Test 4: *Newton's Laws, Part 1*

Equations and Constants:

$\bar{v} = \frac{\Delta x}{\Delta t}$ $v = \frac{dx}{dt}$ $\bar{a} = \frac{\Delta v}{\Delta t}$ $a = \frac{dv}{dt}$ $\bar{v} = \frac{1}{2}(v_i + v_f)$ $|g| = 10\ m/s^2$

$x = \frac{1}{2}at^2 + v_i t + x_i$ $v = at + v_i$ $v_f^2 = v_i^2 + 2a\Delta x$ $R = \frac{v^2 \sin 2\theta}{g}$ $a_c = \frac{v^2}{r}$

$\sum F = ma$ $w = mg$ $w_\perp = mg\cos\theta$ $w_\parallel = mg\sin\theta$

Multiple Choice: *Choose the letter of the best answer. 3 points each.*

1. _____ Here's a classic! Imagine you are holding an apple at rest in your hand. What is the reaction to the weight of the apple?
   a. Of course it is your hand holding the apple up.
   b. Don't be daft! It is the force of gravity on the apple.
   c. The force of the apple pushing down on your hand.
   d. The apple pulling up on the earth.
   e. Hey! I don't see the right answer there!

2. _____ Newton's Third Law says that forces always come in
   a. pairs. b. fruit. c. free-body diagrams. d. balance.

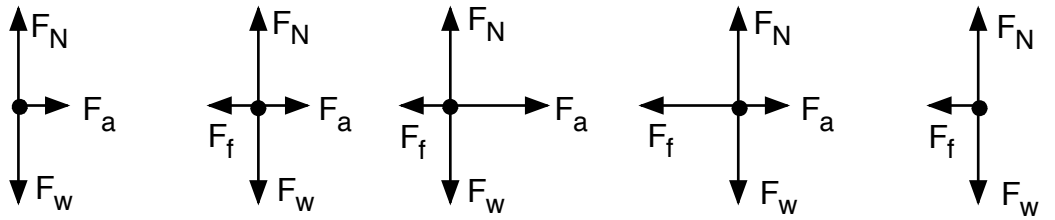
3. _____ What is the mass of something that weighs 750 N?
   a. 75 kg. b. 750 kg. c. 7500 kg. d. 750 N.

Questions 4 and 5 refer to the following:
You are standing in an elevator. You weigh 600 N and there is a normal force on you of 700 N.

4. _____ What is the magnitude of your acceleration?
   a. 0.6 m/s^2. b. 1.17 m/s^2. c. 1.7 m/s^2. d. 8.3 m/s^2. e. 11.7 m/s^2.

5. _____ Which of the following could be happening?
   a. You are going up at constant speed.
   b. You are standing still in the elevator.
   c. You are going down and slowing down.
   d. You are going up and slowing down.
   e. It is impossible under any circumstance.

6. _____ Which of the following would be the best free-body diagram of a car driving down the highway with a constant speed?



a. b. c. d. e.

7. _____ So what is meant by the term "inertia?"
   a. It's an object's resistance to acceleration.
   b. It's just another word for the weight of something.
   c. Nobody really knows, but it sounds cool.
   d. Objects at rest want to stay at rest.
   e. Objects want to stop.

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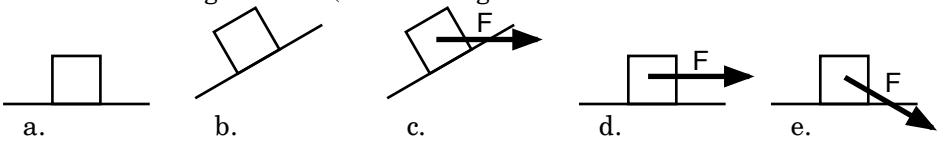
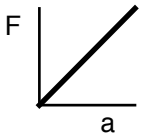
8. _____ A mass is on a frictionless surface. In which of the following situations would the normal force on the mass be the greatest? (Assume angles are the same and F's are the same.)



a. b. c. d. e.

9. _____ Some students do a lab in which they they applied a variety of net forces to a cart and measured the resulting accelerations. The graph of their results is shown. What is the physical significance of the slope?



a. It would be the mass of the cart.
b. It would be the inverse of the mass of the cart.
c. It would be the force of friction on the cart.
d. It would be the time it took the cart to move.
e. None of the above are true.

10. _____ A book is at rest on a table. Which of the following statements must be true?
a. There are no forces acting on the book.
b. The net force on the book is zero.
c. Gravity is not acting on the book.
d. The table is pushing up on the book more than gravity is pulling down on the book.

11. _____ Acceleration is always in the direction of the
a. friction force. b. net force. c. weight. d. normal force.
e. applied force.

12. _____ Equal forces act on two bodies, A and B. If the mass of B is 3 times greater than the mass of A, the acceleration of A will be:
a. 3 times that of B
b. 9 times that of B
c. the same
d. 1/3 that of B
e. 1/9 that of B

13. _____ The force required to maintain an object at a constant speed in outer space is
a. zero
b. equal to the mass of the object
c. equal to the weight of the object
d. equal to the force required to stop it
e. none of the above

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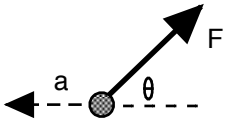
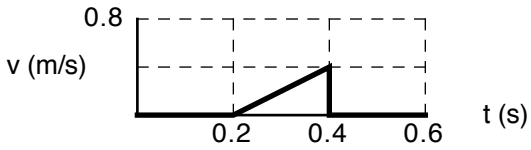
Problem Solving: *Show all work. 10 points each. Include appropriate Free-Body Diagrams!*

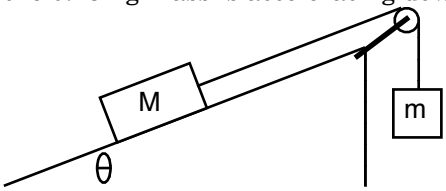
14. Two forces are acting on a 2.5 kg object. One of the forces is shown in the diagram, along with the acceleration of the object. ($F = 45$ N, $\theta = 20^o$, $a = 3$ m/s^2. In unit-vector notation, what is the second force?



15. Some students did a lab in which they measured the acceleration of a wooden block (M = 230 grams) pulled across a table by a mass (m) hanging over a pulley. They got the resulting velocity graph from their computer. If the force of friction had a magnitude of 0.32 N, what was the mass m?



16. A 150 gram mass is connected through a pulley to a 0.45 kg mass on an inclined with a 55° base angle. If the 0.45 kg mass is accelerating down the incline at 1.2 m/s^2, what is the force of friction?



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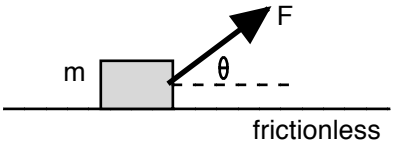
17. An 3 kg object is given an initial velocity of 5 m/s up a ramp with a base angle of 35°. There is a frictional force of magnitude 7 N. How far up the ramp does the object go?

18. A 12 kg box is being pulled across a frictionless table by a force of F at an angle of 35°. If the box is accelerating at 11 m/s^2, what is the normal force on the box?



19. Two objects are on a frictionless table. The larger object is pushed with some force F, as shown. What is the force of the larger object on the little object?