4. A block of wood, which has a mass of m = 5.00 kg., is at rest on a horizontal surface which has a coefficient of sliding friction of μ = 0.43. A spring scale is attached to a hook on the end of the block and is pulled until the reading on the scale is 47.0 N. As a result the block accelerates to the right.
   a. What is the magnitude of the normal force acting on this block?
   b. What is the magnitude of the frictional force on this block as it slides to the right?
   c. What is the rate of acceleration of this block?



5. A crate, which has a mass of 65.0 kg., is sitting at rest on an inclined plane, which has a coefficient of sliding friction of μ = 0.430, as shown to the right. The end of the incline is lifted until the angle of the incline reaches α = 27.0^o, at which point the crate accelerates down the incline at a constant rate.
   a. Complete the free body diagram showing all the forces acting on the crate.
   b. What is the magnitude of the normal force acting on this crate?
   c. What is the magnitude of the frictional force acting on this crate?
   d. What is the rate of acceleration of this crate as it slides to the bottom of the inclined plane?



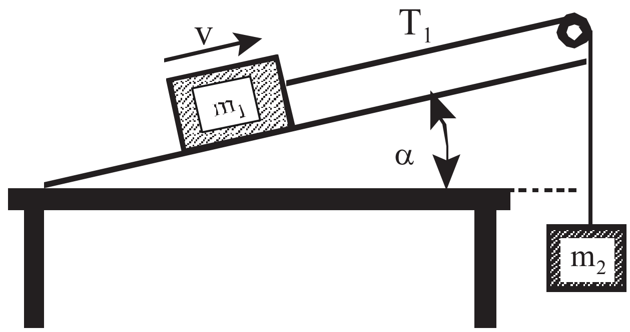
6. A sled, which has a mass of m = 125 kg., is sitting on an icy horizontal surface. A rope is attached to the front end of the sled such that the angle between the rope and the horizontal is α = 28.0^o and a force of 585 N is applied to the rope. As a result the sled accelerates to the right at a rate of 3.30 m/sec^2.
   a. Complete the free body diagram showing all the forces acting on the sled.
   b. What is the magnitude of the frictional force acting on this sled?
   c. What is the magnitude of the normal force acting on the sled?
   d. What is the coefficient of sliding friction between the sled and the icy horizontal surface?
   e. What will be the displacement of this sled at the end of 5.0 seconds?

Answers to opposite side: 7a. 52.0 N b. 2.37 m/sec^2 c. 0.741 sec d. 1.76 m/sec 8a. 2.40 m/sec^2 8b. 60.0 N c. 195 N
9a. 8.03 m/sec^2 b. 66.5 N 10a. 22.3 N b. 22.3 N c.75.0 N d. 126 N

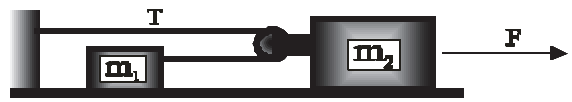
PHYSICS HOMEWORK #32 NEWTON'S LAWS

SECOND LAW $\Sigma F = ma$

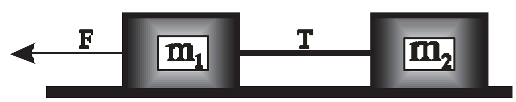
7. A mass of m_1 = 6.00 kg is sitting on an inclined plane, which meets the horizontal at an angle of α = 22.0°, which has a coefficient of sliding friction of μ = 0.290, and which is L = 3.50 meters long, as shown to the right. A string is attached to mass m_1, it is strung over a pulley, and is then attached to a second mass m_2 = 7.0 kg. which is initially a distance of h = 65.0 cm above the floor. As a result m_1 accelerates up the incline at a constant rate.
   a. What is the magnitude of the tension T in the string connecting the two masses?
   b. What will be the rate of acceleration of this system?
   c. How long will it take for mass m_2 to reach the floor ?
   d. What will be the speed of m_2 just as it reaches the floor ?



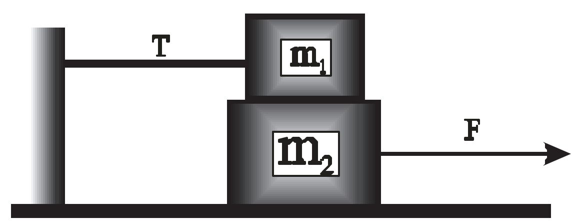
8. Two masses are sitting on a horizontal surface as shown to the right. The coefficient of sliding friction between these two masses and the horizontal surface is μ_k = 0.520. A string is attached to the end of mass m_1= 8.00 kg. This string is then looped around a pulley and is finally attached to the left vertical surface. The pulley is attached to mass m_2 = 12.0 kg as shown and then a force F is applied to m_2 such that m_2 accelerates toward the right at a constant rate of a_2 = 1.20 m/sec^2.
   a. What will be the corresponding acceleration a_1 of mass m_1 ?
   b. What will be the tension T in the string that is accelerating mass m_1 ?
   c. What will be the magnitude of the force F required to accelerate this system at the given acceleration ?



9. Two masses, m_1 = 3.00 kg and m_2 = 7.00 kg. are sitting on a horizontal surface, which has a coefficient of kinetic friction of μ_k = 0.150, as shown to the right. The two masses are attached together by a string in which the tension is T. A force F = 95.0 N is applied to the system as shown so as to accelerate the two masses to the left at a constant rate a.
   a. What will be the rate of acceleration of this system ?
   b. What will be the tension T in the string connecting the two masses together?



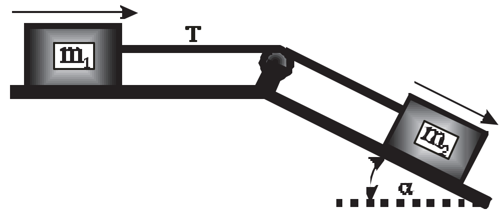
10. Two masses are arranged as shown. m_1 has a mass of 6.00 kg and is attached to the vertical surface on the left with a string in which the tension is T. m_2 has a mass of 9.00 kg, is sitting on the horizontal surface and is being pulled to the right by a force F so that m_2 is accelerating to the right at a constant rate of a = 3.20 m/sec^2. The coefficient of sliding friction between m_1 and m_2 is μ_1 = 0.380 while the coefficient of sliding friction between m_2 and the horizontal surface is μ_2 = 0.510.
   a. What will be the tension T in the string?
   b. What is the magnitude of the frictional force between m_1 and m_2?
   c. What will be the magnitude of the frictional force between m_2 and the horizontal surface?
   d. What will be the magnitude of the force F required to accelerate m_2 to the right at 3.20 m/sec^2 ?



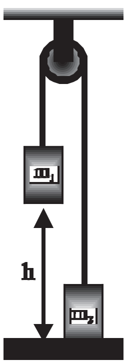
Answers to opposite side: 1b. 361 N c. 397 N 2. 748 N 3b. 64.5 N c. 0.12 4a. 49 N b. 1.1 N 4c. 5.2 m/sec^2 5b. 568N c. 244 N d. 0.692 m/sec^2 6b. 104 N c. 950 N d. 0.109 e. 41.3 m

PHYSICS HOMEWORK #33 NEWTON'S LAWS

SECOND LAW $\Sigma F=ma$

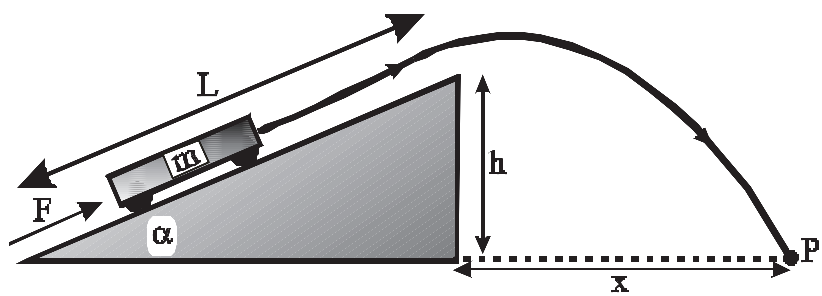


11. In the diagram at the right m_2 = 8.50 kg. is accelerating down the incline at a constant rate. m_1 is being pulled by a string attached between these two masses. The coefficient of friction between m_1 and the horizontal surface is μ_1 = 0.220 while the coefficient of friction between μ_2 and the incline is μ_2 = 0.380. The angle between the incline and the horizontal is $\alpha = 42.0^o$. As a result the system accelerates down the incline at 1.65 m/sec^2.
    a. What is the mass of m_1 ?
    b. What is the tension in the string connecting the two masses together ?
    c. What will be the acceleration of this system if m_1 = 10.0 kg and m_2 = 2.00 kg.?



12. Two masses are connected together by a string which is then hung over a pulley which is mounted on the ceiling as shown in the diagram to the left. Mass m_1 = 7.50 kg and mass m_2 = 6.50 kg. Initially mass m_1 is suspended h = 135 cm above the floor while mass m_2 is sitting on the floor.
    a. What will be the net [unbalanced] force on this system?
    b. What will be the resulting acceleration of this system ?
    c. What will be the tension in the string as m_1 accelerates to the floor ?
    d. How long will it take for m_1 to reach the floor?
    e. What will be the velocity of m_1 just as it reaches the floor ?

13. A cart, which has a mass of m = 4.50 kg., is sitting at the bottom of an inclined plane which is L = 4.20 meters long and h = 1.30 meters high. The coefficient of rolling friction between the cart and the surface of the incline is μ = 0.0950. A force of F = 40.0 N is applied as shown so as accelerate the cart all the way up the incline until the car leaves the end of the incline and flies through the air until it lands at point P which is X meters from the base of the incline as shown.
    a. What will be the rate of acceleration of the cart as it moves up the incline?
    b. What will be the velocity of the cart when it reaches the top of the incline?
    c. How long after the cart leaves the top of the incline will the cart land on the floor?
    d. How far from the base of the incline X will the cart land on the floor?



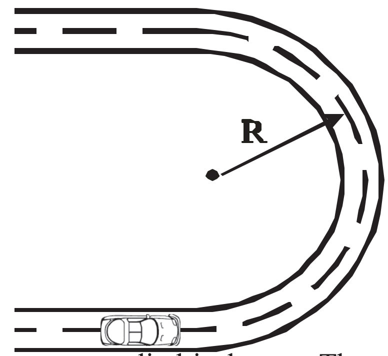
Answers to opposite side: 14. 9.75 N 15. 5980 N [up to the left] 16a. 7.23 m/sec b. 12.4 m/sec^2, 1.27 g's
16c. F_f up, F_N left, F_g down d. 622 N e. 622 N f. 490 N g. 0.788 17a. 28.0 m/sec b. 6.29 m/sec^2
17c. 0.64 g's d. down and to the right [toward the center]

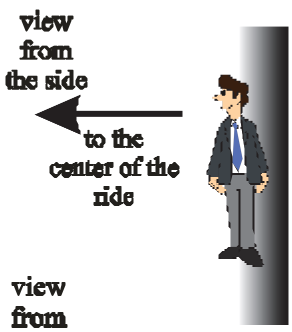
PHYSICS HOMEWORK #34 NEWTON'S SECOND LAW

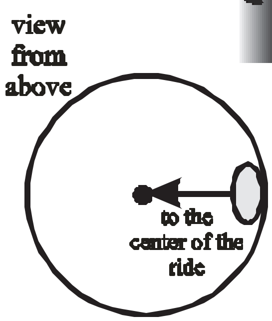
CENTRIPETAL FORCE $F_c = \dfrac{m \cdot v^2}{r}$

14. A ball, which has a mass of 0.65 kg., is moving in a circular path, which has a radius of 1.35 meters, with a linear speed of 4.50 m/sec. What is the magnitude of the centripetal force acting on this ball?

15. A car, which has a mass of 1200 kg is moving with a speed of 18.0 m/sec as it passes through a curve in the road which has a radius of curvature of R = 65.0 meters as shown to the right. What are the magnitude and direction of the centripetal force acting on this car when at the location shown?

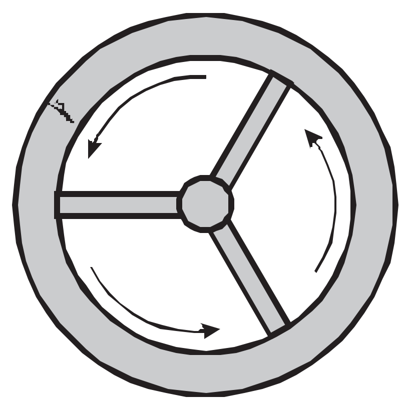






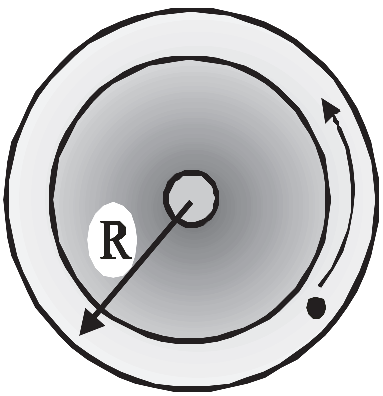
16. There is an amusement ride called the "ROTOR" where you enter a cylindrical room. The room begins to spin very fast until at some point the floor beneath you "falls out". Suppose that this room has a radius of 4.20 meters and that the room rotates such that you make one complete revolution in 3.65 seconds. The diagram to the left shows an occupant of this ride standing suspended next to the exterior wall of this ride.
   a. What will be your linear speed as the room spins at this speed?
   b. What is the magnitude of your centripetal acceleration? How many "g's" is this?
   c. On the diagram to the left label all of the forces acting on the rider.
   d. What will be the magnitude of the centripetal force acting on a 50.0 kg person on this ride?
   e. What will be the magnitude of the normal force acting on this person?
   f. What will be the minimum frictional force acting on this person?
   g. What is the minimum coefficient of friction between the rider and the wall?

17. One of the classic stories of science fiction is the concept of a spoked wheel space station [as in 2001 A Space Odyssey]. The point of this concept is to use the rotation of the wheel to generate an artificial gravity. Suppose that a space station was built as shown to the right with a radius of R = 125 meters and a period of rotation of 28.0 seconds.
   a. What would be the linear speed of a person standing on the outer rim of the space station as shown to the right ?
   b. What would be the magnitude of the centripetal acceleration of this person?
   c. How many "g's" is this acceleration?
   d. What would be the direction of the centripetal acceleration of this person while in the location shown?



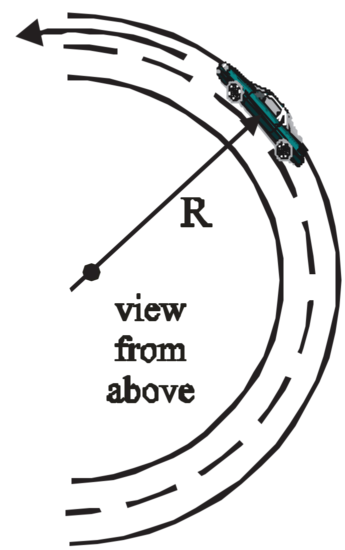
Answers to opposite side: 11a. 4.78 kg b. 18.2 N c. 0 m/sec^2 12a. 9.8 N b. 0.70 m/sec^2 c. 68.3 N 12d. 1.96 secretary e. 1.37 m/sec 13a.4.97 m/sec^2 b. 6.46 m/sec c. 0.76 sec d. 4.66 m

CENTRIPETAL FORCE

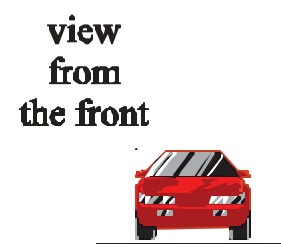


18. Consider a roulette wheel, as shown to the left, where the radius of the wheel is R = 0.850 meters. A ball, which has a mass of 135 grams, is thrown into the roulette wheel after which it rotates counter-clockwise with a speed of v = 3.40 m/sec.
   a. What will be the magnitude of the centripetal acceleration of this ball?
   b. What will be the direction of the centripetal acceleration of this ball while in the position shown?
   c. What will be the magnitude of the centripetal force acting on this ball?
   d. What will be the direction of the centripetal force acting on this ball?
   e. Suppose that the ball escaped from the roulette wheel while in the position shown, what will be the direction of motion of the ball as it exits the wheel?

19. An automobile, which has a mass of 1140 kg, is moving with a velocity of 22.0 m/s around a curve in the highway which has a radius of R = 85.0 meters and which has a coefficient of static friction of μ = 0.720.
   a. Draw a freebody diagram showing each of the forces acting on this car.
   b. What will be the magnitude of the normal force acting on this car?
   c. What will be the maximum frictional force available to this car as it passes through the curve?
   d. What will be the direction and magnitude of the centripetal acceleration of this car?
   e. What will be the direction and magnitude of the centripetal force acting on this car?
   f. Is this car going too fast to make it safely through the curve? Explain!



20. An automobile, which has a mass of 2200 kg, is moving around a flat curve in the highway which has a radius of R = 92.0 meters and which has a coefficient of static friction of μ = 0.670.
   a. Draw a freebody diagram showing each of the forces acting on this car.
   b. What will be the magnitude of the normal force acting on this car ?
   c. What is the maximum speed with which this car can pass through the curve without losing control?
   d. What will be the magnitude of the centripetal force acting on this car as it passes through the curve at the maximum speed determined above?



21. You are standing a distance of 17.0 meters from the center of a merry-go-round. The merry-go-round takes 9.50 seconds to go completely around once and you have a mass of 55.0 kg.
   a. What will be your speed as you move around the center of the merry-go-round?
   b. What will be your centripetal acceleration as you move around the center of the merry-go-round?
   c. What will be the magnitude of the centripetal force necessary to keep your body moving around the center of this merry-go-round at the calculated speed?
   d. How much frictional force will be applied to you by the surface of the merry-go-round?
   e. what is the minimum coefficient of friction between your shoes and the surface of the merry-go-round?

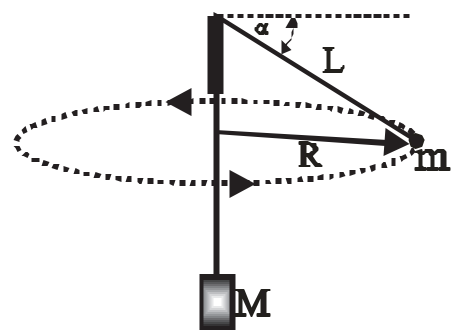
Answers to opposite side: 22a. F_f - down incline, F_N - perpendicular to incline, F_g - straight down
22b. 35.3 m/sec c1. 24,900 N c2. 8220 N 23a. T - up and to the left, F_g - straight down
23b. 0.437 N c. 5.99 m/sec d. 0.460 N e. 45 gm 24a. F_g - down, F_N - down b. 15.3 m/sec

PHYSICS HOMEWORK #36 — NEWTON'S SECOND LAW
CENTRIPETAL FORCE

22. An automobile, which has a mass of 1850 kg., is moving through a banked curve, which has a radius of curvature of R = 122 meters, as shown to the right. The angle between the roadbed and the horizontal is $\alpha = 28.0^{o}$ while the coefficient of static friction between the tires of the car and the roadbed is $\mu = 0.330$.

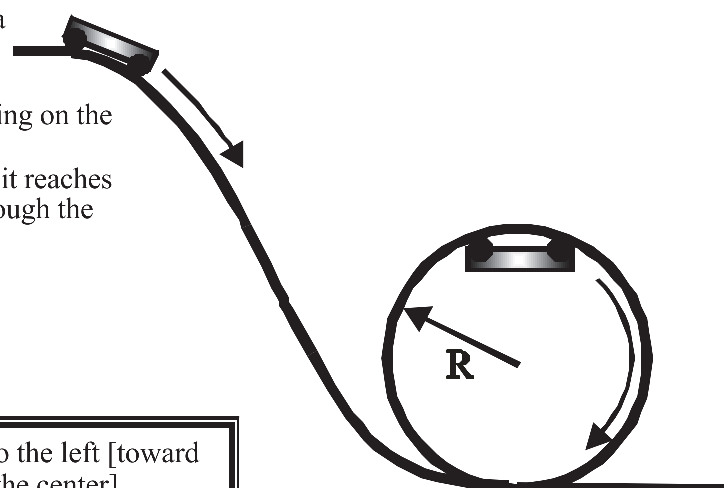
a. Draw the freebody diagram showing each of the forces acting on the car as it passes through the curve.
b. What will be the maximum speed with which the car can negotiate the curve without losing control?
c. While moving at this maximum speed, what will be the direction and magnitude of:
1. the normal force acting on the car.
2. the frictional force acting on the car.
3. the centripetal force acting on this car.
d. What will be the minimum speed with which the car can negotiate the curve without losing control?
e. With what speed should the car proceed through the curve if there was no friction at all?

23. A rubber stopper, which has a mass of m = 14.5 grams, is tied to the end of a string which is threaded through a glass tube. You then spin the rubber stopper about your head in a horizontal circle as shown to the right. The stopper sags $\beta = 18.0^{o}$ below the horizontal as shown and the distance from the top of the tube to the stopper is L = 1.25 m.



a. Draw the freebody diagram showing each of the forces acting on the rubber stopper.
b. What will be the magnitude of the centripetal force acting on the stopper?
c. What is the speed of the stopper?
d. What is the tension in the string?
e. How much Mass M is hanging on the end of the string?
f. How long will it take for the stopper to move around the circular path 10 times?

24. A roller coaster rolls down a hill and then passes through a loop-the-loop which has a radius of R = 24.0 meters as shown.
a. Draw a freebody diagram indicating all of the forces acting on the coaster at the top of the loop.
b. What will be the minimum velocity of the coaster when it reaches the top of the loop if the coaster is to make it safely through the loop?



Answers to opposite side: 18a. 13.6 m/sec^2 b. up and to the left [toward the center] c. 1.84.N d. up and to the left [toward the center]
18e. up and to the right [tangent to the curve]
19a. F_N - up, F_f - down and left [toward the center], F_g - straight down
19b. 11,200 N c. 8040 N d. 5.69 m/sec^2 e. 6490 N f. all is well!
20a. same as 19a b. 21,600 N c. 24.6 m/sec d. 14,500 N
21a. 11.2 m/sec b. 7.44 m/sec^2 c. 409 N d. 409 N e. 0.759

PHYSICS HOMEWORK #37

NEWTON'S SECOND LAW
UNIVERSAL GRAVITATION

PLANET	RADIUS	MASS	ALTITUDE	PERIOD
Sun	6.96×10^{8} m	1.99×10^{30} kg	N/A	N/A
Earth	6.38×10^{6} m	5.97×10^{24} kg	1.50×10^{11} m	365.25 days
Moon	1.74×10^{6} m	7.35×10^{22} kg	3.80×10^{8} m	27.3 days
Mars	3.39×10^{6} m	6.42×10^{23} kg	2.28×10^{11} m	687 days
Jupiter	7.14×10^{7} m	1.90×10^{27} kg	7.79×10^{11} m	4333 days
Io	1.82×10^{6} m	7.87×10^{22} kg	3.48×10^{8} m	1.53×10^{5} sec
Saturn	6.00×10^{7} m	5.68×10^{26} kg	1.13×10^{12} m	10,759 days
Titan	2.58×10^{6} m	1.19×10^{23} kg	1.22×10^{6} m	1.42×10^{6} sec
Neptune	2.43×10^{7} m	1.03×10^{26} kg	4.50×10^{12} m	60,188 days
Triton	1.90×10^{6} m	1.34×10^{23} kg	3.54×10^{5} m	5.08×10^{5} sec
Pluto	1.50×10^{6} m	1.50×10^{22} kg	5.91×10^{12} m	90,885 days

Universal gravitational constant $G = 6.67 \times 10^{-11}$ Nm^2/kg^2

$$F_g = \frac{G \cdot m_1 \cdot m_2}{r^2}$$

1. What will be the gravitational force between two masses, $m_1 = 15$ kg. and $m_2 = 35$ kg., if the distance between the two masses is measured to be 18.5 cm., center to center?

2. What will be the gravitational force between a 12.0 kg. mass and the Earth when the mass is sitting on the Earth's surface?

3. What will be the gravitational force between a 12.0 kg. mass and the planet Mars when the mass is sitting on the surface of Mars?

4. What will be the gravitational force constant "g_{Mars}" on the surface of Mars?

5. What would be the gravitational force constant "$g_{Jupiter}$" on the surface of Jupiter, if Jupiter had a surface?

6. What is the gravitational attraction between the Earth and the Moon?

7. A satellite, which has a mass of 550 kg. and a radius of 2.20 meters, is orbiting the Earth at an altitude of 375 kilometers.
   a. What will be the magnitude of the gravitational force between this satellite and the Earth ?
   b. What must the velocity of this satellite be in order for the satellite to remain in a stable orbit ?
   c. What will be the magnitude of the centripetal acceleration of this satellite ?
   d. How long will it take for this satellite to orbit the Earth once ?

8. A space ship is orbiting the planet Mars at an altitude of 1200 km. above the surface of Mars.
   a. What is the required velocity for this space ship to remain in a stable orbit ?
   b. What will be the period of this orbit ?

Answers to opposite side: 9a. 6.53×10^{3} m/sec 9b. 2.97×10^{6} m 10a. 3.07×10^{3} m/sec b. 3.58×10^{7} m 11a. 1.13×10^{4} m/sec b. 1.89×10^{27} kg 12a. 2.42×10^{4} m/sec b. 1.99×10^{30} kg 13a. 4.34×10^{20} N 13b. 2.03×10^{20} N c. 2.14 14a. 6.70×10^{3} m/sec b. 8.33×10^{3} sec c. decrease 15. 9.13 m/sec^2 16a. 8.55 m/sec^2 b. toward the center of the Earth c. 2780 N

PHYSICS HOMEWORK #38 — NEWTON'S SECOND LAW UNIVERSAL GRAVITATION

9. A satellite is to orbit the Earth so that its period is 2.50 hours.
   a. What velocity is required to maintain this orbit ?
   b. What will be the altitude of this orbit ?

10. A satellite is designed so that it will orbit the Earth once every 24.0 hours. [Called geosynchronous orbit because the satellite will remain above the same point on the Earth's surface !]
   a. What velocity will be required to maintain this orbit ?
   b. What will be the altitude of this orbit ?

11. The moon Io orbits the planet Jupiter at an altitude of 3.48×10^8 m with an orbital period of 1.529×10^5 seconds.
   a. What is the orbital velocity of Io about Jupiter ?
   b. According to this information what is the mass of the planet Jupiter ?

12. The planet Mars orbits the sun at a distance of 2.28×10^{11} m with an orbital period of 687 days.
   a. What is the orbital velocity of Mars about the Sun ?
   b. According to this information, what is the mass of the sun ?

13a. What is the magnitude of the gravitational force of the Sun on the Earth's moon ?
   b. What is the magnitude of the gravitational force of the Earth on the moon ?
   c. How does the gravitational force of the Sun on the moon compare to the force of the Earth on the moon ?

14. A satellite is orbiting the Earth at an altitude of 2500 km. above the Earth's surface.
   a. What velocity is required for this satellite to maintain a stable orbit ?
   b. What will be the orbital period of this satellite ?
   Suppose that you are on the space shuttle Endeavor and are orbiting the Earth at the same altitude as the satellite, but you are trailing the satellite by 28 km. and would like to catch up with and capture the satellite for repair and maintenance.
   c. Should you increase or decrease your orbital velocity in order to catch up with the satellite ? [Support your answer with quantitative evidence!]

15. What will be the gravitational acceleration in the space shuttle when it is orbiting the Earth at an altitude of 225 km. above the Earth's surface ?

16. A satellite, which has a mass of 325 kg., is orbiting the Earth at an altitude of 450 km. above the Earth's surface with a linear velocity of 7640 m/sec.
   a. What will be the magnitude of the centripetal acceleration of this satellite?
   b. What will be the direction of the centripetal acceleration of this satellite?
   c. What will be the magnitude of the centripetal force acting on this satellite?

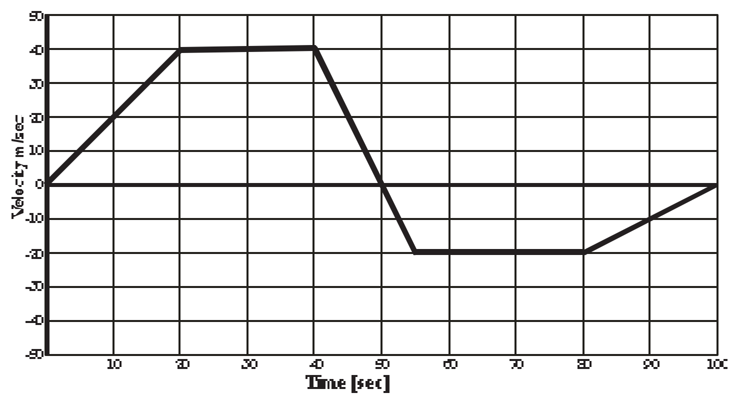
Answers to opposite side : 1. 1.02×10^{-6} N   2. 117 N   3. 44.7 N   4. 3.73 m/sec^2
5. 24.9 m/sec^2 6. 1.94×10^{20} N   7a. 4.80×10^3 N   b. 7.68×10^3 m/sec   c. 8.73 m/sec^2
7d. 5.53×10^3 sec   8a. 3.05×10^3 m/sec   b. 9.44×10^3 sec

PHYSICS HOMEWORK #39 MECHANICS REVIEW

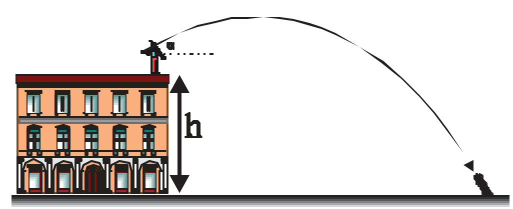
1. A car is moving down a highway with an initial velocity of 35.0 m/sec when the brakes are applied and the car begins to slow down at the rate of -5.0 m/sec^2.
   a. What will be the velocity of this car 4.0 seconds after the brakes are applied?
   b. How far will the car move during the first 4.0 seconds that the brakes are applied?
   c. What will be the average velocity of the car during these 4.0 seconds?
   d. How long will it take for this car to come to a halt?

2. A ball, which has a mass of 1.25 kg., is thrown straight up from the top of a building 86.0 meters tall with an initial velocity of 42.0 m/sec.
   a. What will be the velocity of this ball at the highest point?
   b. What will be the acceleration of this ball at the highest point?
   c. How long will it take for this ball to reach the highest point?
   d. What will be the height of this ball above the ground when it reaches the highest point?
   e. How long will it take for this ball to reach the ground?
   f. What will be the velocity of this ball when it reaches the ground?
   g. When will this ball be 144 meters above the ground?

3. A graph is made, as shown to the right, plotting the velocity of a car as a function of time.
   a. What is the velocity of this car when t = 30 seconds?
   b. How far did this car travel during the first 20 seconds?
   c. What is the acceleration of this car when t = 10 seconds?
   d. What is the displacement of this car between t = 50 seconds and t = 100 seconds?
   e. What is the acceleration of this car when t = 50 seconds?
   f. During which time interval/intervals does this car have zero acceleration?
   g. What are the units of the slope of this graph?
   h. Write the equation describing the velocity of this car between t = 40 seconds and t = 55 seconds.



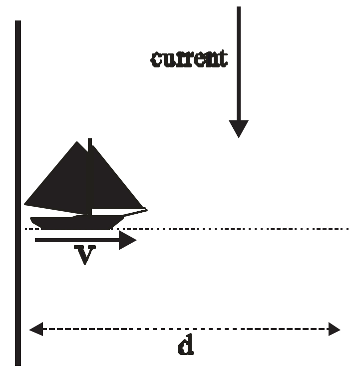
4. A baseball is thrown, with an initial velocity of 37.0 m/sec at an angle of 26.0° above the horizontal, from the top of a building which is 72.0 meters high.
   a. What will be the horizontal and vertical components of this baseball's velocity?
   b. What will be the vertical velocity of this baseball at the highest point of its trajectory?
   c. What will be the horizontal velocity of this baseball at the highest point of its trajectory?
   d. What is the "trajectory"?
   e. How long will it take for this baseball to reach the highest point?
   f. What will be the highest point reached by this baseball?
   g. How long will it take for this baseball to reach the ground?
   h. How far from the base of the building will the baseball strike the ground?
   i. What will be the baseball's velocity just as it reaches the ground?



Answers to opposite side: 5a. 200 s b. 1000 m c. 2600 m at 22.6° downstream d. 13 m/sec at 22.6° downstream 5e. 24.6° upstream f. 343 s 6. Fn - perpendicular to incline, Ff - parallel to and down the incline, Fa - up the incline 6a(cont). Fg - straight down b. 427 N c. 235 N d. 345 N e. 1380 J f. 441 J g. AMA = 1.28 h. IMA = 4 6i. 32% j. 940 J 7a. -1.08 Nm b. -2.57 Nm c. 2.57 Nm d. 1.75 kg e. 22.3 N 8a. 608 N b. 580 N & 665 N

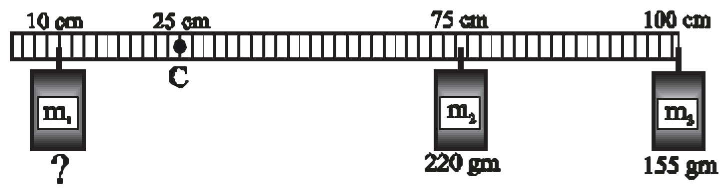
PHYSICS HOMEWORK #40 MECHANICS REVIEW

5. A boat, which has a speed of 12.0 m/sec in still water, heads directly across a river which has a current of 5.0 m/sec and which is 2400 meters wide.
   a. How long will it take for this boat to reach the opposite shore of the river?
   b. How far downstream will this boat reach the opposite shore of the river?
   c. What will be the final displacement of this boat when it reaches the opposite shore of the river?
   d. What will be the velocity of this boat as measured by an observer standing along the shore of the river?
   e. In direction should this boat be aimed if it is to go directly across the river?
   Suppose that this boat was aimed directly up stream.
   f. How long will it take for this boat to go 2400 meters upstream?

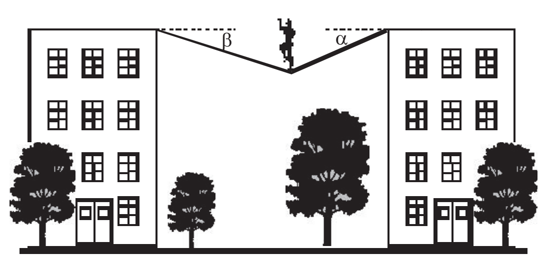


6. A 45.0 kg crate is sitting at the bottom of an inclined plane which is 4.0 meters long and 1.0 meters high. This crate is then pushed up the incline at a constant force. The coefficient of friction between the crate and the incline is $\mu = 0.55$.
   a. Complete the freebody diagram showing all of the forces acting on this crate.
   b. What will be the magnitude of the normal force acting on this crate as it slides up the incline at a constant speed?
   c. What will be the frictional force acting on this crate as it slides up the incline at a constant speed?
   d. What is the magnitude of the force required to push this crate up the incline at a constant speed?
   e. How much work will be done by the applied force on the crate as it is pushed to the top of the incline?
   f. How much gravitational potential energy will this crate have when it reaches the top of the incline?
   g. What is the AMA of this inclined plane?
   h. What is the IMA of this inclined plane?
   i. What is the efficiency of this inclined plane?
   j. How much energy was wasted by the frictional force in pushing the crate to the top of the incline?

7. Three weights are hung from a meterstick, which has a mass of 145 grams, as shown in the diagram to the right. The system is at equilibrium.
   a. What is the torque supplied by the 220 gram mass about the 25.0 cm mark on the meterstick?
   b. What is the total clockwise torque about the 25.0 cm mark of the meterstick?
   c. What is the total counterclockwise torque about the 25.0 cm mark of the meterstick?
   d. What is the mass m_1 required to produce equilibrium about the 25.0 cm mark of the meterstick?
   e. How much upward force must be applied to this meterstick at the 25.0 cm mark in order to generate equilibrium?



8. A tightrope walker, who has a mass of 62.0 kg., is standing on a cable stretched between two buildings as shown to the right where the angles formed by the cable and a horizontal line between the two buildings are $\beta = 22.0^{o}$ and $\alpha = 36.0^{o}$.
   a. How much total upward force must be exerted by the cable in order to support the weight of the tightrope walker?
   b. What will be the tensions, T_β and T_α, in the sections of the cable to the left and right of the tightrope walker?



Answers to opposite side: 1a. 15 m/sec b. 100 m c. 25 m/sec d. 7.0 s 2a. 0.0 m/sec b. -9.8 m/sec^2 2c. 4.28 s 2d. 220 m e. 10.3 s f. -58.7 m/sec g. 6.84 s & 1.73 s 3a. 40 m/sec b. 400 m c. 2.0 m/sec^2 3d. -750 m 3e. -4.0 m/sec^2 f. 20 s < t < 40 s & 55 s < t <80 s g. m/sec^2 h. v = -4t + 200 4a. 16.2 m/sec 4b. 0.0 m/sec 4c. 33.3 m/sec d. path followed by projectile e. 1.65 s f. 85.4 m g. 5.83 s h. 194 m i. 53 m/sec at -51^o