

# Concept Review

## Chapter 1

### Summary of Terms

**Denialism** Being doubtful over substantiated claims.

**Fact** A phenomenon about which competent observers can agree.

**Law** A general hypothesis or statement about the relationship of natural quantities that has been tested over and over again and has not been contradicted. Also known as a principle.

**Hypothesis** An educated guess; a reasonable explanation that is not fully accepted as factual until tested over and over again by experiment.

**Pseudoscience** Fake science that has no tests for its validity.

**Science** The collective findings of humans about nature, and a process of gathering and organizing knowledge about nature based upon experimental evidence.

**Scientific Method** An orderly method for gaining, organizing, and applying new knowledge.

**Scientific Notation** A number written in the general form:  $C \times 10^n$  where C, called the coefficient, is a number less than 10 but equal to or greater than 1.

**Significant Figure** Digits in any measured value that are known with certainty plus one final digit that is estimated and hence uncertain.

**Skepticism** Being doubtful over unsubstantiated claims.

**Technology** Method and means of solving practical problems by applying the findings of science.

**Theory** A synthesis of a large body of information that encompasses well-tested hypotheses about certain aspects of the natural world.

### Review Questions

#### 1.1 Science Is a Way of Understanding the Natural World

1. What would have to be done to refute Aristotle's hypothesis that heavier objects fall faster?
2. Are experiments better at proving ideas right or proving them wrong?
3. According to Figure 1.3, what is usually the first step to conducting scientific research?

#### 1.2 An Investigation of Sea Butterflies

4. Is the sea butterfly more closely related to a snail or an insect?
5. According to the results, why do the amphipods abduct the sea butterflies?

#### 1.3 Technology Is Applied Science

6. What is technology?
7. What issue aggravates almost every problem faced by humans today?

8. Are medical X rays used because they carry zero risks?

#### 1.4 We Are Still Learning About the Natural World

9. Is it possible for a fact to change?
10. What do we call a suggested explanation for an observable phenomenon?
11. Which works to unify a broad range of observations: a scientific hypothesis or a scientific theory?

#### 1.5 Chemistry Is Integral to Our Lives

12. Why is chemistry often called the central science?
13. What is the difference between basic research and applied research?
14. What pledge has been made by members of the American Chemistry Council through the Responsible Care program?

**1.6 Measuring with Units**

15. What are the two major systems of measurement used in the world today?
16. Why are prefixes used in the metric system?
17. A milligram is equal to how many grams?
18. What is true about the numerator and denominator of a conversion factor?

**1.7 Scientific Notation**

19. When is scientific notation used?
20. Is  $5 \times 10^{-31}$  a very large or very small number? Is it greater or less than zero?

**1.8 Significant Figures**

21. How is precision different from accuracy?
22. Is it possible for an uncertain digit to be significant?

**Quantitative Questions**

23. We can define a “risk/benefit” ratio as the amount of risk taken divided by the amount of potential benefit:

$$\text{risk benefit ratio} = \text{risk/benefit}$$

If the risks are equal to the benefits, then the risk/benefit ratio equals one. If an activity offered you a risk/benefit ratio of 100, would you take it? How about if the risk/benefit ratio was 0.01? Is the risk/benefit ratio of buying a lottery ticket large or small?

24. Using conversion factors, calculate the age of some one who is exactly 25 years old in units of months. How many days is this? (Assume 1 year = 365 days)
25. Using conversion factors, show that there are about 63 billion seconds in 2000 years. (Assume 1 year = 365 days)
26. A mass of 18.0 grams of water contains  $6.02 \times 10^{23}$  water molecules. Write out two conversion factors from this equality.
27. Using your conversion factors from the previous question, show that 36.0 grams of water contains  $1.20 \times 10^{24}$  molecules of water.
28. Using your conversion factors from question 26, show that 27.0 grams of water contains  $9.03 \times 10^{23}$  molecules of water.



## Solutions (Odd-Numbered)

1. An experiment.
3. Scientific research usually begins with the asking of a very broad question.
5. The amphipods abduct the sea butterflies as a means of chemical defense against predators.
7. The rapid growth of our human population.
9. Yes, when competent observers agree that it should.
11. A scientific theory.
13. Basic research leads to a greater understanding of how the natural world works. Applied research focuses on developing applications of knowledge gained through basic research.
15. The two major unit systems are the United States Customary System and the Système International.
17. A milligram is equal to one thousandth of a gram.
19. Scientific notation is used to express very large or very small numbers conveniently.
21. Accuracy is how close measured values are to the truth. Precision is a function of the reproducibility of the measurements. The greater the precision, the closer the measured values will be to each other regardless of whether they are accurate.

23. A large risk/benefit ratio, such as 100, can be indicated as follows:

$$\text{RISK/benefit} = 100$$

This is a risky activity that you might choose to avoid. A small risk/benefit ratio, such as 0.01, can be indicated as follows:

$$\text{risk/BENEFIT} = 0.01$$

This activity offers much benefit for only little risk and so may be worthwhile. Regarding the purchase of a lottery ticket, the chances of losing a small amount of money (the risk) far exceeds the chances of gaining a large amount of money (the benefit). The risk/benefit ratio, therefore, is quite large. Furthermore, with continued purchases, the small amount of money lost each time can really add up. Lottery tickets are a clear example of where our powers of wishful thinking win over our powers of analytical thinking. It's true that wishful thinking can be fun. But it's also true that wishful thinking can be damaging. We should be mindful as we seek a proper balance between risks and benefits.

25.  $(2000 \text{ years})(365 \text{ days/1 year})(24 \text{ hours/1 day})(60 \text{ min/1 hour})(60 \text{ sec/1 min}) = 63,072,000,000 \text{ seconds}$
27.  $(36.0 \text{ grams of water})(6.02 \times 10^{23} \text{ molecules of water/18.0 grams of water}) = 1.20 \times 10^{24} \text{ molecules of water.}$

### Solutions to Chapter 1

#### Calculation Corner

##### Unit Conversion

- a. 7.32 kg
- b. 518 lb
- c. 4.846 qt
- d. 0.1 kcal
- e. 400 J