Solutions | Chapter 2 handout "A Mathematical Toolkit"

Answers To (pg 16)
PRACTICE PROBLEMS

Have students refer to Appendix A of the Solutions Appendix for complete solutions to Practice Problems.

1. **a.** 5.8×10^3 m
   b. 4.5×10^5 m
   c. 3.02×10^8 m
   d. 8.6×10^{10} m
2. **a.** 5.08×10^{-4} kg
   b. 4.5×10^{-7} kg
   c. 3.600×10^{-3} kg
   d. 4×10^{-3} kg
3. **a.** 3×10^8 s
   b. 1.86×10^5 s
   c. 9.3×10^7 s

Answers To (pg 17)
PRACTICE PROBLEMS

Have students refer to Appendix A of the Solutions Appendix for complete solutions to Practice Problems.

4. **a.** 1.1×10^{-2} m
   b. 7.62×10^{-11} m
   c. 2.1×10^3 m
   d. 1.23×10^5 m
5. **a.** 1.47×10^{-1} kg
   b. 1.1×10^{-8} kg
   c. 7.23×10^3 kg
   d. 4.78×10^{-4} kg

Answers To (pg 18)
PRACTICE PROBLEMS

Have students refer to Appendix A of the Solutions Appendix for complete solutions to Practice Problems.

6. **a.** 8×10^{-7} kg
   b. 7×10^{-3} kg
   c. 3.96×10^{-19} kg
   d. 4.6×10^{-12} kg
7. **a.** 2×10^{-8} m^2
   b. -1.52×10^{-11} m^2
   c. 3.0×10^{-9} m^2
   d. 4.6×10^{-19} m^2
8. **a.** 5.4×10^{-7} mg
   b. 6.2×10^{-3} mg
   c. 2.8×10^{-14} g
   d. 7.9×10^3 m

Answers To (pg 19)
PRACTICE PROBLEMS

Have students refer to Appendix A of the Solutions Appendix for complete solutions to Practice Problems.

9. **a.** 8×10^{12} m^2
   b. 6×10^{10} m^2
   c. 3×10^{-11} m^2
   d. 6.25×10^9 m^2
10. **a.** 3×10^4 kg/m^3
    b. 3×10^{12} kg/m^3
    c. 3×10^{-12} m/s
    d. 3×10^{-4} m/s
11. **a.** 2×10^4 kg·m/s
    b. 3×10^{12} kg·m/s^2

3 Close

CONVERGENT QUESTION

Explain how SI and powers of 10 are related. [Powers of 10 are an integral part of the prefixes used with SI.]

CONCEPT REVIEW ANSWERS

1.1 1.574×10^8
1.2 It would be a larger number in the case of the smaller unit.
1.3 Note (or write down) the time indicated by a portable clock when you leave home. Note the time indicated by the same clock when you arrive at school. Subtract the first time from the second time. Convert hours or minutes to seconds.
1.4 Critical Thinking: Make sure the two clocks are synchronized. That is, that they show the same time. Either set your watch by the clock at school, carry the watch home and set your clock at home to agree with your watch, or use a time signal given by a radio station, for example, to set both clocks at the same time.

Answers To pg 24
PRACTICE PROBLEMS

Have students refer to Appendix A of the Solutions Appendix for complete solutions to Practice Problems.

12. **a.** 4 **c.** 2 **e.** 2
b. 3 **d.** 4 **f.** 3
13. **a.** 2 **c.** 4 **e.** 4
b. 4 **d.** 3 **f.** 3

Answers To pg 25
PRACTICE PROBLEMS

Have students refer to Appendix A of the Solutions Appendix for complete solutions to Practice Problems.

14. 26.3 cm (rounded from 26.281 cm)
15. **a.** 2.5 g (rounded from 2.536 g)
b. 475 m (rounded from 474.5832 m)

Answers To pg 26
PRACTICE PROBLEMS (cont)

16. **a.** 3.0×10^2 cm^2
b. 13.6 km^2
17. **a.** 2.73 cm/s
b. 0.253 cm/s

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CONCEPT REVIEW ANSWERS

2.1 It would be more precise but less accurate.
2.2 No, it doesn't change the fineness of the divisions on its scale.
2.3 Between 181.5 and 182.5 cm.
2.4 **Critical Thinking:** It is a measure of precision. The way the question is asked can affect the accuracy.

Answers To pg 33
PRACTICE PROBLEMS

Have students refer to Appendix A of the Solutions Appendix for complete solutions to Practice Problems.

18. $b = y - mx$
19. **a.** $v = \frac{d}{t}$
b. $v = \frac{d}{t}$
c. $v = \pm\sqrt{2ad}$
d. $v = \frac{ab}{c}$
20. **a.** $E = fs$
b. $E = \frac{mv^2}{2}$
c. $E = mc^2$
21. $d = \frac{(v^2 - v_0{}^2)}{2a}$
22. **a.** $a = \frac{v - v_0}{t}$
b. $a = \frac{2(y - v_0 t)}{t^2}$
c. $a = \frac{v^2 - v_0{}^2}{2y}$
d. $a = \frac{v^2}{2s}$

Answers To pg 34
PRACTICE PROBLEMS

Have students refer to Appendix A of the Solutions Appendix for complete solutions to Practice Problems.

23. **a.** 6 cm^2
b. 4.50 m
24. **a.** incorrect
b. correct
c. incorrect

CONCEPT REVIEW ANSWERS

4.1 There are four times as many people as cars, or, for every car there are four people.
4.2 The circumference of a circle can be found by multiplying the length of its radius by the number π and then by the number 2.
4.3 $S = 20T$
4.4 **Critical Thinking:** $15/2\pi$ m = 2.4 m. Since $C = \pi d$, increasing C by 15 m increases πd by 15 m, which increases d by $15/\pi$ m, and thus increases the radius by half that amount. Or, think of the graph of C versus d in Figure 2–16. Move vertically a distance ΔC, and this moves to the right a distance Δd/slope = $\Delta d/\pi$. The radius of Earth is not needed.

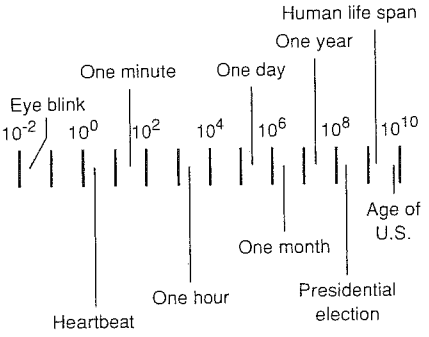
Answers To REVIEWING CONCEPTS

pg 35

1. The International System of Units allows scientists all over the world to make measurements in the same system. Thus scientists know exactly what is meant by measurements made by other scientists.
2. seconds, time; meters, length; and kilograms, mass
3. The derived units are combinations of the fundamental units.
4. **a.** centimeter **b.** millimeter **c.** kilometer
5. the precision of a measuring device, which is limited by the finest division on its scale
6. Student answers will vary, but could include the following.
a. 365 days in a year **b.** The length of a meter stick is 1003.9 mm.
7. The final digit is estimated.
8. **a.** Zeros are necessary to indicate the magnitude of the value, but there is no way of knowing whether or not the instrument used to measure the values actually measured the zeros. The zeros may serve only to locate the six.
b. Write the number in scientific notation, including only the significant digits.

Answers To APPLYING CONCEPTS

1. **a.** Student answers will vary. Two possible answers:
$\frac{g}{cm^3}, \frac{kg}{m^3}$.
b. derived unit
c. $\frac{kg}{m^3}$
2. Student answers will vary, but could be about
a. 1 cm
b. 0.1 mm
c. 3 m
d. 1 km
3. Student answers will vary.
4. Student answers will vary, but could include some of the following.



Answers To REVIEWING CONCEPTS (cont)

pg 36

9. The slope of a linear graph is the ratio of the vertical change to the horizontal change, or rise over run.
10. **a.** Longer reaction distance because $d = vt$ and t is larger.
b. Larger slope because the vertical distance increases more rapidly with speed.
11. Temperature is the independent variable; volume is the dependent variable.
12. **a.** temperature **b.** volume
13. **a.** parabolic **b.** Linear, since y is being plotted versus the square of x, not x.
14. **a.** inverse relationship **b.** direct relationship **c.** direct relationship with the square of v
15. **a.** hyperbola **b.** straight line
c. parabola
16. Make sure that the terms on both sides of an equation have the same units, and check that the problem is set up correctly.

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5. A meter stick's smallest division is a millimeter. Both answers should reflect a measurement to the nearest tenth of a centimeter, for example, 84.0 cm and 83.8 cm.
6. **a.** less precise
b. more accurate
7. Only like terms can be added or subtracted. 5 m and 1 s cannot be added; but divided, 5 m/s becomes a velocity.
8. Negative, because the change in vertical distance is negative for a positive change in horizontal distance.
9. Zero. The change in vertical distance is zero.
10. Solve for k: $kv^2 = d$, $k = d/v^2$. The units of k are $m/(m/s)^2 = s^2/m$.
11. Answers will vary according to the relationship chosen.
12. **a.** Lower density means faster speed, so the rock falls faster in air.
b. Since a vacuum would have a zero density, the rock should fall infinitely fast. Nothing can fall this fast.

Answers To PROBLEMS

Refer to Problems and Solutions Manual for complete solutions.

1. **a.** 5×10^{24} m
   b. 1.66×10^{-19} m
   c. 2.033×10^{9} m
   d. 1.030×10^{-7} m
2. **a.** 0.423 m
   b. 6.2×10^{-12} m
   c. 2.1×10^{4} m
   d. 2.3×10^{-5} m
   e. 2.14×10^{-4} m
   f. 5.70×10^{-7} m
3. 0.31 mg, 1021 μg, 0.000 006 kg, 11.6 mg
4. **a.** 6.12×10^{9} s
   b. 2.94×10^{-6} m
   c. 1.250×10^{-4} kg
   d. 7.50×10^{7} g
5. **a.** 3
   b. 1
   c. 4
   d. 5
6. **a.** 3
   b. 1
   c. 3
7. 9.4×10^{3} mL, 108 m, 51 mm
8. **a.** 34.7 m
   b. 25.022 m
   c. 46.00 cm^2
   d. 3.1 kg
9. **a.** 2.9×10^{9} m^2
   b. 2.0×10^{5} m/s
   c. 1.3×10^{-6} km^2
   d. 1.9×10^{2} kg/m^3
10. **a.** 7.4 mm
    b. 49.6 m^2
    c. 70.4 kg
11. 69.2 m^2
12. **a.** 101.6 m
    b. 584 m^2
13. 2.4×10^{2} m^3
14. 362.1 m
15. 48.2 kg
16. **a.** (a) 80 g, (b) 260 g, (c) 400 g
    b. (a) 37 cm^3, (b) 11 cm^3, (c) 7 cm^3
    c. The steepness represents the increased mass of each additional cubic centimeter of the substance.
17. **a.** Refer to the Problems and Solutions Manual.
    b. a straight line
    c. $M = mV$, where m is the slope.
    d. mass/volume; density
18. **a.** Refer to the Problems and Solutions Manual.
    b. The acceleration varies directly with the force.
    c. $F = ka$
    d. $m/s^2 \cdot N$
19. **a.** Refer to the Problems and Solutions Manual.
    b. hyperbola
    c. Acceleration varies inversely with the mass.
    d. $a = c/M$
    e. $kg \cdot m/s^2$
20. **a.** 75.7 cm^3
    b. 1.46×10^{3} g
21. **a.** $l = \dfrac{gT^2}{4\pi^2}$
    b. $g = \dfrac{4\pi^2 l}{T^2}$
22. **a.** 683 g
    b. 6.3 cm^3
23. 6.02×10^{18} km
24. **a.** 1.08×10^{5} km/h
    b. 3.00×10^{4} m/s
25. **a.** 1.67×10^{3} km/h
    b. 464 m/s
26. 1.4 m/s
27. **a.** 0.50 km
    b. 0.20 h
28. $0.12 \dfrac{dm^3}{h}$
29. Each pizza costs 30 cents more to make.

Answer To THINKING PHYSIC-LY

No. Just because a calculator gives an answer to nine places, it does not mean that all places are valid. In this case, the numbers must be rounded to the nearest hundredth.

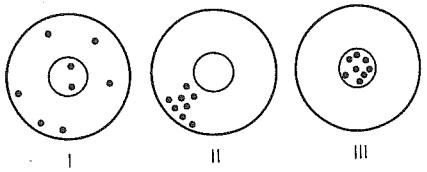
CONCEPT DEVELOPMENT

- Discuss the error in this advertising statement: *Net weight before cooking,* 4 *oz.* (113.4 g). [Actually there are two errors here, one, the two numbers are not expressed to the same number of significant digits; and two, ounces and grams should not be equated.]

- Students may tend to confuse significant digits and decimal places. They're not the same thing, and are not usually related. Significant digits are a reasonably convenient, fast way of handling the inevitable uncertainties in data.

- Emphasize that all measurements have some uncertainty. When you use measurements in a formula, the significant digit rules help obtain a meaningful answer that takes into account the uncertainty.

- A good analogy to differentiate between precision and accuracy is the target analogy. Draw targets on the chalkboard as shown here.



The dots represent bullet holes in the target. The first target shows good accuracy and poor precision; the second shows good precision and poor accuracy. The third represents good accuracy and good precision.