Introduction

I have modified and provided answers to some of the more illuminating review questions and exercises from Hewitt's *Conceptual Physics***, 9th** edition. I have also included 'Things to Know by Heart' at the end of the three major divisions. You should commit these rules to memory as we cover them is class. This workbook should be used as another resource that is available to assist you in this introductory physics course. It is not a substitute for the classroom teacher or the textbook-your two main resources. I hope this helps you in your studies.

Sincerely,

R. E. Tremblay

Conceptual Physics-9th edition Answers by R. E. Tremblay
Ch. 3 Pg.51

Review questions

2. What two units of measurement are necessary for describing speed?
Ans. Distance and time.

3. What kind of speed is registered by an automobile?
Ans. Instantaneous speed.

5. What is the average speed in kilometers per hour for a horse that gallops a distance of 15 km in a time of 30 min?
Ans. $\frac{15km}{\frac{1}{2}hr} = 30\frac{km}{hr}$

6. How far does a horse travel if it gallops at an average speed of 25 km/hr for 30 min.?
Ans. Our distance rule is given by $\Delta X = V_o t + \frac{1}{2}at^2$. Since there is no acceleration, the rule simplifies to $\Delta X = V_o t = 25\frac{km}{hr}(.5hr) = 12.5km$

7. Distinguish between speed and velocity.
Ans. Speed is the rate at which an object changes its position. Velocity is the speed and direction of an object.

8. If a car moves with constant velocity, does it also move with constant speed?
Ans. Yes.

9. If a car is moving at 90 km/hr and it rounds a corner, also at 90 km/hr, does it maintain a constant speed? A constant velocity?
Ans. It maintains a constant speed but its velocity is changing because its direction of travel is changing.

10. Distinguish between velocity and acceleration.
Ans. Velocity is the speed and direction of an object. Acceleration is the rate at which an objects changes its velocity.

11. What is the acceleration of a car that increases its velocity from 0 to 100 km/hr in 10 seconds?
Ans. $a = \frac{\Delta V}{\Delta t} = \frac{V_2 - V_1}{\Delta t} = \frac{100km/hr}{10\sec} = \frac{10km/hr}{\sec}$ forward.

Ch. 3 Pg.51
Review questions continued.

12. What is the acceleration of a car that maintains a constant velocity of 100 km/hr for 10 seconds?

Ans. $a = \frac{\Delta V}{\Delta t} = \frac{V_2 - V_1}{\Delta t} = \frac{100 km/hr - 100 km/hr}{10 \sec} = \frac{0 km/hr}{\sec}$

13. When are you most aware of motion in a moving vehicle?

Ans. You are most aware of motion in a moving vehicle when it changes its speed or direction-when it accelerates.

18. What is meant by a "freely falling body".

Ans. A freely falling body is an object that only has the force of gravity on it.

19. What is the gain in speed per second for a freely falling object?

Ans. All objects in free fall near the Earth's surface accelerate down at 10 m/s^2.

20. What is the velocity of an object, 5 seconds after it is dropped? 6 seconds?

Ans. 50 m/s; 60 m/s

23. What relationship between distance traveled and time did Galileo discover for accelerating objects?

Ans. The distance traveled is proportional to the falling time squared.

24. What is the distance traveled for a free falling object that starts from rest, 5 sec and 6 sec after it is released?

Ans. Our equation for distance is given by $\Delta X = V_o t + \frac{1}{2} a t^2$. Since the object starts from rest, its initial velocity is 0 m/s and the equation reduces to: $\Delta X = \frac{1}{2} a t^2 = \frac{1}{2} 10 \frac{m}{s^2} (5 \sec)^2 = 75 m$

25. What is the effect of air resistance on falling objects? What is the acceleration if there is no air resistance?

Ans. Air resistance reduces the acceleration due to gravity of a falling object. Without air resistance, all objects in free fall near the earth's surface accelerate down at approximately 10 m/s/s.

26. Consider these measurements: 10 m, 10 m/s, 10 m/s^2. Which is velocity, which is acceleration and which is speed?

Ans. You ask and answer this one in class for plus 2 pts.

Ch. 3 Pg. 52
Exercises

1. What is the impact speed when a car moving at 100 km/hr bumps into the rear of another car traveling in the same direction at 98 km/hr?
Ans. 2 km/hr.

2. Harry Hotshot can paddle a canoe in still water at 8 km/hr. How successful will he be at canoeing upstream in a river that flows at 8 km/hr?
Ans. He will not go anywhere.

3. Is a fine for speeding based on ones average speed or instantaneous speed?
Ans. It is based on your instantaneous speed.

4. One airplane travels due north at 300 km/hr while another travels due south a 300 km/hr. Are their speeds the same? Are their velocities the same? Explain.

Ans. Their speeds are the same because they are both changing their positions by 300 km every hour. Their velocities are not the same because they are moving in different directions.
6. Can an automobile with a velocity toward the north, have an acceleration toward the south?
Ans. Yes. The car can be moving north and slowing down. That would give it a change in velocity south, which means that it is accelerating south-even though it is going north.

7. Can an object reverse it direction of travel while maintaining a constant acceleratio5. Can an give an example. If not, explain why.
Ans. Yes. A ball thrown straight up will rise and then reverse its direction and fall. All the while, it will have a constant acceleration of 10 m/s/s down.

8. You are driving north on the highway. Then, without changing speed, you round a curve and drive east. (a) Does your velocity change? (b) Do you accelerate? Explain.
Ans. You have a new velocity and therefor have accelerated.

9. Correct your friend who says, "The dragster rounded the curve at a constant velocity of 100 km/h."
Ans. The dragster rounded the curve at a constant **speed** of 100 km/h.

11. Starting from rest, one car accelerates to a speed of 50 km/h, and another car accelerates to a speed of 60 km/h. Can you say which car underwent the greater acceleration?
Ans. No. You need to know how much time it took.

12. Cite an example of something with constant speed that also has a varying velocity. Can you also give an example of something with a constant velocity, that travels at a varying speed.
Ask and answer correctly in class for plus 2 points.

EXERCISES CH.3 continued

13. Cite an example of something that undergoes acceleration while moving at constant speed. Can you also give an example of something that accelerates while traveling at constant velocity? Explain.
Ans. A girl riding a bicycle around a corner at a constant speed of 10 mi/hr is an example of an object accelerating without changing its speed. There are no examples of objects that accelerate while moving at constant velocity.

14. (a) Can an object be moving when its acceleration is zero?
Ans. Yes. A car moving at constant velocity is an example.
(b) Can an object be accelerating when its speed is zero?
Ans. Yes, as long as its speed is zero for only on instant in time.

15. Can you give an example wherein the acceleration of a body is opposite in direction to its velocity? Do so if you can.
Ans. Yes. The direction of acceleration is the same as the direction of an object's change in velocity. If you are driving in your car and then apply the brakes, the change in velocity is backward so the acceleration is also backward.

18. What is the acceleration of a car that moves at a steady velocity of 100 km/hr for 100 seconds? Explain you answer.
Ans. Acceleration is zero. The problem states that the car is moving at constant velocity therefore there can be no acceleration.

22. Suppose that a freely falling object were somehow equipped with a speedometer. By how much would its speed reading increase with each second of fall?
Ans. Its speed reading would increase by 10 m/s every second.

23. Suppose that the freely falling object in the preceding exercise were also equipped with an odometer. Would the readings of distance fallen each second indicate equal or different falling distances for successive seconds? Explain.

Ans. The object would always fall further than it did in the preceding second because it would be falling faster and faster each second.

24. For a freely falling object dropped from rest, what is its acceleration at the end of the 5th second of fall? The 10th? Defend your answer.
Ans. 10 m/s/s. 10 m/s/s. All objects in free fall near the Earth's surface accelerate at 10m/s/s all the time(when we disregard air friction).

25. If air resistance can be neglected, how does the acceleration of a ball that has been tossed straight upward compare with its acceleration if simply dropped?
Ans. The acceleration will be the same in both cases. 10 m/s/s down.

EXERCISES CH.3 continued

26 When a ball player throws a ball straight up, by how much does the speed of the ball decrease each second while ascending? By how much does it increase each second while descending? How much time is required for rising compared to falling?
Ans. As long as we disregard air friction: a) 10 m/sec every second b) 10 m/sec every second c) Rising and falling times are equal.

27. Someone standing at the edge of a cliff throws a ball straight up at a certain speed and another ball straight down with the same initial speed. If air resistance is negligible, which ball will have the greater speed when it strikes the ground below? Explain.
Ans. They will strike the ground at different times but with the same speed. The ball thrown upward will be moving at the initial speed when it returns to the point of release.

29. If you drop an object, its acceleration toward the ground is 10 m/s/s. If you throw it down instead, would its acceleration after throwing be greater than 10 m/s/s? Why or why not?
Ans. Once the object leaves your hand, it is in free fall. It will therefore accelerate down at 10 m/s/s if we disregard air friction.

30. In the preceding exercise can you think of a reason why the acceleration of the object thrown downward through the air would actually be less than 10 m/s/s?
Ans. If we consider air friction, then the acceleration of an object in free fall is always less than 10 m/s/s.
32. Consider a vertically-launched projectile when air drag is negligible. When is the acceleration due to gravity greater: when ascending, at the top, or when descending? Defend you answer.
Ans.The acceleration due to gravity is always constant. It is approximately equal to 10m/s/s.

33. If it were not for air friction, why would it be dangerous to go outdoors on rainy days?
Ans. Air friction prevents an object from accelerating. Instead of falling faster and faster and faster, the rain actually falls at a constant velocity that is slow enough to prevent injury to physics students and their friends.

34. Extend Tables 2.2 and 2.3 to 10 seconds, assuming no air resistance.

Time	Velocity
6 sec	60 m/sec
7 sec	70 m/sec
8 sec	80 m/sec
9 sec	90 m/sec

Rule: $V_f = V_o + at$

Since the object was dropped, we know that V_o = o m/s.
Because the object is in free fall we know that a = 10 m/s/s. For example, the velocity at

10 sec	100 m/sec	9 seconds is determined as follows:

$$V_f = 0\frac{m}{s} + 10\frac{m}{s^2}(9\,\text{sec}) = 90\frac{m}{\text{sec}}$$

EXERCISES CH.3 continued

34.

Rule: $\Delta X = V_o t + \frac{1}{2} a t^2$

Time	Displacement
6 sec	180 m
7 sec	245 m
8 sec	320 m
9 sec	405 m
10 sec	500 m

Example: What is the displacement of the object after 6 seconds of free fall?
Write the rule and then substitute the appropriate values.

Rule: $\Delta X = V_o t + \frac{1}{2} a t^2$

$$\Delta X = 0\frac{m}{s}(6\,\text{sec}) + \frac{1}{2}10\frac{m}{\text{sec}^2}(6\,\text{sec})^2 = 180\ meters$$

Extra ch 3. Exercises

Extra A climber near the summit of a vertical cliff accidentally knocks loose a large rock. She sees it shatter at the bottom of the cliff 8 seconds latter. a) What was the speed of the rock when it hit the ground? b) How far did the rock fall?

a) $V_f = V_o + at = 0\frac{m}{s} + 10\frac{m}{\text{sec}^2}(8\,\text{sec}) = 80\frac{m}{\text{sec}}$

b) $\Delta X = V_o t + \frac{1}{2}at^2 = 0\frac{m}{\text{sec}}(8\,\text{sec}) + \frac{1}{2}(10\frac{m}{\text{sec}^2})(8\,\text{sec})^2 = 320\ meters$

Extra ch 3. Exercises

Extra. If you throw a rock off a cliff, how do the horizontal components of its velocity compare for all points along its trajectory?
Ans. Since the horizontal velocity of an object in free fall never changes(when we disregard air friction), the horizontal components are equal at all points along its trajectory.

Extra. How far below an initial straight line path will a projectile fall in 1 sec? Does your answer depend on the angle of launch or on the initial speed of the projectile? Defend your answer.
Ans. The projectile will fall 5 meters below a straight line path in the first second-regardless of the launch angle or speed. The projectile is in free fall and accelerates down at 10 m/s/s.
Extra ch 3. Exercises

Extra. Suppose you are on a ledge in the dark and wish to estimate the height of the ledge above the ground. So you drop a stone over the edge and hear it strike the ground in 1 second. What is the height of the ledge? How could you use the stone to estimate the height if you weren't close enough to the edge to simply drop the stone? Explain.
Ans. Distance below a straight line path in 1 second is given by:

$$\Delta X = \frac{1}{2} g t^2 = \frac{1}{2}(10\frac{m}{s^2})(1s)^2 = 5\, meters$$

Extra: Suppose you swim in a direction directly across a flowing river and end up a distance down stream that is less than the width of the river. How does your swimming speed compare to the flow rate of the river?
Ans. Your swimming speed must be faster than the river because you swam further across stream than the river carried you down stream.

Extra: Suppose you are driving along in a bus and throw a ball straight up into the air. While the ball is still in the air the driver steps on the brake. Where does the ball land relative to the car?
Ans. The ball lands forward

Extra: Is acceleration how fast you go or how fast you get fast?
Ans. How fast you get fast is closer to the answer. It also should include how fast you get slow or how fast you change direction. More specifically, acceleration is the rate at which an object changes its velocity.

CH 3 PROBLEMS, p 53

2. What is the acceleration of a vehicle that changes its velocity from 100 km/hr to a dead stop in 10 seconds?

Ans. $A = \frac{\Delta V}{\Delta T} = \frac{-100\frac{km}{hr}}{10\sec} = -10\frac{km/hr}{\sec}$

The negative sign indicates that the vehicle actually accelerated backward.

5. a) What is the instantaneous velocity of a freely falling object 10 seconds after it is released from a position of rest? b) What is its average velocity during this 10 second interval? c) How far will it go during this time?

a) $V_f = V_o + at = 0\frac{m}{\sec} + 10\frac{m}{\sec^2}(10\sec) = 100\frac{m}{\sec}$

b) $Average\ Velocity = \frac{V_f + V_o}{2} = \frac{100\frac{m}{s} + 0\frac{m}{s}}{2} = 50\frac{m}{\sec}$

c) $\Delta X = V_o t + \frac{1}{2}at^2 = 0\frac{m}{s}(10\sec) + \frac{1}{2}(10\frac{m}{\sec^2})(10\sec)^2 = 500\ meters$

6. A car goes from 0 to 50 m/s in 10 seconds. If you wish to find the distance traveled using the equation $\Delta X = V_o t + \frac{1}{2}at^2$, what value should you use for ‘a’ ?

Ans. Since we are not told that the car is in free fall, we must calculate the acceleration of the car as follows:

$$A = \frac{\Delta V}{\Delta T} = \frac{50\frac{m}{s} - 0\frac{m}{s}}{10\sec} = 5\frac{m}{s^2}$$

Extra Ch. 3 problem:

A bullet is fired horizontally with an initial velocity of 250 m/s from a tower that is 20 meters high. a) Calculate the time the bullet is in the air. b) If air resistance is neglected, calculate the horizontal distance the bullet travels before striking the ground.

Ans. **a)** The vertical distance that an object in free fall will drop below a straight line path is given by: $\Delta X = V_o t + \frac{1}{2}at^2$. From reading the problem, we know that ΔX is 20 meters and that the initial velocity is 0 m/s. We also have memorized that the acceleration of an object in free fall a=g=10 m/s/s. You can now solve for time. If you don't know any algebra, we can still find the time. First plug the known values into the equations follows.
$20\text{m} = \frac{1}{2}(10\frac{\text{m}}{\text{s}^2})\text{t}^2;\quad \text{t}^2 = 4\sec^2;\ \text{therefore,}\ \text{t} = 2\,\text{seconds}$. Another way to get the answer to this problem is to become more familiar with the free fall distance-time table on page 29. By inspection of the table you can determine that if an object starts from rest, it will fall 20 meters in 2 seconds

b) The horizontal distance traveled by the bullet in two seconds can be found by using the following rule: $\Delta X = V_o \text{t} + \frac{1}{2}at^2$ where you know that the acceleration in the horizontal direction is 0 m/s^2. The equation then becomes $\Delta X = V_o t = 250\frac{m}{s}(2\sec) = 500 meters$

Ch 2 Conceptual Physics-9th edition Answers by R. E. Tremblay
pg. 36 Review Questions

9. Cite Newton's 1st law of motion.
Ans. An object at rest will remain at rest. An object in motion will remain in motion at a constant velocity, unless an unbalanced force is applied to it.

10. What is the net force on a cart that is pulled to the right with 100 pounds of force and to the left with 30 pounds of force?
Ans. 70 pounds to the right.

11. Why do we say that force is a vector quantity?
Ans. To know the complete value of a force we must know its magnitude and direction. Anything that has both magnitude and direction is given the name *vector*.

14. What is the net force on a bag pulled down by gravity with 18 newtons and pulled upward by a rope with a force of 18 newtons.
Ans. 0 newtons.

15. What does it mean to say that something is in mechanical equilibrium?
Ans. When an object is in mechanical equilibrium, the sum of all the forces on it are zero and it therefore cannot accelerate.

17. Consider a book that weighs 15 newtons at rest on a flat table. a) How many newtons of support force does the table provide? b) What is the net force on the book in this case?
Ans. a) Because the net force is 0 and we are told that the book is pushing down on the table with a force of 15 newtons, we must conclude that the table is pushing up on the book with a force of 15 newtons.
b) Because the book is at rest on the table, those of us that believe in Newton's 1st law of motion know that the net force on the book must be zero.

Ch. 2 Pg. 36 Exercises

1. A ball is rolling across the top of a billiard table and slowly rolls to a stop. How would Aristotle interpret this observation? How would Galileo interpret it?

Ans. Aristotle would say that the rolling billiard ball stopped because a force was not acting on it to keep it going. He would be wrong. Galileo would say that an unbalanced force must have acted upon the ball to stop it.

13. In terms of newton's first law, how does a car head rest help to guard against whiplash in a rear-end collision?
Ask in class.

18. Consider a pair of forces, one having a magnitude of 20 N and the other 12 N. What maximum net force is possible for these two forces? What is the minimum?
Ans. Maximum will occur if the forces are applied in the same direction. 32 newtons.
Minimum will occur if the forces are applied in opposite directions to each other. 8newtons

19. Can an object be in mechanical equilibrium if only one force acts on it?
Ans. No. If only one force acts on the object, if will have an unbalanced force on it and will accelerate.

20. When a ball is tossed straight up, it momentarily comes to a stop at the top of its path. Is it in equilibrium during this brief moment? Why or Why not?
Ans. Although the ball stops moving at the top of its flight, it is always accelerating down. Therefore, it is not in equilibrium at any point. Not even at the instant at the top of its flight that it stops.

22. Ask in class.

29 a) As you stand on a floor, does the floor exert an upward force against your feet? b) How much force does it exert? c) Why are you not moved upward by this force?
Ans. a) Yes. b) A force equal to your weight. c) Gravity is pulling you down and the floor is pushing you up. These forces are equal in magnitude and opposite in direction so the net force on you is zero.

31 Can you say that no force acts on a body at rest? Or is it correct to say that no net force acts on it? Defend your answer.
Ans. No net force is the correct answer. An object at rest can have several forces acting on it. When you add up all the forces, if the answer is zero, the object will remain at rest.

33. Pull horizontally on a crate with a force of 200 newtons and it slides across the floor in dynamic equilibrium. How much friction is acting on the crate?
Ans. 200 newtons in the opposite direction.

Ch. 2 Pg. 36 Exercises continued

36 Because the earth rotates once per 24 hours, the western wall in your room moves toward you at a linear speed of about 800 miles/ hour. When you stand facing the wall you are carried along at the same speed, so you don't notice it. But when you jump upward, with your feet no longer in contact with the floor, why doesn't the high-speed wall slam into you?
Ans. When you jump upward, you are still moving east with a speed of 800 miles/hour, so the western wall, which is also moving east at 800 miles/hour, cannot catch you.

37. A child learns in school that the Earth is traveling faster than 100,000 kilometers per hour around the sun and in a frightened tone asks you why we aren't swept off. what is your ans?
Ans. We are also moving around the sun at 100,000 kilometers per hour.

39. The chimney of a stationary toy train consists of a vertical spring gun that shoots a steel ball a meter or so straight into the air-so straight that the ball always falls back into the chimney. Suppose the train moves at constant speed along the straight track. a) Do you think the ball will still return to the chimney if it is shot from the moving train? b) How about if the train accelerates along the straight track? c) How about if it moves at a constant speed on a circular track? d) Why are your answers different?
Ans. a) Yes. b) No. c) No. d) The train changes its horizontal velocity while the ball is in the air but the horizontal velocity of the ball does not change.

Extra: Why did Galileo use incline planes to investigate free fall?

Ans. Objects in free fall, near the Earth's surface, accelerate down at 10m/s/s when we disregard air friction. In a short amount of time, freely falling objects are moving quite rapidly. In order to calculate the acceleration, one must determine the position of the object at known times. Galileo did not have the benefit of today's accurate timing devices so he used an inclined plane to slow down the motion of a falling object.

Chapter 10 Review Questions pg. 197

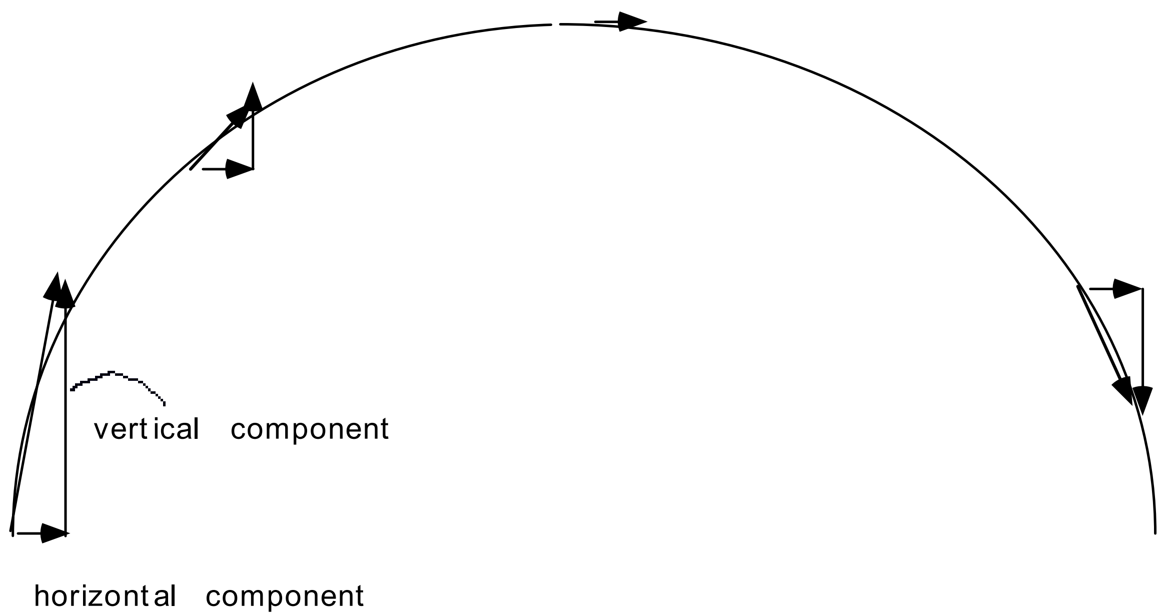
1. Why does a horizontally moving projectile have to have a large speed to become an Earth satellite?
Ans. Please ask in class.

3. Why does the vertical component of velocity for a projectile change with time, whereas the horizontal component of velocity doesn't?
Ans. The force of gravity acts in the down direction, changing the vertical(up-down) component of velocity.

4 True or false. When air resistance does not affect the motion of a projectile, its horizontal and vertical components of velocity remain constant.
Ans. False. Although the horizontal component doesn't change, the vertical component is changed by the downward pull of gravity.

5. A rock is thrown upward at an angle. What happens to the horizontal component of its velocity as: a) it rises? b) it falls?
Ans. The horizontal component of the velocity of an object in free fall never changes(as long as we are disregarding air friction).

6. A rock is thrown upward at an angle. What happens to the vertical component of its velocity as: a) it rises? b) it falls?



Ans. a) As the rock rises, the vertical component of its velocity gets smaller.
b) As the rock falls, the vertical component of its velocity gets larger.

Chapter 10 Review Questions continued pg. 197

7. A projectile falls beneath the straight-line path it would follow if there were no gravity. How many meters does it fall below this line if it has been traveling for: a) 1 sec? b) 2 seconds? See fig. 10.6, pg. 180

Ans. a) 5 meters. b) 20 meters

Compare these answers to the distance an object in free fall would drop in 1 sec. In 2 sec. See table 3.3 page 47

8. Does your answer to the last question depend on the angle at which the projectile is launched?

Ans. No.

10 A projectile is launched vertically at 100 m/s. If air resistance can be neglected, at what speed will it return to its initial level?

Ans. 100 m/s(the same speed with which it left).

12. Why will a projectile that moves horizontally at 8 km/s follow a curve that matches the curvature of the earth?

Ans. Every second the projectile will travel a horizontal distance of 8 km and drop a vertical distance of 5 meters. The Earth curves 5 meters for every 8 km of surface, so the object never changes its distance from the Earth's surface.

15.Why doesn't the force of gravity change the speed of a satellite in circular orbit?

Ans. Gravity is pulling at right angles to the direction that the satellite in circular orbit is moving. The force a right angles changes the direction of the satellite's motion, not its speed.

Ch. 10 pg.198 Exercises

1. A heavy crate accidentally falls from a high-flying airplane just as it flies directly above a shiny red Camaro smartly parked in a car lot. Relative to the Camaro, where will the crate crash? Look at the diagram in the text.
Ans. The crate lands behind the Camaro, in the direction that the plane was heading

6. A friend claims that bullets fired by some high powered rifles travel for many meters in a straight line path without dropping. Another friend disputes this claim and states that all bullets from any rifle drop beneath a straight line path a vertical distance given by $\Delta X = \frac{1}{2} g t^2$ and that the curved path is apparent at low velocities and less apparent at high velocities. Now its your turn. Will all bullets drop the same vertical distance in equal times? Explain.
Ans. Yes. All objects in free fall, near the Earth's surface accelerate down at 10 m/s/s when we disregard air friction.

Chapter 10 Review Questions continued pg. 198

9. When a rifle is being fired at a distant target, why is the barrel lined up so that it points exactly at the target?
Ans. When the bullet leaves the barrel it is in free-fall and will begin accelerating down at approximately 10 m/s/s and will fall below a straight line path.

10. A park ranger shoots a monkey hanging from a branch of a tree with a tranquilizing dart. The ranger aims directly at the monkey, not realizing that the dart will follow a parabolic path and thus fall below the monkey. The monkey, however, sees the dart leave the gun and lets go of the branch to avoid being hit. Will the monkey be hit anyway? Does the velocity of the dart affect your answer, assuming it is great enough to travel to the tree before hitting the ground? Defend your answer.
Ans. We will discuss this in class.

14. Assuming no air resistance, why does an 8-km/s horizontally fired projectile not strike the earth's surface?
Ans. Ask in class.

16. When the space shuttle coasts in a circular orbit at constant speed about the earth, is it accelerating?
Ans. Yes it is accelerating toward the center of the earth. An acceleration toward the center of the orbit is called centripetal acceleration. All objects that move in a circle at constant speed accelerate toward the center of the circle.

21. A satellite can orbit 5 kilometer above the moon, but not at 5 kilometer above the Earth. Why?
Ans. The moon does not have an atmosphere to slow the satellite down and the Earth does.

42. If you stop an Earth satellite dead in its tracks, it would simply crash into the Earth. Why don't the communications satellites that "hover motionless" above fixed positions over the same spot on the Earth crash?
Ask this one in class.

Extra: True or false. When air resistance does not affect the motion of a projectile, it covers equal horizontal distances in equal time intervals.
Ans. True.

Ch. 10 problems pg. 200

2. An airplane is flying horizontally with speed 280 m/s when an engine falls of-don't you hate when that happens. Neglecting air resistance, if it takes 30 seconds for the engine to hit the ground:
a) How high was the plane?

Ans. a) $\Delta X = V_o t + 1/2\ at^2$
Since the initial velocity V_o vertically is zero, the equation reduces to:
$\Delta X = 0 + 1/2\ at^2 = 1/2\ (10\ m/s)(30\ sec)^2 =$ **4500 meters**

b) calculate how far horizontally the engine travels while it falls.
Since the engine is not accelerating in the horizontal direction, the equation reduces to:

Ans. b) $\Delta X = \overline{V}\ t = 280\ \frac{m}{s}(30sec) = 8400\ meters$

c) If the plane continues flying in a straight line at 280 m/s, where is the engine relative to the plane when the engine hits the ground?

Ans. c) The engine is 4500 meters directly below the plane.

Ch. 4 Newton's Second Law of Motion
p.65 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 weight near the earth's surface?
Ans. 1 kilogram.

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; p.66 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 70 kilograms and my weight is about 700 newtons. Being proportional means that if I doubled my mass to 140 kilograms, my weight would double and be 1400 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.

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 are 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
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.

Extra: Why do action and reaction pairs of forces never cancel one another?
Ans. Action - reaction refers to forces that are applied to different objects. Forces can only cancel each other out if they are applied to the same object.

Extra: If the forces that act on a bullet and the recoiling gun from which it is fired are equal in magnitude, why do the bullet and gun have very different accelerations?
Ans. Because they have different masses. $A = \frac{F}{M}$

Exercises Ch 4, p.66

1. 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.

2. 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 +2 pts.

3 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.

5. 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.

6 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.

9. 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

11. 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.

14. 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.

15. 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= $\frac{100newtons}{6} \approx 17newtons$

c) 10 kilograms; an objects mass doesn't change with location.

Exercises Ch 4, p.67 continued

18. a)What is your own mass in kilograms? b) What is your weight in newtons.
Ans. a) My mass is 73 kilograms. b) My weight is 730 newtons

$\frac{160lbs}{2.2} = 72.7 \approx 73kg$ $\qquad$ $weight = 73kg(10\frac{m}{s^2}) = 730newtons$

I divided my weight in pounds by 2.2 in order to determine my mass. You should divide your weight in pounds by 2.2 to determine your mass.

19. 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.

30. 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.

32. 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.

33 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.

34. 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.

35. 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

Extra exercises CH. 4

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.

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.

Problems ch 4. pg. 68

2. What is the acceleration of a 40-kg block of cement when pulled sideways with a net force of 200 Newtons?

Ans. $a = \frac{\sum F}{M} = \frac{200 newtons}{40 ki\log rams} = 5\frac{m}{s^2}$

4. If a mass of 1 kg is accelerated $1 m/s^2$ 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. $1/2 m/s^2$.

Ch. 5 Review Questions

4. State Newton's third law of motion.

-See the things to know by heart page of this manual.

5 Consider hitting a baseball with a bat. If we call the force on the ball the action force, identify the reaction force.

Ans. The reaction force is the backward force on the bat due to the ball.

9. The Earth pulls down on you with a gravitational force that we call your weight. Do you pull up on the Earth with the same amount of force?

Ans. Yes. Newton's third law tells us that we do.

10. If the forces that act on a bullet and the recoiling gun from which it is fired are equal in magnitude, why do the bullet and gun have very different accelerations?

Ans. The have very different masses. According to Newton's second law of motion, the acceleration of an object is inversely proportional to its mass. Therefore, the small mass bullet receives a very large acceleration.

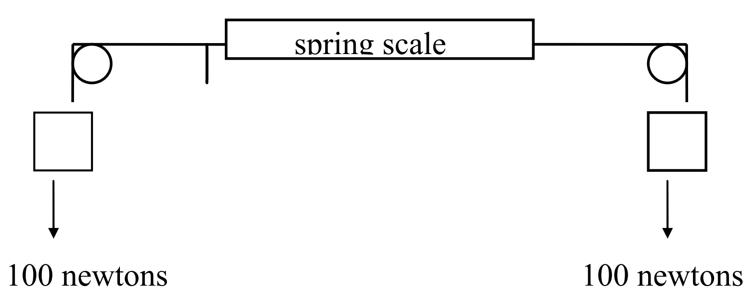
13. Can you physically touch another person without that person touching you with the same magnitude of force?
Ans. No! No! A thousand times No!

16. What is a vector quantity? Give three examples.
Ans. A vector is something that has magnitude(a number) and direction. Three things that are vectors are displacement, velocity, and acceleration.

17. What is a scalar quantity? Give three examples.
Ans. A scalar quantity has magnitude only. Speed, distance traveled and volume are examples of scalar quantities.

Ch. 5 Exercises p. 82

8. Two 100 newton weights are attached to a spring scale as shown. Does the scale read 0, 100, or 200 newtons. Hint: Would it read any differently if one of the ropes were tied to the wall instead of to the hanging 100 newton weight?



Ans. It reads 100 Newtons. Ask in class if this confuses you.

14. You push a heavy car by hand. The car in turn pushes back on you with a force that is equal in magnitude and opposite in direction to the first force. Why don't the forces cancel each other out making acceleration impossible?

Ans. The forces act on different objects so they cannot cancel each other out.

16. The strong man will push the two initially stationary freight cars of equal mass apart before he himself drops to the ground (see diagram pg. 83 in text). Is it possible for him to give either of the cars a greater speed than the other? Why or why not.
Ans. Not possible. Ask in class if you don't understand.

19. a) If a Mack truck and a Honda Civic have a head-on collision, upon which vehicle is the impact force greater? Explain you answer.
Ans. The forces on the truck and car are equal in magnitude but opposite in direction- Newton's third law of motion.

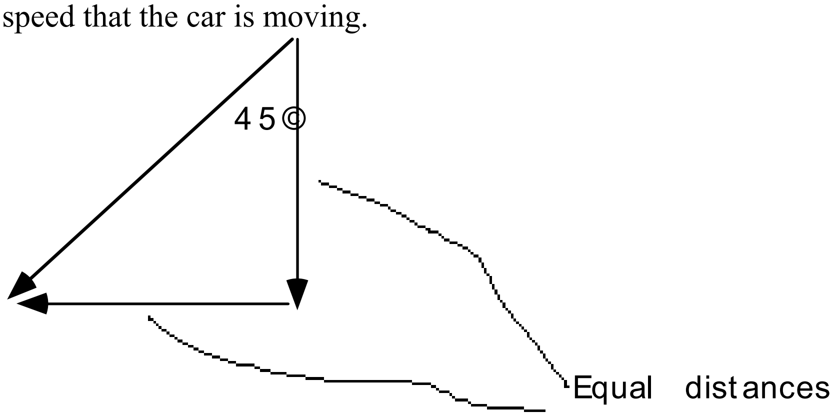
24. Two people of equal mass attempt a tug-of-war with a 12meter long rope while standing on frictionless ice. When they pull on the rope, they each slide toward each other. How do their accelerations compare, and how far does each person slide before they meet?
Ans. Their accelerations are equal and they meet in the middle. If you don't understand why, please ask in class.

28. When two vectors sum to zero, how must they be related?
Ans. They will be equal in magnitude and opposite in direction.

Ch. 5 Exercises p. 82 continued

31. a) Why does vertically falling rain make slanted streaks on the side windows of a moving automobile? b) If the streaks make an angle of 45°, what does this tell you about the relative speed of the car and the falling rain.
Ans. a) As the rain moves down the side window, the car moves forward, making the rain flow toward the back of the window.

b) A 45° angle is created only when the vertical distance that the rain falls is equal to the horizontal distance that the car moves. This can only happen if the rain is falling at the same speed that the car is moving.



Volunteer to help demonstrate problem 31 in class for plus 2.

Extra: If you walked at 1 m/s down the aisle of a bus that is moving at 10 m/s along the road, how fast are you moving relative to the road when you walk toward the: a) front of the bus? b) Toward the rear of the bus?
Ans. a) 10 m/s + 1 m/s = 11 m/s b) 10 m/s - 1 m/s = 9 m/s

Extra: An airplane travels 200 km/hr through the air. If it heads directly against a 40 km/hr wind, what is its speed relative to the ground below?
Ans. The wind is blowing in the opposite direction of motion. We will label the forward direction as plus and the opposite direction as minus.
+200 km/hr + - 40 km/hr = 160 km/hr.

Chapter 5 problem # 2

2a) 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 back?

Ans. The wall will push back on you with a force of 30 newtons.

b) If you mass is 60 kilograms, what is your acceleration?

Ans. $a = \frac{\sum F}{M} = \frac{30 newtons}{60 ki\log rams} = .5\frac{m}{s^2}$

Ch. 8 Review Questions p. 147

1. Why is the linear speed greater for a horse on the outside of a merry-go round than for a horse closer to the center?
Ans. The horse on the outside of the merry-go-round has to go further in the same amount of time than the one on the inside.

2. What is meant by tangential speed?
Ans. Tangential speed is the linear speed of the object, tangent to the curve.

3. Distinguish between tangential speed and rotational speed.
Ans. Rotational speed, often called angular velocity, is the rate at which an object rotates. The angular velocity of the crankshaft of an engine is measured in revolutions per minute, RPM. It is the number of rotations per unit time. The tangential speed is the linear speed of an object, tangent to the curve.

8. What is rotational inertia, and how does it compare to inertia as studied in previous chapters?

Ans. Rotational inertia, often called moment of inertia, is the sum of the products of an object's mass multiplied by their distance to the center of rotation squared. Inertia is the resistance an object has to a change in its velocity and only depends on the mass of an object.

9. Inertia depends on mass; rotational inertia (better known as moment of inertia) depends on mass and something else. What?

Ans. Moment of inertia, 'I' depends on mass and its distance from the center of rotation.

$$I = \sum mr^2$$

15. What does a torque tend to do to an object.

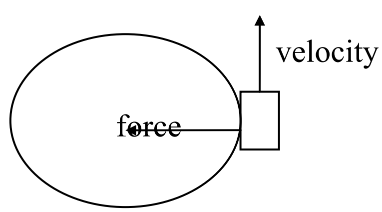
Ans. Torque will change the angular velocity of on object. If it is not rotating, and unbalanced torque will make an object start to rotate.

17. How do clockwise and counterclockwise torques compare when a system is balanced?

Ans. They are equal.

26. When you whirl a can at the end of a string in a circular path, what is the direction of the force that is exerted on the can?

Ans. The force is directed toward the center of the circle.



27. Is it an inward force or an outward force that is exerted on the cloths during the spin cycle of an automatic washer?

Ans. Inward force.

Ch. 8 Review Questions p. 148 continued

28. If the string breaks that holds a whirling can in its circular path, what kind of force causes it to move in a straight-line path-centripetal, centrifugal, or no force? What law of physics supports your answer?

Ans. No force. Newton's first law of motion.

29. If you are not wearing a seat belt and you slide across your seat and slam against a door when the car rounds a curve, what kind of force is responsible-centripetal, centrifugal or no force?

Ans. No force was applied to you. The car had a centripetal force applied to it which caused the car to slide out from under you. Ask about this in class please.

Extra In what direction should a force be applied to produce maximum torque?

Ans. At right angles to a line that radiates out from the center of the object.

35. Distinguish between linear momentum and angular momentum.
Ans. Linear momentum is the product of an object's mass times its velocity. Angular momentum is the product of an objects moment of inertia and its angular velocity. Angular momentum depends on the rate at which an object is rotating, its mass and the distance of the mass from the center of rotation.

37. What does it mean to say that angular momentum is conserved?
Ans. Unless an unbalanced torque is applied to an object, it total angular momentum will not change. Its moment of inertia and its angular velocity can change but they will change in such a way that the total angular momentum is constant.

L=Iw where $I = \sum mr^2$ and w is the angular velocity of the object.

Chapter 8 Exercises pg. 150

10. If you walk along the top of a fence, why does holding your arms out help you to keep your balance?
Ans. Holding your arms out increases your moment of inertia.

18. Is the net torque changed when a partner on a seesaw stands or hangs from her end instead of sitting?
Ans. Since torque is the product of perpendicular component of the force multiplied by the distance to the pivot, torque is not effected because neither one of these things changes.

36. When a long-range cannonball is fired toward the equator from a northern or southern latitude, it lands west of its intended target. Why?
Ans. Ask this one in class for +2 points.

37. When you are in the front passenger seat of a car turning to the left, you may find yourself pressed against the right-side door. Why do you press against the door? Why does the door press against you? Does the correct answer involve a centrifugal force or Newton's laws of motion?

Ans. Ask this one in class for + 2 points.

Ch. 9 Gravity
Review Questions p. 172

4. State Newton's law of universal gravitation in words. Then do the same with one equation.

Ans. The attractive force of gravity between two objects in directly proportional to the mass of the objects and inversely proportional to the their separation distance squared.

$F = \gamma \frac{m_1 m_2}{d^2}$; where $\gamma = 6.67 \, X \, 10^{-11} \frac{Nm^2}{kg^2}$ Just remember that this is a small number.

6. What is the magnitude of the gravitational force between the earth and a 1 kilogram object?

Ans. Weight = mg = 1 kg(10 m/s/s)= 10 newtons.

7. What is the magnitude of the gravitational force between the earth and your body?

Ans. This is another way of asking what your weight is. For me the answer is 160 pounds, which equals about 730 newtons in the metric system.

9. How does the force of gravity between two objects change when the distance between them is doubled?

Ans. The force of gravity is inversely proportional to the distance between the two objects. That means if you double the distance between the objects, the force of gravity pulling them together will be $\frac{1}{2^2} = \frac{1}{4}$ of its previous value.

Extra. How does the force of gravity between two objects depend on their masses?

Ans. The force of gravity is directly proportional to the mass of each object. That means if you double the mass of one of the objects, you will double the force of gravity on the object.

Ch. 9 Exercises p. 174

3, What would be the path of the moon if somehow all gravitational forces on it vanished to zero?

Ans. The moon would move in a straight line at constant speed. It would not be a satellite of the Earth.

9. A friend says that astronauts in orbit are weightless because they're beyond the pull of Earth's gravity. Correct your friend's ignorance.

Ans. Ask about this one in class for + 2 points.

12. The earth and the moon are attracted to each other by gravitational force. Does the more massive earth attract the less massive moon with a force that is greater, smaller or the same as the force with which the moon attracts the earth?

Ans. The forces are equal in magnitude and opposite in direction(Newton's 3rd law).

20. If you were in a car that drove off the edge of a cliff, why would you feel weightless? Would gravity still be acting on you in this state?
Ans. Gravity would still be acting on you. The sensation of having weight requires that you be in contact with something that doesn't have the same acceleration that you do. Both you and the car are accelerating down at the same rate, 10m/s/s down.

22. If you were in a freely falling elevator and you dropped a pencil, you would see the pencil hovering. Is the pencil falling? Explain.

Ans. Yes, the pencil is falling with the same acceleration and velocity that you are. Because you and the pencil are always falling at the same rate, it never reaches your feet. This is very similar to cars on the highway. If they are all going at the same speed in the same direction then they keep their same position, just as they would if they were all at rest.

24. If the mass to the earth somehow increased, with all other factors remaining the same, would your weight also increase?
Ans. Yes. The force of gravity is directly proportional to the mass of the objects involved. Increasing the mass of one of the objects increases the force of gravity pulling the objects together. $F = \gamma \frac{m_1 m_2}{d^2}$
Extra: What are the magnitude and direction of the gravitational force that acts on a man who weights 700 newtons at the surface of the earth?
Ans. Magnitude= 700 newtons; Direction is toward the center of the earth.

Problems ch. 9 pg 176

1. Find the change in the force of gravity between two planets when the distance between them is decreased by a factor of five.
Ans. If the distances is 1/5 of the original separation , the new force is 25 times the original force. Ask in class if you don't understand this.

3. The value of 'g' at the earth's surface is approximately 10 m/s^2. What is the value of 'g' at a distance from the earth's center that is 4 times the earth's radius?

Ans. 10/16 = 5/8 m/s^2
If you don't know why I divided by 16, ask in class. Thanks.

Things to know by heart---Review for test 1---*Physics for Today*

	Equation	Metric Units
Displacement - an objectÜs distance and direction from an earlier location. The symbol that we use for displacement is Î X. If you know an objectÜs starting velocity and acceleration,	$\Delta X = X_2 - X_1$	meters
you can calculate its displacement with the following formula:	$\Delta X = V_o t + \frac{1}{2} a t^2$	meters; m
Speed- The rate at which an object changes its position.		meters/sec
Vector- Something that has both magnitude and direction.		

Average Velocity- (ÛVÜ) An objectÜs speed and direction. average $V = \frac{\Delta X}{\Delta T}$ m/s

meters/sec;

Instantaneous Velocity- (ÛVf') An objectÜs speed and direction at a particular time. $V_f = V_0 + a\,t$ meters/sec; m/s

Acceleration- (ÛAÜ)The rate at which an objectÜs velocity changes. You can change an objectÜs velocity by changing its speed or direction. $A = \frac{\Delta V}{\Delta T}$ m/s/s m /sec^2

The **acceleration** of all objects **in freefall** (ÛgÜ), near the EarthÜs surface, when we disregard air friction, is always **10 m/s/s** down.

Inertia- An objectÜs resistance to a change in its velocity. The more inertia an object has, the harder it is to change its speed or direction.

Mass- (ÛmÜ) A measure of an objectÜs inertia. If an object has a large mass, it has a lot of inertia. kilogram; kg

Force-(F) A push or pull. Newton; $\frac{kg \cdot m}{sec^2}$

Force of gravity- The force of attraction that all objects have for each other. $F = \frac{\gamma\, m_1 m_2}{d^2}$ Newton

Torque-The turning effect of a force. $\text{torque} = F \perp d$ meter-newtons; foot-pounds

Angular velocity- (Ûω Ü)The rate at which an object is spinning. rotations / second

Moment of inertia- (ÛIÜ) An objectÜs resistance to a change in its angular velocity. $I = m\,d^2$ $kg \cdot m^2$

Angular momentum- (ÛLÜ) The product of an objectÜs moment of inertia and its angular velocity. Angular momentum is conserved. $L = I\omega$

Newton's Three laws of motion:

1. An object at rest will remain at rest, an object in motion will remain in motion at a constant velocity, unless an unbalanced force is applied to it.
2. The acceleration of an object is directly proportional to the unbalanced force applied to the object and inversely proportional to the objectÜs mass. $A = \frac{F}{M}$
3. For every force applied to an object, there is another force that is exactly equal in magnitude but opposite in direction applied to the other object.

Here is an example of one of the more mathematical questions that may be asked on test 1:

A fast moving radio controlled car enters the room and is moving with a velocity of 6 m/sec. After 2 seconds it is moving at 10 meters per second and is 16 meters from the place where it first entered the room. In two more seconds it is moving at 14 m/s.
Determine the following: a) its initial velocity b) its acceleration c) distance traveled after 4 seconds.

Part (a) Initial velocity is the velocity of an object at the beginning of the problem. From reading the problem, we determine that the initial velocity of the object is **6 m/sec**.

Part(b) Acceleration is defined as the rate at which an object's velocity changes.

$$A=\frac{\Delta V}{\Delta T}=\frac{10\frac{m}{s}-6\frac{m}{s}}{2\sec}=\frac{4\frac{m}{s}}{2\sec}=2\frac{m}{\sec^2}$$

Part(c) Use the displacement formula to determine how far the object has gone. Note that the initial velocity of the car is 6 m/s and that we determined in part 'b' that the acceleration of the car is 2m/s/s. Also notice that we want the distance traveled in 4 seconds.

V_o= 6m/s a= 2m/s^2 t= 4 seconds

Therefore, since $\Delta X = V_o t + \frac{1}{2} at^2$

$$\Delta X = 6 \cdot 4 + \frac{1}{2} 2 \cdot 4^2 = 40 \text{ meters}$$

Study hard and good luck on the exam.

Hewitt, 9th edition
Section 2-Answers by R.E.Tremblay

Ch. 6 Review Questions p. 100

1. Which has a greater momentum, a heavy truck at rest or a moving skateboard?
Ans. The skate board. Momentum = mass x velocity. Since the truck is not moving, it has zero velocity and therefore has zero momentum.

2. How does impulse differ from force?
Ans. Impulse is the product of force and time. It is not just force.

3. What are the two ways to increase impulse?
Ans. Increase force or increase the time that the force is applied.

7. For the same force, which cannon imparts the greater speed to a cannonball--a long barrel or short barrel cannon?
Ans. A long barrel cannon imparts more speed than a short barrel because the projectile is in the barrel for more time. Remember, impulse = $F\Delta t$. More time means more impulse, which means a larger change in momentum, which means a faster moving cannon ball.

9. Why might a wine glass survive a fall onto a carpet floor but not onto a concrete floor?
Ans. The carpet provides a larger stopping time than a concrete floor. This will result in a smaller force for any given change in momentum.

From $F\Delta t = \Delta p$ we get $F = \Delta p/\Delta t$. There is an inverse relationship between Force and time. A large stopping time results in a small force applied to the glass.

11. Why would it be a bad idea to have the back of your hand against the outfield wall when you catch a fly ball?
Ans. The wall would prevent your hand from moving backward as it applies the force to stop the ball. The result is a short stopping time, which would produce a large force on your hand. It would probably sting and may pop the ball out of your glove.
From $F\Delta t = \Delta p$ we get $F = \Delta p/\Delta t$. There is an inverse relationship between Force and time. A small stopping time results in a large force applied to the hand.

18. What does it mean to say that a quantity is conserved?
Ans. A quantity is conserved when its total amount never changes. Even if you can't find all the pieces, you know that they are somewhere.

19. Why can we say that when we fire a bullet from a gun, that momentum is conserved.
Ans. The total momentum of the gun and bullet before the trigger is pulled is zero. If we add the momentum of the bullet to the momentum of the gun after the trigger is pulled, we expect to get zero. Remember that momentum is a vector, meaning that it has both magnitude and direction. As an example, pretend that the bullet has momentum of
+ 2 kg m/sec. The gun will have - 2 kg m/sec. +2 -2 = 0

Ch. 6 Exercises p. 101

1. To bring a supertanker to a stop, its engines are typically cut off about 25 km from port. Why is it so difficult to stop or turn a supertanker?

Ans. A moving supertanker will have a lot of momentum even when it is moving slowly because it has a lot of mass. Momentum is found by multiplying the objects mass times its velocity.

2. In terms of impulse and momentum, why do padded dashboards make automobiles safer?
Ans. Padded dashboards are safer than unpadded dashboards because the padded dashboard will increase the time required to stop your head from moving forward during an accident. The

increased stopping time results in a smaller force being applied to the person's head. Algebraically we can see that the force 'F' is inversely proportional to the stopping time.

$$F\Delta T = \Delta P \text{ therefore } F = \frac{\Delta P}{\Delta T}$$

3. In terms of impulse and momentum, why do air bags in cars reduce the chances of injury in car accidents?

Ans. The air bag increases the stopping time and therefore decreases the force applied to your face.

5. In terms of impulse and momentum, why are nylon ropes, which stretch considerably under tension, favored by mountain climbers?

Ans. If the climber falls, he hopes that the rope will apply the force that stops him. The stretching of the nylon rope increases the stopping time, which decreases the force on his body.

$$F\Delta T = \Delta P \text{ therefore } F = \frac{\Delta P}{\Delta T}$$

Again, we can say that the force is inversely proportional to the time that the force is applied.

9. It is generally much more difficult to stop a heavy truck than a skateboard when they move at the same speed. State a case where the moving skateboard could require more stopping force. (Consider relative times.)

Ans. The skateboard could require a larger stopping force than the truck if the stopping time for the skateboard was very small.

$$F\Delta T = \Delta P \text{ therefore } F = \frac{\Delta P}{\Delta T}$$

Ch. 6 Exercises p. 101 continued

14. If a ball is projected upward from the ground with 10 kg m/s of momentum, what is the momentum of recoil of the world? Why do we not feel this?

Ans. The earth must recoil with 10 units of momentum. The earth has so much mass that it would have a very tiny change in its velocity.

$$\Delta P = M\Delta V \text{ therefore } \Delta V = \frac{\Delta P}{M}$$

The earth's change in velocity is inversely proportional to its mass.

23 A fully dressed person is at rest in the middle of a pond on perfectly frictionless ice and must get to shore. How can this be accomplished?
Ans. The person could take off their shoe and throw it in the opposite direction that they want to go in. Conservation of momentum demands that they will move slowly in the opposite direction on the frictionless ice.

39. When you are traveling in your car at highway speed, the momentum of a bug is suddenly changed as it splatters onto your windshield. Compared to the change in momentum of the bug, by how much does the momentum of your car change?
Ans. The car has the same amount of change in momentum as the bug does. Ask for a more detailed explanation in class. So why does the bug die?

40. If a Mack truck and a Ford Escort have a head-on collision, which vehicle will experience the greater force of impact? The greater change in momentum? The greater acceleration.
Ans. Same size force on the truck and the Ford Escort. Same size impulse on the truck and Ford Escort. Same size change in momentum of the truck and Ford Escort.
The Ford Escort will have a larger acceleration than the truck. Acceleration kills!

$$a = \frac{f}{m}$$

From Newton's second law of motion, we can see that acceleration is inversely proportional to the object's mass.

41. Would a head-on collision between two cars be more damaging to the occupants if the cars stuck together or if the cars rebounded upon impact?
Ans. The occupants in a head on collision will experience an impulse equal to their change in momentum. If the vehicles bounce, there is a larger change in momentum and therefore a larger impulse.

Ch. 6 Problems. Pg. 103

1. What is the impulse to stop a 10-kg bowling ball moving at 6 m/s?
Ans.

$$F\Delta T = \Delta P = M\Delta V$$

$= 10kg(-6\frac{m}{s}) = -60\frac{kgm}{\sec}$ = 60 kg m/sec backward

2. A car with a mass of 1000 kg, moves at 20 m/s. What braking force is needed to bring the car to a halt in 10 seconds?

Ans. Using the impulse equals the change in momentum equation

$$F\Delta T = \Delta P = M\Delta V$$

we see that ,

$$F = \frac{M\Delta V}{\Delta T} = \frac{1000\,kg(-20\,m/s)}{10\,\text{sec.}} = 2000\ newtons\ backward$$

6. Lillian (mass 40 kg) standing on slippery ice catches her leaping dog (mass 15 kg) moving horizontally at 3 m/s. What is the speed of Lillian and her dog after the catch?

9. Ask in class.

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Ch. 7 Review Questions p. 120

2. What do we call the quantity force x distance, and what quantity does it change?

Ans. Work by definition equals Force x displacement. When work is done to an object, the object gains some form of energy.

3. Cite an example where a force is exerted on and object without doing work on the object.

Ans. If the object is not displaced, then no work is done to it**.** An example would be you pushing on a wall that does not move. Although you applied a force, there was zero displacement and therefore no work was done to the wall.

4. How many joules of work are done when a force of 1 N moves a book 2 meters.
Ans. Since work = force x displacement, 1N x 2 meters = **2 joules** of work.

5. Which requires more work--lifting a 50-kg sack a vertical distance of 2 m or lifting a 25-kg sack a vertical distance of 4 m.
Ans. First note that kilograms are not units of force. The 50-kg sack actually weighs 500 newtons, therefor the force required to lift it will be 500 newtons. Likewise, the force required to lift the 25-kg sack will be 250 newtons.

The work done lifting the 50-kg sack will be: W=FΔX= 500n x 2m= 1000joules
The work done lifting the 25-kg sack 4 m will be: W= FΔX = 250m x 4m = 1000 joules.
Equal amounts of work are done in both cases.

7. How many watts of power are expended when a force of 1 newton moves a book 2 meters in a time interval of 1 second?
Ans.

$$Power = \frac{work}{time} = \frac{1n(2m)}{1second} = \frac{2joules}{second} = 2wa$$

9. A car is lifted a certain distance in a service station and therefore has potential energy with respect to the floor. If it were lifted twice as high, how much potential energy would it have?
Ans. G.P.E. = mgh. Because you doubled the height h, you must also have doubled the gravitational potential energy of the car.

10. Two cars are lifted to the same height in a service station. If one car is twice as massive as the other, how do their gravitational potential energies compare?
Ans. **G.P.E. = mgh** . **The car that is twice as massive must also gain twice as much gravitational potential energy as the other one. This must be true because G.P.E. is directly proportional to the mass of the object.**
Ch. 7 Review Questions p. 120 continued

11. How many joules of potential energy does a 1-kg book gain when it is elevated 4 m? When it is elevated 8 m?
Ans. **G.P.E. = mgh = 1 kg x 10 m/s/s x 4 m = 40 joules**.
G.P.E. = mgh = 1 kg x 10 m/s/s x 8 m = 80 joules.

13. How many joules of kinetic energy does a 1-kg book have when it is tossed across the room at at speed of 2m/s?

Ans. $K.E. = \frac{1}{2}mv^2 = \frac{1}{2}1kg(2\frac{m}{s})^2 = 2\frac{kg \bullet m}{\sec^2}$ = 2 joules

14. A moving car has kinetic energy. a) If it speeds up until it is going four times as fast, how much kinetic energy does it have in comparison? b) Compared to its original speed, how much work must the brakes supply to stop the four-times-as-fast car?

Ans. a. It will have 16 times as much kinetic energy.

b. The breaks will have to do 16 times as much work. Ask in class about this.

15. Compared to some original speed, a) how much work must the brakes of a car supply to stop a four-times-as-fast car? b) How will the stopping distance compare?

Ans. a) Looking at the equation: $KE = \frac{1}{2}mv^2$ we see that the kinetic energy is proportional to the velocity squared. Since the car is going 4 times faster, it will have 4^2 = 16 times more kinetic energy and therefore, the brakes will have to do 16 times more work.

b) Since work = FΔX were ΔX is the displacement, in order to do 16 times as much work the car will have to go 16 times further. We are assuming that the force is constant.

Extra: What will be the kinetic energy of an arrow shot from a bow having a potential energy of 40 joules?

Ans. If the bow transfers all of its energy to the arrow, the arrow will have 40 joules of kinetic energy as it leaves the bow. The total energy of the arrow will continue to be 40 joules for the entire flight.

22 a) Can a machine multiply input force?

Ans. Yes it can.

b) Can a machine multiply input distance?

Ans. Yes it can.

c) Can a machine multiply input energy?

Ans. No. No. No. A machine will never, ever produce more energy than is supplied to it.

25. If the man in fig. 7.15 pulls 1 meter of rope downward with a force of 100 newtons, and the load rises 1/7 as high, what is the maximum load that can be lifted?

Ans. $Work_{in} = Work_{out}$. Work = FΔX

Since the distance out is $1/7^{th}$ of the distance in, the force out will be 7 times larger than the force in. Therefore the force out will be 700 newtons. Ask about this one in class.

Ch. 7 Review Questions p. 120 continued

33. If a moving object doubles its speed, how much more momentum does it have?

Ans. Since momentum is directly proportional to velocity, t will have twice as much momentum.

34. If a moving object doubles its speed, how much more impulse does it provide to whatever it bumps into?

Ans. Double.

How much more work does it do as it is stopped?

Ans. Kinetic energy is proportional to velocity squared. Doubling the objects velocity will increase its kinetic energy four times so it will have to do four times as much work in order to stop.

Chapter 7, Exercises (pg. 121)

4. When a rifle with a longer barrel is fired, the force of the expanding gas pushes the bullet for a longer distance. What effect does this have on the velocity of the emerging bullet? Why?

Ans. The bullet will be moving faster than it would if fired from a gun with a shorter barrel. Since the work done on the bullet equals the force applied multiplied by the displacement, a longer barrel means that more work is done to the bullet. The kinetic energy gained by the bullet equals the work done to it.

Work = $F\Delta X = \Delta K.E. = 1/2\ mv^2$

More work done to the bullet means that it gains more kinetic energy. When an object gains kinetic energy, it gains velocity.

13. a. At what point in its motion is the KE of a pendulum bob or a child's swing, at maximum?

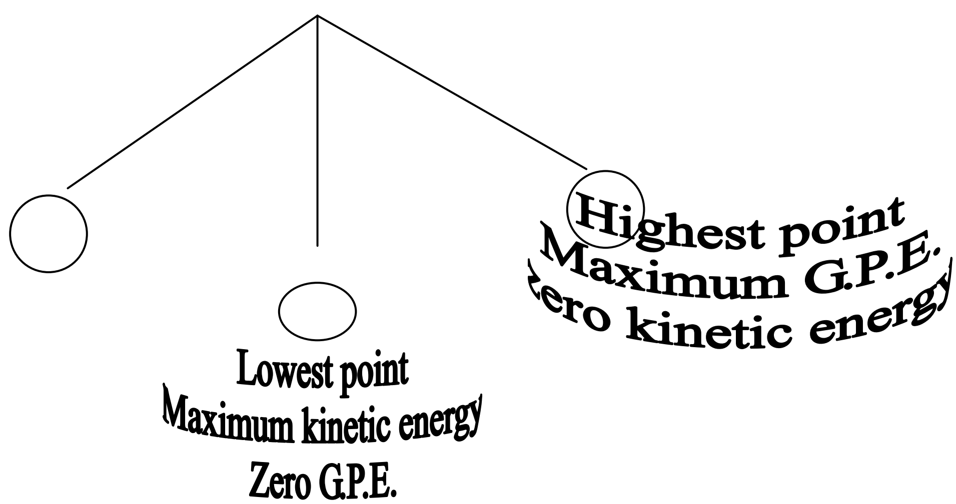
Ans. At the bottom of its path. Can you explain why? If you can't, ask in class.

b. At what point is its PE at maximum?

Ans. At the top of its swing.

c. When is KE half of its maximum value and what percentage of its PE does it have?

Ans. When the center of mass of the swing is half way between the highest and lowest points, one-half of its energy will be in the form of gravitational potential energy and the other half of its energy will be in the form of kinetic energy.



Chapter 7, Exercises continued

14. A physics instructor demonstrates energy conservation by releasing a heavy pendulum bob, allowing it to swing out and back. What would happen if in his exuberance he gave the bob a slight shove as it left his nose? Explain.

Ans. If he pushes the bob away, he will do work to the system and put extra energy into it. The pendulum bob would swing out and back higher than the release point and would hit his nose, if he didn't move out of the way.

20. On a slide a child has potential energy that decreases by 1000 joules while its kinetic energy increase by 900 joules. What other form of energy is involved, and how much?

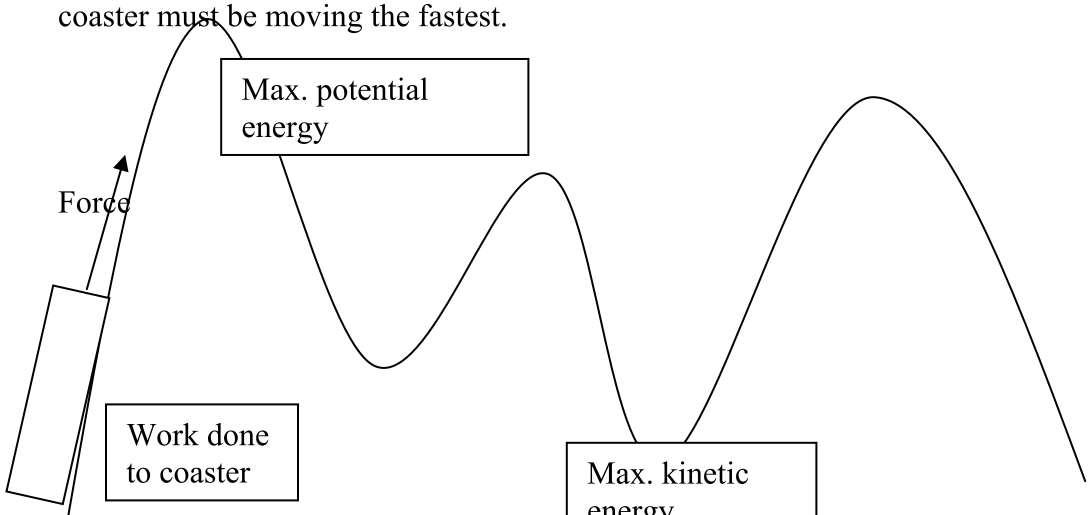
Ans. 100 joules of energy are 'missing'. The 100 joules of energy were used to do work against the force of friction.

21. Someone wants to sell you a superball and claims that it will bounce to a height greater than the height at which it was dropped. Can this be?

Ans. No, it is not possible. Conservation of energy would not allow it. I do believe in the conservation of energy- I do believe.

24+25. Discuss the design of a roller coaster in terms of work, gravitational potential energy and kinetic energy. Does each hill have to be lower than the preceding hill? Can the coaster ever go higher than the first hill?

Ans. Work in done to the coaster when it is pulled up the first hill. That is where the coaster gets all of its energy. At the top of the first hill, the energy is mainly in the form of gravitational potential energy. This is where the 'h' in mgh is the largest. As the coaster goes down a hill, its gravitational potential energy decreases and its kinetic energy increases. The kinetic energy is at maximum when the coaster is at its lowest point. This is also where the coaster must be moving the fastest.



Chapter 7, Exercises continued

Ans. ex.24+25 continued

The total energy would remain constant. If there were no friction, the total energy would always be equal to the work done on the coaster. Because we believe in the conservation of energy, we know that when the coaster goes up a hill and its GPE increases, its kinetic energy must decrease. When a coaster goes down a hill, its GPE will decrease and its kinetic energy must increase. The hills can have any height less than that of the first hill. The coaster will not be able to go up a hill that is higher than the first without having extra energy added somehow. This would violate the law of conservation of energy.

35. In the absence of air resistance, a ball thrown vertically upward with a certain initial velocity and kinetic energy, will return to its original position with the same speed and kinetic energy. When air resistance is considered, will it return to its original level with the same, less, or more kinetic energy? Are any laws of physics violated?

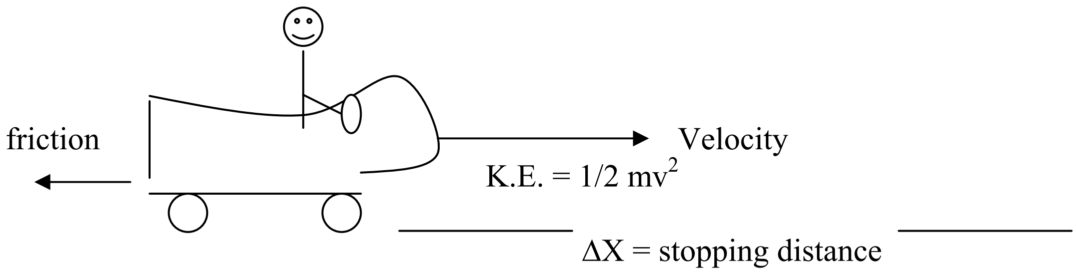
Ans. When we consider air resistance, the ball will return to its original height moving slower than when it was thrown upward. This is caused by the fact that the ball did work when it pushed air molecules out of its way. Because it did work, it used up some of its energy and therefore has less kinetic energy than when it started. All is as it should be.

45. An exciting demonstration involves a physics instructor lying on a bed of nails with a cinder block on his chest. The block is then smashed with a sledge hammer and the teacher is unharmed. Why must the teacher make sure that he is lying on a lot of nails and that the block is massive and will break fairly easily?

Ans. The nails will puncture the teacher's skin if the pressure is too great. Since pressure is Force/Area, the larger the area of contact is the smaller the pressure will be. More nails mean more area, which means smaller pressure. Work is done to the block when it is broken. This uses up some of the energy in the sledge hammer. Also, if the block is massive, it will have a lot of inertia and will not be driven into the teacher’s chest. That would be a bad thing-ouch.

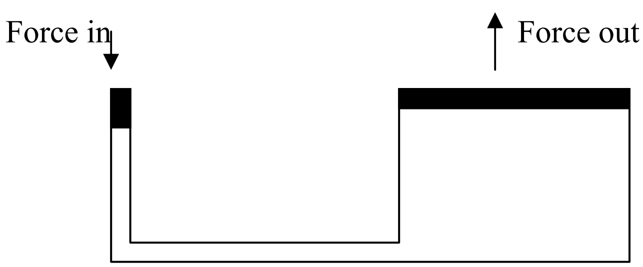
Problems, chapter 7

2. A car moving at 50 km/hr requires15 meters of stopping distance. Predict the stopping distance for the same car, with identical road conditions, if it is moving at 150 miles/hr. Use the concept of conservation of energy to answer this question.



Ans. The car's velocity has tripled. From KE = 1/2 mv^2 we see that its kinetic energy is 9 times its original value. It must do 9 times as much work in stopping.
Work = FΔX and since F is constant, the stopping distance must be 9 times further.
9(15m)= 135 meters

3. In the hydraulic machine shown, the small piston is pushed down 10 cm while the large piston only rises 1 cm. If the small piston is pushed down with a force of 100 N, how much force will the large piston exert?



Ans. Because we believe in the conservation of energy, we know that the work done to the machine will equal the work that we get out of the machine. FΔX in = FΔX out. Since the distance out is 1/10 the distance in, the force out must be 10 times the force in.

Work in = Work out Force in x Distance in = Force out x Distance out

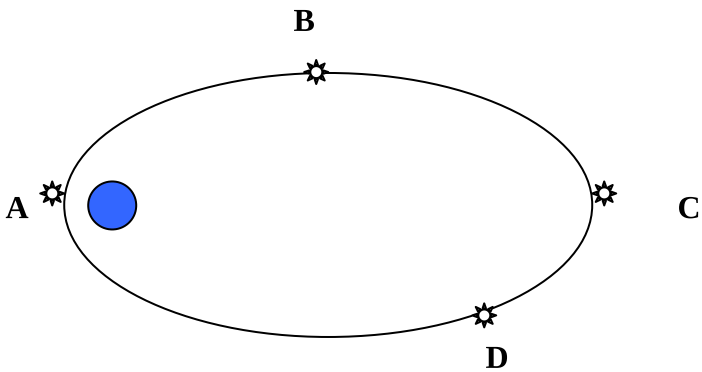
$$\text{Force out} = \frac{\text{Force in x Distance in}}{\text{Distance out}} = \frac{100 \text{ N x } 10 \text{ cm}}{1 \text{ cm}} = 1000 \text{ Newtons}$$

If this confuses you, ask in class.

Pg. 200 Exercise 49

At which of the indicated positions does the satellite in elliptical orbit experience the greatest:

- **a) gravitational force**
- **b) speed**
- **c) velocity**
- **d) momentum**
- **e) kinetic energy**
- **f) gravitational potential energy**
- **g) total energy**
- **h) acceleration**



Ask and answer in class for + 4 points

Ch. 13 Review Questions pg. 262

1. Give two examples of a fluid.

Ans. Liquids and gasses are fluids. Therefore, air and water are examples of fluids.

2. Distinguish between force and pressure.

Ans. Correctly ask and answer this question in class for + 2 points.

3. What is the relationship between liquid pressure and the depth of a liquid?

Ans. Pressure at depth 'h' = density of fluid x g x h.
Pressure is directly proportional to depth. If you triple the depth, you triple the pressure.

What is the relationship between liquid pressure and the its density?

Ans. Pressure is directly proportional to the density of the liquid. If you use a fluid with double that of the original, the pressure will double.

4. If you swim twice as deep under water, how much more water pressure is exerted on your ears?

Ans. Because fluid pressure is directly proportional to depth, you would experience twice as much pressure if depth were doubled.

How does pressure beneath salt water compare to pressure beneath fresh water at the same depth?

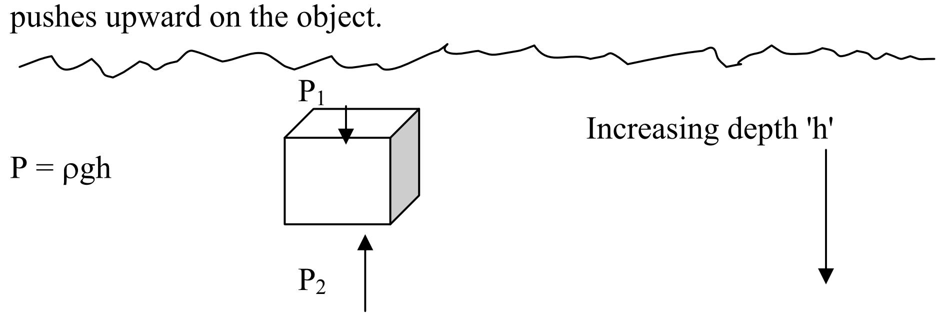
Ans. Salt water is denser than fresh water. Therefore pressure will be greater beneath the salt water than the fresh water at the same depth.

5. How does water pressure one meter below the surface of a small pond compare to water pressure one meter below the surface of a large lake?

Ans. The pressures will be equal. The pressure on an object submerged in a fluid does not depend on the surface area of the fluid or object.

7. Why does buoyant force act upward on an object submerged in a fluid?

Ans. The buoyant force on an object submerged in a fluid is caused by the pressure difference between the top and bottom of the object. The larger pressure at greater depth pushes upward on the object.



9. How does the volume of a solid, insoluble object submerged in a fluid compare to the volume of the fluid displaced?

Ans. Their volumes are equal. Archimedes was the first to realize this.

Ch. 13 Review Questions pg. 262 continued

16. Does the buoyant force on a submerged object depend on the volume of the object?

Ans. Yes! Yes! Yes!

21. What happens to the pressure in all parts of a confined fluid if the pressure in one part is increased?

Ans. It increase until the pressure is equal in all places within the confined fluid.

Extra: How does the buoyant force acting on a boat floating at rest compare to the weight of the boat?

Ans. They are equal in magnitude and opposite in direction.

Hewitt, 9th edition
Ch. 13 Exercises pg. 263

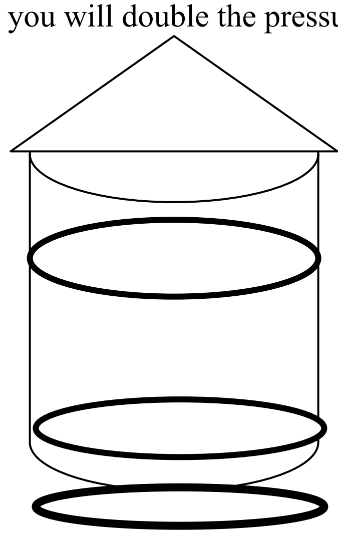
1. Stand on a bathroom scale and read your weight. When you lift one foot off so you're standing on one foot, does the reading change? Does the force read force or pressure?
Ans. The reading does not change because the scale reads force and not pressure.

2. Why are persons confined to bed less likely to develop bedsores on their bodies if they use a waterbed rather than an ordinary mattress?
Ans. Ask in class.

3. Why does a sharp knife cut better than a dull knife?
Ans. A sharp knife produces more pressure than a dull knife when the same force is applied. Pressure is inversely proportional to the area of contact.
$P = F/A$ A sharp knife applies the force over a smaller area resulting in a larger pressure.

6. An exciting demonstration is walking on glass with bare feet. Although I don't recommend that you try this at home, it is based on a sound physics principle. Can you explain the concept?
Ans. If you use the right glass, you can break it up into a lot of small pieces that don't have narrow points. When you walk on the glass, the total area of contact is large and because pressure is inversely proportional to area, the pressure on your feet will be small.

9. Why is a water tower elevated?
Ans. Water pressure is directly proportional to the height or depth of the water. $P = \rho gh$ The higher the tower is above the faucet, the greater the water pressure will be. If you double the height, you will double the pressure.



Why are the hoops closer together near the bottom of the water tower?
Ans. The increase pressure at depth produces a larger force pushing out on the walls of the tower.

Ch. 13 Exercises pg. 264

10. An aluminum block and a lead block, each with the exact same volume of 10 cm^3 are submerged in water. How does the volume of water displaced compare?
Ans. They have the same volume, so they displace the same amount of water. Volume is a measure of the amount of space that an object occupies.

18. Why do you appear to weigh less when you wade out into the water?
Ans. There is a buoyant force pushing you up. It is caused by the larger water pressure at depth pushing you upward.

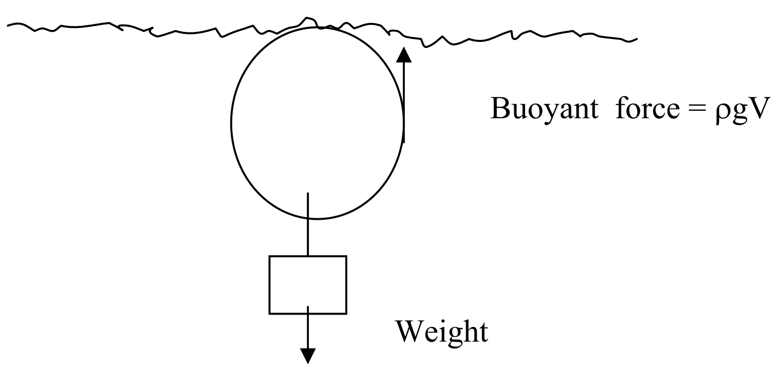
19. If you cut your finger, why does it bleed less when you hold it above your head?
Ans. When you hold your finger above your head, you have increase the height of the blood. This increases the pressure pushing back against that caused by the heart.

26. Is it always true that heavy objects sink and light objects float?

Ans. No. A boat that is too heavy to lift will float while a coin that is not very heavy will sink. In order for an object to float, the buoyant force must equal the objects weight before the object is completely submerged. This is a good one to ask about in class.

28. As Styrofoam is loaded into a boat, will it sink deeper into the water or rise?
Ans. The Styrofoam has weight and will cause the boat to sink deeper into the water until the buoyant force increases to equal the larger total weight of the boat and foam.

32. An air filled balloon is weighted until it is just barely submerged. If the balloon is then placed a little deeper in the water, will it float up, remain at the new location or sink?
Ans. It will sink. When you place the balloon deeper, the increased water pressure surrounding the balloon compresses it, reducing its volume 'V' and therefore reduces the upward buoyant force on it. The object's weight remains constant and pulls the balloon down.



Gases and Plasmas: Chapter 14, pg. 285 Review questions

9. How does the pressure at the bottom of a 76 centimeter column of mercury in a barometer compare to one standard atmospheric pressure.
Ans. They are equal. If air pressure increases, it will push the mercury higher. If air pressure decreases, the mercury column will fall.

10. How does the weight of mercury in a barometer compare to the weight of a column of air from sea level to the top of the atmosphere which has an equal cross-sectional area?
Ans. They must be the same weight. This comes from solving $P = F/A$ for force. $F = PA$ The same pressure multiplied by the same area must exert the same force.

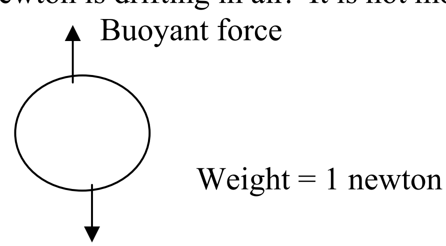
11. Why would a water barometer have to be 13.6 times higher that a mercury barometer?
Ans. Because water is only 1/13.6 the density of mercury, a column of water would have to be 13.6 times higher to produce the same pressure.
$P = \rho g h$

12. Is soda sucked up a straw?
Ans. No. It is pushed up by the surrounding air pressure. Remember: Pressure pushes. Vacuums don't suck!

13. A shallow well pump, also known as a vacuum pump, will not work if the well is more than 10.3 meter (33 feet) deep. Why not?
Ans. A vacuum pump depends on air pressure to push the water up. The pump removes air from the pipe that leads to the well. The atmospheric pressure then pushes water up the pipe. A column of water 10.3 meters deep h as the same pressure as the atmosphere, so air pressure cannot push the water any higher than that.

16. What happens to the density of an air mass if its volume is cut in half?
Ans. You can see from the density equation, $\rho = m/v$ that density is inversely proportional to volume. If the volume of air is cut in half, its density must double because double (2) is the inverse of 1/2.

19. A balloon that weighs 1 newton is drifting in air. It is not moving up or down.



How much buoyant force is acting on the balloon?
Ans. 1 newton. Since the balloon is not accelerating up or down, we know from Newton's 1st law of motion that the net up-down force must be zero. If the buoyant force

increases the balloon will accelerate up. If the buoyant force decreases, the balloon must accelerate dow

Chapter 14, pg. 285 Review questions continued

23. What happens to the internal pressure in a fluid flowing in a horizontal pipe when its speed increases?
Ans. Conservation of energy tells us that if the fluid's velocity increases, its internal pressure must decrease. Although this may seem counter intuitive, Bernoulli's principle provides lift to air plane wings and soaring birds. You might want to ask about this one in class.

26. How does Bernoulli’s principle apply to the flight of airplanes?
Ans. As the plane moves forward, wind rushes over the top of the wing faster than the bottom. Bernoulli’s principle tells us that as the velocity of a fluid increases, its pressure decreases. Therefore, the air pressure over the top of the wing is less than the air pressure over the bottom of the wing. The wing is pushed up by the higher air pressure under the bottom of the wing.

Ch. 14 pg. 286 Exercises

7. When an air bubble rises in water, what happens to it mass, volume and density?
Ans. Mass remains constant, its volume will increase and therefor its density will decrease. If you are confused by this, ask in class.

15. Wood a vacuum cleaner pick up dust on the surface of the moon? Please not that the moon does not have an atmosphere.
Ans. It would not pick up dust on the moon’s surface. Do you know why?

25. Why is it so difficult to breathe when snorkeling at a depth of 1 m, and practically impossible to breathe at a depth of 2-m. Why can’t a diver10-m below the surface, breathe from a tube extending to the surface?
Ans. The pressure on an object submerged in a fluid is given by the equation:
$P = \rho g$depth. The pressure at just 1 meter below the surface $=1000\text{kg/cm}^3(10\ \text{m/s}^2)1\text{m}=10{,}000\text{N/m}^2$. When you breath through a tube from 1 meter below the surface, your chest would have to exert a pressure of 10,000 Pascals.

45. What physics principle underlies these three observations? When passing an oncoming truck on the highway, your car tends to sway toward the truck. The canvas roof of a convertible automobile bulges upward when the car is traveling at high speeds. The windows of older trains sometimes break when a high-speed train pass by on the next track.
Ans. Bernoulli’s principle. The fast moving air has lower internal pressure.

Chapter 14. Problems pg. 288

1. What change in pressure occurs in a party balloon that is squeezed to one-third its volume with no change in temperature?
Ans. Its pressure triples.

2. Air in a cylinder is compressed to one-tenth its original volume with no change in temperature. What happens to its pressure?

Ans. Its pressure is increased by a factor of ten.

Temperature, Heat and Expansion: Ch. 15 pg. 303 Review questions

2. What are the freezing and boiling temperatures of water in Celsius, Fahrenheit and Kelvins?

Ans. Water freezes at 0˚C = 32˚F = 273 K
Water boils at 100˚ C = 212˚ F = 373 K

5. Why doesn't the Kelvin scale have any negative numbers?

Ans. When the molecules and atoms of a system have an average kinetic energy of zero, they cannot give any net energy to their surroundings. The system cannot lose any energy and is at its coldest possible temperature. By agreement, the system is at zero Kelvins and cannot get any colder.

7. When you touch a cold surface, does cold travel to your hand? Explain.

Ans. No. Heat always travels from high temperature objects to low temperature objects. Heat flow from your hand toward the cold object.

8. Distinguish between temperature and heat.

Ans. Temperature is a measure of the average kinetic energy of the molecules and atoms of a system. Heat is the amount of energy that is transferred from one place to another because of a temperature difference.

9. Distinguish between heat and internal energy.

Ans. Internal energy is the sum of all energies stored in a substance. Heat is the energy that is transferred because of a temperature difference.

10. What determines the direction of heat flow?

Ans. Heat always flow from high temperature objects to low temperature objects.

12. Distinguish between calorie and Calorie.

Ans. One Calorie equals 1000 calories. Nutritionists use the term Calorie instead of kilocalorie.

15. Does a substance that heats up quickly for its mass, have a high or low specific heat capacity?

Ans. It has a low specific heat capacity.

17. How does the specific heat capacity of water compare to other common substances.

Ans. Water has one of the highest specific heat capacities known. There are however a few substances whose specific heat capacity is higher.

Exercises Ch. 15 pg.302

Extra: What is temperature a measurement of?

Ans. Temperature is a measure of the average kinetic energy of the molecules and atoms of a substance.

12. Why does the pressure of gas enclosed in a rigid container increase as the temperature increases?

Ans. On average, the molecules of a higher temperature substance are moving faster and impart a greater force per unit area to the walls of the container as they randomly collide with it.

18. Why does the presence of large bodies of water tend to moderate the climate of near by land?

Ans. Ask and answer this one in class for plus two points.

20. In the old days, on a cold winter night it was common to bring a got object to bed with you. Which would be better to keep you warm-a 10-kilogram iron brick or a 10-kilogram jug of hot water at the same temperature? Explain.

Ans. Ask and answer this one in class for plus two points.

21. Desert sand is very hot during the day and cool during the night. What does this tell you about its specific heat capacity?

Ans. The sand must have a low specific heat capacity.

Problems Ch. 15 pg. 304

2. If you wish to warm 100 kg of water by 20˚C for your bath, how much heat is required? Give your answer in calories and joules

Ans. $Q = mc\Delta T = 100{,}000g(1\frac{cal}{g^{\circ}C})20^{\circ}C = 2{,}000{,}000$ calories

Since approximately 4.2 joules = 1 calorie, we would need 8,400,000 joules of energy.

Heat Transfer: Ch. 16 Review Questions; pg. 320

1. What are the three methods of heat transfer?
   Ans. Conduction, convection, and radiation.

8. How is heat transferred from one place to anther by convection?
   Ans. The fluid moves. The fluids density changes with a change in temperature, and gravity pulls the denser portion of the fluid beneath the less dense portion.

16. What exactly is radiant energy?
   Ans. Radiant energy is actually electromagnetic radiation-light.

Change of Phase: Ch. 17 Review Questions pg. 336

1. What are the four common phases of mater?
Ans. Solid, liquid, gas and plasma

2. Do all of the molecules in a liquid have the same speed?
Ans. No. They have a large variety of speeds.

4. Why does warmer water evaporate faster than cooler water?
Ans. The average kinetic energy of the warmer water molecules is greater than that of the cooler water molecules.

5. What is sublimation?
Ans. Ask and answer this question in class for plus two points.

7. Why is a steam burn more damaging than a burn from boiling water of the same temperature?
Ans. When water goes from gas to liquid, it must give off the stored heat of vaporization. So you get an extra 540 calories/gram of energy deposited on your skin. Ouch!

8. Why do you feel uncomfortably warm on a hot and humid day?
Ans. Ask in class for +1 point

14 Why doesn't water boil at 100°C when the air pressure above its surface is increased?
Ans. Water, or any liquid, will only boil when the vapor pressure from its molecules is equal to the pressure over the surface. When we increase the pressure over the surface, the molecules must on average, have more kinetic energy (higher temperature) in order to boil.

15. Why is the boiling temperature lower at higher altitudes?
Ans. There is less air pressure at higher altitudes. Water, or any liquid, will only boil when the vapor pressure from its molecules is equal to the pressure over the surface. When we decrease the pressure over the surface, the liquid molecules will produce enough vapor pressure to escape (boil) at lower temperatures.

16. Why do foods cook faster in a pressure cooker?
Ans. The boiling water in the pressure cooker is at a higher temperature than normal.

18. What happens to the pressure at the bottom of a geyser when some of the water above gushes out?
Ans. Since the pressure at the bottom of a column of water is directly proportional to the depth, when water gushes out, pressure at the bottom is reduced .

19. The temperature of boiling water doesn't increase when you add more heat. Why not?
Ans. In order to boil, water must receive 540 calories of energy per gram that boils. So instead of continuing to warm the liquid water, the energy goes into to changing its state from liquid to gas-boiling.

Change of Phase: Ch. 17 Review Questions pg. 337 continued

20. When will water boil at less than 100 ˚C?
Ans. When the air pressure above it is reduced.

31. How many calories are needed to change the temperature of 1 gram of water by 1 ˚C?
Ans. 1 calorie.
To melt 1 gram of ice?
Ans. 80 calories.
To vaporize one g of boiling water at 100 ˚C?
Ans. 540 calories.

33. Cite two reasons firewalkers don't burn their wetted feet when walking barefoot on red-hot coals?
Ans. Ask and answer in class for plus two.

Pg. 339 Problem 1 Ask in class.

Thermodynamics Chapter 18 Pg. 357 Review questions

6. State the lowest possible temperature in celsius and in kelvins.

Ans. The lowest possible temperature on the Celsius scale is -273.15 ˚C, which we will round off to -273˚C.
The lowest possible temperature in kelvins is 0 kelvins. Nothing can be colder than this. This is the temperature where the average kinetic energy of the molecules and atoms of the substance is zero.

9. How does the law of conservation of energy relate to the first law of thermodynamics?

Ans. The first law is a conservation of energy statement. If energy flows out of a system its energy go goes down. If energy flow into a system its energy goes up. If a system does work, its energy goes down. If work is done to a system, it loses energy.

10. What happens to the internal energy of a system when mechanical work is done on it? What happens to its temperature?

Ans. Its internal energy increases and its temperature increases.

11. What is the relationship between heat added to a system, change in its internal energy, and external work done by the system?

Ans. The first law of thermodynamics states that:

$\Delta U = \pm Q \pm W$ where
U is the internal energy of the system
Q is the heat that may flow into or out of the system
W is the work done to or by the system

If heat is added to a system then its internal energy will increase.
If work is done by the system then its internal energy must decrease.
There is no free lunch!

12. What condition is necessary for a process to be adiabatic?

Ans. A process is adiabatic when a gas is compressed or expanded and there is no heat exchange with the environment. There will however be a temperature change.

13. What happens to the internal energy of a system when work is done to a system? Work done by a system?

The first law of thermodynamics states that:

$\Delta U = \pm Q \pm W$ where
U is the internal energy of the system

Q is the heat that may flow into or out of the system
W is the work done to or by the system

Ans. This question illustrates the reason for the + and - symbols in front of the W
Its internal energy must increase.

When work is done by a system its internal energy must decrease.

Thermodynamics Chapter 18 Pg. 357 Review questions continued

15-17What generally happens to the temperature of rising and sinking air? Explain.

Ans. This is an example of adiabatic cooling and warming and follows the rules in the first law of thermodynamics. Rising air is surrounded by air of lower pressure and it therefor expands. Because it expands, it does work. Since it does work it must loose energy. Therefor its temperature decreases. When air sinks, it is surrounded by air of higher pressure. The surrounding air compresses it, doing work to the sinking air. Since work is done to it, the sinking air gains energy and its temperature increases.

21. How does the second law of thermodynamics relate to the direction of heat flow?

Ans. The second law of thermodynamics states that left to itself, a systems entropy will increase. A consequence of this is that net heat flow is from higher temperature objects to lower temperature objects. This happens because of the transfer of kinetic energy during the random collisions of atoms and molecules.

29. What is the physicist's term for measure of amount of disorder?

Ans. Entropy

Chapter 18; Exercises pg. 358

5. When air is quickly compressed, why does its temperature increase?

Ans. First law again folks. When the air is compressed work is done to it. Therefore its internal energy will increase. Since it is compressed quickly, very little heat can leave the system, so its temperature increases.

Things to know by heart---Review for test 2	**Equation**	**Units**
Momentum = Mass x Velocity;	p=mv;	kgm/sec
Momentum is a vector;		
Change in momentum = Mass x change in velocity;	$\Delta p = m\Delta v$	kgm/sec
Impulse=Force x time the force is applied; The only way to change an object's momentum is to apply an Impuse. Impulse is a vector.	Impulse= $F\Delta t$	kgm/sec
Impulse = change in momentum;	$F\Delta t = m\Delta v$	kgm/sec
Work = Force x displacement in the direction of motion;	$W = F\Delta x$	kgm^2/sec^2, joules
Gravitational potential energy is the energy an object has because of the work that was done in lifting it against the force of gravity.		
Gravitational Potential Energy = mass x g x height;	GPE= mgh	kgm^2/sec^2, joules
Kinetic energy is the energy that an object has because of its motion. The faster it moves, the greater its kinetic energy. An object's mass also contributes to its kinetic energy.		
Kinetic Energy = $\frac{1}{2} mass\, x\, velocity^2$;	K.E. = $\frac{1}{2}mv^2$	kgm^2/sec^2, joules
Pressure is force per unit area;	$P = \frac{F}{A}$	$\frac{N}{m^2}$, pascals
Pressure caused by the weight of a fluid equals the density of the fluid x g x depth of fluid	$P = \rho gh$	$\frac{N}{m^2}$, pascals
The density of water is $1000\frac{kg}{m^3} = 1\frac{g}{cm^3}$		
A buoyant force is caused by the difference in pressure on the top and bottom of an object that is submerged in a fluid. The buoyant force equals the density of the fluid x g x submerged volume of the object.	$B.F. = \rho gV$	N, newtons
Temperature is a measure of an object's average kinetic energy.		celsius, kelvins
Heat is the amount of energy that is transferred between substances because of their temperature difference.		calories, joules
When there is a temperature change, the heat can be calculated by multiplying the object's mass by its specific heat capacity and by the temperature change.	$Q = mc\Delta t$	joules, calories
When a solid is melted, or a liquid frozen, the heat required can be calculated by multiplying its heat of fusion by its mass. When a liquid is turned to a gas or a gas changes	$Q = H_f m$	joules, calories

to a liquid, the energy transferred is found by multiplying its heat of vaporization by its mass. | $Q = H_v m$ | joules, calories

Some important constants for water are: [ ] ; [ ] ;

Things to know by heart---Review for test 2 — Equation — Units

Some important constants for water are:

$c_{liquid} = 1 \frac{calorie}{gram \cdot {}^\circ C}$; [ ]

First Law of Thermodynamics indicates that energy is conserved. — $\Delta U = W + Q$ — joules, calories

- There is no free lunch.

The Second Law of Thermodynamics

states that the natural tendency of a system is to have its entropy increase. A consequence of the second law is that heat flows from objects of higher temperature to those of lower temperature.

Here is a 10 point sample question for test 2:

How much heat is required t change 2 grams of ice at -10 degrees celsius to water vapor at 130 degrees celsius?

Step 1. Warm the ice to the melting point. The melting point of water is 0 degrees celsius. When warming from -10 to 0 degrees, Δt = 10 degrees.

$$Q = mc\Delta t = 2g\left(\frac{.5cal}{g\cdot{}^\circ C}\right)10^\circ C = 10 calories$$

Step 2. Melt the solid.

$$Q = H_f m = \left(80\frac{cal}{g}\right)2g = 160 calories$$

Step 3. Warm the liquid to the boiling point. The boiling point of water is 100 degrees celsius. The liquid's temperature rises from 0 to 100 degrees celsius, therefore Δt = 100 degrees celsius.

$$Q = mc\Delta t = 2g\left(\frac{1cal}{g\cdot{}^\circ C}\right)100^\circ C = 200 calories$$

Step 4. Boil the liquid.

$$Q = H_v m = \left(540\frac{cal}{g}\right)2g = 1080 calories$$

Step 5. Warm the vapor. The vapor's temperature will rise from 100 to 130 degrees celsius, therefore Δt=30 degrees.

$$Q = mc\Delta t = 2g\left(\frac{.5cal}{g\cdot{}^{\circ}C}\right)30^{\circ}C = 30 calories$$

The total energy required is found by taking the sum of all the individual steps.

```
     10 calories
    160 calories
    200 calories
   1080 calories
+    30 calories
   1480 calories
```

Total heat = 1480 calories   Study hard and good luck on the exam.

Electrostatics; Ch. 22 pg. 343 Review questions

Extra: Which is stronger, the electrical force between an electron and a proton or the gravitational force between these particles? Is the difference large or small?
Ans. The electrical force is much stronger.

1. In terms of attraction and repulsion, how do negative particles affect negative particles? How do negatives affect positives.
Ans. Negative particles repel negative particles and attract positive particles.

2. Why does gravitational force predominate over electrical force for astronomical bodies?
Ans. The stars, planets, moons interstellar dust etc. have an even distribution of protons and electrons and are therefore electrically neutral. Since the net charge is zero, the electrical force is zero.
3. Name the positive and negative charge carriers
Ans. The protons are positively charged and the electrons are negatively charged. They each have the same amount of charge, but have opposite types.
4. How does the charge of one electron compare the charge of another?
Ans. If you seen one electron, you seen them all. They all have exactly the same mass and charge.
Extra: What kind of charge does an atom acquire when electrons are stripped away from it?
Ans. The atom becomes positively charged when it loses electrons.
6. What is a positive ion? A negative ion?
Ans. A positive ion is an atom that is positively charged because it lost an electron. A negative ion is an atom that is negatively charged because it has gained an electron.

11. How is Coulomb's law similar to Newton's law of gravitation? How is it different?
Ans. Coulomb's law $F = kq_1q_2/d^2$

Law of gravity $F = \gamma m_1m_2/d^2$

Similarities: a) they both are force laws
b) Force is inversely proportional to distance squared.

c) They both have constants

Differences: a) Charges come in two types while mass only comes in one type.
b) Gravity only attracts while the electric force can attract or repel objects.
c) The electric force is much, much larger than the force of gravity.

Extra: What happens to the electrical force between two charged objects when the distance between them is doubled? Tripled?

Ans. The force is inversely proportional to the separation distance squared. Therefore if the distance is doubled, the new force is 1/2 squared = 1/4 of its original value. If the distance is tripled, the new force is 1/3 squared = 1/9 of the original value. There are two steps here. <u>Invert</u> and <u>square</u>.

36. When a Van de Graaff generator charges a person, the hair on their head stands up. Why does this happen?

Ans. Like charge objects repel each other. The person's head and strands of hair have the same charge. The person's head repels his or her hair and the strands of hair repel each other. Coulomb's law describes this.

Chapter 22: Exercises pg. 435

3. Why do clothes often cling together when tumbling in the clothes dryer?

Ans. The electrons from one area of the clothing are transferred to another. The parts of the clothing that lost electrons are left positively charged while the parts that gained electrons are negatively charged. Unlike charged areas of the clothing attract each other.

5. When combing your hair, electrons are transferred from your hair to the comb? What is the charge of your hair? Charge of the Comb?

Ans. Since your hair lost electrons, it is positively charged. The comb gained electrons and is therefor negatively charged.

11. Strictly speaking, when an object acquires a positive charge by the transfer of charge, what happens to the mass? What happens to its mass when it acquires a negative charge?

Ans. An object becomes positively charged when is loses electrons. Therefore its mass must decrease a tiny, tiny bit. When it becomes negatively charged, it has gained electrons and therefor its mass must increase a tiny, tiny bit.

19. How does the magnitude of electrical force between a pair of charged objects change when the objects are moved twice as far apart?

Ans. The new force will be 1/4 of the old force.

20. How does the magnitude of electric force compare between a pair of charged particles when they are brought to half their original distance of separation?

Ans. 4 times greater. Do the other parts yourself and ask in class if you are unsure.

23. The proportionality constant k in Coulomb's law is very large while the proportionality constant γ in Newton's law of gravity is almost zero. What does this mean for the relative strengths of these two forces?
Ans. The electric force is fundamentally much larger than the force of gravity.

Extra: Compare the force and acceleration of an electron and a proton placed separately in an electric field.
Ans. The magnitude of the force on each will be the same but the direction of the force applied to them will be opposite. Since the proton is about 1840 times more massive that the electron, its acceleration will only be $1/1800^{th}$ that of the electron.

Chapter 22: Problems pg. 437

1. Two point charges are separated by 6 cm. The attractive force between them is 20 N. Find the force between them when they are separated by 12 cm.

Ans. Since the separation distance is doubled, the force will be 1/2 squared = $1/4^{th}$ the original value. 1/4 (20N) = 5 newtons. Remember, there is an inverse-square relationship between the distance and the force.

7. The potential difference between a storm cloud and the ground is 100 million volts. If a charge of 2 Coulombs flashes in a bolt from the cloud to Earth, what is the change of potential energy?
Ans. From the definition of voltage, $V = \frac{E}{q}$ if we solve for energy we get:
$$E = Vq = 100 million\ \ volts(2 Coulombs) = 200 million\ \ joules$$

Chapter 23: Review Questions; pg. 453

4. What is an ampere?
Ask and correctly answer this one in class for plus 2 points.

7. How much energy is supplied to each coulomb of charge that flows through a 12-Volt battery?
Ans. Since Voltage is the amount of energy in joules per coulomb of charge, 12 Volts will yield 12 joules of energy per coulomb of charge.

11. If the resistance in a circuit is doubled while the voltage is kept constant, what happens to the current?

Ans. We can see from Ohm's law (I = V/R) that the current I is inversely proportional to the resistance R. Therefore, if the resistance is doubled while the voltage is kept constant, the current will be 1/2 of its original value.

12. If the resistance of a circuit remains constant while the voltage across the circuit is changed to 1/2 of its original value, what happens to the current?

Ans. From Ohm's law (I = V/R) we see that current is directly proportional to voltage. Cutting the voltage in half will cut the current in half.

Extra: What role do resistors normally play in an electric circuit?
Ans. Resistors are used to regulate the amount of current and therefore the power in various parts of an electrical circuit. When you turn the volume up on your radio, you are actually decreasing the resistance and increasing the current in the portion of the circuit that produces the sound.

Chapter 23: Review Questions; pg. 453 continued

13. How does water moisture on your skin affect your skin's electrical resistance?
Ans. Your skin's resistance goes down as it becomes more moist.

14. For a given voltage, what happens to the amount of current that flows in your skin when you perspire?
Ask and answer this one correctly in class for plus 2 points.

19. What does it mean to say that a certain current is 60 HZ?
Ans. It means that the current is changing direction at a rate of 60 complete cycles per second. This is an example of alternating current which is abbreviated AC.

27. When you pay your household electric bill, which of the following are you paying for: voltage, current, power or energy?
Ans. You are billed for a certain number of kilowatt hrs. Kilowatts are units of power. Power times time = Energy.

Chapter 23: Review Questions p. 454

29 What is the relationship between electrical power, current and voltage?
Ans, The relationship is given by P = IV:
We can see that power is directly proportional to the current I, as well as the voltage V.
If the current is measured in amps and the voltage is in volts, then the power will be in watts.

30. Which of these is a unit of power and which is a unit of energy: a watt; a kilowatt; a kilowatt-hour?

Ans. Watts and kilowatts are units of power.
Kilowatt-hour is a unit of energy. Looking at the equation for power:
Power = Energy/time
If you multiply power by time, you are left with energy.
Power(time) = $\frac{Energy}{time} time = Energy$

33. In a circuit of two lamps in series, if the current through one lamp is 1 amp, what is the current through the other lamp?
Ans. Since resistors in series all have exactly the same current through them, the current is the second lamp must also be 1 amp.

Chapter 23: Exercises p. 455

4. What happens to the brightness of light emitted by a light bulb when the current that flows in it increases?
Ans. Since the power in a devise is proportional to the current, $P = IV$, the larger the current, the brighter the bulb.

6. Your tutor tells you that an ampere and a volt are the same thing. Are they?
Ans. No. An amp is a measure of the charge per unit time that flow through a devise. Voltage is the amount of energy per unit charge. They are related but are very different things.

16. Only a small percentage of the electric energy fed into a common light bulb is transformed into visible light. What happens to the rest?
Ans. It comes off as invisible light in the infra-red part of the spectrum.

20. What is the effect on current in a wire if both the voltage across it and the resistance are doubled? Both halved?
Ans. The current remains unchanged. $I = \frac{V}{R}$ baby.

21. Will the current in a light bulb connected to a 220-V source be greater or less than when the same bulb is connected to 110-V source?
Ans. Greater. Current is directly proportional to Voltage. $I = \frac{V}{R}$

24. Would you expect to find dc or ac in the filament of a light bulb in your home? How about in the headlight of an automobile?
Ans. AC in your home and DC in your car.

25. Are your car headlights wired in parallel or series.
Ans. Parallel. When one bulb burns out the other keeps on shining.

Electric current: Chapter 23 problems; pg. 457

2. Rearrange the equation $I = \frac{V}{R}$ to express resistance in terms of current and voltage. The solve the following: A certain device in a 120-V circuit has a current rating of 20 amps. What is the resistance of the device?

Ans. $R = \frac{V}{I}$

$R = \frac{120 volts}{20 amps} = 6 ohms$

Extra: Solve the formula $P = IV$, for I, and then find the current drawn by a 1200-watt hair dryer connected to 120-volt source. Then using Ohm's law, find the resistance of the hair dryer.

Ans. Since P=IV then $I = \frac{P}{V}$. Therefore the current $I = \frac{1200W}{120V} = 10 amps$

The resistance $R = \frac{V}{I}$ therefore $R = \frac{120V}{10A} = 12 ohms$

4. The total charge that an automobile battery can supply without being recharged is given in terms of ampere-hours. A typical 12-V battery has a rating of 60 ampere=hours. Suppose you forget to turn off the headlights in your parked car. If each of the two headlights draws 3 amps, how long will it be before your battery is "dead"?

Ans. Charge = current x time therefore time = $\frac{charge}{current} = \frac{60 amp-hrs}{6 amps} = 10 hours$

Chapter 24 magnetism; Review questions, pg. 474

6. An electric field surrounds an electric charge. What additional field surrounds an electric charge when it is moving?
Ans. A magnetic field.

16. a) In what direction relative to a magnetic field does a charged particle move in order to experience maximum deflecting force?
Ans. The charged particle must move at right angles to the field.
b) In what direction relative to a magnetic field does a charged particle move in order to experience mimimum deflecting force?
Ans. The charged particle must move parallel to the field.

24. What is the evidence for the Earth having a magnetic field?
Ans. Compass needle, which is actually a magnet that is free to rotate, lines up with the Earth's magnetic field.

Ch. 24 Exercises pg. 476

7. a) What surrounds a stationary electric charge?
Ans. An electric field.
b) What surrounds a moving electric charge?
Ans. A magnetic field and an electric field.

8. "An electron always experiences a force in an electric field but not always in a magnetic field." Defend this statement.
Ans. An electron always has its own electric field around it but only has a magnetic field when it is moving.

17. The north pole of a compass is attracted to the north pole of the Earth, yet like poles repel each other. Can you resolve this apparent dilemma?
Ans. Yes. The Earth's north magnetic pole is really the south pole of a magnet.

22. Magnet A has twice the magnetic field strength of magnet B (at equal distance) and at a certain distance pulls on magnet B with a force of 50 newtons. With how much force, then, does magnet B pull on magnet A?
Ans. 50 newtons of course. Newton's 3^{rd} law never ails.

30. Two charged particles are projected into a magnetic field that is perpendicular to their velocities. If the charges are deflected in opposite directions, what does this tell you about them?
Ans. They must have opposite charges.

Chapter 19 Vibrations and Waves
Review Questions pg. 377

9. How many vibrations per second are represented in a radio wave of 101.7 MHZ?
Ans. The M represents million and HZ represents vibrations per second, therefore we have the frequency is 101.7 million vibrations per second.

10. How do frequency and period relate to each other?
Ans. They are inversely proportional to each other. Frequency = $\frac{1}{T}$ where T represents the period.

13. What is the relationship among frequency, wavelength, and wave speed?
Ans. V = frequency x wavelength, therefore the wave's speed is directly proportional to its frequency and wavelength.

Extra: As the frequency of a wave of constant speed is increased, does the wavelength increase or decrease.
Ans. $V = f\lambda; solving\ for\ \lambda\ we\ get\ \lambda = \frac{V}{f}$
Since there is an inverse relationship between frequency and wavelength, as the frequency increases the wavelength must decrease.

14. In a transverse wave, in which direction does the medium vibrate when compared to the direction that the wave is "moving"?
Ans. The wave vibrates at right angles (90˚) to the direction of wave propagation.

15. In what direction are the vibrations relative to the direction of wave travel in a longitudinal wave.
Ans. The vibrations are in the direction of propagation.

18. Define: a) constructive interference
b) destructive interference
Ans. a) Constructive interference is the increase in wave amplitude caused by the superposition of waves. This occurs when the crest and trough of one wave is in the same space as the crest and trough of another wave.
b) Destructive interference is the decreased in wave amplitude caused by the superposition of waves. This occurs when the crest of on wave is in the same space as the trough of another wave.

Extra: What does it mean to say that one wave is out of phase with another?
Ans. It means that their crests and trough don't occur at the same place at the same time. This results in destructive interference. If they are 180˚ out of phase, complete destructive interference occurs.

Chapter 19 Vibrations and Waves
Review Questions pg. 377 continued

22. In the Doppler effect, does frequency change? Does wavelength change? Does wave speed change?
Ans. Both the frequency and wavelength change. The wave speed remains constant.

24. What is meant by a blue shift and a red shift for light?
Ans. Blue shift for light indicates an increase in frequency and tells you that the objects are approaching one another. Red shift is a decrease in frequency and indicates that the objects are moving apart.

Ch. 19 Vibrations and waves; Exercises pg.378

12. If we double the frequency of a vibrating medium, what happens to the period of the wave?
Ans. Since the period is inversely proportional to the frequency, the period will be one-half its original value if its frequency is doubled while keeping wave velocity constant.

16. You dip your finger repeatedly into a puddle of water and make waves. What happens to the wavelength if you dip your finger more frequently?
Ans. From the equation for wave velocity ($V = f\lambda$), increasing the frequency must decrease the wavelength in order to maintain a constant velocity.

25. Why is there a Doppler effect when the source of sound is stationary and the listener is in motion? In which direction should the listener move to hear a higher frequency? A lower frequency?

Ans. The Doppler effect is produced by the relative motion of the wave emitter and receiver. If the crests arrive sooner than the source emitted them there will be an increase in frequency. If the crests arrive less frequently than the source emitted them there will be a decrease in frequency.

29. How does the Doppler effect aid police in detecting speeding motorists?
Ans. The police radar unit sends out waves of invisible light at a specific frequency. Some of the waves bounce off the vehicle and return back to the officer. The faster your relative motion, the larger the frequency shift. The unit then calculates your speed and displays it on a screen.

Ch. 19. Problems pg. 379

3. A skipper on a boat notices wave crests passing his anchor chain once every 5 seconds. He estimates the distance between wave crests to be 15 meters. What is the speed of the wave?
Ans. $V = f\lambda = \frac{1}{\sec}(15m) = 15\frac{m}{s}$

Ch. 26 Properties of Light; Exercises pg. 512

11. Do radio waves travel at the speed of sound, or at the speed of light, or somewhere in between?
Ans. Radio waves are light and therefore travel at the speed of light.

13. What is the same about radio waves and visible light?
Ans. The both are electromagnetic radiation and travel as bundles of energy called photons, at the speed of light.
b) What is different about them?
Ans. They have different frequencies and wavelengths.

20. What determines whether a material is transparent or opaque?
Ans. The resonant frequency of the electrons in the material. If the frequency of the light is the same as the resonant frequency of the electrons, the material is opaque.

38. When you are looking at a distant galaxy through a telescope, how is it that you are looking back in time?
Ans. It takes many years for the light from the galaxy to reach Earth. We see the galaxy as it was when the light left it.

Ch. 27 Color; Review Questions pg. 529

1. What is the relationship between the frequency of light and its color?

Ans. Different frequencies of visible light are different colors. In order of increasing frequency we have:

Red, orange, yellow, green, blue and violet.

⟶

Increasing frequency

3. When outer electrons are set into vibration, what do they emit?

Ans. Light.

4. What happens to light that falls on a material that has a natural frequency equal to the frequency of the light?

Ans. The light is absorbed due to resonance.

5. What happen to light that has a natural frequency above or below the frequency of the light?

Ans. The light is scattered.

6. What color light is transmitted through a piece of red glass?

Ans. Red.

22. Which interacts more with high-frequency light, small particles or large particles?

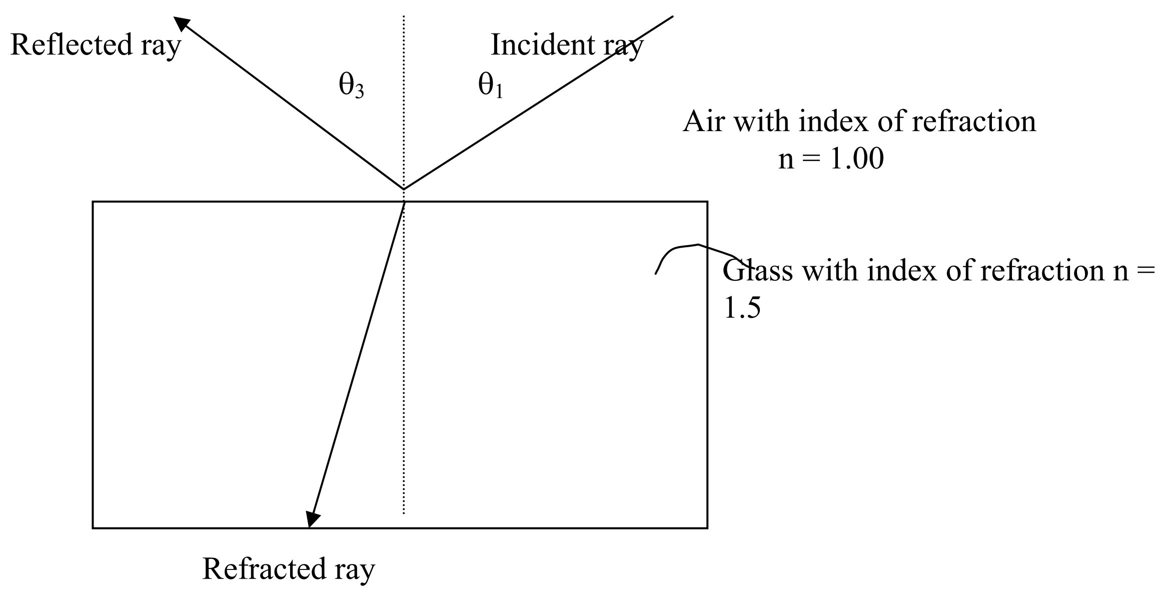
Ans. Small particles scatter high-frequency light the best.

25. Why does the sun look reddish at sunrise and sunset but not a noon?
Ans. Ask and answer in class for plus 2 points.

27. What is the evidence for a variety of particle sizes in a cloud?
Ans. The cloud appears white because it is scattering all colors. This only happens because of the presence of different size particles.

Chapter 28 Reflection and Refraction Review questions pg. 557

1. Distinguish between reflection and refraction.



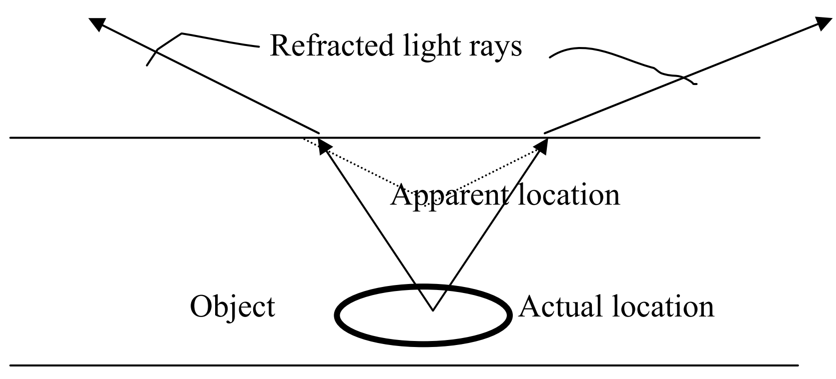
Ans. The reflected ray occurs when the incident ray bounces of the interface between the two media. The angle of incidence θ_1 equals the angle of reflection θ_3. The refracted ray is the part of the wave that enters a medium that has a different index of refraction than the medium that it is coming from, and changes direction. The angle of refraction will be smaller than the angle of incidence if the second medium has a larger index of refraction than the first. All three ray paths in the diagram above are reversible.

5. What is the law of reflection?
Ans. When a wave reflects off of a smooth surface, the angle of incidence equals the angle of reflection.

6. Relative to the distance of an object in front of a plane, flat mirror(like the one in your bathroom), how far behind the mirror is the virtual image?
Ans. The virtual image is as far behind the mirror as the object is in front of it.

Chapter 28 Reflection and Refraction Review questions pg. 558

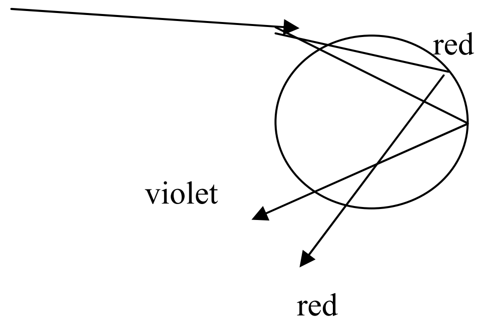
13. What is a mirage?
Ans. When light passes media having different indices of refraction it changes direction. The change in direction will make objects appear to be located someplace where they are not. The apparent dislocation of an object caused by the refraction of light is called a mirage.



16. Does refraction make a swimming pool seem deeper or shallower than it really is?
Ans. Refraction makes objects appear closer to the surface than they actually are. The pool seems to be shallower than it really is. That can be dangerous for non-swimmers.

21. Does a single raindrop illuminated by sunlight deflect light of a single color or does it disperse a spectrum of colors?

Ans. A single raindrop disperses a rainbow of colors. Because the colors go in different directions, you only see one color at a time from a particular raindrop.

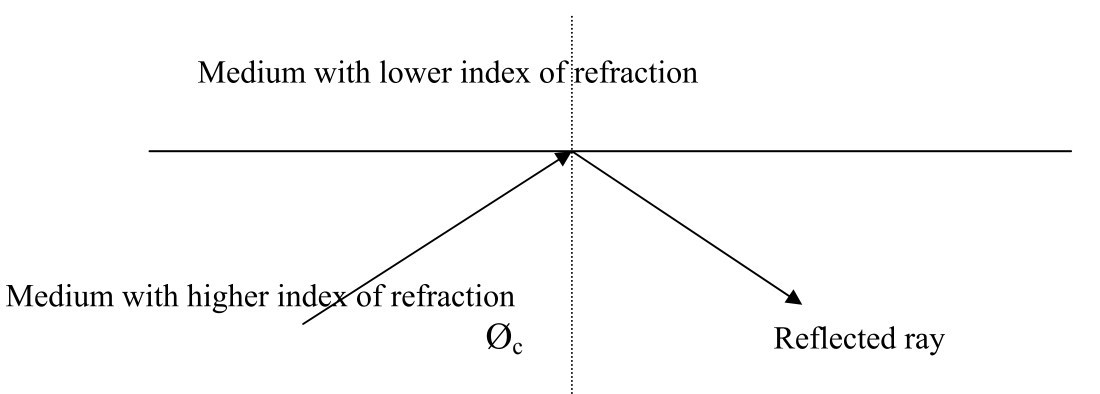


all other colors are in between the red and violet

Chapter 28 Reflection and Refraction Review questions pg 557

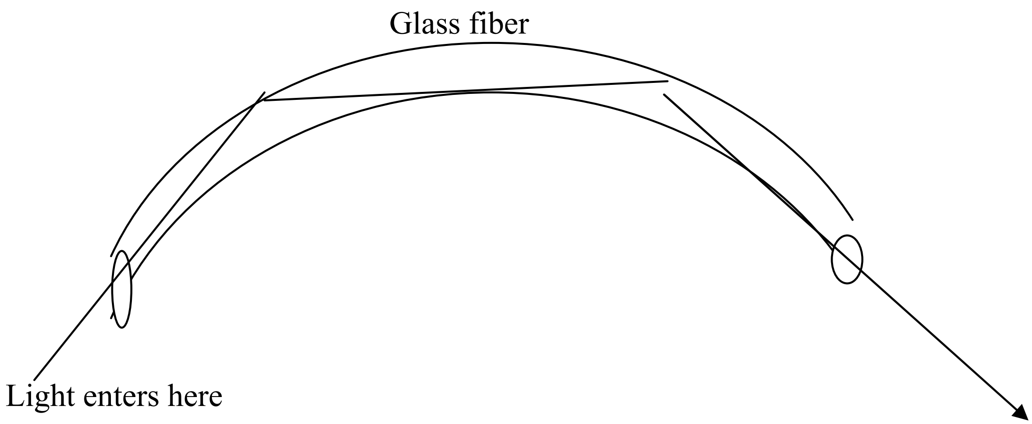
24. What is meant by critical angle?

Ans. The critical angle is the angle of incidence that results in an angle of refraction of 90˚. When light moving from a medium of higher index of refraction to one of lower index of refraction strikes the interface at an angle equal to or larger than the critical angle, it will not exit in to new medium. Instead, all of the light is reflected back to the original medium. This is called total internal reflection.



Where $Ø_c$ is the critical angle

27. Light normally travels in a straight line but it bends in an optical fiber. Explain why.
Ans. The fiber has a higher index of refraction than its surrounds. Light is sent down the fiber at an angle larger than the critical angle. The light then undergoes total internal reflection in the fiber as explained in question 24.



Chapter 11: Properties of Matter
Review questions pg. 222

1. What causes dust particles and tiny grains of soot to move with Brownian motion?
Ans. The dust particles and tiny grains of soot move when atoms that are vibrating with kinetic energy collide with them.

2. Who first explained Brownian motion and made a convincing case for the existence of atoms?
Ans. Albert Einstein.

20. Why do we say that materials in our world are mostly space?
Ans. The atoms that make up the world around us are mostly space. Ask in class for further information.

21. How does the mass and electric charge of a proton compare with the mass and charge of an electron?
Ans. The proton is much more massive than an electron. It requires more that 1800 electrons to equal the mass of just one proton. Their charges however, are exactly the same amount; 1.6 X 10^{-19} Coulombs. The proton has the positive type of charge and the electron has the negative type.

22. What does the atomic number tell you about the element?
Ans. The atomic number tells you the number of protons in the nucleus of the atom and determine which element it is.

23. The nucleus of a neutral iron atom contains 26 protons. How many electrons does a neutral iron atom contain?
Ans. 26 electrons.

24. How does the mass and charge of a proton compare with those of a neutron?
Ans. Their masses are almost identical. The proton has a $+1.6 \times 10^{-19}$ Coulomb charge while the neutron has no charge.

25. What is an isotope?
Ans. An isotope of an element has the same number of protons and other isotopes of that element, but has a different number of neutrons.

26. What does the atomic mass number tell you about the element?
Ans. The atomic mass number tells you the total number of protons and neutrons in the nucleus of the atom.

Chapter 11 Exercises pg. 224 continued

16. The atomic masses of two isotopes of cobalt are 59 and 60.
a) What is the number of protons and neutrons in each?
Ans. They both have the same number of protons. From the periodic table of the elements on page 215 we see that they will have 27 protons. They will have 32 and 33 neutrons respectively.
b) How many electrons will they each have when they are electrically neutral?
Ans. They will have 27 electrons when they are electrically neutral.

17. A particular atom contains 29 electrons, 34 neutrons and 29 protons. What is the atomic number of this element, and what is its name?
Ans. It is atomic number 29 and from the table of elements on page 215, we see that it is copper.

Chapter 33: The Atomic Nucleus and Radioactivity
Review questions pg. 658

5. How do the electric charges of alpha, beta and gamma rays differ?

Ans. The alpha 'ray' consists of alpha particles. Each alpha particle has a + 2 charge.
The beta 'ray' consists of electrons. Each electron has a -1 charge. A magnetic field will push the oppositely charged particles in opposite directions.
The gamma ray consists of photons of light. They are not charged at all.

6. How does the source differ for a beam of gamma rays and a beam of X rays.

Ans. Gamma rays come from the nuclei of some atoms. X rays come from the reconfiguration of electrons surrounding the nucleus of an atom. They may also be produced when an electron undergoes a large acceleration.

7. Give two examples of a nucleon.

Ans. Protons and neutrons are found in the nuclei of atoms and are therefor called nucleons.

11. Give the atomic number for deuterium and for tritium.

Ans. Deuterium and tritium are both isotopes of hydrogen. Deuterium has one proton and one neutron while tritium has one proton and two neutrons. The both have atomic number 1.

Extra: How does the mass of a nucleon compare with the mass of an electron.

Ans. One nucleon is approximately 1800 times more massive than an electron.

Extra: When beta emission occurs, what change takes place in an atomic nucleus?
Ans. Beta emission occurs when a neutron emits an electron. The neutron changes into a proton in the process. The atomic nucleus now has one more proton that before the emission and thus is now an atom of a different element.

13. Distinguish between an isotope and an ion.
Ans. An isotope of an element has a different number of neutrons than a different isotope of the same element. An ion is a charged atom. It is charged because it does not have the same number of protons as electrons.

18. What is meant by radioactive half-life?
Ans. Radioactive half-life is the <u>time</u> required for one half the remaining radioactive nuclei to undergo radioactive decay.

24. When thorium, atomic number 90, decays by emitting an alpha particle, what is the atomic number of the resulting nucleus. What happens to its atomic mass?
Ans. An alpha particle consists of two protons and two neutrons. When thorium undergoes alpha decay, the remaining nucleus will have 88 protons instead of 90. The new atom will be atomic number 88, which is radium-a different element than before. The alpha particle consists of two protons and two neutrons. Alpha decay reduces the atomic mass by four.

Ch. 33 Review questions continued. Pg. 658-659

25. When thorium decays by emitting a beta particle(an electron), what is the atomic number of the resulting nucleus? What happens to its atomic mass?
Ans. When a nucleus undergoes beta decay, one of its neutrons changes into a proton as it emits an electron. Therefore, the atomic number increases by one. The new atomic number will be 91. Although the fleeing electron carries a tiny bit of mass away with it, the atomic mass of the atom does not change.

26. How does the atomic mass change for questions 24 and 25?
Ans. I included this answer in the answers to # 24 and #25.
Chapter 33: The Atomic Nucleus and Radioactivity

27. What is the effect on the makeup of a nucleus when it emits an alpha particle? A beta particle? A gamma ray?
Ans. When the nucleus of an atom emits an alpha particle, it loses two protons and two neutrons. When the nucleus of an atom emits a beta particle a neutron changes to a proton. When the nucleus of an atom emits a gamma ray the nucleus reconfigures itself to a less energetic state.

35. Which isotope of carbon is radioactive? Carbon-12 or Carbon -14
Ans. Carbon-14 is a radioactive isotope of carbon.

37. Why is there more C-14 in new bones than there is in old bones of the same mass?
Ans. Carbon-14 changes to Nitrogen-14 with a half-life of 5,730 years. So the amount of Carbon-14 present in a substance is reduced over time

Chapter 33: The Atomic Nucleus and Radioactivity
Exercises pg. 659

1. X rays are most similar to which of the following: alpha, beta, or gamma?
Ans. X rays and gamma rays are most similar because they are both photons of light. The others are not.

3. Some people say that all things are possible. Is it at all possible for a hydrogen nucleus to emit an alpha particle? Explain your answer.
Ans. A hydrogen nucleus contains only one proton and zero, one or two neutrons. An alpha particle consists of two protons and two neutrons. Therefore a hydrogen atom cannot emit an alpha particle. It cannot emit what it doesn't have.

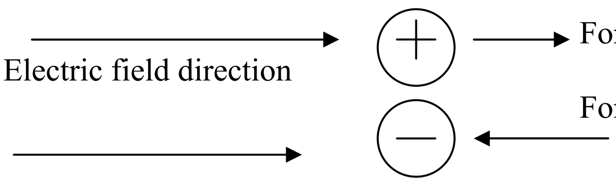
4. Why are alpha and beta rays deflected in opposite directions in a magnetic field? Why aren't gamma rays deflected?
Ans. Alpha rays consist of positively charged helium nuclei. Beta rays consist of negatively charged electrons. Gamma rays are uncharged photons of light. A magnetic field will apply a force to a moving charged particle. Positively charged particles are accelerated in one direction and negative charged particles are accelerated in the opposite direction. Because gamma rays are not charged, they are unaffected by the magnetic field.

5. The alpha particle has twice the electric charge of the beta particle but, for the same velocity, accelerates less than the beta in a magnetic field. Why?

Ans. From Newton's second law of motion we know that acceleration is directly proportional to the net force applied to an object and inversely proportional to the objects mass. Although the force applied to the alpha particle is twice that applied to the beta particle, the alpha particle is approximately 3600 times more massive than the beta.

6. How do the paths of alpha, beta and gamma radiation compare in an electric field?

Ans. The positively charged alpha particle will accelerate in the direction of the magnetic field, the negatively charged beta will accelerate in the opposite direction of the field and the gamma photon will not be effected by the electric field.



7. Which type of radiation results in the greatest change in atomic mass? Atomic number?

Ans. Alpha radiation. Alpha radiation. The resulting nucleus will be missing two protons and two neutrons. The atomic mass will be four less than the original and the atomic number will be two fewer than the original.

Chapter 33: The Atomic Nucleus and Radioactivity
Exercises pg. 659 continued

8. Which type of radiation results in the least change in atomic mass? The least change in atomic number?

Ans. Gamma radiation. There is no change in mass number or atomic number because a gamma ray is a photon of light.

10. In bombarding atomic nuclei with proton "bullets", why must the protons be accelerated to high energies if they are to make contact with the target nuclei?

Ans. Atomic nuclei are positively charged. The proton "bullets" are positively charged. They will be repelled away from each other by the electromagnetic force.

20. The amount of radiation from a point source is inversely proportional to the distance from the source. If a Geiger counter 1 meter from a small sample reads 360 counts per minute, what will be its counting rate 2 meters from the source? 3 meters from the source?

Ans. Doubling the distance will result in a count of $(1/2)^2$ = 1/4 the original count. 1/4 of 360 = 90 counts per minute. Tripling the distance will result in $(1/3)^2$ = 1/9 the original count. 1/9 of 360 = 40 counts per minute.

24. When ${}^{226}_{88}Ra$ decays by emitting an alpha particle, what is the atomic number of the resulting nucleus? What is the name of the element?
Ans. When the nucleus of an atom emits an alpha particle, it loses two protons and two neutrons. The remaining nucleus will be atomic number 86 and its mass number will be 222. The reaction can be written as follows:

$${}^{226}_{88}Ra \longrightarrow {}^{222}_{86}Ra + {}^{4}_{2}He$$

25. When ${}^{218}_{84}Po$ emits a beta particle, it transforms into a new element. A) What are the atomic number and atomic mass of this new element? B) What are atomic number and atomic mass if the polonium instead emits an alpha particle?
Ans. A) Beta emission occurs when a neutron emits an electron as it changes into a proton. When ${}^{218}_{84}Po$ emits a beta particle, its atomic number increases by one and its atomic mass remains unchanged. The resulting atom will be atomic number 85 and its atomic mass is 218. The reaction can be written as follows:

${}^{218}_{84}Po \longrightarrow {}^{218}_{85}At + {}^{0}_{-1}\beta$ where ${}^{0}_{-1}\beta$ represents the emitted electron.

B) When the nucleus of an atom emits an alpha particle, it loses two protons and two neutrons. If ${}^{218}_{84}Po$ emits an alpha particle its new atomic number will be 82 and its new atomic mass will be 214. The reaction can be written as follows:

$${}^{218}_{84}Po \longrightarrow {}^{214}_{82}Pb + {}^{4}_{2}He$$

Chapter 33: The Atomic Nucleus and Radioactivity
Exercises pg. 660 continued

26. State the number of protons and neutrons in each of the following nuclei:
${}^{2}_{1}H,\ {}^{12}_{6}C,\ {}^{56}_{26}Fe,\ {}^{197}_{79}Au,\ {}^{90}_{38}Sr,\ and\ {}^{238}_{92}U.$
Ans. Hydrogen 2 has 1 proton and 1 neutron.
Carbon 12 has 6 protons and 6 neutrons.
Iron 56 has 26 protons and 30 neutrons.
Gold 197 has 79 protons and 118 neutrons.
Strontium 90 has 38 protons and 52 neutrons.
Uranium 238 has 92 protons and 146 neutrons.

27. How is it possible for an element to decay forward in the periodic table-that is, to decay to an element of higher atomic number?

Ans. When the nucleus of an atom of an element undergoes beta decay, one of its neutrons changes to a proton as it emits an electron. This will increase the number of protons and therefor the atomic number, by one.

Prob.1 If a sample of a radioactive isotope has a half-life of 1 year, how much of the original sample will be left:
At the end of one year?
Ans. 1/2
At the end of two years?
Ans. 1/4
At the end of three years?
Ans. 1/8

Prob. 2 A sample of a particular radioisotope is placed near a Geiger counter, which is observed to register 160 counts per minute. Eight hours later the detector counts at a rate of 10 counts per minute. What is the half-life of the material?
Ans. The half-life is 2 hours. Here is my reasoning. If you cut 160 in half you will have 80. 1/2 of 80 = 40. 1/2 of 40 = 20. 1/2 of 20 = 10. We repeated this process 4 times. Four half-lives have elapsed. Eight hours divided by 4, equals 2 hours.

Some things to know by heart--Review for test 3--*Physics for Today*	<u>**Equation**</u>	<u>**Units**</u>
<u>**Coulomb's Law**</u>**-**The law that describes the electric force 'F' between two charged objects. It is the electric force that makes objects solid. The electric force is much stronger than gravity.	$F = k\frac{q_1 q_2}{d^2}$	Newtons
'k' is a constant.		
'**q**' represents charge. No one knows exactly what charge is.		
Charge comes in two types, positive and negative. Electrons are charged negatively and protons are charged positively. Objects become charged when the gain or lose electrons. Objects that have the same charge repel each other and objects that have a different charge, attract each other with a force that can be calculated using Coulomb's law.		Coulombs
'**d**' is the distance between the two charged objects. Notice that the electric force is inversely proportional to the square of the distance		

between the objects.

Ohm's Law- The law that describes the relationship $I = \frac{V}{R}$

between voltage **V**, resistance **R** and electrical current **I**.

The **current** **I** is a measure of the amount of charge that moves through a conductor per second. amps

The **voltage** **'V'** is a measure of the amount of energy available per unit charge. volts Joules/sec

The **resistance** **'R'** impedes the flow of electrons. ohms

Sound and light have wave properties.

The distance from one crest to the next is the **wavelength** (λ). meters, nanometers

The **frequency** (f) of a wave the number of waves per second that pass a fixed position. 1/sec or Hz

The **velocity** of a wave is constant in a given medium and always equals its frequency times its wavelength. **v = fλ** m/s

The **period** (T) of a wave is the time for one complete wave to pass a fixed position. seconds

There is an inverse relationship between the frequency of a wave and its period. **f = 1/T** 1/sec or Hz

The human ear can detect sound frequencies ranging from 20-20,000 Hz

Sound travels at about 340 m/s in air.

Light comes in bundles of energy called photons and travels at 3×10^8 m/s in air. The amount of energy in a photon depends on its frequency, **E = hf** joules or wavelength. **E = hc/λ** joules

Some things to know by heart--Review for test 3--*Physics for Today*

Refraction is the bending of a wave as is it moves from one medium to another.

Diffraction is the bending of a wave through an opening as the wave passes by the opening.

Radio waves, infrared, visible, ultraviolet, x-rays and gamma rays are the main forms of electromagnetic radiation that are called light. Only visible light with a wavelength range of 400 to 700 nanometers can be seen by the human eye.

Radiation: Alpha $({}^{4}_{2}He)$, Beta $({}^{0}_{-1}\beta)$, and gamma $({}^{0}_{0}\gamma)$ are three types of radiation.

Alpha occurs when 2 protons and 2 neutrons are ejected from the nucleus of an atom.

Beta occurs when a neutron changes into a proton while emitting an electron.

gamma occurs when a nucleus emits a photon of light as it rearranges itself into a less energetic state.

<u>Here is a 10 point sample question for test 3</u>: In the circuit drawn below, R_1 = 2 ohms, R_2= 3 ohms and R_3 = 1.8 ohms.

Find:

1) The series equivalent of the two parallel resistors.

$$\frac{1}{R}=\frac{1}{2}+\frac{1}{3}=\frac{3}{6}+\frac{2}{6}=\frac{5}{6}$$

$$R=\frac{6}{5}=1.2\,ohms$$

2) The total resistance in the circuit below.

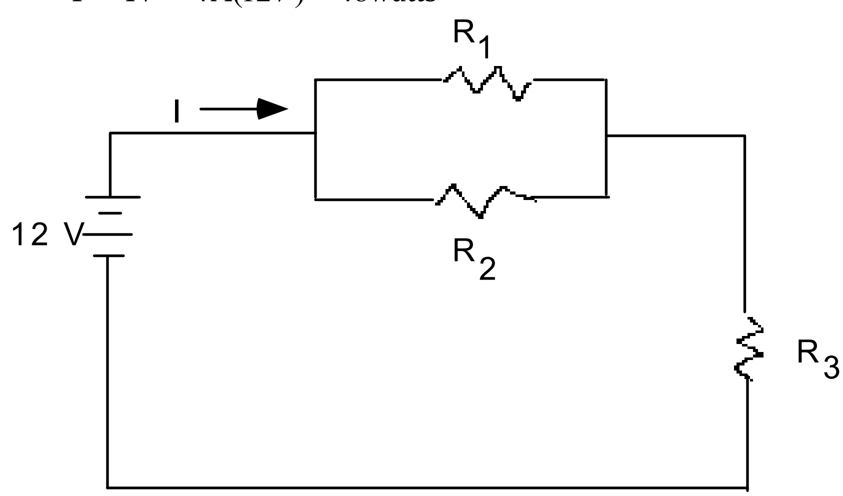
$$R_T=1.2\,ohms+1.8\,ohms=3\,ohms$$

3) The current 'I'.

$$I=\frac{V}{R}=\frac{12}{3}=4\,amps$$

4) The power required by the circuit is:

$$P=IV=4A(12V)=48\,watts$$



Study hard and good luck on the exam.