Physics – 6th Grade High School
Project 1 – August /September 2017
Teacher: Erick Domínguez

From everyday experience, we recognize that motion of an object represents a continuous change in the object's position. Is it possible to recognize the types of motion acting in a determine body?

1. Motion of bodies.

What will you achieve at the end of this purpose?

Synthesize, analyze, interpret, and evaluate qualitative and/or quantitative data; solve problems involving quantitative data; determine whether the evidence supports or refutes the initial prediction or hypothesis and whether it is consistent with scientific theory; identify sources of bias and/or error; and suggest improvements to the inquiry to reduce the likelihood of error.

Use appropriate numeric, symbolic, and graphic modes of representation for qualitative and quantitative data.

Analyze, in quantitative terms, the forces acting on an object, and use free-body diagrams to determine net force and acceleration of the object in one dimension.

Pool of Knowledge: 09/1/2017 **Due Date: 09/4/2017**

Activities:

1.1 Respond the following conceptual questions.

a. What´s classical mechanics? And what are the different types of motion? And define them using a diagram.

b. If the average velocity of an object is zero in some time interval, what can you say about the displacement of the object for that interval?

c. If a car is traveling eastward, can its acceleration be westward? Explain.

d. Two cars are moving in the same direction in parallel lanes along a highway. At some instant, the velocity of car A exceeds the velocity of car B. Does that mean that the acceleration of car A is greater than that of car B? Explain.

1.2 Draw a conceptual diagram with the following:

a. Motion and types of motion.

b. Applications of motion in technology.

1.3 Express the following numbers in scientific notation or standard:

a. 2.4×10^{10} m/s

b. 10.33×10^{9} m/s

c. 3.23×10^{-7} m/s

d. 0.00000000000000000148 s

e. 12,000,000,000,000 m

f. 25×10^{-14} m/s

g. 43.587759×10^{5} m/s

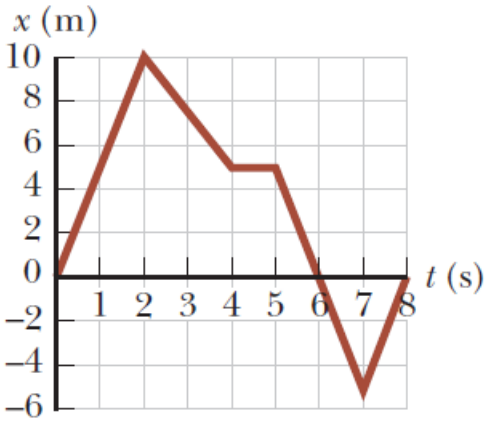
h. 25.000000000

i. 53.487×10^{-5} m/s

1.4 Solve the following exercises:

a. A car travels in the +x-direction on a straight and level road. For the first 4.00 s of its motion, the average velocity of the car is $v_{av\text{-}x} = 6.25$ m/s. How far does the car travel in 4.00 s?

b. The position versus time for a certain particle moving along the x axis is shown in Figure P2.1. Find the average velocity in the time intervals (a) 0 to 2 s, (b) 0 to 4 s, (c) 2 s to 4 s, (d) 4 s to 7 s, and (e) 0 to 8 s.



c. The speed of a nerve impulse in the human body is about 100 m/s. If you accidentally stub your toe in the dark, estimate the time it takes the nerve impulse to travel to your brain.
d. A person walks first at a constant speed of 5.00 m/s along a straight line from point A to point B and then back along the line from B to A at a constant speed of 3.00 m/s. (a) what is her average speed over the entire trip? (b) What is her average velocity over the entire trip?
e. The driver of a car slams on the brakes when he sees a tree blocking the road. The car slows uniformly with an acceleration of 25.60 m/s2 for 4.20 s, making straight skid marks 62.4 m long, all the way to the tree. With what speed does the car then strike the tree?
f. A baseball is hit so that it travels straight upward after being struck by the bat. A fan observes that it takes 3.00 s for the ball to reach its maximum height. Find (a) the ball's initial velocity and (b) the height it reaches.
g. *Why is the following situation impossible?* A freight train is lumbering along at a constant speed of 16.0 m/s. Behind the freight train on the same track is a passenger train traveling in the same direction at 40.0 m/s. When the front of the passenger train is 58.5 m from the back of the freight train, the engineer on the passenger train recognizes the danger and hits the brakes his train, causing the train to move with acceleration 23.00 m/s2. Because of the engineer's action, the trains do not collide.

2. Motion in two dimensions.

What will you achieve at the end of this purpose?

Synthesize, analyze, interpret, and evaluate qualitative and/or quantitative data; solve problems involving quantitative data; determine whether the evidence supports or refutes the initial prediction or hypothesis and whether it is consistent with scientific theory.

Describe the contributions of scientists to the fields under study.

Analyze, in quantitative terms, the forces acting on an object, and use free-body diagrams to determine net force and acceleration of the object in two dimensions.

Pool of Knowledge: **Due Date:**

Activities:

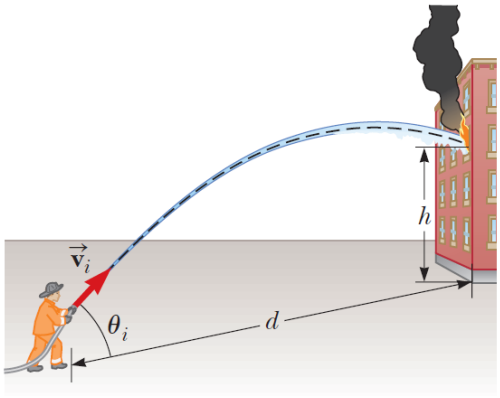
2.1 What contributions have made Newton's laws of motion to humanity?

2.2 Solve the following exercises:

a. A motorist drives south at 20.0 m/s for 3.00 min, then turns west and travels at 25.0 m/s for 2.00 min, and finally travels northwest at 30.0 m/s for 1.00 min. For this 6.00-min trip, find (a) the total vector displacement, (b) the average speed, and (c) the average velocity. Let the positive x axis point east.
b. A squirrel has x- and y-coordinates (1.1 m, 3.4 m) at time t1=0 and coordinates (5.3 m, -0.5 m) at time t= 3.0 s .For this time interval, find (a) the components of the average velocity, and (b) the magnitude and direction of the average velocity.
c. A jet plane is flying at a constant altitude. At time t1 = 0 it has components of velocity vx = 90 m/s, vy = 110 m/s. At time t2 = 30.0 s the components are vx = -170 m/s, vy = 40 m/s. (a) Sketch the velocity vectors at and How do these two vectors differ? For this time interval calculate (b) the components of the average acceleration, and (c) the magnitude and direction of the average acceleration.

Note: Ignore air resistance and take *g* = 9.80 m/s2 at the Earth's surface in exercise c

d. A firefighter, a distance d from a burning building, directs a stream of water from a fire hose at angle θi above the horizontal as shown in Figure P4.21. If the initial speed of the stream is vi, at what height h does the water strike the building?



e. Figure P4.40 represents the total acceleration of a particle moving clockwise in a circle of radius 2.50 m at a certain instant of time. For that instant, find (a) the radial acceleration of the particle, (b) the speed of the particle, and (c) its tangential acceleration.

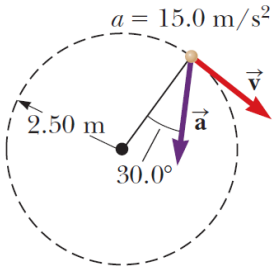


Figure P4.40

2.3 Answer the following questions:

a. A spacecraft drifts through space at a constant velocity. Suddenly, a gas leak in the side of the spacecraft gives it a constant acceleration in a direction perpendicular to the initial velocity. The orientation of the spacecraft does not change, so the acceleration remains perpendicular to the original direction of the velocity. What is the shape of the path followed by the spacecraft in this situation?
b. If you know the position vectors of a particle at two points along its path and also know the time interval during which it moved from one point to the other, can you determine the particle's instantaneous velocity? Its average velocity? Explain.
c. A projectile is launched at some angle to the horizontal with some initial speed vi, and air resistance is negligible. (a) Is the projectile a freely falling body? (b) What is its acceleration in the vertical direction? (c) What is its acceleration in the horizontal direction?
d. Explain whether or not the following particles have an acceleration: (a) a particle moving in a straight line with constant speed and (b) a particle moving around a curve with constant speed.

3. Forces and interactions.

What will you achieve at the end of this purpose?

Analyze, with reference to Newton's laws, a technology that applies these laws and propose ways to improve its performance.

Distinguish between, and provide examples of, different forces and describe the effect of each type of force on the velocity of an object.

Analyze and solve problems involving the relationship between the force of gravity and acceleration for objects in free fall.

Pool of Knowledge: **Due Date:**

Activities:

3.1 Search the definition:

a. Force and its components.

b. Inertia.

c. Mass.

d. Difference between mass and force.

3.2 Explain and make examples of each one of the Newton's laws of motion using a conceptual map.

3.3 With a diagram of your choice explain the similarities and differences between the 3 Newton's laws of motion.

3.4 Solve the following exercises:

a. Identify action–reaction pairs in the following situations: (a) a man takes a step (b) a snowball hits a girl in the back (c) a baseball player catches a ball (d) a gust of wind strikes a window.

b. As shown in Figure CQ5.22, student A, a 55-kg girl, sits on one chair with metal runners, at rest on a classroom floor. Student B, an 80-kg boy, sits on an identical chair. Both students keep their feet off the floor. A rope runs from student A's hands around a light pulley and then over her shoulder to the hands of a teacher standing on the floor behind her. The low-friction axle of the pulley is attached to a second rope held by student B. All ropes run parallel to the chair runners. (a) If student A pulls on her end of the rope, will her chair or will B's chair slide on the floor? Explain why. (b) If instead the teacher pulls on his rope end, which chair slides? Why this one? (c) If student B pulls on his rope, which chair slides? Why? (d) Now the teacher ties his end of the rope to student A's chair. Student A pulls on the end of the rope in her hands. Which chair slides and why?

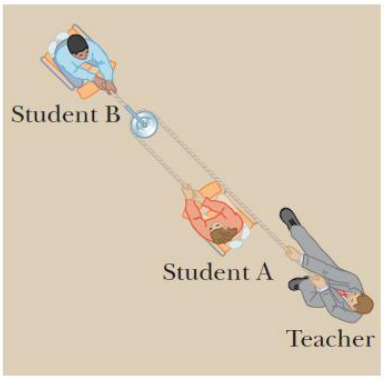


Figure CQ5.22

c. A 1 000-kg car is pulling a 300-kg trailer. Together, the car and trailer move forward with an acceleration of 2.15 m/s2. Ignore any force of air drag on the car and all friction forces on the trailer. Determine (a) the net force on the car, (b) the net force on the trailer, (c) the force exerted by the trailer on the car, and (d) the resultant force exerted by the car on the road.
d. A 3.00-kg object undergoes an acceleration given by $\vec{\mathbf{a}} = (2.00\hat{\mathbf{i}} + 5.00\hat{\mathbf{j}})\ \mathrm{m/s^2}$. Find (a) the resultant force acting on the object and (b) the magnitude of the resultant force.
e. (a) A car with a mass of 850 kg is moving to the right with a constant speed of 1.44 m/s. What is the total force on the car? (b) What is the total force on the car if it is moving to the left?
f. A rifle bullet with a mass of 12.0 g traveling toward the right at 260 m/s strikes a large bag of sand and penetrates it to a depth of 23.0 cm. Determine the magnitude and direction of the friction force (assumed constant) that acts on the bullet.

Closing Activity. September 22 2017.

Water Bottle Rocket project

With the previous knowledge acquired in class get in teams to construct your own **Water Bottle Rocket.**

The goal of the project is to obtain by a logical way the high that the rocket reach at his maximum point with this the Student will increase the understanding of physics involved in rockets and the Newton's Laws of Motion on this.

	Requirements	Total points
Construction of the project	• **Quality of design and materials, safety considered.** • **The rocket is propelled only with water and air pressure.**	**3 pts**
Flight Performance of the project	• **The rocket must fly at least 3 seconds.** • **The rocket is propelled only with water and air pressure.** • **Ability to re-launch rocket 3 times.**	**2 pts**
Data/Graphs/Tables	• **Student must collect data for 3+ variables.** • **3+ trials per variable tested with averages and recorded.**	**2 pts include 5 + measurements of your rocket.**
Written Report	• **Explain your reasons for your design.** • **Explain the physics found in your project.** • **Discuss any potential problem(s) and how you remedy this.**	**3 pts creative cover page, name of student, class period, course, date.** **Organization includes the requirements with drawings, labels, pictures, formulas and calculations.**