proprep™

Workbook

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Properties of Matter

Elementary Properties

Questions

1) State whether the following properties are physical or chemical:
   a. Liquid water freezes into ice.
   b. Zinc reacts with hydrochloric acid solution to produce hydrogen gas and a solution of zinc chloride in water.
   c. Copper is reddish brown.
   d. A bronze statue develops a green coating.

Answer Key

1)   a. Physical.   b. Chemical.   c. Physical.   d. Chemical.

Significant Figures

Questions

1) Express each of the following in decimal form:
   a. 2.78×10^{-3}
   b. 3245.9×10^{-5}
   c. 21.4×10^{-2}
   d. 5.678×10^{2}
   e. 8.2×10^{3}

2) Express each of the following in exponential form:
   a. 4,300
   b. 0.00976
   c. 56,322
   d. 724.8

3) How many significant figures are shown in the following? Explain.
   a. 0.0617
   b. 0.0089
   c. 429.52
   d. 9.035
   e. 62000
   f. 567.70

4) Express each of the following numbers to three significant figures:
   a. 27,000
   b. 276.3
   c. 53.07
   d. 8.9777×10^{4}
   e. 0.05467

5) Calculate each of the following and express the answers with the appropriate number of significant numbers:
   a. 0.7382×0.0035
   b. $0.23 + 12.692 - 0.075$
   c. $\dfrac{45.82 \times 35.6}{0.050}$
   d. $\dfrac{2.345 + 0.6329}{2.1 + 8.78 - 0.023}$

Answers

1) a. 0.00278   b. 0.032459   c. 0.214   d. 567.8
   e. 8200.

2) a. 4.300×10^3 b. 9.76×10^{-3} c. 5.6322×10^4 d. 7.248×10^2

3) a. 0.0617 has three significant figures; zeros to the left of the first nonzero digit are not significant.
   b. 0.0089 has two significant figures; zeros to the left of the first nonzero digit are not significant.
   c. 429.52 has five significant figures; non-zero digits are always significant.
   d. 9.035 has four significant figures; zeros between non-zero digits are significant.
   e. 62000 can have from 2 to 5 significant figures since there is no decimal point.
   f. 567.70 has five significant figures; zero to the right of the decimal point are significant.

4) a. 2.70×10^4 b. 276   c. 53.1   d. 8.98×10^4
   e. 0.0547

5) a. 2.6×10^{-3} b. 12.85   c. 3.3×10^4 d. 0.274.

Basic Tools for Calculations

Questions

1) Perform the following conversions:
   a. 0.145 L = ___ mL
   b. 18.2 mL = ___ L
   c. 671 cm^3 = ___ L
   d. 3.64 m^3 = ___ cm^3

2) Perform the following conversions:
   a. 1.67 kg = ___ g
   b. 711 g = ___ kg
   c. 3896 mm = ___ cm
   d. 0.211 cm = ___ mm
   e. 1 m^2 = ___ km^2
   f. 1 m^3 = ___ cm^3

3) Perform the following conversions:
   a. 62.2 in. = ___ cm
   b. 87 ft. = ___ m
   c. 1.36 lb = ___ g
   d. 252 lb = ___ kg
   e. 1.79 gal = ___ L

4) Which is the greater mass, 3378 μg or 0.00618 mg?

5) Which is the greater mass, 3456 mg or 0.000584 kg?

6) On a thermometer, the lowest temperature mark is at -10°C and the highest is 65°C. What are the equivalent Fahrenheit temperatures?

7) In San Bernardino, California, the lowest and highest temperatures are 20°F and 120°F. What are the equivalent Celsius temperatures?

8) A non-SI unit used in pharmaceutical work is the grain (gr), while 16 gr = 1 g.
   An aspirin tablet contains 6.0 gr of aspirin.
   A 160 lb individual takes two aspirin tablets a day.
   a. What is the quantity of aspirin in two tablets, expressed in milligrams?
   b. What is the dosage rate of aspirin, expressed in milligrams of aspirin per kilogram of body mass?

9) A $3\,\text{L}$ sample of butyric acid has a mass of $2{,}100\,\text{g}$.

What is the density of butyric acid in $\dfrac{\text{g}}{\text{mL}}$?

10) A $16\,\text{L}$ sample of chloroform at $20°\text{C}$ has a density of 1.48 grams per milliliter. What is the mass of the chloroform at $20°\text{C}$ in kilograms?

11) A sample of ethanol at $25°\text{C}$ weighs $340\,\text{g}$ and has a density of 0.789 grams per milliliter. What is the volume of the sample at $25°\text{C}$ in liters?

12) A square piece of aluminum foil, $10\,\text{in.}$ on a side, weighs $2.673\,\text{g}$.
What is the thickness of this foil?

The density of aluminum is $2.70\,\dfrac{\text{g}}{\text{cm}^3}$.

13) Which of the following has a greater mass?
   a. A rectangular bar of iron, $80\text{cm}\times2.5\text{cm}\times1.5\text{cm}$.
   b. A sheet of aluminum foil, $12.5\text{m}\times3.5\text{m}\times0.005\text{cm}$.

The following densities are given: iron, $7.86\,\dfrac{\text{g}}{\text{cm}^3}$ and aluminum, $2.70\,\dfrac{\text{g}}{\text{cm}^3}$.

14) To determine the mass of an irregularly shaped piece of copper, the following experiment is performed:
100 pieces of copper are added to $8.5\,\text{mL}$ of water in a graduated cylinder.

The total volume becomes $9\,\text{ml}$. The density of copper is $8.92\,\dfrac{\text{g}}{\text{cm}^3}$.

Determine the mass of a single piece of copper, assuming that all the pieces are of the same dimensions.

15) To determine the volume of an irregularly shaped vessel, the vessel was weighed empty ($120\,\text{g}$), and when filled with carbon tetrachloride ($282.5\,\text{g}$).
What is the volume capacity of the vessel, in mL?

The density of carbon tetrachloride is $1.59\,\dfrac{\text{g}}{\text{mL}}$.

16) A solution consisting of 7% acetone and 93% water by mass has a density of $0.9867\,\dfrac{\text{g}}{\text{mL}}$.

What mass of acetone, in kilograms, is present in $7.50\,\text{L}$ of solution?

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17) A solution of sucrose in water is 28% sucrose by mass and has a density of $1.118\dfrac{g}{mL}$.

What volume of this solution, in liters, must be used in an application requiring $1.095\,kg$ of sucrose?

18) Ethylene glycol has a density of $1.11\dfrac{g}{mL}$ at $20°C$.

      a. What is the mass, in grams, of $465\,mL$ ethylene glycol?
      b. What is the mass, in kilograms, of $17.2\,L$ ethylene glycol?
      c. What is the volume, in mL, occupied by $72.0\,g$ ethylene glycol?

Answer Key

1)   a. $145\ mL$ b. $0.0182\ L$ c. $0.671\ L$ d. $3.64\cdot10^6 cm^3$

2)   a. $1670\ g$ b. $0.711\ kg$ c. $389.6\ cm$ d. $2.11\ mm$ e. $1\cdot10^{-6} km^2$ f. $1\cdot10^{-6} cm^3$

3)   a. $165.61\ cm$ b. $26.52\ m$ c. $616.9\ g$ d. $114.41\ kg$ e. $6.78\ L$

4) $3378\ \mu g$

5) $3456\ \mu g$

6) $14°F$ and $149°F$, respectively.

7) $-6.67°C$ and $48.89°C$, respectively.

8)   a. $750\ mg$ b. $10.32\dfrac{mg\ aspirin}{kg\ body\ mass}$

9) $0.7\dfrac{g}{mL}$

10) $23.68\ kg$

11) $0.43\ L$

12) $0.00153\ cm$

13) b

14) $0.446\ g$

15) $102.2\ mL$

16) $0.518\ kg$

17) $3.5\,L$

18) a. $516.159\ g$ b. $19.1\ kg$ c. $64.86\ mL$