Ch. 4 Newton's Second Law of Motion ; 11th edition
p.61 Review Questions

3. How great is the force of friction compared with your push on a crate that doesn't move on a level floor?
Ans. They are equal in magnitude and opposite in direction.

4. As you increase your push, will friction on the crate increase also?
Ans. Yes it will.

5. Once the crate is sliding, how hard do you push to keep it moving at constant velocity.
Ans. With a force that is just equal to the kinetic or sliding friction.

6. Which is normally greater, static friction or kinetic friction?
Ans. Static friction is almost always greater.

10. What relationship does mass have with inertia?
Ans. Mass is a measure of an object's inertia.

11. What relationship does mass have with weight?
Ans. An object's weight is directly proportional to its mass. Weight = mg. If you triple the object's mass, its weight is tripled.

12. Which is more fundamental, mass or weight? Which varies with location.
Ans. Mass is more fundamental. Weight changes with location.

14. Fill in the blanks: The Standard International unit for mass is the kilogram. The SI unit for force is the newton.

16. What is the weight of a 1-kilogram object near the earth's surface?
Ans. 10 Newtons.

19. Clearly distinguish among mass, weight, and volume.
Ans. **Mass** is a measure of an objects resistance to a change in its velocity.
Weight is the force of gravity on an object.
Volume is the amount of space t hat an object occupies.

20. Is acceleration directly or inversely proportional to mass? Give an example.
Ans. Acceleration is inversely proportional to the mass of an object. Sport Utility Vehicles are generally more massive than cars and have poor acceleration unless a lot of extra horsepower is added.

21. If the net force acting on a sliding block is somehow tripled, by how much does the acceleration increase?
Ans. Since acceleration is directly proportional to the net force applied to an object, if the net force is tripled, the acceleration will be tripled.

Ch. 4 Newton's Second Law of Motion; ; 11th edition
p.61 Review Questions continued

22. If we say that one quantity is proportional to another quantity, does this mean they are equal to each other? Explain briefly, using mass and weight as an example.
Ans. Being proportional does not mean being equal. Your weight is proportional to your mass but not equal to your mass. My mass is about 75 kilograms and my weight is about 750 newtons. Being proportional means that if I doubled my mass to 150 kilograms, my weight would double and be 1500 newtons. Mass and weight are not equal, but they are proportional to each other.

23. If the net force on a sliding block is tripled, by how much does the acceleration increase?
Ans. The acceleration of an object is directly proportional to the net force applied to the object. If you triple the net force on the object, you triple its acceleration.

24. If the mass of a sliding block is tripled while a constant net force is applied, by how much does the acceleration decrease?
Ans. The acceleration of an object is inversely proportional to its mass. If you triple the mass of the object while maintaining the same net force, its acceleration will be one-third of its original value.
25. If the mass of a sliding block is tripled at the same time the net force on it is tripled, how does the resulting acceleration compare to the original acceleration?
Ans. There will be no change in the object's acceleration. Please look at formula that follows. $a = \frac{3F}{3m}$ is the same as $a = \frac{F}{m}$; so there is no change in the acceleration.
26. How does the direction of acceleration compare to the direction of the net force applied to the object?
Ans. They are always in the same direction.
27. What is meant by *free fall*??
Ans. An object is in free fall when the only forces acting on it are gravity and possibly air friction. Air friction is often ignored when its value is small when compared to the force of gravity on the object.

30. What is the net force that acts on a 10 newton freely falling object?
Ans. If we ignore air friction, the net force on an object in free fall is its weight, in this case, 10 newtons.

31. a) What is the net force that acts on a 10 newton falling object when it encounters 4 newtons of air resistance? b) 10 newtons of air resistance?
Ans. a) 10N-4N=6 newtons b) 10N-10N= 0 newtons

32. What two principal factors affect the force of air resistance on a falling object?
Ans. The speed of the falling object and its shape (the larger the surface area perpendicular to the direction of motion, the larger the air friction).

33. What is the acceleration of a falling object that has reached its terminal velocity?
Ans. 0 m/s/s. Can you explain why?

Ch. 4 Newton's Laws Second Law of Motion; 11th edition
Extra Review Questions Ch. 4

What kind of path would the planets follow if suddenly no force acted on them?
Ans. Since there are no unbalance forces acting on the planets, Newton's fist law of motion tells us that they would travel in a straight line at constant speed. All the planets, including the Earth, would stop revolving around the Sun, and we would not continue to live happily ever after.

Extra: A cart is pulled to the left with a force of 100 newtons and to the right with a force of 30 newtons. What is the net force on the cart?
Ans. The forces are in opposite directions. If we choose left as positive and right as negative, we can say that we have two forces, one equals plus 100 newtons and the other equals minus 30 newtons. Now add the two forces.
100 newtons + - 30 newtons = 70 newtons to the left.

Extra: Consider a woman weighing 500 newtons who stands with her weight evenly divided on a pair of bathroom scales. a) What is the reading on each scale? b) If she shifts her weight so one of the scales reads 300 newtons, what will the other scale read?
Ans. a) 250 newtons b) 200 newtons

Extra: a) What is the acceleration of an object that moves at constant velocity? b) What is the net force on the object in this case?
Ans. a) 0 m/s/s, when there is no change in velocity, there can be no acceleration. b) 0 Newtons, an object moving at constant velocity does not have an unbalanced force acting on it.
Ch. 4 Review questions
Extra: If you push horizontally with a force of 50 newtons on a crate and make it slide at constant velocity, a) how much friction acts on the crate? b) If you increase your force, will the crate accelerate? Explain.

a) 50 newtons. We are told that the crate moves at constant velocity. From Newton's 1st law, we know that the net force must be zero. In order to get a net force of zero we need to have 50 newtons of backward force to off-set the 50 newtons that we push with.

b) Yes. Since the force that you apply is larger than the frictional force, you will have an unbalance force. Whenever an unbalanced force is applied to an object, the object accelerates.

Exercises Ch 4, p.63; 11th edition

1. Can the velocity of an object reverse direction while maintaining a constant acceleration? If so, give an example, if not explain why.
Ask and answer in class for + 1 point.

8. A 400-kg bear grasping a vertical tree slides down at constant velocity. What is the friction force that acts on the bear?
Ans. 4000 newtons

9. In the orbiting space shuttle you are handed two identical boxes, one filled with sand and the other filled with feathers. How can you tell which is which without opening the boxes.
Ans. Push each of them. The one that is more difficulty to accelerate is the one that is more massive-the one with the sand in it.

13. When a junked car is crushed into a compact rectangle, does a) its mass change? b) Its weight change? Explain.
Ans. Its mass and weight do not change. Its volume (the amount of space it takes up) changes.

14. Gravitational force on the moon is only 1/6 that of the gravitational force on the earth. What would be the weight of a 10 kilogram object on the a) earth and on the b) moon?
c) What would its mass be on the moon and on the earth?
Ans. a) Earth Weight = mg = 10 kg(10 m/s/s)= 100 newtons.
b) Moon weight = $\frac{1}{6} \cdot 100\ newtons\ =\ 17\ newtons$
c) 10 kilograms; an object's mass doesn't change with location.

17. a)What is your own mass in kilograms? b) What is your weight in newtons.
Ans. a) My mass is 75 kilograms. b) My weight is 750 newtons

$\frac{165\ lbs}{\frac{2.2\ lbs}{1\ kg}} = 75\ kg$ $\qquad\qquad$ $Weight\ =\ mg\ =\ 75\ kg \cdot 10\ \frac{m}{s^2} =\ 750\ newtons$

I divided my weight in pounds by 2.2 in order to determine my mass and then multiplied my mass by 'g' to get my metric weight. You should divide your weight in pounds by 2.2 to determine your mass and then calculate your metric weight.

34. What is the acceleration of a rock at the top of its trajectory (flight path) when thrown straight upward? Is your answer consistent with Newton's second law of motion?
Ans. 10 m/s/s down. This is consistent with Newton's second law.

Exercises Ch 4; 11th edition
p.64 continued

36. A friend says that as long as a car is at rest, no forces act on it. What do you say if you are in the mood to correct your friend.
Ans. We know that the car has weight so there must me at least one force on it. We also know that a car at rest is not accelerating so the sum of all forces on the car must be zero. There is another force, called the normal force, that is pushing the car up away from the road. I will explain later in the semester how the road is able to push up on the car with a force that is exactly equal to its weight.

37. When your car moves along the highway at constant velocity, the net force on it is zero. Why then, do you continue running your engine?
Ans. The engine is supplying the energy that allows the wheels to push the car forward. Wind friction (and other sources of friction) is pushing the car backward. When the car is moving at constant velocity, the sum of all these forces must be zero. If you turn off the engine, frictional forces will slow the car down.

38. a) What is the net force on an apple that weights 1 newton when you hold it at rest above the floor? b) What is the net force on it when you release it?
Ans. a) Zero. b) 1 newton

39. A "shooting star" is usually a grain of sand from outer space that gives off light as it burns up. What exactly causes this burning?
Ans. Air friction.

Extra: If an object has no acceleration, can you conclude that no forces are exerted on it? Explain.
Ans. No. You can only conclude the sum of all the forces on the object is zero.

Extra: If it takes 1 Newton of force to push horizontally on your book to make it slide at constant velocity, how much force of friction acts on the book?
Ans. There must be a 1 Newton force of friction back in the opposite direction. The forces will cancel each other out and the net force will be zero-the book must then move at constant velocity.

Extra: Can an object round a curve without any force acting on it?
Ans. No. Going around a curve involves changing the direction of travel. An object cannot change its speed or direction without the application of an unbalanced force.

Extra: What is the net force on a Mercedes convertible traveling along a straight road at a steady speed of 100 km/hr?
Ans. 0 Newtons. Do you know why? If not, ask in class.

Extra If we find an object that is not moving even though we know it to be acted on by a force, what inference can we draw.
Ans. Because it is not accelerating, we know that the sum of all forces that are acting on the object is zero. Since we are told that a force acts on the object, we know that there must be one or more forces acting on the object whose sum is equal in magnitude and opposite in direction to the first force.

Exercises Ch 4; 11th edition

Extra If the earth exerts a force of 1000 newtons on an orbiting communications satellite, how much force does the satellite exert on the earth? Explain.
Ans. Newtons third law of motion tells us that satellite must be exerting a 1000 newton force on the earth.

Extra Your weight is the result of a gravitational force of the earth on your body. What is the corresponding reaction force?
Ans. The mass of your body is pulling back on the earth.

Extra: A rocket becomes progressively easier to accelerate as it travels through space. Why is this so? (Hint: About 90% of the mass of a newly launched rocket is fuel.)
Ans. If you don't know the answer to this one, please ask in class.

Problems ch 4. pg. 65; 11th edition

2. What is the acceleration of a 40-kg block of cement when pulled sideways with a net force of 200 Newtons?
Ans. $a = \frac{\sum F}{m} = \frac{200\ newtons}{40\ kilograms} = 5\ \frac{m}{s^2}$

4. If a mass of 1 kg is accelerated 1m/s^2 by a force of 1 newton, what would be the acceleration of 2 kg acted on by a force of 2 newtons?
Ans. 1 m/s^2

Extra problem CH. 4

a) If you stand next to a wall on a frictionless skateboard and push the wall with a force of 30 N, how hard does the wall push on you?
Ans. 30 newtons in the opposite direction.

b) If your mass is 60 kg, what is your acceleration?
Ans. $a = \frac{\sum F}{m} = \frac{30\frac{kg \cdot m}{s^2}}{60\ kg} = \frac{1}{2}\frac{m}{s^2}$