THE GREAT NEWTON'S REVIEW FOR TEST

NEWTON'S LAWS: (why does the chicken cross the road?.....)

1. Why does a child in a wagon seem to fall backward when you give the wagon a sharp pull?
2. If the acceleration of a body is zero, are no forces acting on it?
3. Why might your foot hurt if you kick a heavy desk or a wall?
4. When you stand still on the ground, how large a force does the ground exert on you? Why doesn't this force make you rise up into the air?
5. Why is the stopping distance of a truck much shorter than for a train going the same speed?
6. Big Bubba has a mass of 100 kg on the earth. What is Big Bubba's mass on the moon where the force of gravity is approximately 1/6-th that of Earth's? _____ Explain or show your work.

7. **TRUE or FALSE:**
   i. An object which is moving rightward has a rightward force acting upon it.

   ii. For an object resting upon a non-accelerating surface, the normal force is equal to the weight of the object. If false, state the situations that may occur to cause the F_N to be different than the weight of the object.

8. Which of the following statements are true of the concept of **force**? List all that apply.
   a. A force is a push or pull exerted upon an object which results from the interaction of that object with its environment.

   b. Bubba approaches Billie and gives him a swift shove. Timid little Billie keeps his hands in his pocket during this interaction. Subsequently, while Bubba places a force upon Billie, Billie does not place a force upon Bubba.

   c. A quarterback throws a football downfield. Once thrown, the force from the quarterback persists upon the ball to cause it to continue on its upward trajectory towards its peak.

   d. A sled slides down the hill and reaches the bottom where it gradually slows to a stop. Once on the level ground, the force of the hill persists upon the sled to allow it to continue its forward motion.

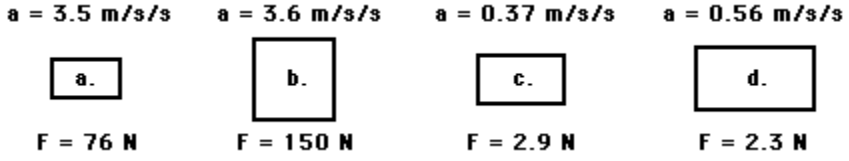
   e. Forces always cause objects to move.

   f. An object can experience two or more forces and not accelerate.

   g. A force is a vector quantity; there is always a direction associated with it.

   h. Force can be measured in kilograms or Newtons depending upon the system of measurement (metric or otherwise).

9. Given the net forces (**F**) upon the objects below and the resulting acceleration (**a**) of each which of the objects below has the greatest inertia?



10. Consider two identical cans, one filled with lead and the other empty. The cans are located far in space at a place where they are "weightless". Describe a method of determining which can has the greater mass.

11. An empty hand is not hurt when it bangs lightly against a wall. Why is it hurt if it does so while carrying a heavy load?

ACTION-REACTION FORCES

12. According to Newton's third law, each team in a tug of war pulls with equal force on the other team. What, then, determines which team will win?

13. According to Newton's third law, every force is accompanied by an equal and opposite *reaction* force. The reason that these forces do not cancel each other is ____.
    a. the action force acts for a longer time period
    b. the two forces are not always in the same direction
    c. one of the two forces is greater than the other
    d. the two forces act upon different objects; only forces on the same object can balance each other.
    e. ... nonsense! They do cancel each other. Objects accelerate because of the presence of a third force.

14. When a rifle shoots a bullet, Newton's Third Law says that the force that the rifle exerts on the bullet is exactly the same size as the force that the bullet exerts on the rifle - yet the bullet gets a **much** greater acceleration than the rifle. How can this be?

15. Tam Anh grabs Sarah by the hand and tries to pull her. She tries to remain standing without moving. A student analyzes the situation as follows. "If Tam Anh's force on Sarah is greater than her force on him, he can get her to move. Otherwise, she'll be able to stay where she is." What's wrong with this analysis?

16. When jumping from a boat to shore, it is always advisable to tie up the boat before jumping. Why?

17. When a small bug is splattered across a fast moving windshield what experiences more force- the bug or the windshield?

18. Why does the force have a greater effect on the bug?

19. If we find a body that we know to be acted on by a force, but that is not moving, what inference can we draw about its state of motion?

20. In a tug-of-war, what is the net force acting on the rope when the participants each pull with opposing forces of 500 N? _____ What is the tensional force within the rope? _____

21. Why can you exert greater force on the pedals of a bicycle if you pull up on the handlebars?

FREE BODY DIAGRAMS and 1-D FORCE

22. Construct free-body diagrams for the following objects; label the forces according to type. Use the approximation that **$g=10\ m/s^2$** to determine the magnitude of all forces and the net force and acceleration of the object.

a. A 2-kg box is at rest on a table.	b. A 2-kg box is free-falling from the table to the ground.	c. A 2-kg box equipped with a parachute is falling at a terminal velocity after being dropped from a plane.

d. A 2-kg box is sliding to the right across a table. The force of friction upon the box is 5 N.	e. An 8-N force is applied to a 2-kg box to move it to the right across the table at a constant velocity of 1.5 m/s.
f. An 8-N force is applied to a 2-kg box to accelerate it to the right across a table. The box encounters a force of friction of 5 N.	g. A 500-kg freight elevator is descending down the shaft at a constant velocity of 0.50 m/s.
h. A 500-kg freight elevator is moving upwards towards its destination. Near the end of the ascent, the upward moving elevator encounters a downward acceleration of 2.0 m/s/s.	i. A 150-N rightward force is applied to a 20-kg box to accelerate it to the right across a rough surface at a rate of 2.0 m/s/s.

23. A 72-kg skydiver is falling from 10000 feet. At an instant during the fall, the skydiver encounters an air resistance force of 540 Newtons. Determine the acceleration of the skydiver at this instant.

24. A 5.2-N force is applied to a 1.05-kg object to accelerate it rightwards across a friction-free surface. Determine the acceleration of the object. (Neglect air resistance.)

25. A 5.2-N force is applied to a 1.05-kg object to accelerate it rightwards. The object encounters 3.29-N of friction. Determine the acceleration of the object. (Neglect air resistance.)

26. A 1250-kg small aircraft decelerates along the runway from 36.6 m/s to 6.8 m/s in 5.1 seconds. Determine the average resistive force acting upon the plane. (Assume that its engine/propeller makes no contributes to its forward motion).

FRICTION

27. Why do you push harder on the pedals of a bicycle when first starting out than when moving at a constant speed?

28. If the coefficient of kinetic (sliding or moving) friction between a 35 kg crate and the floor is 0.30, what horizontal force is required to move the crate at a steady speed across the floor? What horizontal force is required if coefficient of friction is zero?

29. (harder) A box is given a push so that it slides across the floor. How far will it go, given that the coefficient of kinetic friction is 0.20 and the push imparts an initial speed of 4.0 m/s? HINT: Draw a free body diagram for the box as it is sliding, note the initial force to get the box moving only acts at the starting point to get the object moving and does not continue to act on the box as it moves.

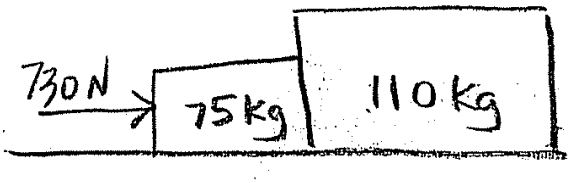
30. (harder) A motorcyclist is coasting with the engine off at a steady speed of 17 m/s but enters a sandy stretch where the coefficient of friction is 0.80. Will the cyclist emerge from the sandy stretch without having to start the engine if the sand lasts for 15 m? If so, what will be the speed upon emerging?

ELEVATORS

31. A 75.0 kg person stands on a scale in an elevator. What does the scale read (in kg) when
    (a) the elevator is at rest,
    (b) the elevator is climbing at a constant speed of 4.2 m/s,
    (c) the elevator is falling at 5.0 m/s,
    (d) the elevator is accelerating upward at 3.5 m/s^2,
    (e) the elevator is accelerating downward at 4.0 m/s^2
    (Hint: get Fn (apparent weight) first and then divide by 9.8)

COUPLED SYSTEMS

32. Two crates of mass 75 kg and 110 kg are in contact and at rest on a horizontal surface. A 730 kg force is exerted on the 75 kg crate. If the coefficient of kinetic friction is 0.15, calculate (a) the acceleration of the system, and (b) the force that each crate exerts on the other.



PULLEYS

33. Figaro the cat (5.0 kg) is hanging on the tablecloth, pulling Cleo's fishbowl (11kg) toward the edge of the table. The coefficient of kinetic (sliding) friction between the tablecloth (ignore its mass) under the fishbowl and the table is 0.44.
    (a) What is the acceleration of Figaro and the fishbowl?
    (b) If the fishbowl is 0.90 m from the edge of the table, how much times does it take for Figaro to pull Cleo off the table?
    Hint: Treat the table cloth like a pulley.