Unit 2.15 Handout 1 (7 total pages)

GROUP A (page 1 of 2) **Motion**

***Relative Motion**, Speed, Velocity and Acceleration*

Background for all groups:

Groups will present information about **relative motion**, speed, velocity, and acceleration. Take notes on the page provided about each area in order to gain a better understanding of each concept in physical science.

An object is in **motion** when it is continuously changing its position relative to a reference point and as observed by a person or detection device. For example, you can see that an automobile is moving with respect to the ground.

The distance the object goes in a period of time is its speed. If the speed of an object is in a specific direction, it is called velocity. The change in velocity over a period of time is the acceleration of the object.

Some questions you will need to answer at the end of the group presentations are:

- Why must motion be with respect to the observer?
- What is the difference between speed and velocity?
- Where is acceleration used?

This lesson will answer those questions.

Motion

All motion is relative to the observer or to some fixed object. Motion can be described as a measure of the distance an object moves in a certain length of time.

Example with bus and car

For example, when you see a bus drive by, it is moving with respect to you. However, if you are in a car that is moving in the same direction, the bus will be moving at a different velocity with respect to you.

If your car is moving in the same direction and same speed as the bus, the bus will appear to not move with respect to you. Of course, if you compare the speed with the ground, both of you will be moving at some velocity.

GROUP A (page 2 of 2) **Motion**

Suppose you saw a person walking to the front of the moving bus. The person would be moving faster than the bus from your viewpoint. However, the person would not notice the speed of the bus while he walks to the front.

Point of reference

In talking about motion, it is important to indicate your point of reference. In the case of moving automobiles, it is usually assumed the speed is with respect to the ground. But there are situations where the speed or velocity may be with respect to another object or an observer.

For example, suppose a car was traveling at 60 miles per hour (mph) and hit another car, but there was hardly a dent. The reason could be that the second car was traveling in the same direction at 59 mph, so the car was going only 1 mph with respect to the second car when it hit it.

Sun looks like it is moving in the sky

Another example of relative motion is how the sun appears to move across the sky, when the earth is actually spinning and causing that apparent motion.

Usually, we consider motion with respect to the ground or the Earth. Within the Universe there is no real fixed point. The basis for Einstein's *Theory of Relativity* is that all motion is relative to what you define as a fixed point.

Notes: _____

GROUP B (page 1 of 2) **Speed and Velocity**

Relative Motion, ***Speed, Velocity*** *and Acceleration*

Background for all groups:

Groups will present information about relative motion, **speed, velocity**, and acceleration. Take notes on the page provided about each area in order to gain a better understanding of each concept in physical science.

An object is in motion when it is continuously changing its position relative to a reference point and as observed by a person or detection device. For example, you can see that an automobile is moving with respect to the ground.

The distance the object goes in a period of time is its **speed.** If the speed of an object is in a specific direction, it is called **velocity.** The change in velocity over a period of time is the acceleration of the object.

Some questions you will need to answer at the end of the group presentations are:

- Why must motion be with respect to the observer?
- What is the difference between **speed and velocity**?
- Where is acceleration used?

This lesson will answer those questions.

Speed and Velocity

Speed is how fast an object is going with respect to an object. **Velocity** is a measure of the speed *in a given direction*. An object's velocity can be constant or changing. An object might move without changing its speed or its direction. That object's velocity is constant. Velocity changes when an object changes speed, or direction, or both. You can say the top speed of an airplane is 300 kilometers per hour (kph). But its velocity is 300 kph in a northeast direction.

We distinguish between speed and velocity because if you add the speeds of objects, their directions are important. For example, the velocity of an airplane with respect to the ground would vary according to the direction of the wind.

GROUP B (page 2 of 2) **Speed and Velocity**

Measurement

To measure speed you use units of length and time. These are measure such as kilometers per hour (km/h) or miles per hour (mi/h). The speed of a moving object may changes. Think of a jogger out on a morning run. The jogger's speed changes during his run. He runs faster on a level or flat path than he does when he runs uphill. He runs fastest downhill. When he stops, time continues to pass, but he is not moving. His speed is zero.

Average speed is the total distance traveled dived by the total time it takes to go that distance. You can use a formula to figure average speed. You probably have used the formula in the past. For GED Science 2014 purposes, the formula to remember is:

Speed = distance ÷ time

For example, if a car went 120 miles in 2 hours, its average speed would be the distance of 120 miles divided by the time of 2 hours equaling 60 miles per hour (mph): 60 = 120 ÷ 2

You can use a variation of the formula to calculate time. (time = distance ÷ speed) If you travel from Milwaukee to Chicago (90 miles) at an average velocity of 60 mph, it would take you 90 mi. ÷ 60 mph = 1.5 hours to travel the distance.

A different way to use the formula is to calculate the distance, distance = time x speed. If you travel from Minneapolis to Chicago at 65 mph for 7 hours, you can calculate the distance traveled.
65 x 7 = 455

Notes: _____

Speed, Time, and Distance Worksheet – Side A

1 a. Mike rides his motorcycle with a constant speed of 60 miles per hour. How far can he travel in 4 hours 45 minutes?	**1 b.** An airplane flies with a constant speed of 960 km/h. How long will it take to travel a distance of 1200 kilometers?
2 a. Julia rides her bike with a constant speed of 12 km/h. How far can she travel in 1 hour?	**2 b.** An airplane flies 390 miles in 3/4 hour. What is its average speed in miles per hour?
3 a. Mike roller skates with a constant speed of 20 km/h. How far can he travel in 1 hour 15 minutes?	**3 b.** Juan roller skates with a constant speed of 20 km/h. How long will he take to travel a distance of 30 kilometers?

Speed, Time, and Distance Worksheet – Side B

1 a. Caleb's airplane trip took 1 hour 12 minutes. For one-half of that time, the airplane flew at a speed of 960 km/h, and for the rest of the time, it flew at a speed of 800 km/h. What distance did Caleb travel?	**1 b.** Grace travels in an airplane a distance of 1980 miles. For one-third of the distance, the airplane flies at a speed of 640 miles per hour, and for the rest of the distance, it flies at a speed of 800 miles per hour. How long does the trip take?	**1 c.** Mary travels in an airplane a distance of 3540 miles. For one-half of the distance, the airplane flies at a speed of 600 miles per hour, and for the rest of the distance, it flies at a speed of 620 miles per hour. How long does the trip take?
2 a. Caleb travels in an airplane a distance of 1620 km. For one-fourth of the distance, the airplane flies at a speed of 600 km/h, and for the rest of the distance, it flies at a speed of 800 km/h. How long does the trip take?	**2 b.** An airplane flies for 3 hours with a constant speed of 740 mph and then for another 30 minutes with a constant speed of 600 mph. What is its average speed for the total trip?	**2 c.** A police car drives for 2 hours with a constant speed of 48 km/h and then for another 2 hours with a constant speed of 72 km/h. What is its average speed for the total trip?
3 a. An airplane flies for 1 hour with a constant speed of 600 km/h and then for another 2 hours 30 minutes with a constant speed of 960 km/h. What is its average speed for the total trip?	**3 b.** Juan's airplane trip took 3 hours 24 minutes. For one-third of that time, the airplane flew at a speed of 732 miles per hour, and for the rest of the time, it flew at a speed of 708 miles per hour. What distance did Juan travel?	**3 c.** Grace's airplane trip took 3 hours 24 minutes. For one-half of that time, the airplane flew at a speed of 720 miles per hour, and for the rest of the time, it flew at a speed of 620 miles per hour. What distance did Grace travel?

$S = \frac{d}{t}$

Speed Distance Time Answer Key – Side A

1 a.	He can travel 285 miles in 4 hours 45 minutes.	**1 b.**	It takes 1 hour 15 minutes or 1 1/4 hours to travel a distance of 1200 kilometers.
2 a.	She can travel 12 kilometers in 1 hour.	**2 b.**	Its average speed is 520 miles per hour.
3 a.	He can travel 25 kilometers in 1 hour 15 minutes.	**3 b.**	He takes 1 hours 30 minutes or 1 1/2 hours to travel a distance of 30 kilometers.

Speed Distance Time Answer Key – Side B

Answer Key

1 a.	Caleb traveled 1056 km.	**1 b.**	The trip takes 2 hours and 40 minutes or 2.7 hours.	**1 c.**	The trip takes 5 hours and 48 minutes or 5.8 hours.
2 a.	The trip takes 2 hours and 11 minutes or 2.2 hours.	**2 b.**	Its average speed is 720 mph.	**2 c.**	Its average speed is 60 km/h.
3 a.	Its average speed is 857.1 km/h.	**3 b.**	Juan traveled 2434.4 miles.	**3 c.**	Grace traveled 2278 miles.