Ch. 2 TEST: Measurement & Calculations VERSION A

MULTIPLE CHOICE QUESTIONS: Choose the letter of the answer choice that best answers the question, taking into account rounding rules and sig figs where it applies, and fill in the circle completely on your answer sheet for the corresponding question. Multiple choice are worth 2 points each.

1. Which of the following units would be most appropriate to use for measuring the distance from North Bend to Issaquah?
   A. millimeter       B. kilogram       C. kilometer       D. cubic centimeter

2. Which of the following units would be most appropriate to use for measuring the volume of soda in a can of Coca-Cola?
   A. mL                B. L                  C. cm              D. mg

3. In division and multiplication, the answer must not have more significant figures than the
   A. number in the calculation with the fewest significant figures
   B. number in the calculation with the most significant figures
   C. average number of significant figures in the problem
   D. least precise measurement in the calculation (i.e. least number of decimal places)

4. In addition and subtraction, the significant figures in the answer must reflect the
   A. number in the calculation with the fewest significant figures
   B. number in the calculation with the most significant figures
   C. average number of significant figures in the problem
   D. least precise measurement in the calculation (i.e. least number of decimal places)

5. The relationship between the mass \( m \) of a material, its volume \( V \), and its density \( D \) is
   A. \( V = mD \)       B. \( m/V = D \)       C. \( D = V/m \)       D. \( D/V = m \)

6. If some measurements agree closely to each other but not the actual value, these measurements are
   A. neither precise nor accurate
   B. accurate, but not precise.
   C. both accurate and precise.
   D. precise, but not accurate.

7. The symbols for units of length in order from largest to smallest are
   A. km, m, cm, mm
   B. mm, m, cm, km
   C. km, mm, cm, m
   D. mm, cm, m, km

8. How many seconds are there in 2 days?
   A. 1,728 sec             B. 86,400 sec       C. 17,280 sec           D. 172,800 sec

9. The number of significant figures in the measurement 0.050010 kg is
   A. 7                 B. 5                C. 4               D. 2

10. The number of significant figures in the measured value 3400 g
    A. 4                 B. 3                C. 2               D. 1
11. Four students each measured the mass of one 1.55 g sample four times. The results in the table below indicate that the data collected by which student reflects the most accuracy and precision?

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12. The number 1.6758 rounded to three significant figures would be
A. 1.67  B. 1.676  C. 1.68  D. 1.7

13. The speed of x-rays is 300,000 m/s. In scientific notation, and with the correct number of significant figures, this speed is...
A. $3.0 \times 10^5$ m/s  B. $3 \times 10^5$ m/s  C. $3.000000 \times 10^5$ m/s  D. $30 \times 10^4$ m/s

14. Using a metric ruler with 1 mm divisions, you find the sides of a rectangular piece of plywood are 3.7 cm and 4.85 cm. You calculate that the area is 17.945 cm$^2$. To the correct number of significant figures, the result should be expressed as
A. 17.945 cm$^2$  B. 17.95 cm$^2$  C. 17.9 cm$^2$  D. 18 cm$^2$

15. What is the sum of 6.079 g + 0.07772 g + 3.00 g?
A. 9.15672 g  B. 9.157 g  C. 9.160 g  D. 9.16 g

16. A Florence flask can contain 550 mL of liquid. What is the capacity of the flask in liters written correctly in scientific notation?
A. $5.50 \times 10^2$ mL  B. $5.5 \times 10^2$ mL  C. $5.50 \times 10^3$ L  D. $5.50 \times 10^1$L

17. The density of aluminum is 2.70 g/cm$^3$. The mass of a solid piece of aluminum is 3.32 g. What is its volume?
A. 1.23 cm$^3$  B. 8.96 cm$^3$  C. 0.813 cm$^3$  D. 6.02 cm$^3$

18. How many grams are in 1 kilogram?
A. 0.001  B. 1000  C. 100  D. 10

19. How many nanoliters are in 15.7 milliliters?
A. 157  B. 2.62  C. $1.57 \times 10^7$  D. $1.57 \times 10^5$

20. How many Megameters are in 465 centimeters?
A. $4.65 \times 10^6$  B. $4.65 \times 10^7$  C. $4.65 \times 10^8$  D. $4.65 \times 10^9$
MULTIPLE CHOICE QUESTIONS: Choose the letter of the answer choice that best answers the question, taking into account rounding rules and sig figs where it applies, and fill in the circle completely on your answer sheet for the corresponding question. Multiple choice are worth 2 points each.

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2. What is the sum of 6.079 g + 0.07772 g + 3.00 g?
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4. The density of aluminum is 2.70 g/cm^3. The mass of a solid piece of aluminum is 3.32 g. What is its volume?
   A. 6.02 cm^3   B. 0.813 cm^3   C. 1.23 cm^3   D. 8.96 cm^3

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   A. 0.001   B. 10   C. 100   D. 1000

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   A. mm, cm, m, km
   B. km, m, cm, nm
   C. mm, m, cm, km
   D. km, mm, cm, m

19. The number 1.6758 rounded to three significant figures would be
   A. 1.67  B. 1.676  C. 1.68  D. 1.7

20. The speed of x-rays is 300 000 m/s. In scientific notation, and with the correct number of significant figures, this speed is...
   A. \( 3.0 \times 10^5 \) m/s  B. \( 3 \times 10^5 \) m/s  C. \( 3.00000 \times 10^5 \) m/s  D. \( 30 \times 10^4 \) m/s
**Multiple Choice:**

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**Short Answer:**

FOR ALL CALCULATIONS, USE DIMENSIONAL ANALYSIS, SHOW YOUR WORK, SHOW THE UNITS, AND THE Rounding Rules. FOR EXTRA CREDIT WRITE YOUR FAVORITE MOVIE BY YOUR NAME. RULES FOR SIG FIGS ALWAYS APPLY!!!!!!

21. Describe why it is important to record measurements that reflect the uncertainty of the measuring device. Give an example to support your answer. (4 pts)

It is important to record measurements that reflect the uncertainty because each tool has a different level of precision. When doing an experiment and you measure the mass very precisely (using a quad beam) a measurement recorded to the thousandths place, but you record the volume with a beaker, a very bad tool for measurement and you try to calculate the density can only be as precise as your beaker.

22. A remedy when you ingest certain poisons is to take medicinal carbon (charcoal) to absorb the poison out of your system. Let's assume medicinal carbon is pure carbon for the sake of this question. The density of pure carbon is 2.26 g/cm³. If you need to take 5 grams of carbon to filter out the amount of poison you just accidentally ingested, what volume of carbon will that be? (2 pts)

\[
D = \frac{m}{V} \quad V = \frac{m}{D}
\]

\[
V = \frac{5g}{2.26 \text{ g/cm}^3} = 2.21 \text{ g/cm}^3
\]

\[
V = 2 \text{ g/cm}^3
\]
23. (1 pt each) Two measuring devices have been set up at a lab station. When called up, go to a lab station, and record the measurements from each device.

a. 

b. 

24. If 1 inch equals approximately 2.54 cm, one foot equals 12 inches, and there are 3 feet in 1 yard, how many centimeters equal 2.5 yards? (4 pts)

\[
2.5 \text{ yds} \left( \frac{3 \text{ ft}}{1 \text{ yd}} \right) \left( \frac{12 \text{ in}}{1 \text{ ft}} \right) \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right) = \frac{228.6 \text{ cm}}{1.23 \text{ cm}}
\]

25. The dimensions of a rectangular solid are measured to be 1223 mm, 8.6 m, and 72 cm. What is the volume of the solid? Record your answer in scientific notation. (4 pts)

\[
1223 \text{ mm} \left( \frac{1 \text{ m}}{1000 \text{ mm}} \right) = 1.223 \text{ m}
8.6 \text{ m}
72 \text{ cm} \left( \frac{1 \text{ m}}{100 \text{ cm}} \right) \times 0.72 \text{ m} = 7.64 \text{ m}^3
\]

26. #SpoilerAlert: Astronaut Mark Watney finds himself stranded alone on Mars after a horrific storm forces his colleagues to abandon the planet, leaving him for dead. He must grow enough food to support himself while he waits for NASA to send a return flight in 4 years.

A. He decides to move Martian soil into the Hab (where he lives) and enrich it with bacteria from his own stool in order to plant potatoes. He measures carefully and finds that there is 92.0 m² of floor space in the Hab and the soil must be at least 10.0 cm in depth. What volume of Martian soil must Mark move into the Hab? (4 pts)

\[
10.0 \text{ cm} \left( \frac{1 \text{ m}}{100 \text{ cm}} \right) = 0.100 \text{ m} \times 92.0 \text{ m}^2 = 9.20 \text{ m}^3
\]

B. Mark needs to eat 1500 Calories a day in order to survive. Potatoes provide 770 calories per kilogram. If Mark is able to grow 180 kilograms of potatoes on the floor of the Hab, how many days will those potatoes support him? Will he be able to survive until NASA is able to return for him?? (4 pts)

\[
180 \text{ kg of Potatoes} \left( \frac{770 \text{ cal}}{1 \text{ kg}} \right) \left( \frac{1 \text{ day}}{1500 \text{ cal}} \right) = 92.4 \text{ days}
92 \text{ days}
\]

Will he not be able to survive on potatoes alone!
27. The measured density of galena is 8.2 g/cm³. The known density of galena is 7.6 g/cm³. Calculate the percent error. (2 pts)

\[ \% \text{ error} = \frac{\text{Actual} - \text{Experimental}}{\text{Actual}} \times 100\% \]

\[ \frac{7.6 - 8.2}{7.6} \times 100\% = -7.89\% \]

<table>
<thead>
<tr>
<th>Copper</th>
<th>zinc</th>
<th>gold</th>
<th>aluminum</th>
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<td>9.0 g/mL</td>
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28. (4 pts) Zoe found a piece of silver colored metal while walking around MSHS. She determined that the mass of the sample was 13.5 grams and the volume of the sample was 1.9 mL. Did Zoe strike it rich with real silver? Explain your thinking & show your work.

a. Show your calculations (2 pts):

\[ \frac{13.5 \text{ g}}{1.9 \text{ mL}} = 7.11 \text{ g/mL} \]

b. Is the metal silver? Explain why or why not (2 pts).

She did not find silver she found zinc because the density was 7.11 g/mL which is the same density as zinc.

29. Connor has two blocks of metal which have the same mass. One block is made of Zinc, and one block is made of silver. Which of the following statements must be true about the volume of these two samples?

(1 pt) Circle the correct statement

a. The zinc and the silver will have equal volumes
b. The zinc will have a greater volume than the silver
c. The silver will have a greater volume than the zinc

(2 pt) Explain your choice:

The mass is the same

\[ \frac{7.1}{10.5} = \frac{m}{V} \]

bigger number

10.5 = \frac{m}{V} \rightarrow \text{smaller number}

Extra Credit is on the back
Extra Credit: Show by dimensional analysis! (2 pts)
One mole (molecular equivalent) of gold has a mass of 196.9655 g. One mole of anything equals $6.022 \times 10^{23}$ items of that thing, so in 1 mole of gold there are $6.022 \times 10^{23}$ atoms. The diameter of a gold atom is $3.58 \times 10^{-10}$ m. If a block of gold of a mass of 202.5 g is drawn into a very thin wire of single gold atoms laid end to end, how long would the wire be? Express your answer in kilometers.

\[
202.5 \text{ g} \left( \frac{1 \text{ mol}}{196.9655 \text{ g}} \right) \left( \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol}} \right) \left( \frac{3.58 \times 10^{-10} \text{ m}}{1 \text{ atom}} \right) \left( \frac{1 \text{ km}}{1000 \text{ m}} \right) = 2.22 \text{ km}
\]
Short Answer:

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21. (1 pt each) Two measuring devices have been set up at a lab station. When called up, go to a lab station, and record the measurements from each device.

a. ____________________________  b. ____________________________

22. If 1 inch equals approximately 2.54 cm, one foot equals 12 inches, and there are 3 feet in 1 yard, how many centimeters equal 4.6 yards? (4 pts)

\[
4.6 \text{ yd} \left( \frac{3 \text{ ft}}{1 \text{ yd}} \right) \left( \frac{12 \text{ in}}{1 \text{ ft}} \right) \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right) = 4120 \text{ cm}
\]

23. The dimensions of a rectangular solid are measured to be 1568 mm, 5.6 m, and 89 cm. What is the volume of the solid? **Record your answer in scientific notation.** (4 pts)

\[
1.568 \text{ m} \\
5.6 \text{ m} \\
0.89 \text{ m} \\
7.8 \text{ m}^3
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24. (4 pts) Zoe found a piece of silver colored metal while walking around MSHS. She determined that the mass of the sample was 44.1 grams and the volume of the sample was 4.2 mL. Did Zoe strike it rich with real silver? Explain your thinking & show your work.
   a. Show your calculations (2 pts):

   \[
   \frac{44.1 \text{ g}}{4.2 \text{ mL}} = 10.5 \text{ g/mL}
   \]

   b. Is the metal silver? **Explain why or why not** (2 pts).

   **Yes**  the density of the metal makes the density of silver.

25. Connor has two blocks of metal which have the **same mass**. One block is made of Zinc, and one block is made of silver. Which of the following statements must be true about the volume of these two samples?

   (1 pt) **Circle** the correct statement
   a. The zinc and the silver will have equal volumes
   b. The zinc will have a greater volume than the silver
   c. The silver will have a greater volume than the zinc

   (2 pt) Explain your choice:

   \[
   \frac{7.1 \text{ g}}{\sqrt[3]{3}} = 10.52 \text{ cm}
   \]

   **Bigger** number

26. Describe why it is important to record measurements that reflect the uncertainty of the measuring device. Give an example to support your answer. (4 pts)

   **See version A**
27. A remedy when you ingest certain poisons is to take medicinal carbon (charcoal) to absorb the poison out of your system. Let's assume medicinal carbon is pure carbon for the sake of this question. The density of pure carbon is 2.26 g/cm³. If you need to take 5 grams of carbon to filter out the amount of poison you just accidentally ingested, what volume of carbon will that be? (2 pts)

\[
\begin{align*}
D &= \frac{m}{V} \\
V &= \frac{m}{D} \\
V &= \frac{5 \text{ g}}{2.26 \text{ g/cm}^3} \\
V &= 2.2 \text{ cm}^3
\end{align*}
\]

28. **Spoiler Alert**: Astronaut Mark Watney finds himself stranded alone on Mars after a horrific storm forces his colleagues to abandon the planet, leaving him for dead. He must grow enough food to support himself while he waits for NASA to send a return flight in 4 years.

A. He decides to move Martian soil into the Hab (where he lives) and enrich it with bacteria from his own stool in order to plant potatoes. He measures carefully and finds that there is 86.0 m² of floor space in the Hab and the soil must be at least 10.0 cm in depth. What volume of Martian soil must Mark move into the Hab? (4 pts)

\[
0.100 \text{ m} \times 86.0 \text{ m}^2 = 8.60 \text{ m}^3
\]

B. Mark needs to eat 1600 Calories a day in order to survive. Potatoes provide 890 calories per kilogram. If Mark is able to grow 460 kilograms of potatoes on the floor of the Hab, how many days will those potatoes support him? Will he be able to survive until NASA is able to return for him??? (4 pts)

\[
460 \text{ kg} \left(\frac{890 \text{ cal}}{1 \text{ kg}}\right) \left(\frac{1 \text{ day}}{1000 \text{ cal}}\right) = 255.8 \text{ days}
\]

29. The measured density of galena is 7.9 g/cm³. The known density of galena is 7.6 g/cm³. Calculate the percent error. (2 pts)

\[
\% \text{ error} = \frac{\text{Actual} - \text{Experimental}}{\text{Actual}} \times 100\%
\]

\[
\frac{7.9 - 7.6}{7.6} \times 100 = 3.9\%\]

Extra Credit is on the back
Extra Credit: Show by dimensional analysis! (2 pts)
One mole (molecular equivalent) of gold has a mass of 196.9655 g. One mole of anything equals 6.022 x $10^{23}$ items of that thing, so in 1 mole of gold there are 6.022 x $10^{23}$ atoms. The diameter of a gold atom is $3.58 \times 10^{-10}$ m. If a block of gold of a mass of 202.5 g is drawn into a very thin wire of single gold atoms laid end to end, how long would the wire be? Express your answer in kilometers.