## Concepts:

- 1. Identify the following using the following terms: weight, friction force, system, net force, normal force, applied force, mass, Newton's Second Law, Newton's First Law.
  - a. \_\_\_\_\_ The "leftover" or "unbalanced" force that is acting on an object.
  - b. \_\_\_\_\_Two objects that are connected and have the same acceleration.
  - c. \_\_\_\_\_  $F_{\rm net} = ma$
  - d. \_\_\_\_\_For example, the force from the floor or a table that holds up objects.
  - e. \_\_\_\_\_ The force of gravity acting on an object.
  - f. \_\_\_\_\_ Objects will maintain a constant velocity if and ony if all the forces on the object are balanced and therefore cancel out.
  - g. \_\_\_\_\_ The force that prevents objects from slipping.
  - h. \_\_\_\_\_Some random force that is trying to move an object.
  - i. \_\_\_\_\_ This is always measured in kg.
- 2. What units are used to measure:
  a. inertia?
  b. force?
  c. acceleration due to gravity?
  d. mass?
  e. weight?
  f. velocity?
  - g. tension? h. normal force? i. distance?
- Acceleration is <u>always</u> in the direction of the
   a. friction force.
   b. net force.
   c. weight.
   d. normal force.
   e. applied force.
- 4. If you are traveling to the right, and speeding up, what is the direction of your acceleration? net force?
- 5. If you are moving the right and slowing down, what is the direction of your acceleration? net force?
- 6. If you are moving to the right with a constant speed, what is the direction of your acceleration? net force?
- 7. How can you tell the direction of the force of friction if something is moving?
- 8. How can you tell the direction of the force of friction if something is at rest?

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9. Draw and label a force diagram that would show all the forces acting on an object for the following:

a. A block at rest on a lab table	b. A block being pushed at constant speed on a rough, level surface
c. A block being pushed across a rough table and speeding up	d. A box sliding to a stop along the floor

- 10. If an object has zero acceleration, can you conclude that no forces are acting on the object? Explain.
- 11. A backpack with a mass of 12 kg is just sitting on the floor. What is the: a. weight of the backpack?
  - b. normal force on the backpack?
  - c. net force on the backpack?
  - d. applied force on the backpack?
  - e. force of friction on the backpack?

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- 12. A car is driving down the road at a constant speed. The car weighs 25,000 N and there is an applied force of 1200 N pushing the car forward. What are
  - a. normal force acting on the car?
  - b. the mass of the car?
  - c. the net force on the car?
  - d. the force of friction on the car?
- 13. What net force is needed to accelerate a 1500 kg car at  $3 \text{ m/s}^2$ ?
- 14. What net force is needed to accelerate a 12,000 N car at 2 m/s<sup>2</sup>? Careful!
- 15. What is the mass of an object if a net force of 100 N causes it to accelerate at 4 m/s<sup>2</sup>?
- 16. For each of the following free-body diagrams, what is the acceleration of the mass? Give both the magnitude and the direction.



17. For each of the following free-body diagrams, what is/are the missing force(s) if the acceleration and mass are as shown?

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Problems:
18. What is the weight (on earth) of a 15 kg child?

- 19. What is the mass (on earth) of a 15 kg child?
- 20. What is the weight of a 30 kg object on the Moon (g = 1.6 m/s<sup>2</sup>)? What is the mass of a 30 kg object on Jupiter (g = 23 m/s<sup>2</sup>)?

21. A small box weighs 100 N on Mars ( $g = 3.7 \text{ m/s}^2$ ), how much would this box weigh on Earth?

22. Imagine there is a 50 kg object with a force of 400 N trying to push it to the right and at the same time there is another force of 150 N trying to pull it to the left. What is the acceleration of the object?

- 23. A 2500 kg car was traveling at 30 m/s when it skids to a stop in a distance of 120 meters.
  - a. What was the net force on the car? (*Find acceleration first.*)
  - b. During this skid, there were three individual forces acting on the car. What were they?
- 24. Imagine you are pulling a heavy box across the floor with a force of 200 N. The box has a mass of 35 kg. The box started at rest, and sped up to 7.5 m/s in only 2.5 seconds. What was the force of friction acting on the box? (*Find acceleration first.*)

25. A small plane of mass 20,000 kg speeds up from 10 m/s to 50 m/s. It travels a distance of 240 meters during this acceleration. If the force of friction on the plane during this was 50,000 N, how much force was generated by the engines? (*Find acceleration first.*)

26. Imagine you are pulling <u>up</u> on a book with a force of 20 N. The mass of the book is 1.2 kg. What is the acceleration of the book?