Chapter 0 Homework Problems

Questions # 1 - 4: Match the letter of the definition on the right to the part of the scientific method on the left.

1. _____ Theory  
2. _____ Scientific law  
3. _____ Hypothesis  
4. _____ Experiment  

5. What is the length of the object pictured to the right to the correct number of significant figures?

   Answer: ___________

6. Underline the significant zeros in each of the following numbers:

   (a) 5.08  
   (b) 508  
   (c) 5.080 x 10^3  
   (d) 0.05080

7. Round off each number to the indicated number of significant figures (s.f.):

   (a) 231.554 (to 4 s.f.)  
   (b) 0.00845 (to 2 s.f.)  
   (c) 144,000 (to 2 s.f.)

8. Write the following numbers in scientific notation:

   (a) 282.0  
   (b) 0.0380  
   (c) 4270.8  
   (d) 58,200.9
9. Write the following numbers in standard notation. Use a terminal decimal point when needed.

- (a) $6.500 \times 10^3$
- (b) $3.46 \times 10^{-5}$
- (c) $7.5 \times 10^2$
- (d) $1.8856 \times 10^2$

10. How many significant figures are in each of the following quantities? Be sure to consider whether the quantity is measured or exact.

- (a) $130.95$
- (b) $2000.003\ g$
- (c) $5\ ft\ 3\ in$
- (d) $510\ J$
- (e) $5.10 \times 10^2\ J$
- (f) $10\ students$

11. Express the results of the following calculations with the correct number of significant figures. Be sure to apply the +/- and \times/\div rules in the correct order of operations.

- (a) $\frac{3.41 - 0.23}{5.233} \times 0.205$
- (b) $\frac{5.556 \times 2.3}{4.223 - 0.08}$

12. What metric prefixes correspond to the following powers of ten?

- (a) $10^3$
- (b) $10^{-6}$
- (c) $10^9$
- (d) $10^{-12}$
- (e) $10^{-2}$

13. The height of a horse is usually measured in hands instead of in feet, where 1 hand equals $\frac{1}{3}\ ft$ (exactly). How tall in centimeters is a horse of 18.6 hands?
14. There are $2.60 \times 10^{15}$ tons of oxygen in the atmosphere (1 ton = 2000 lbs). How many metric tons (tonnes) of oxygen are present (1 tonne = 1000 kg)?

15. If a raindrop weighs 0.52 mg on average and $5.1 \times 10^5$ raindrops fall on a lawn every minute, what mass (in kg) of rain falls on the lawn in 1.5 h?

16. An Olympic-size pool is 50.0 m long and 25.0 m wide.
   (a) How many gallons of water ($d = 1.0 \text{ g/mL}$) are needed to fill the pool to an average depth of 4.8 ft?

   (b) What is the mass (in kg) of water in the pool?

17. A 1.0 oz (mass) piece of chocolate contains 15 mg of caffeine, and a 6.0 fl oz (volume) mug of regular coffee contains 105 mg of caffeine. How many pounds of chocolate would you need to consume to get as much caffeine as you would from a typical 1.5 cup (volume) serving of coffee? Note: 1 cup $\equiv 8$ fl oz, 1 lb $\equiv 16$ oz (both exact by definition)

18. Convert 106°F (the body temperature of many birds) to K and °C
19. These organic solvents are used to clean compact disks:

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Density (g/mL) at 20°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroform</td>
<td>1.492</td>
</tr>
<tr>
<td>Diethyl ether</td>
<td>0.714</td>
</tr>
<tr>
<td>Ethanol</td>
<td>0.789</td>
</tr>
<tr>
<td>Isopropanol</td>
<td>0.785</td>
</tr>
<tr>
<td>Toluene</td>
<td>0.867</td>
</tr>
</tbody>
</table>

(a) If a 15.00 mL sample of CD cleaner weighs 11.775 g at 20°C, which solvent is most likely present?

(b) The chemist analyzing the cleaner calibrates her equipment and finds that the pipet is accurate to ±0.02 mL, and the balance is accurate to ±0.003 g. What are the highest and lowest densities that could be obtained for this measurement with this equipment? Is this equipment precise enough to distinguish between ethanol and isopropanol?

20. The following dartboards illustrate the types of errors often seen in measurements. The bull’s-eye represents the accepted value, and the darts represent the data.

(a) Which experiments yield the same average result?
(b) Which experiment(s) display(s) high precision?
(c) Which experiment(s) display(s) high accuracy?
(d) Which experiment(s) show(s) a systematic error?