

Chapter 1 – Describing the Physical Universe

Section Review 1.1

1. What are the main activities involved in studying physics?

Physics is concerned with understanding natural laws related to matter and energy. This includes observations and experiments.

2. You are doing an experiment to find out if expensive batteries will run your radio longer than cheaper batteries. List a question, a hypothesis, the independent and dependent variables, and the control variable(s) for this experiment. Then, write a step-by-step procedure to test your hypothesis.

Q. Will the most exp. brand of battery purchased at a local store allow my radio to operate for a longer period than the least exp. battery from the same store?

H. The most exp. alk batt. will allow my radio to operated for a longer per. of t than less exp. bat.

Ind. V. Cost of battery

Dep. V. Length of operation

Control V. Volume of sound, Type of batt. (must be alkaline), quantity of batteries per package

Procedure: Purchase batteries, Record price for each. enough for 3 trials. Adjust radio to spec. volume to be maintained. Install batt. and record time of operation for each of 3 sets of batteries. Avg. op. time for the 3 trials for each brand. Graph results.

3. Compare and contrast natural law, hypothesis, and scientific theory.

Natural Law- a rule that describes an action or set of action in the universe.

Hypoth. a tentative, testable statement that tries to explain a set of scientific observations.

Theories start out as hypotheses.

Theory- A comprehensive, well-tested, description of how and why a process in nature works the way it does. there can be no contradictions to an acceptable theory. Usually, one or more natural laws fit into a comprehensive theory.

Section Review 1.2

1. List two common systems of units and give examples of distance measurements for each.

a. ***SI: meters, cm, millimeter, kilometers***

b. ***English: yard, inch, mile***

2. What are significant digits, and how are they used when working with measured quantities?

Significant figures are the meaningful digits in a measured quantity. In doing calculations with measured quantities, there should be NO MORE digits in the answer than the LEAST number of significant digits in the measured quantities.

3. Study Figure 1.10. Explain why each target-and-arrow examples was chosen for each of the labeled structures. **Accuracy is represented by the arrow in the bull's eye of the target since that position is the GOAL of an accurate archer.**

Precision is represented by several arrows hitting the target in the same spot because all attempts represent the same value. Resolution is represented by a view of the target allowing an observer to discriminate between positions from the center on the target in smaller increments.

Section Review 1.3

1. List three commonly-used units for speed.

- a. **mi/hr,**
- b. **ft/s,**
- c. **cm/s, km/hr, m/s**

2. State the steps used to solve physics problems.

- a. **Determine what the question is asking you to determine (FIND)**
 - b. **Identify the information you are given (GIVEN)**
 - c. **Gather all useful relationships involving the variables with which you are working. (Formula)**
 - d. **Substitute the information you are given with the proper relationship to solve.**
- Plug and Chug!**

3. Calculate the average speed of a car that drives 140 kilometers in 2 hours.

Find: Speed, Given: $d=140\text{km}$ & $t=2\text{hr}$, Formula: $s=d/t$

Plug and Chug: $s=140\text{km}/2\text{hr}$

$$s = 70\text{km/hr}$$

4. How long will it take if you swim 100 meters if you swim at a speed of 1.25 m/s?

Find: Time, Given: $d=100\text{m}$ & $s=1.25\text{m/s}$, Formula: $s=d/t$ rearrange: $t=d/s$

Plug and Chug: $t=100\text{m}/1.25\text{m/s}$ $t=80\text{s}$

5. How far will a dog travel if he runs for one minute at a constant speed of 5 m/s?

Find: distance, Given: $t=1\text{min}$ & $s=5\text{m/s}$, Formula: $d=st$, $60\text{s}/1\text{min}$

Plug and Chug: $d=(5\text{m/s})(1\text{min})(60\text{s}/\text{min})$ $d=300\text{m}$

Chapter 1 Review

Understanding Vocabulary

Select the correct term in the term bank on page 24 to complete the sentences.

- 1. The measure of the inertia of a body is measured as **__mass__**.
- 2. Newton's description of the force needed to change the motion of an object is an example of a(n) **__natural law__**.
- 3. In a system designed to measure the acceleration of a car on a ramp, the angle of the ramp would be treated as a(n) **__variable__**.
- 4. Units of inches, feet, centimeters, and meters may be used to measure **__distance or length__**.

5. An archer aiming at the center of a target hits the target with four arrows. If the arrows are 20 cm from the center but within 2 cm of each other, the archer's shooting would be considered precise but not accurate.
6. To calculate speed, distance is divided by time.

Reviewing Concepts

Section 1.1

1. List and define the two categories we use to classify everything in the universe.

a. *Matter- is all of the stuff in the universe that has mass and takes up space.*

b. *Energy- is the measure of the ability to make things change.*

2. How have physicists come to understand the natural laws?

Physicists use experiments and analysis to better understand natural laws. Natural laws are developed and refined as more information is discovered.

3. Define the term *matter*. Matter has mass and takes up space.

4. Explain why light is not considered to be matter. *Light is not matter because it does not take up space and it does not have mass.*

5. Define the term *system* as it relates to experiments. *A system is a group of objects, effects, and variables that are related.*

6. When designing an experiment, how do you determine what to include in the system? *YOU choose the system to include all the objects, effects and variables that affect what you are trying to understand. The fewer the variables, the easier it is to find the cause and effect relationships.*

7. List the steps of the scientific method.

1. *Ask a question.*
2. *Formulate a hypothesis.*
3. *Design a procedure to test the hypothesis.*
4. *Conduct the investigation and collect data.*
5. *Analyze the data.*
6. *Use the data to make a conclusion.*
7. *If necessary, refine the question and go through each step again.*

8. Explain the difference between a hypothesis and a theory.

A hypothesis is a tentative, untested statement that attempts to explain a set of scientific observations. A theory is a generally accepted explanation for scientific observations that is continually tested by collecting new and different evidence.

9. Explain the difference between a control variable and an experimental variable.

A control variable is one that is kept the same throughout the experiment. A variable that is altered by the scientist is called the experimental variable.

10. You wish to do an experiment to determine how a ball's radius affects how fast it rolls down a ramp. List the independent and dependent variables in this experiment.

Independent variable: radius of the ball

Dependent variables: angle of ramp, initial speed, mass of the ball, internal structure (hollow or solid), starting position, condition of the ramp's surface.

11. What is the goal of an experiment? *To produce scientific evidence*

12. What are the characteristics of scientific evidence? **Objective: describes only what happened, Repeatable: others can follow the same procedure will observe same results.**

13. Define the term *model* and give three examples. A model represents a relationship between variables.

a. *Models may be conceptual (explanation)*

b. *physical (representing a form or structure)*

c. *graphical (graphs and variables) or mathematical (formulas relating variables)*

Section 1.2

14. Why are units important when measuring quantities? *Units are important when measuring quantities because units allow people to communicate amounts uniformly.*

15. What is the current name given to the metric system? Name two reasons for using this system in place of the English System. International System of Units (SI)

a. *Since all units in SI are related*

b. *Units are based on a decimal or base-ten system, easier than English*

16. Define the word *time* as it is used in physics calculations.

A quantity or an interval rather than as a particular moment.

17. On which axis of a graph is time generally placed?

Time is generally placed on the x-axis of a graph.

18. What are the meanings of the following terms, as applied to science measurements?

accuracy – describes how close a measurement is to the actual or accepted value

precision – how close a series of events or measurements are to one another.

resolution – the ability to discern between two measurements mathematically or between two objects visually.

19. How is the correct number of significant figures determined in a science problem?

The answer can have no more sig figs than the smallest number of sig. figs in any of the original data.

Section 1.3

20. Write the form of the speed equation that you would use in each of the following scenarios. Let v = speed, t = time, and d = distance.

a. You know distance and speed and want to find the time. $t = d/v$ (s)

b. You know time and distance and want to find the speed. $v = d/t$

c. You know speed and time and want to find the distance. $d = v \times t$

21. What is the speed of an object that is standing still? 0 because it is not traveling any distance.
so $s = 0/t$, $s = 0$

22. Your friend rides her bicycle across town at a constant speed. Describe how you could determine her speed.

Measure the total d the bike travels, and the total t it takes to travel d . Then divide d/t

23. Fill in the missing information in the table showing common units for speed below:

Distance	Time	Speed	Abbreviation
meters	seconds	meters/second	m/s
kilometers	hours	km/h	km/ h
centimeters	second	centimeters per second	cm/s

24. Summarize the four steps for solving physics problems as described in the text.

a. **Find**

b. **Given**

c. **Formula/Relate**

d. **Plug and Chug**

Solving Problems

Section 1.1

1. You want to find out whether the birds near your school prefer thistle seed or sunflower seed. You have a bag of thistle seed, a bag of sunflower seed, and two bird feeders. Describe the experiment you would do to see which type of seeds birds prefer. Write down our question, your hypothesis, and the procedure you would follow when doing your experiment.

H: The birds prefer sunflower seeds, Procedure: Fill 1 feeder with thistle and the other with same amt. sunflower seeds. Wait several days and observe amt of each seed remaining in each. Concl. the feeder with the least are the preferred seeds.

2. You are doing an experiment to determine whether a dropped ball's mass affects the rate at which it falls. Describe the system you are studying. Write down your question, your hypothesis, and the procedure you would follow when doing your experiment. *System: Balls of diff. mass, Earth and the air. Question: Does the mass of a ball affect the rate at which it falls? Hypoth. The mass of the ball does not affect the rate at which it falls. Proc. Obtain several balls that differ only by mass a specified distanc an recored the time for each to fall. Since the ball all fall the same distance, use the time data to determine if their speeds differ over the specified distance. Concl. Similar times for each ball would indicate that madd does not affect the rate at which they fall.*

Section 1.2

3. Order the following lengths from shortest to longest.

- a. 400 mm = **0.4m** b. 22 km = **22,000m** c. 170 m d. 3.3 cm = **0.033m**
d < a < c < b

4. Convert:

- a. 3 km = **3,000** m
b. 1.5 m = **150** cm
c. 110 cm = **1.10** m
d. 2.5 cm = **25** mm

5. Convert:

- a. 3 min = **180** s
b. 200 s = **3** min, **20** s.
c. 2.00 days = **2,880** min
d. 1,000 min = **41.67** hr

6. Determine your age in each of the following units.

- a. months
b. days
c. hours
d. seconds

7. Luis rides his new bike while his brother records his position and time. They create the data table shown below.

Position (m)	0.00	105	270	400	540	600
Time (s)	0.00	30	60	90	120	150

a. Name the dependent variable and the independent variable.
Dep Var.: Position, Ind. Var. Time

b. On which axis would each variable be placed on a graph?
y-axis position, x-axis time

Section 1.3

8. Use the data from Luis's bike ride in question 7 to answer the following:

a. What was Luis's speed (in meters per second) for the entire ride from 0 to 150 s?
 $600m/150s = 4m/s$

b. What was Luis's speed (in meters per second) between 60 and 90 s?
 $s(60-90) = (400-270m)/(90s-60s) = 4.3m/s$

c. During which 30 s interval did Luis have the greatest speed? **between 30 & 60s.**

Calculate his speed during this interval. $s = 5.5m/s$

9. A bicyclist, traveling at 22 mph, rides a total of 44 mi. How much time (in hours) did it take?
 $t=d/v = 44mi/22mph = 2hr$

10. A mouse travels in a straight line at a steady speed of 2 m/s for 10 seconds. How far (in meters) did the mouse travel?
 $d=vxt = 2m/s \times 10s = 20m$

11. The gray wolf is a threatened animal that is native to the United States. A wildlife biologist observes an adult wolf traveling 250 m in 100 s. What is the average speed (in meters per second) of the gray wolf over this interval?
 $v=d/t = 250 m/100s = 2.5m/s$

12. It takes Brooke 10 min to walk 1 mi. What is her speed in miles per second?
 $v=d/t = 1mi / 10min(60s/min) = 0.0017 mi/s$

13. If it takes 500 s for the light from the Sun to reach Earth, what is the distance to the Sun in meters? (Note: The speed of light is 300,000,000 m/s).
 $d=vxt = (300,000,000 m/s)(500s) = 150,000,000,000 meters$

Test Practice

Section 1.1

1. Scientific evidence must be

a. objective b. subjective c. repeatable **d. both objective and repeatable**

2. _____ is a measure of a system's ability to change or create change in other systems.

a. Mmass b. A natural law **c. Energy** d. An experiment

3. A factor that affects the behavior of a system is known as a
- a. hypothesis b. natural law c. theory **d. variable**

Section 1.2

4. A rectangle is measured to be 14.2 cm long by 6.8 cm wide. The area of the rectangle should be reported as

- a. 96.56 cm² b. 96.5 cm² c. 96.6 cm² **d. 96 cm²**

5. The diagram on page 27 represents a centimeter scale placed next to a rectangle. The dimension of the rectangle adjacent to the centimeter scale would be *most* accurately given as

- a. 3.40 cm b. 3.48 cm **c. 2.48 cm** d. 2.5 cm

The diagram on page 27 represents a portion of a centimeter scale. Answer the following two questions about this diagram.

6. The greatest number of significant figures that should be reported when measuring with this scale is

- a. 1. **b. 3.** c. 5. d. 7.

7. The highest degree of resolution possible using this centimeter scale is

- a. 1.0 mm **b. 0.5 mm** c. 1.0 cm d. 0.5 cm

8. The number of seconds represented by an elapsed time of 3 h, 42 min, 3 s is

- a. 13,323 s** b. 2,703 s c. 225 s d. 3 s

9. A 12-inch ruler compares most closely in length to

- a. 1.0 m b. 12 cm **c. 300 mm** d. 5 μ m

10. On a graph, the _____ variable is normally plotted on the x-axis.

- a. control **b. dependent** c. experimental d. independent

Section 1.3

11. Traveling at an average speed of 55 mph, in 14 hr a driver will travel

- a. 770 mi** b. 393 mi c. 69 mi d. 55 mi

Applying Your Knowledge – skip this section