Warm Up:

1. A 1200 kg car is accelerated from rest with a net force of 4000 N. What is the car's velocity after 6.0 seconds?

2. A force of 22 N is applied at an angle 25 degrees above the horizontal axis. Resolve the force into x and y components.

Newton's Second Law Practice

Ivy Way Science

Strategy:

Read the problem carefully.
Sketch if needed.
List the _____.
Draw a _____ _____ diagram (force diagram).
Separate the forces that are acting in the x direction and the _____. Resolve any forces that are _____.
Use ΣF=___ separately in the x direction and y direction.
Use the acceleration you found to solve the _____ equations.

3. A force of 15 N is applied to a mass m. The mass moves in a straight line with its speed increasing by 10 m/s every 2 seconds. Find the mass m.

4. In order to drag a 100 kg log along the ground at constant velocity you have to pull on it with a force of 300 N (horizontally). (a) What is the resistive (friction) force exerted by the ground?
   (b) What force must you exert if you want to give the log an acceleration of 2.0 m/s?

5. A 64 kg girl weighs herself in Newtons by standing on a scale in an elevator. What does the scale read (in N) when (a) the elevator is descending at a constant rate of 2.0 m/s?
   (b) the elevator is accelerating downward at 1.8 m/s^2?
   (c) you are approaching the top floor with a velocity of 2.5 m/s and decelerating at 1.0 m/s^2?

6. You are a given a gift of mass M in a fancy gift bag. The handles of the gift bag could rip easily; they can only withstand a tension of T Newtons. What is the fastest time that you would be able to accelerate the gift bag from rest to a height of h meters without ripping the bag? Answer in terms of M, T, h and g.

Friction:

_____ friction occurs when there is motion at the interface between 2 bodies.

The _____ of friction is dimensionless. The value for static friction is generally _____ than the value for kinetic friction.

The formula for static friction is calculating a maximum value, because friction cannot _____ the force that it is opposing.

The formulas for friction are _____ and _____.

Define normal force: _____.

Note that F_N is OFTEN equal to _____ but not ALWAYS.

7. A 50 N box is pulled horizontally along a flat floor having a coefficient of kinetic friction of 0.3. What tension force is needed to accelerate the box by 1.8 m/s2?

8. The coefficient of static friction between a car's tires and the road is 0.4. What is the greatest acceleration that the car can achieve on a flat road? Why do we use the coefficient of *static* friction?

9. A box of mass M must be moved across a level floor at constant velocity. The coefficient of friction between the box and the floor is μ. One method is to push down on the box at an angle θ with the horizontal. Another method is to pull up on a handle attached to the box at an angle θ with the horizontal.
   (a) Sketch each scenario.
   (b) Explain why one method is better than the other.
   (c) Calculate the applied force necessary to move the box by *each* method in terms of M, g, μ, and θ.

Inclined Planes:

Strategy:

Read the problem carefully.

Sketch if needed.

List the givens.

Draw a _____ _____ diagram (force diagram).

Rotate the drawing so that the axes align with the _____.

Now the force of _____ is no longer on the y axis.

Resolve any forces into components that are parallel and perpendicular to the inclined plane.

The equations for the weight are

_____ and _____. Note: "the sine _____ down the plane.

Use ΣF=___ separately in the parallel and perpendicular directions.

Usually there is only acceleration _____ to the plane. Use a to solve the kinematic equations.

10. Find the acceleration of a 2.0 kg box down a smooth plane inclined 35° to the horizontal. Draw a FBD.

11. A box of mass M sits on an inclined plane with a coefficient of static friction μ. How steeply can you tilt the plane without the box sliding? Find the angle θ in terms of M, g, and μ. Draw a FBD!

12. A sledder goes down Suicide Hill (θ=32°, μ=0.25). What is the sledder's acceleration? How long does it take to reach the bottom of the 50 m slope?

13. You are pushing a 5 kg box up a 25 degree ramp with a force of 8 Newtons. The coefficient of kinetic friction is 0.36. What is the acceleration of the box? Is it moving up or down the ramp?

Connected Body Problems:

List 3 types of connected body problems:_____

Strategy:

Read the problem carefully. Sketch if needed.

List the givens.

Draw a separate _____ for each object in the problem.

Use ΣF=___ separately for each object.

Each body must have the same _____. In addition, these forces are the same throughout the problem:_____ and _____.

Solve the system of equations to find _____.

Use a to solve the kinematic equations.

14. Atwood's machine: Two masses are connected by a light string over a frictionless pulley. Find the acceleration of each mass and the tension in the string for m_1=200 gm and m_2=100 gm.

Answers:

1. F=ma
   4000=1200 a
   a=3.33 m/s2

   v=vo +at
   v=3.33 x 6
   v=20 m/s

2. Fx=F cos θ
   Fx=22 cos 25
   Fx= 19.9 N

   Fy=Fsinθ
   Fy=22 sin 25
   Fy=9.3 N

3. m= 3.0 kg
4. (a) 300 N, (b) 500 N
5. (a) 627 N, (b) 512 N, (c) 563 N
6. Rad (2hM/(T-Mg))
7. 3.4 m/s2. There is no sliding between the tire and the road.
8. –
9. 9
10. 5.6 m/s^2
11.