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SCIENCE 20

Unit B: Changes in Motion
Student Guide

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Unit B: Changes in Motion
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Unit B Changes in Motion

When you experience uniform motion, such as when you're on a bus or on a train, you may have very little sense of motion, even if you're going fast. Changes in motion occur as you ride a roller coaster, slalom down a ski slope, or snowboard down a mountain. The exhilaration you feel in these situations comes from changes in motion—rather than motion itself. Any changes in motion are due to the effects of forces.

❑ Read the Unit B introduction on pages 164 and 165 of the textbook.

Chapter 1: Describing Motion

Imagine a get-together with some friends. To meet at a common location, you and your friends will have to figure out how to get there. Whether you inline skate, ride a bicycle, take a bus, drive a car, or use some other mode of transportation, you will undergo motion. Motion is an important aspect of daily life for everyone.

❑ Turn to page 166 of the textbook, and read the chapter introduction.

Your reaction time is an important factor in how safely you drive a car. In the next activity, you will investigate reaction time.

Try This Activity: Reaction Time

❑ **Read the activity on page 167 of the textbook. Follow the directions, and answer the questions.**

Note: You may ask a friend or family member to be your partner. You may also substitute a 30-cm ruler for a metre-stick.

Check your answers with those in the "Suggested Answers" in the online course.

Lesson 1.1: Average Speed

When you take a trip in a vehicle and look at the speedometer, you can see your instantaneous speed for any moment of the trip. In contrast, the average speed of your trip is a description of the speed that relates to the entire trip. You can expect that the average speed of someone cycling, riding an oxcart, or travelling on foot will be very different.

❑ Read pages 168 to 172 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read “1.1 Summary” on page 173 of the textbook. Then, complete “1.1 Questions”.

Check your answers with those in the “Practice Answers” in the online course.

Assignment

❑ Go to Assignment 1.1: Average Speed.

Lesson 1.2: Identifying and Solving Problems with New Technologies

Although automobiles have been in general use in Canada for decades, many recently developed technologies have made significant improvements to automobiles. Think of air bags, anti-lock brakes, high-intensity discharge (HID) headlights, and GPS navigation systems. However, developing new technologies to solve one problem may introduce new problems.

❑ Read pages 174 to 176 of the textbook, ending at the “High-Intensity Discharge (HID) Headlights” activity. Answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

Have you noticed that some automobiles in oncoming traffic have particularly bright headlights that emit a somewhat bluish tint? These headlights are likely high-intensity discharge (HID) headlights. Not only are HID headlights brighter than the more conventional automobile headlights, but they are also more efficient. The improved visibility they provide drivers is impressive. But are there risks associated with this new technology? Find out in the next activity.

Utilizing Technology: High-Intensity Discharge (HID) Headlights

❑ **Read the activity on pages 176 and 177 of the textbook. Follow the directions, and answer the questions.**

Note: If you do not have classmates to share your findings with, ask a friend or family member to help you do question 5 of “Evaluation”.

Check your answers with those in the “Suggested Answers” in the online course.

❑ Read “1.2 Summary” on page 177 of the textbook. Then, complete “1.2 Questions” on pages 177 and 178.

Check your answers with those in the “Practice Answers” in the online course.

Assignment

- ❑ Go to Assignment 1.2: Identifying and Solving Problems with New Technologies.

Lesson 1.3: Average Velocity

Imagine you are a pilot flying from Westlock to a fly-in breakfast in Lacombe. To know that you are going to get to your destination at a certain time, you need to keep track of both speed and direction of the airplane's motion. You might be travelling fast enough to get there on time; but if you are going in the wrong direction, you will still miss out on the breakfast in Lacombe.

The average velocity of an object in motion is an indication of not only how fast the object changes position, but the direction of this change. A pilot must always be aware of the airplane's average velocity.

- ❑ Read pages 179 to 181 of the textbook, stopping at "Average Velocity". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

Speed is a scalar quantity. Average velocity is a vector quantity.

- ❑ Starting at "Average Velocity," read pages 181 to 184 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

- ❑ Read "1.3 Summary" on page 185 of the textbook. Then, complete "1.3 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

- ❑ Go to Assignment 1.3: Average Velocity.

Lesson 1.4: Graphical Description of Uniform Motion

Imagine drinking a soft drink while riding in a vehicle that is moving along a straight, level road. The driver is keeping the speedometer at a constant speed—the vehicle is moving with uniform motion. With this kind of motion, you can hold a beverage so that the surface of the liquid remains level and appears motionless. If you are not travelling with uniform motion, watch out! You are more likely to spill your drink. A sudden stop—such as during a motor vehicle collision—will not only cause you to spill your drink, but may leave you with an injury.

❑ Read pages 186 and 187 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

In the next investigation you will graph the motion of a toy bulldozer moving with uniform motion

Investigation: Graphical Descriptions of Uniform Motion

❑ **Read the investigation on pages 188 and 189 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

❑ Starting at "A Graph Tells a Story" on page 189 of the textbook, read up to the activity "Writing a Script to Describe Motion" on page 190.

Software that can graph for you may ease the analysis and interpretation of motion. You will use graphing software in the next activity.

Utilizing Technology: Writing a Script to Describe Motion

❑ **Read the activity on pages 190 and 191 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

❑ Answer Practice questions 21 and 22 on page 191 of the textbook.

Check your answers with those in the "Practice Answers" in the online course.

- ❑ Read "1.4 Summary" on page 192 of the textbook. Then, complete "1.4 Questions" on pages 192 and 193.

Check your answers with those in the "Practice Answers" in the online course.

Assignment

- ❑ Go to Assignment 1.4: Graphical Description of Uniform Motion.

Lesson 1.5: Graphical Description of Accelerated Motion

When taking a short trip in a vehicle, you will see the speedometer change as you travel. This indicates that you are not travelling with uniform motion. The vehicle's motion is non-uniform and involves accelerated motion.

- ❑ Read pages 194 and 195 of the textbook, ending at "A Graphical Description of Accelerated Motion". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

- ❑ Read "A Graphical Description of Accelerated Motion" at the bottom of page 195 of the textbook.

Investigation: Accelerated Motion—Speeding Up

- ❑ Read the entire investigation on pages 196 and 197 of the textbook.

If you have access to a supervised laboratory and a partner to help you, do Path 1. If you do not have access to these resources, do Path 2.

Path 1

- ❑ Follow the directions in the investigation. Ideally, use a long table or board (at least 1.5 m long) with one end raised approximately 4 to 8 cm.

- ❑ Answer questions 1 to 7 on page 197.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

For this path you will watch two students carry out this investigation.

- ❑ Make predictions to the questions posed in the purpose.

❑ View the segment “Accelerated Motion—Part A Speeding Up, Part B Slowing Down” in the “Multimedia Segments” in the online course. You only need to watch Part A of this segment.

❑ Use the sample data for this investigation in the “Suggested Answers” in the online course to answer questions 1 to 7 on page 197.

Check your answers with those in the “Suggested Answers” in the online course.

❑ Read pages 198 to 200 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

❑ Read “Another Way to Think About Acceleration” at the top of page 201 of the textbook.

Investigation: Accelerated Motion—Slowing Down

❑ Read the entire investigation on page 201 of the textbook.

If you have access to a supervised laboratory and a partner to help you, do Path 1. If you do not have access to these resources, do Path 2.

Path 1

❑ Follow the directions in the investigation, answer the questions.

Check your answers with those in the “Suggested Answers” in the online course.

Path 2

For this path you will watch two students carry out this investigation.

❑ Make predictions to the questions posed in the purpose.

❑ Answer question 1 of “Design” on page 201. You may do this by yourself.

❑ View the segment “Accelerated Motion—Part A Speeding Up, Part B Slowing Down” in the “Multimedia Segments” in the online course. You only need to watch Part B of this segment.

❑ Use the sample data for this investigation in the “Suggested Answers” in the online course to answer questions 3 to 9 on page 201.

Check your answers with those in the “Suggested Answers” in the online course.

In the preceding investigation, the cart was slowing down; yet it was accelerating. You may have thought that an accelerating object is one that is speeding up. But that is not necessarily true. From a scientific point of view, a vehicle is actually accelerating when its driver steps on the brake pedal to slow down. During braking, the acceleration vector points in the opposite direction of the velocity vector. That is, the car is undergoing negative acceleration.

When talking about everyday situations, people generally think about only **positive** acceleration when using the word *acceleration*. This conversational practice can stand in the way of a full scientific understanding of acceleration as **any** change in velocity.

Note that an object slowing down—such as a car coming to a stop—may be said to be *decelerating*.

❑ Read page 202 of the textbook, and answer Practice questions 26 to 29 on page 203.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "1.5 Summary" on pages 203 and 204 of the textbook. Then, complete "1.5 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 1.5: Graphical Description of Accelerated Motion.

Lesson 1.6: Calculating Displacement During Accelerated Motion

A vehicle must pick up speed in the acceleration lane before merging into highway traffic. When designing an acceleration lane, you have to decide how long to make it. This decision requires you to calculate how far a vehicle will travel while catching up to the speed of highway traffic.

For an object moving with uniform motion, you can simply determine its displacement by using the formula $\Delta\vec{d} = \vec{v}\Delta t$. For an object moving with accelerated motion, the velocity is changing. Without an obvious velocity value to substitute into the formula, how can you calculate displacement? In this lesson you will discover a method for determining the displacement of an object while it is accelerating. You will apply this to the design of acceleration lanes.

❑ Read pages 205 to 208 of the textbook, stopping at "Acceleration Due to Gravity". Answer the questions as you encounter them.

Note: The acceleration of an automobile is assumed to be constant. Because of this assumption, the associated velocity–time graph is a straight line.

Check your answers with those in the "Practice Answers" in the online course.

When merging into traffic from an acceleration lane, a vehicle might accelerate at a rate as high as 3.0 m/s^2. In contrast, the magnitude of the acceleration of a falling object—say a pen off the edge of a desk—is a constant 9.81 m/s^2. This acceleration downward is due to gravity.

❑ Read from “Acceleration Due to Gravity” on page 208 of the textbook to “1.6 Summary” on page 212. Answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

❑ Read “1.6 Summary” on page 212 of the textbook. Then, complete “1.6 Questions” on pages 212 and 213.

Check your answers with those in the “Practice Answers” in the online course.

Assignment

❑ Go to Assignment 1.6: Calculating Displacement During Accelerated Motion.

Lesson 1.7: Determining Stopping Distance

The ocean liner *Titanic* required a distance of over 700 m to come to a stop from a cruising speed of about 33 km/h. Compared to this ship, a motor vehicle is nimble—even when it’s going much faster, a motor vehicle can be stopped in a fraction of the distance needed by the ocean liner. Nevertheless, determining a motor vehicle’s stopping distance is critical for safe driving.

❑ Read pages 214 to 216 of the textbook, ending at “Controlling Traffic at Intersections”. Answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

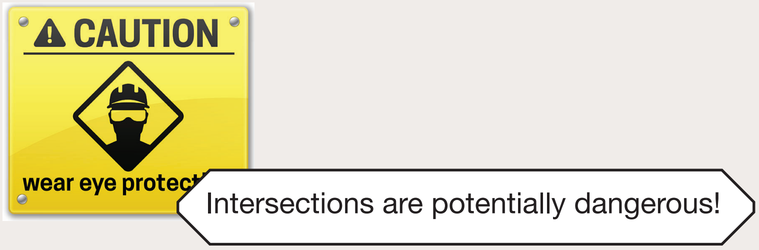
Traffic safety engineers must take into account the stopping distances needed by vehicles.

❑ Starting at “Controlling Traffic at Intersections,” read pages 216 to 218 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the “Practice Answers” in the online course.

Sometimes a traffic light seems to take forever to change, especially if you are waiting for it to turn green. However, the lights are timed by traffic safety engineers for the most favourable and safe traffic flow. The yellow light, which indicates that the red light is about to come on, has to be on just long enough so drivers can safely avoid being in the intersection when the red light comes on. The next investigation is about the functioning of yellow lights at actual intersections. This investigation is limited to questioning and proposing a design for the investigation. These skills are fundamental to the application of science to new situations.

Investigation: Traffic Lights—Designing a Field Study



Do not actually go to an intersection to collect the data for this investigation. The only exception would be if your teacher agrees to accompany you and goes over the safety precautions that must be followed.

- ❑ **Read the investigation on pages 219 of the textbook. Follow the steps to design a procedure for a field study.**

Check your answers with those in the "Suggested Answers" in the online course.

- ❑ Read "1.7 Summary" on page 220 of the textbook. Then, complete "1.7 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

- ❑ Go to Assignment 1.7: Determining Stopping Distance.

Lesson 1.8: A Closer Look at Braking

Having the ability to bring a vehicle to a stop within a certain distance can prevent a motor vehicle collision. Stopping distance is the sum of the reaction distance and the braking distance. A closer look indicates that braking distance depends on the magnitude of the horizontal force between the tires and the road. During normal braking, the magnitude of this horizontal force increases. However, slippery road conditions can prevent the buildup of this force and can make braking distances dangerously long.

- ❑ Read pages 221 and 222 and the first paragraph on page 223. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

In the next activity, you will use an applet to study factors affecting the change in velocity of a moving vehicle. If possible, work with someone who can help you record the data.

Utilizing Technology: Factors Influencing the Rate of Deceleration

Note: In this activity, the direction of the force is indicated by a sign convention where the positive direction is the direction of the vehicle's initial velocity. The negative direction is opposite the direction of the initial velocity.

❑ Read the activity on pages 223 and 224 of the textbook. Follow the directions, and answer the questions.

Check your answers with those in the "Suggested Answers" in the online course.

❑ Read pages 225 and 226 of the textbook, ending at "1.8 Summary". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "1.8 Summary" on page 226 of the textbook. Then, complete "1.8 Questions" on page 227.

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 1.8: A Closer Look at Braking.

Lesson 1.9: Newton's First Law of Motion

When the driver of a vehicle applies the brakes, a net force is applied to the vehicle. This is the force that opposes the vehicle's forward motion. According to Newton's second law of motion, the automobile undergoes a negative acceleration. However, what happens when the net force on a moving vehicle is in the direction of the vehicle's forward motion? What happens when the net force is equal to zero? These are questions you will explore in this lesson. You will gain more insight into the concept of net force and Newton's first law of motion.

❑ Read page 228 of the textbook and "Newton's Second Law Applied to Speeding Up" at the top of page 229. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

After working with the applet “Newton’s Second Law,” you discovered factors that affect the rate at which a vehicle slows down. In the next activity you will use the same applet to study factors that affect acceleration in the positive direction. As in the previous activity in Lesson 1.8, sign convention will be used in the next activity. The positive direction will represent the direction of the vehicle’s initial velocity.

Utilizing Technology: Factors Influencing the Rate of Acceleration

Having someone record the data in this activity will be helpful.

- ❑ **Read the activity on pages 229 and 230 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the “Suggested Answers” in the online course.

- ❑ Read page 231 of the textbook and the paragraph at the top of page 232.

Newton’s first law of motion explains why a curling rock continues to slide down the ice after it is thrown. The law also explains why a satellite remains in its orbit without the application of an external force to maintain its speed. But this law also has a downside, which is shown during a vehicle collision. Fortunately, vehicles have safety features that protect passengers from the aftermath of the first law. The next two activities show how the first law applies to vehicle safety.

Utilizing Technology: Whiplash

- ❑ **Read the activity on page 232 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the “Suggested Answers” in the online course.

Rear-end collisions can cause serious injuries. The same is true for front-end collisions.

Utilizing Technology: Forward Crash

- ❑ **Read the activity on page 232 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the “Suggested Answers” in the online course.

- ❑ Read page 233 of the textbook, and answer Practice questions 47 to 49.

Check your answers with those in the "Practice Answers" in the online course.

- ❑ Read "1.9 Summary" on page 234 of the textbook. Then, complete "1.9 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

- ❑ Go to Assignment 1.9: Newton's First Law of Motion.

Chapter 1 Summary

- ❑ Read "Chapter 1 Summary" on page 235 of the textbook. Remember to use one of the given options to make your own summary of the key concepts and important chapter terms.

- ❑ Turn to "Chapter 1 Review Questions" on pages 235 to 239 of the textbook. Do questions 2, 4, 6, 8, 10, 12, 14, 16, 18, and 20. Then, do as many of the remaining questions as you feel are necessary to understand the concepts covered in this chapter.

Check your answers with those in the "Suggested Answers" in the online course.

Chapter 2: Collisions

A goaltender in hockey needs to wear protective gear against speeding pucks. Some hockey players are able to shoot a puck at speeds of over 150 km/h! When designing such protective gear, like masks, the designer must have a good understanding of the forces associated with the motion of objects—especially colliding objects.

- ❑ Turn to page 240 of the textbook, and read the chapter introduction.

To slow down gradually, a driver may simply take his or her foot off the gas pedal before applying the brakes. As the vehicle "coasts," it slows down. Many objects slow down after being set in motion. For example, a sliding hockey puck or a rolling marble eventually comes to a stop.

Significant characteristics of objects in motion can be learned by investigating marbles in motion.

Try This Activity: Characteristics of an Object in Motion

- ❑ **Read the entire activity on page 241 of the textbook.**

Your teacher may be able to provide you with the U-shaped channel shown in the diagram on page 241. If you can obtain the U-shaped channel, do Path 1. If the channel is unavailable, do Path 2.

Path 1

- ❑ **Follow the directions in the activity, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

- ❑ **Use the sample data for this activity in the "Suggested Answers" in the online course to answer questions 1 to 5 on page 241.**

Check your answers with those in the "Suggested Answers" in the online course.

Lesson 2.1: Momentum

A hockey goalie wears equipment—such as leg pads and a face mask—as protection from pucks that may reach speeds of more than 150 km/h! A tennis ball can also travel at this speed. So, why don't tennis players need to wear the same rugged protection? Thinking in terms of momentum makes this question and many other questions relating to objects in motion easier to answer.

- ❑ Read pages 242 to 244 of the textbook. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

- ❑ Read "2.1 Summary" on page 245 of the textbook. Then, complete "2.1 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

- ❑ Go to Assignment 2.1: Momentum.

Lesson 2.2: Change in Momentum

A swinging hammer hitting a nail, drops of rain landing on an umbrella, and an owl pouncing on its prey in flight all involve a collision and a change in momentum. Whenever there is a change in momentum, there is a force exerted between the interacting bodies. This force can be very high.

Several factors determine the magnitude of the force associated with a change in momentum. In this lesson and in Lesson 2.3, you will examine these factors and pay special attention to the time interval over which the change in momentum occurs.

❑ Read pages 246 and 247 of the textbook, ending at "Factors Affecting the Change in Momentum of an Object". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

Changes in momentum are most striking during a collision. However, changes in momentum can be gradual and don't need to involve collisions at all.

❑ Read "Factors Affecting the Change in Momentum of an Object" on page 247 of the textbook.

Investigation: Changes in Momentum

❑ **Read the entire investigation on pages 248 and 249 of the textbook.**

If you have access to a U-shaped channel like the one shown in the diagram on page 248, do Path 1. If you do not have access to the channel, do Path 2.

Path 1

❑ **Follow the directions in the investigation, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

❑ **Use the sample data for this investigation in the "Suggested Answers" in the online course to complete step 6 of the procedure on page 248 and to answer question 2 to 6 on page 249.**

Check your answers with those in the "Suggested Answers" in the online course.

❑ Read pages 249 and 250 of the textbook, starting at "Calculating the Change in Momentum". Then, answer Practice questions 7 and 8 on page 251.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "2.2 Summary" on page 251 of the textbook. Then, complete "2.2 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 2.2: Change in Momentum.

Lesson 2.3: Impulse

In Lesson 2.2, you discovered what determines the magnitude of the force when there is a change in momentum. You found that the time interval over which the change in momentum occurs is critical to the magnitude of the force involved.

In this lesson you will see that the change in momentum of an object is equal to a special quantity called impulse. This quantity is equal to the product of the force acting on an object and the time interval over which the force acts on the body.

❑ Read pages 252 to 255 of the textbook, ending at the activity "The Evolution of Safety Technologies" on page 255. Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

A modern vehicle has seat belts, air bags, and numerous other safety features. Vehicles were not always built with these safety features. In the next activity you will look into the advances in vehicle safety.

Utilizing Technology: The Evolution of Safety Technologies

❑ **Read the activity on page 255 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

❑ Read "2.3 Summary" on page 256 of the textbook. Then, complete "2.3 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 2.3: Impulse.

Lesson 2.4: A Closer Look at Forces and Newton's Third Law

Suppose a vehicle hits a concrete barrier (or another immovable object) and comes to a sudden stop. If you are a passenger, you will tend to keep moving forward according to Newton's first law of motion. Without safety restraints, your body will then collide with a part of the vehicle, which will by then be stationary. By taking a closer look at the forces on both your body and the vehicle part, you gain a better understanding of why you could sustain injuries. As some may know, being a passenger in a vehicle that is involved in a collision is a terrifying experience.

You have examined the dynamics of objects interacting mainly from the perspective of one of the involved objects. In this lesson you will widen your perspective to include the experience of the other object involved. You will take a closer look at the forces on both objects and the relationship between these forces as expressed in Newton's third law of motion.

❑ Read pages 257 to 259 of the textbook. Answer the questions as you encounter them.

In the next activity, you will explore the forces and the changes in momentum of objects during an interaction.

Utilizing Technology: Newton's Laws and the Interaction of Objects

❑ **Read the activity on pages 260 and 261 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

❑ Read "2.4 Summary" on page 262 of the textbook. Then, complete "2.4 Questions" on pages 262 and 263.

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 2.4: A Closer Look at Forces and Newton's Third Law.

Lesson 2.5: Conservation of Momentum

For collisions between vehicles, an investigator may collect data from police photographs of the collision, assess the damage to the vehicles, and measure the distance each vehicle moved after the collision. By analyzing this information, the investigator may determine the motion of each vehicle prior to the collision. Vital to the data analysis is an understanding of the relationship between the total momentum both before and the total momentum after a collision.

❑ Read page 264 of the textbook and the first paragraph on page 265.

In the next activity, you will examine the total momentum before and after collisions by watching a series of applets called "Momentum and Collisions".

Utilizing Technology: Momentum and Collisions

❑ **Read the activity on pages 265 to 267 of the textbook. Follow the directions, and answer the questions.**

Check your answers with those in the "Suggested Answers" in the online course.

❑ Read pages 268 to 271 of the textbook, ending at "2.5 Summary". Answer the questions as you encounter them.

Check your answers with those in the "Practice Answers" in the online course.

❑ Read "2.5 Summary" on page 271 of the textbook. Then, complete"2.5 Questions".

Check your answers with those in the "Practice Answers" in the online course.

Assignment

❑ Go to Assignment 2.5: Conservation of Momentum.

Lesson 2.6: Designing a Helmet

Firefighters, cyclists, football players, and construction workers have something in common—they are all exposed to hazards that could lead to head injuries and, thus, wear helmets or hard hats for protection. To ensure that helmets and hard hats will provide the necessary protection, their designs must be tested. In this lesson you will apply your knowledge of changes in motion to develop test procedures for a helmet.

- ❑ Read pages 272 to 274 of the textbook. Answer the questions as you encounter them.
- ❑ Carefully work through Example Problem 2.13 on pages 275 and 276 of the textbook. Then, answer Practice questions 23 and 24 on page 277.

Check your answers with those in the "Practice Answers" in the online course.

In the next investigation, you will have an opportunity to design and test a helmet.

Investigation: Designing and Testing a Helmet

- ❑ **Read the entire investigation on pages 277 to 279 of the textbook.**

If you have access to a supervised laboratory and a partner to help you, do Path 1. If you do not have access to these resources, do Path 2.

Path 1

- ❑ **Follow the directions in the investigation, and answer the questions.**

  Note: Do questions 7 and 8 of "Evaluation" on page 279 only if you know of another group that has completed this investigation.

Check your answers with those in the "Suggested Answers" in the online course.

Path 2

- ❑ **Use the sample data for this investigation in the "Suggested Answers" in the online course to answer questions 2 to 6 on page 279.**

Check your answers with those in the "Suggested Answers" in the online course.

- ❑ Read "Protecting Your Head" on page 280 of the textbook.

In the next activity, you will do some research to support the following statement:

The use of bicycle helmets results in a significant reduction in head injuries among cyclists.

Utilizing Technology: Collecting Evidence—Bicycle Helmets and Injury Reduction

- ❑ **Read the activity on page 280 of the textbook. Follow the directions, and answer the questions.**

  Note: If you worked on this activity by yourself, share your findings with a friend or family member.

Check your answers with those in the "Suggested Answers" in the online course.

- ❑ Read "2.6 Summary" on page 280 of the textbook. Then, complete "2.6 Questions" on page 281.

Check your answers with those in the "Practice Answers" in the online course.

Assignment

- ❑ Go to Assignment 2.6: Designing a Helmut.

Chapter 2 Summary

- ❑ Read "Chapter 2 Summary" on page 281 of the textbook. Remember to use one of the given options to make your own summary of the key concepts and important chapter terms.

- ❑ Turn to "Chapter 2 Review Questions" on pages 282 and 283 of the textbook. Do questions 1, 3, 5, 7, 9, 11, 13, 15, 17, and 19. Then, do as many of the remaining questions as you feel are necessary to understand the concepts covered in this chapter.

Check your answers with those in the "Practice Answers" in the online course.

Unit B Conclusion

The exhilaration you experience as you ride a roller coaster, slalom down a ski slope, or snowboard down the fresh snow of a mountain is due to changes in motion. Any changes in motion are due to the effects of forces.

- ❑ Read the Unit B conclusion, including "Career Profile: Mechanical Engineer," on page 284 of the textbook.

- ❑ Turn to "Unit B Review Questions" on pages 285 to 291 of the textbook. Do questions 2, 4, 6, 8, 9 to 16,18, 20, and 21. Then, you may do as many of the remaining questions as you feel are necessary to understand the concepts covered in this unit.

Check your answers with those in the "Suggested Answers" in the online course.

Assignment

- ❑ Go to the Unit B Review Assignment, and answer all the review questions. Be sure to submit your completed assignment.

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