Applications of Newton's Laws Worksheet (p. 1)
All work on pages 1 and 2 needs to be done on your own paper.

Friction

1. What is friction?

2. What causes friction between two solid surfaces? Other than the roughness of the surfaces, what most affects the frictional force experienced?

3. Explain the difference between sliding and static friction.

Terminal Velocity

4. What causes fluid friction? What two factors affect the amount of fluid friction experienced?

5. What is the net force on a 10 N falling object that encounters 4 N of air resistance? 10 N of air resistance?

6 N down ***zero***

6. What is the acceleration of a falling object that has reached its terminal velocity?

7. Why does a heavy parachutist fall faster than a lighter one who wears the same size parachute? This is referring to after the parachute is opened.

8. Is a skydiver who has reached her terminal speed in freefall? Explain

9. How does the weight of a falling body compare with the air resistance it encounters before it reaches terminal velocity? After?

10. Why is it that a cat that falls from the top of a 50 story building will hit the ground at the same speed as it would if it fell from the 20th story?

11. If Galileo dropped two balls from the top of the Leaning Tower of Pisa, air resistance was not really negligible. Assuming the balls were the same size and shape, one made of wood and the other of metal, which ball struck the ground first? Explain

12. What will be the acceleration of a skydiver when air resistance builds up to be half her weight?

Circular Motion

13. What is the force that acts on an object in a circular motion? In what direction does this force act?

14. Why do you feel like you are flung sideways when your car travels around a sharp curve?

15. Swing a bucket of water around in a full circle. Does the water stay in the bucket? Explain.

16. When you observe an object moving in a circle, what can you infer about the net force acting on it?

17. What holds the moon in its orbit around the earth?

Applications of Newton's Laws Worksheet (p. 2)
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18. Why must there be a force acting in order for an object to successfully make it around a curved path?

19. What causes the force on a car as it travels through a curve? Why does a car skid on an icy curve?

20. Betty is riding her bike around in a circle with a radius of 3 m. If it takes her 9 s to travel once around, what is her rotational speed and her linear (tangential speed)?
0.11 rot/s *2.1 m/s*

21. A 1200 kg car is driving for 11 s in a circle with a 35 m radius. What is the car's rotational speed and its linear speed? *0.09 rot/s* *20 m/s*

22. Skyler takes 10 seconds to walk around in a circle with a radius of 2 meters. What is Skyler's rotational speed? What is his linear speed? *0.1 rot/s* *1.3 m/s*

23. Daniella takes 10 seconds to walk around in a circle with a radius of 4 meters. What is Daniella's rotational speed? What is her linear speed? *0.1 rot/s* *2.5 m/s*

24. Below are a number of situations involving circular motion. In each case, identify the source of the force needed to keep the objects in question moving in their circular paths.

    Example: A race car going around a corner:
    Friction from the road holds the car in a circular path.

    a) a ball at the end of a string being swung in a horizontal circle:

    b) a sprinter running around the curve at the end of the track:

    c) you in your seat on a roller coaster going through the bottom of a dip:

    d) you in a car going around a horizontal corner to the left:

    e) you in the "Rotor", a carnival ride where you stand inside a spinning room and are pressed against the wall of the ride:

    f) Mars going around the sun:

Gravitation

25. Complete: Gravity force is directly proportional to the _____ of the masses and _____ proportional to the _____ of the distance between them.

26. If the gravitational force of attraction between two objects is 100N, what would the gravitational force be if the distance between them were (a) doubled (b) halved (c) tripled?
25 N *400 N* *11 N*

27. If the gravitational force of attraction between two objects is 100N, what would the gravitational force be if the mass of one of the objects were (a) doubled (b) halved (c) tripled?
200 N *50 N* *300 N*

Applications of Newton's Laws Worksheet (p. 3)

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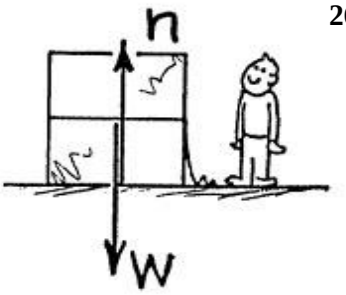
Concept-Development Practice Page **5-1**

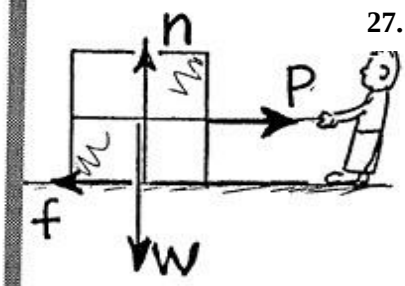
Friction



26. A crate filled with delicious junk food rests on a horizontal floor. Only gravity and the support force of the floor act on it, as shown by the vectors for weight **W** and normal force **n**.

a. The net force on the crate is (zero) (greater than zero).

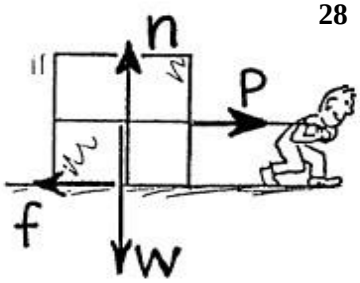
b. Evidence for this is _____.



27. A slight pull **P** is exerted on the crate, not enough to move it. A force of friction **f** now acts,

a. which is (less than) (equal to) (greater than) **P**.

b. Net force on the crate is (zero) (greater than zero).

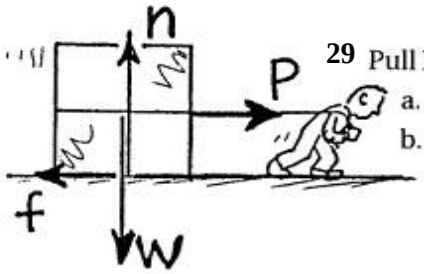


28 Pull **P** is increased until the crate begins to move. It is pulled so that it moves with constant velocity across the floor.

a. Constant velocity means acceration is (zero) (greater than zero).

b. Net force on the crate is (less than) (equal to) (greater than) zero.

c. Friction **f** is (less than) (equal to) (greater than) **P**.



29 Pull **P** is further increased and is now greater than friction **f**.

a. Net force on the crate is (less than) (equal to) (greater than) zero.

b. The net force acts toward the right, so acceleration acts toward the (left) (right).

30 If the pulling force **P** is 150 N and the crate doesn't move, what is the magnitude of **f**? _____

31 If the pulling force **P** is 200 N and the crate doesn't move, what is the magnitude of **f**? _____

32 If the force of sliding friction is 250 N, what force is necessary to keep the crate sliding at constant velocity? _____

33 If the mass of the crate is 50 kg and sliding friction is 250 N, what is the acceleration of the crate when the pulling force is 250 N? _____ 300 N? _____ 500 N? _____

Applications of Newton's Laws Worksheet (p. 4)

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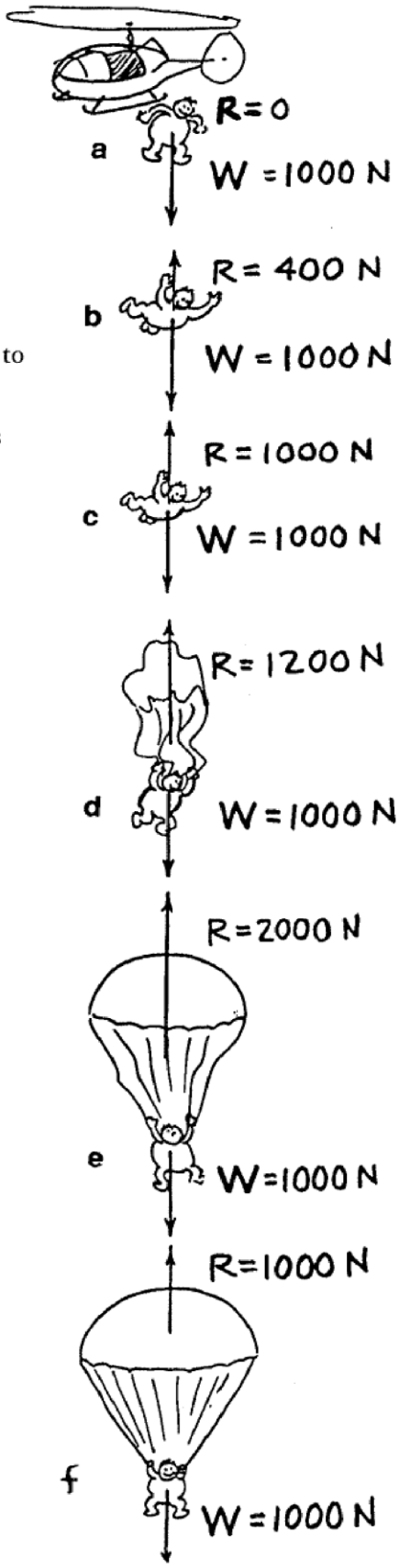
Falling and Air Resistance

Bronco skydives and parachutes from a stationary helicopter. Various stages of fall are shown in positions *a* through *f*. Using Newton's 2nd law,

$$a = \frac{F_{NET}}{m} = \frac{W-R}{m}$$

find Bronco's acceleration at each position (answer in the blanks to the right). You need to know that Bronco's mass *m* is 100 kg so his weight is a constant 1000 N. Air resistance *R* varies with speed and cross-sectional area as shown.



a = _____

a = _____

a = _____

a = _____

a = _____

a = _____

Circle the correct answers.

34. When Bronco's speed is least, his acceleration is

(least) (most).

35. In which position(s) does Bronco experience a downward acceleration?

(a) (b) (c) (d) (e) (f)

36 In which position(s) does Bronco experience an upward acceleration?

(a) (b) (c) (d) (e) (f)

37. When Bronco experiences an upward acceleration, his velocity is

(still downward) (upward also).

38 In which position(s) is Bronco's velocity constant?

(a) (b) (c) (d) (e) (f)

39. In which position(s) does Bronco experience terminal velocity?

(a) (b) (c) (d) (e) (f)

40. In which position(s) is terminal velocity greatest?

(a) (b) (c) (d) (e) (f)

41. If Bronco were heavier, his terminal velocity would be

(greater) (less) (the same).

Conceptual PHYSICS