## Chapter 1: Chemical Foundations

1. Which of the following is an example of a quantitative observation?
   A) The piece of metal is longer than the piece of wood.
   B) Solution 1 is much darker than solution 2.
   C) The liquid in beaker A is blue.
   D) The temperature of the liquid is 60°C.
   E) At least two of the above (A-D) are quantitative observations.

   ANS: D DIF: Easy REF: 1.2
   KEY: Chemistry | general chemistry | general concepts | scientific method
   MSC: Conceptual

2. A quantitative observation
   A) contains a number and a unit
   B) does not contain a number
   C) always makes a comparison
   D) must be obtained through experimentation
   E) is none of these

   ANS: A DIF: Easy REF: 1.2
   KEY: Chemistry | general chemistry | general concepts | scientific method
   MSC: Conceptual

3. Generally, observed behavior that can be formulated into a statement, sometimes mathematical in nature, is called a(n)
   A) observation
   B) measurement
   C) theory
   D) natural law
   E) experiment

   ANS: D DIF: Easy REF: 1.2
   KEY: Chemistry | general chemistry | general concepts | scientific method
   MSC: Conceptual

4. The statement “The total mass of materials is not affected by a chemical change in those materials” is called a(n)
   A) observation
   B) measurement
   C) theory
   D) natural law
   E) experiment

   ANS: D DIF: Easy REF: 1.2
   KEY: Chemistry | general chemistry | general concepts | scientific method
   MSC: Conceptual

5. A chemical theory that has been known for a long time becomes a law.

ANS: F DIF: Easy REF: 1.2
KEY: Chemistry | general chemistry | general concepts | scientific method
MSC: Conceptual

6. Which of the following metric relationships is incorrect?
   A) 1 microliter = $10^{-6}$ liters
   B) 1 gram = $10^{3}$ kilograms
   C) $10^{3}$ milliliters = 1 liter
   D) 1 gram = $10^{2}$ centigrams
   E) 10 decimeters = 1 meter

   ANS: B DIF: Easy REF: 1.3
   KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | prefixes
   MSC: Quantitative

7. For which pair is the SI prefix not matched correctly with its meaning?
   A) $\text{mega} = 10^{6}$
   B) $\text{kilo} = 1000$
   C) $\text{deci} = 10$
   D) $\text{nano} = 10^{-9}$
   E) $\text{centi} = 0.01$

   ANS: C DIF: Easy REF: 1.3
   KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | prefixes
   MSC: Conceptual

8. A metric unit for length is
   A) gram
   B) milliliter
   C) yard
   D) kilometer
   E) pound

   ANS: D DIF: Easy REF: 1.3
   KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | base unit
   MSC: Conceptual

9. Which of the following is *not* a unit in the SI system?
   A) ampere
   B) candela
   C) Kelvin
   D) meter
   E) calorie

   ANS: E DIF: Easy REF: 1.3
   KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | base unit
   MSC: Conceptual

10. Order the four metric prefixes from smallest to largest.
    A) nano- < milli- < centi- < kilo-

B) milli- < nano- < centi- < kilo-
C) kilo- < centi- < nano- < milli-
D) kilo- < centi- < milli- < nano-
E) centi- < nano- < kilo- < milli-

ANS: A DIF: Easy REF: 1.3
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | prefixes
MSC: Conceptual

11. 8.1 kilogram(s) contains this many grams.
A) $8.1 \times 10^{2}$
B) $8.1 \times 10^{3}$
C) 81
D) 0.81
E) $8.1 \times 10^{-3}$

ANS: B DIF: Easy REF: 1.3
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | mass
MSC: Conceptual

12. Convert 0.3980 m to mm.
A) 398.0 mm
B) $3.980 \times 10^{-3}$ mm
C) $3.980 \times 10^{-4}$ mm
D) 0.03980 mm
E) none of these

ANS: A DIF: Easy REF: 1.3
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | prefixes
MSC: Conceptual

13. 6.1 seconds contain this many picoseconds.
A) $6.1 \times 10^{12}$
B) $6.1 \times 10^{-12}$
C) $6.1 \times 10^{-9}$
D) $6.1 \times 10^{9}$
E) $6.1 \times 10^{15}$

ANS: A DIF: Easy REF: 1.3
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | prefixes
MSC: Conceptual

14. 9.49 seconds contain this many nanoseconds.
A) $9.49 \times 10^{7}$
B) $9.49 \times 10^{9}$
C) $9.49 \times 10^{12}$
D) $9.49 \times 10^{10}$
E) $9.49 \times 10^{8}$

ANS: B DIF: Easy REF: 1.3

KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | prefixes
MSC: Conceptual

15. The distance of 21 km equals
A) 0.021 m
B) 0.21 m
C) 210 m
D) 2100 m
E) $2.1 \times 10^4$ m

ANS: E DIF: Easy REF: 1.3
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | prefixes
MSC: Conceptual

16. What is the measure of resistance an object has to a change in its state of motion?
A) mass
B) weight
C) volume
D) length
E) none of these

ANS: A DIF: Easy REF: 1.3
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Conceptual

17. The degree of agreement among several measurements of the same quantity is called _____. It reflects the reproducibility of a given type of measurement.
A) accuracy
B) error
C) precision
D) significance
E) certainty

ANS: C DIF: Easy REF: 1.4
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Conceptual

18. As part of the calibration of a new laboratory balance, a 1.000-g mass is weighed with the following results:

| Trial | Mass |
|---|---|
| 1 | 1.201 ± 0.001 |
| 2 | 1.202 ± 0.001 |
| 3 | 1.200 ± 0.001 |

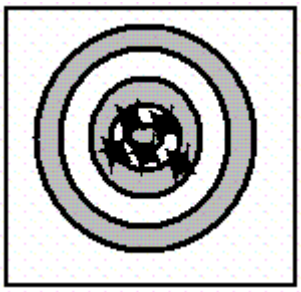
The balance is:
A) Both accurate and precise.
B) Accurate but imprecise.
C) Precise but inaccurate.
D) Both inaccurate and imprecise.
E) Accuracy and precision are impossible to determine with the available information.

ANS: C DIF: Easy REF: 1.4
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Conceptual

Consider the following three archery targets:

I. 

II. 

III. 

19. Which of the following figure(s) represent a result having high precision?
A) Figure I only
B) Figure II only
C) Figure III only
D) Figure I and Figure II
E) Figure II and Figure III

ANS: E DIF: Easy REF: 1.4
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Conceptual

20. Which of the following statements concerning these figures is correct?
A) Figure I represents systematic error and Figure II represents random error.
B) Figure I represents random error and Figure II represents systematic error.
C) Figure I and Figure II represent random error.
D) Figure I and Figure II represent systematic error.
E) Figure III represents no errors.

ANS: B DIF: Easy REF: 1.4
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Conceptual

21. Which of the following is the least probable concerning five measurements taken in the lab?
A) The measurements are accurate and precise.
B) The measurements are accurate but not precise.
C) The measurements are precise but not accurate.
D) The measurements are neither accurate nor precise.
E) All of these are equally probable.

ANS: B DIF: Easy REF: 1.4
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Conceptual

22. You measure water in two containers: a 10-mL graduated cylinder with marks at every mL, and a 1-mL pipet marked at every 0.1 mL. If you have some water in each of the containers and add them together, to what decimal place could you report the total volume of water?
A) 0.01 mL
B) 0.1 mL
C) 1 mL
D) 10 mL
E) none of these

ANS: B DIF: Moderate REF: 1.4
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Conceptual

23. The agreement of a particular value with the true value is called
A) accuracy
B) error
C) precision
D) significance
E) certainty

ANS: A DIF: Easy REF: 1.4
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Conceptual

24. The amount of uncertainty in a measured quantity is determined by:
A) both the skill of the observer and the limitations of the measuring instrument
B) neither the skill of the observer nor the limitations of the measuring instrument
C) the limitations of the measuring instrument only
D) the skill of the observer only
E) none of these

ANS: A DIF: Easy REF: 1.4
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Conceptual

25. A scientist obtains the number 0.045006700 on a calculator. If this number actually has four (4) significant figures, how should it be written?
A) 0.4567
B) 0.4501
C) 0.0450
D) 0.04500
E) 0.04501

ANS: E DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures | rounding MSC: Conceptual

26. Express the number 0.000333 in scientific notation.
A) $333 \times 10^{-6}$
B) $3.33 \times 10^{2}$

C) $3.33 \times 10^{4}$
D) $3.33 \times 10^{-4}$
E) $0.333 \times 10^{-3}$

ANS: D DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures | scientific notation MSC: Conceptual

27. Express 165,000 in exponential notation.
A) $1.65000 \times 10^{5}$
B) $1.65 \times 10^{5}$
C) $1.65000 \times 10^{-5}$
D) $1.65 \times 10^{-5}$
E) $165 \times 10^{3}$

ANS: B DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures | scientific notation MSC: Conceptual

28. Express the number 0.0810 in scientific notation.
A) $810 \times 10^{-4}$
B) $8.10 \times 10^{2}$
C) $8.1 \times 10^{-2}$
D) $8.10 \times 10^{-2}$
E) $0.810 \times 10^{-1}$

ANS: D DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures | scientific notation MSC: Conceptual

29. Express the number $6.49 \times 10^{-3}$ in common decimal form.
A) 0.00649
B) 6.49
C) 6490
D) 0.0649
E) 0.000649

ANS: A DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures | scientific notation MSC: Conceptual

30. Express the number $2.37 \times 10^{4}$ in common decimal form.
A) 237000
B) 0.0000237
C) 0.000237
D) 23700
E) 2370

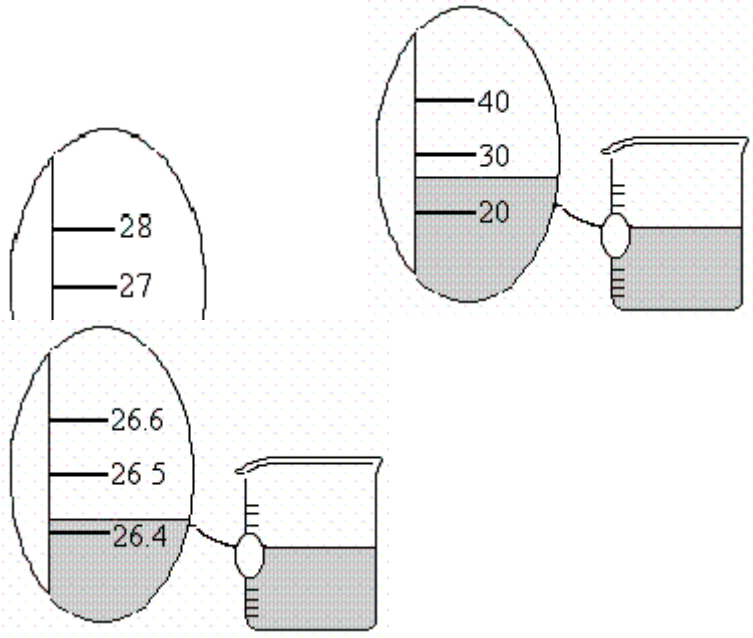
ANS: D DIF: Easy REF: 1.5

KEY: Chemistry | general chemistry | general concepts | measurement | significant figures | scientific notation MSC: Conceptual

31. We generally report a measurement by recording all of the certain digits plus ____ uncertain digit(s).
A) no
B) one
C) two
D) three
E) four

ANS: B DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Conceptual

32. The beakers shown below have different precisions as shown.




Suppose you pour the water from these three beakers into one container. What would be the volume in the container reported to the correct number of significant figures?
A) 78.817 mL
B) 78.82 mL
C) 78.8 mL
D) 80 mL
E) 79 mL

ANS: E DIF: Moderate REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Conceptual

33. You are asked to determine the perimeter of the cover of your textbook. You measure the length as 39.36 cm and the width as 24.83 cm. How many significant figures should you report for the perimeter?
A) 1
B) 2

C) 3
D) 4
E) 5

ANS: E DIF: Moderate REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Quantitative

34. Consider the numbers 23.68 and 4.12. The sum of these numbers has ____ significant figures, and the product of these numbers has ____ significant figures.
A) 3, 3
B) 4, 4
C) 3, 4
D) 4, 3
E) none of these

ANS: D DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Conceptual

35. Using the rules of significant figures, calculate the following:

$$\frac{6.167 + 68}{5.10}$$

A) 14.5
B) 16
C) 15
D) 82
E) 14.54

ANS: C DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Quantitative

36. Using the rules of significant figures, calculate the following: $4.0021 - 0.179$
A) 3.823
B) 4
C) 3.8231
D) 3.82
E) 3.8

ANS: A DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Quantitative

37. How many significant figures are there in the number 0.04560700?
A) 4
B) 5
C) 7
D) 8
E) 9

ANS: C DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Conceptual

38. How many significant figures are there in the number 0.0006428?
A) 7
B) 3
C) 8
D) 4
E) 0

ANS: D DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Conceptual

39. How many significant figures are there in the number 3.1400?
A) 1
B) 2
C) 3
D) 4
E) 5

ANS: E DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Conceptual

40. How many significant figures should be reported for the difference between 18.6172 mL and 18.57 mL?
A) 1
B) 2
C) 3
D) 4
E) 6

ANS: B DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Conceptual

41. What is the best answer to report for $\frac{3.478\ \text{g} \times 1.164\ \text{g}}{2.00\ \text{mL}} - 0.169\ \text{g/mL}$ g/mL?
A) 1.8510 g/mL
B) 1.851 g/mL
C) 1.85 g/mL
D) 1.9 g/mL
E) 2 g/mL

ANS: C DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Quantitative

42. What is the best answer to report for $(513 \times 0.0039) + 25.35$?

A) 27.351
B) 27.35
C) 27.3507
D) 27
E) 27.4

ANS: E DIF: Easy REF: 1.5
KEY: Chemistry | general chemistry | general concepts | measurement | significant figures
MSC: Quantitative

43. Convert 2751.4 g to mg.
A) 2.7514 mg
B) 27.514 mg
C) 275.14 mg
D) $2.7514 \times 10^3$ mg
E) $2.7514 \times 10^6$ mg

ANS: E DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

44. Express the volume $781.2\ \text{cm}^3$ in liters.
A) 781.2 L
B) 78.12 L
C) 7.812 L
D) 0.7812 L
E) 0.07812 L

ANS: D DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

45. Convert 44.7 $\text{m}^3$ to $\text{mm}^3$.
A) $4.47 \times 10^7\ \text{mm}^3$
B) $4.47 \times 10^{10}\ \text{mm}^3$
C) $4.47 \times 10^4\ \text{mm}^3$
D) $4.47 \times 10^{-5}\ \text{mm}^3$
E) $4.47 \times 10^{-8}\ \text{mm}^3$

ANS: B DIF: Moderate REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

46. The pressure of the earth's atmosphere at sea level is $14.7\ \text{lb/in}^2$. What is the pressure when expressed in $\text{g/m}^2$? (2.54 cm = 1 in., 2.205 lb = 1 kg)
A) $2.62 \times 10^5\ \text{g/m}^2$
B) $1.03 \times 10^7\ \text{g/m}^2$
C) $5.02 \times 10^4\ \text{g/m}^2$

D) $4.30 \times 10^{0}\ \text{g/m}^2$
E) $2.09 \times 10^{-5}\ \text{g/m}^2$

ANS: B DIF: Difficult REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

47. Convert 4338 mL to qt. (1 L = 1.06 qt)
A) 4598 qt
B) 4.092 qt
C) $4.092 \times 10^{-3}$ qt
D) 4092 qt
E) 4.598 qt

ANS: E DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

48. Convert 34.4 lb to g. (1 lb = 453.6 g)
A) $7.58 \times 10^{-2}$ g
B) $1.56 \times 10^{3}$ g
C) $7.58 \times 10^{4}$ g
D) $1.56 \times 10^{2}$ g
E) $1.56 \times 10^{4}$ g

ANS: E DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

49. Convert 59.4 mi to km. (1 m = 1.094 yd, 1 mi = 1760 yd)
A) $6.50 \times 10^{1}$ km
B) $3.69 \times 10^{1}$ km
C) $9.56 \times 10^{7}$ km
D) $5.43 \times 10^{1}$ km
E) $9.56 \times 10^{1}$ km

ANS: E DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

50. The density of liquid mercury is 13.6 g/mL. What is its density in units of $\text{lb/in}^3$? (2.54 cm = 1 in., 2.205 lb = 1 kg)
A) $1.57 \times 10^{-2}\ \text{lb/in}^3$
B) $4.91 \times 10^{-1}\ \text{lb/in}^3$
C) $1.01 \times 10^{-1}\ \text{lb/in}^3$
D) $7.62 \times 10^{-2}\ \text{lb/in}^3$
E) $1.83\ \text{lb/in}^3$

ANS: B DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

51. Convert 0.0494 $ft^3$ to L. (2.54 cm = 1 in., 1 L = 1 $dm^3$)
A) $1.40 \times 10^{1}$ L
B) 1.40 L
C) $1.51 \times 10^{-3}$ L
D) $1.74 \times 10^{-3}$ L
E) 1.62 L

ANS: B DIF: Moderate REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

52. In March 2008, gold reached a milestone value of $1000 per troy ounce. At that price, what was the cost of a gram of gold? (1 troy ounce = 31.10 g)
A) less than $1
B) between $1 and $10
C) between $10 and $50
D) between $50 and $100
E) over $100

ANS: C DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

53. It is estimated that uranium is relatively common in the earth's crust, occurring in amounts of 4 g / metric ton. A metric ton is 1000 kg. At this concentration, what mass of uranium is present in 1.5 mg of the earth's crust?
A) 6 ng
B) 6 $\mu$g
C) 6 mg
D) $6 \times 10^{-5}$ g
E) 6 cg

ANS: A DIF: Moderate REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

54. A 20.0 mL sample of glycerol has a mass of 25.2 grams. What is the density of glycerol in ounces/quart? (1.00 ounce = 28.4 grams, and 1.00 liter = 1.06 quarts)
A) 41.9 oz/qt
B) $4.19 \times 10^{-2}$ oz/qt
C) 837 oz/qt
D) 47.0 oz/qt
E) 26.4 oz/qt

ANS: A DIF: Difficult REF: 1.6

KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

55. During a physics experiment, an electron is accelerated to 93 percent of the speed of light. What is the speed of the electron in miles per hour? (speed of light = $3.00 \times 10^8$ m/s, 1 km = 0.6214 mi)
A) $2.8 \times 10^8$ mi/h
B) $6.2 \times 10^{11}$ mi/h
C) $6.7 \times 10^8$ mi/h
D) $1.0 \times 10^7$ mi/h
E) $6.2 \times 10^8$ mi/h

ANS: E DIF: Moderate REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

56. In the spring of 2008, petrol cost £1.179 per litre in London. On the same day, the exchange rate was \$1 = £0.493. What was the price of London petrol in dollars (\$) per gallon? (1 gal = 3.7854 L)
A) \$4.46 /gal
B) \$2.20 /gal
C) \$9.05 /gal
D) \$1.58 /gal
E) \$7.68 /gal

ANS: C DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

57. For spring break you and some friends plan a road trip to a sunny destination that is 2105 miles away. If you drive a car that gets 33 miles per gallon and gas costs \$3.199/gal, about how much will it cost to get to your destination?
A) \$410
B) \$220
C) \$200
D) \$660
E) \$6700

ANS: C DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

58. Convert 7.9 kg to lb. (1 kg = 2.205 lb)
A) 17 lbs
B) 1.7 lbs
C) 3.6 lbs
D) 0.017 lbs
E) 17.42 lbs

ANS: A DIF: Easy REF: 1.6

KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

59. Manganese makes up $1.3 \times 10^{-4}$ percent by mass of the elements found in a normal healthy body. How many grams of manganese would be found in the body of a person weighing 206 lb? (2.205 lb = 1 kg)
A) 0.59 g
B) 0.12 g
C) 12 g
D) 59 g
E) $1.2 \times 10^{-4}$ g

ANS: B DIF: Moderate REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

60. In 1928, 29.3 g of a new element was isolated from 660 kg of the ore molybdenite. The percent by mass of this element in the ore was:
A) 44 %
B) 6.6 %
C) 29.3 %
D) 0.0044 %
E) 19.3 %

ANS: D DIF: Moderate REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Quantitative

61. 409 Kelvin equals
A) 136°F
B) 273°F
C) 682°F
D) 136°C
E) 682°C

ANS: D DIF: Easy REF: 1.7
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | temperature
MSC: Quantitative

62. The melting point of a certain element is 391°C. What is this on the Fahrenheit scale?

$$\left( T_{°F} = T_{°C} \times \left( \frac{9°F}{5°C} \right) + 32°F \right)$$

A) 490°F
B) 249°F
C) 977°F
D) 736°F
E) 672°F

ANS: D DIF: Easy REF: 1.7

KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | temperature
MSC: Quantitative

63. Convert: –48.2°C = _____ °F. $\left(T_{°F} = T_{°C} \times \left(\frac{9°F}{5°C}\right) + 32°F\right)$

A) –86.8°F
B) –119°F
C) –54.8°F
D) 119°F
E) 224.8°F

ANS: C DIF: Easy REF: 1.7
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | temperature
MSC: Quantitative

64. As warm water sits in a cool room, you measure the temperature change ($\Delta T = T_{final} - T_{initial}$). Which of the following is true?

A) The temperature change (ΔT) is bigger if you are measuring in °F.
B) The temperature change (ΔT) is bigger if you are measuring in °C.
C) The temperature change (ΔT) will be the same regardless of the scale you use.
D) Answer A or B is correct, depending on the difference in temperature between the water and the room.
E) None of the above.

ANS: A DIF: Easy REF: 1.7
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | temperature
MSC: Conceptual

65. The melting point of picolinic acid is 136.5°C. What is the melting point of picolinic acid on the Fahrenheit scale?

$\left(T_{°F} = T_{°C} \times \left(\frac{9°F}{5°C}\right) + 32°F\right)$

A) 107.8°F
B) 245.7°F
C) 168.5°F
D) 409.5°F
E) 277.7°F

ANS: E DIF: Easy REF: 1.7
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | temperature
MSC: Quantitative

66. In 1984, some drums of uranium hexafluoride were lost in the English Channel, which is known for its cold water (about 17°C). The melting point of uranium hexafluoride is 148°F. In what physical state is the uranium hexafluoride in these drums?

$$\left(T_{°F} = T_{°C} \times \left(\frac{9°F}{5°C}\right) + 32°F\right)$$

A) solid
B) liquid
C) gas
D) a mixture of solid and liquid
E) not enough information

ANS: A DIF: Moderate REF: 1.7
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | temperature
MSC: Conceptual

67. The melting point of indium is 156.2°C. At 323°F, what is the physical state of indium?

$$\left(T_{°F} = T_{°C} \times \left(\frac{9\ °F}{5\ °C}\right) + 32\ °F\right)$$

A) Solid.
B) Liquid.
C) Gas.
D) Not enough information.
E) At 323°F, the indium is partially solid and partially liquid; there is an equilibrium between the two states.

ANS: D DIF: Moderate REF: 1.7
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | temperature
MSC: Conceptual

68. On a new temperature scale (°Z), water boils at 120.0°Z and freezes at 40.0°Z. Calculate the normal human body temperature using this temperature scale. On the Celsius scale, normal human body temperature could typically be 37.1°C, and water boils at 100.0°C and freezes at 0.00°C.
A) 2968°Z
B) 12.4°Z
C) 69.7°F
D) 111°Z
E) 29.7°Z

ANS: C DIF: Difficult REF: 1.7
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Quantitative

69. The calibration points for the linear Reaumur scale are the usual melting point of ice and boiling point of water, which are assigned the values 0°R and 80°R, respectively. The boiling point of ethanol is 78.4°F. What is this temperature in °R?
A) 158.4°R
B) 49.1°R
C) 25.8°R
D) 208.4°R

E) 20.6°R

ANS: E DIF: Difficult REF: 1.7
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | temperature
MSC: Conceptual

70. A monolayer containing $3.23 \times 10^{-6}$ g of oleic acid has an area of 20.0 $cm^2$. The density of oleic acid is 0.895 g / mL. What is the thickness of the monolayer (the length of an oleic acid molecule)?
A) $7.22 \times 10^{-5}$ cm
B) $5.54 \times 10^{-6}$ cm
C) $5.78 \times 10^{-5}$ cm
D) $1.80 \times 10^{-7}$ cm
E) $1.45 \times 10^{-7}$ cm

ANS: D DIF: Moderate REF: 1.8
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | density
MSC: Quantitative

71. The density of gasoline is 0.7025 g/mL at 20°C. When gasoline is added to water:
A) It will float on top.
B) It will sink to the bottom.
C) It will mix so, you can't see it.
D) The mixture will improve the running of the motor.
E) None of these things will happen.

ANS: A DIF: Easy REF: 1.8
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | density
MSC: Conceptual

72. A piece of zinc with a mass of 12.14 g is submerged in 46.3 $cm^3$ of water in a graduated cylinder. The water level increases to 48.0 $cm^3$. The correct value for the density of zinc from these data is:
A) 7.141 $g/cm^3$
B) 7.1 $g/cm^3$
C) 0.14 $g/cm^3$
D) 0.253 $g/cm^3$
E) 3.95 $g/cm^3$

ANS: B DIF: Moderate REF: 1.8
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | density
MSC: Quantitative

The density of a liquid is determined by successively weighing 25, 50, 75, 100, and 125 mL of the liquid in a 250-mL beaker.

73. If volume of liquid is plotted along the horizontal axis, and total mass of beaker plus liquid is plotted on the vertical axis:
A) The *x*, or horizontal, intercept is the negative value of the weight of the beaker.
B) The *y*, or vertical, intercept is the weight of the empty beaker.
C) The slope of the line is 1.0.
D) The line will pass through the origin.
E) The slope of the line is independent of the identity of the liquid.

ANS: B DIF: Moderate REF: 1.8
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | density
MSC: Conceptual

74. Considering the plot of total mass (*y*-axis) versus volume (*x*-axis), which of the following is true?
A) The plot should be rather linear because the slope measures the density of a liquid.
B) The plot should be curved upward because the slope measures the density of a liquid.
C) The plot should be curved upward because the mass of the liquid is higher in successive trials.
D) The plot should be linear because the mass of the beaker stays constant.
E) None of the above.

ANS: A DIF: Difficult REF: 1.8
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | density
MSC: Conceptual

75. A 20.0 mL sample of glycerol has a mass of 25.2 grams. What is the mass of a 57-mL sample of glycerol?
A) 8.8 g
B) 45 g
C) $2.9 \times 10^4$ g
D) 72 g
E) 71.8 g

ANS: D DIF: Easy REF: 1.8
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | density
MSC: Quantitative

76. Suppose that you purchased a water bed with the dimensions 2.55 m × 2.53 dm × 235 cm. What mass of water does this bed contain?
A) $1.52 \times 10^3$ g
B) $1.52 \times 10^4$ g
C) $1.52 \times 10^5$ g
D) $1.52 \times 10^8$ g
E) $1.52 \times 10^6$ g

ANS: E DIF: Moderate REF: 1.8
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | density
MSC: Quantitative

77. A freighter carrying a cargo of uranium hexafluoride sank in the English Channel in late August 1984. The cargo of uranium hexafluoride weighed $2.253 \times 10^8$ kg and was contained in 30 drums, each containing $1.47 \times 10^6$ L of $UF_6$. What is the density (g/mL) of uranium hexafluoride?
A) 1.53 g/mL
B) 5.11 g/mL
C) 2.25 g/mL
D) 0.196 g/mL
E) 51.1 g/mL

ANS: B DIF: Moderate REF: 1.8
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | density
MSC: Quantitative

78. The boiling of water is a
A) physical change because the water merely disappears
B) physical change because the gaseous water is chemically the same as the liquid
C) chemical change because heat is needed for the process to occur
D) chemical change because a gas (steam) is given off
E) chemical and physical damage

ANS: B DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter MSC: Conceptual

79. The state of matter for an object that has a definite volume but not a definite shape is
A) solid state
B) liquid state
C) gaseous state
D) elemental state
E) mixed state

ANS: B DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter | states of matter
MSC: Conceptual

80. The state of matter for an object that has both definite volume and definite shape is
A) solid state
B) liquid state
C) gaseous state
D) elemental state
E) mixed state

ANS: A DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter | states of matter
MSC: Conceptual

81. _____ are substances with constant composition that can be broken down into elements by chemical processes.
A) Solutions
B) Mixtures

C) Compounds
D) Quarks
E) Heterogeneous mixtures

ANS: C DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter MSC: Conceptual

82. A method of separation that employs a system with two phases of matter, a mobile phase and a stationary phase, is called
A) filtration
B) chromatography
C) distillation
D) vaporization
E) homogenization

ANS: B DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter MSC: Conceptual

83. Which of the following statements is false?
A) Solutions are always homogeneous mixtures.
B) The terms “atom” and “element” can have different meanings.
C) Elements can exist as atoms or molecules.
D) Compounds can exist as atoms or molecules.
E) At least two of the above statements (A-D) are false.

ANS: D DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter MSC: Conceptual

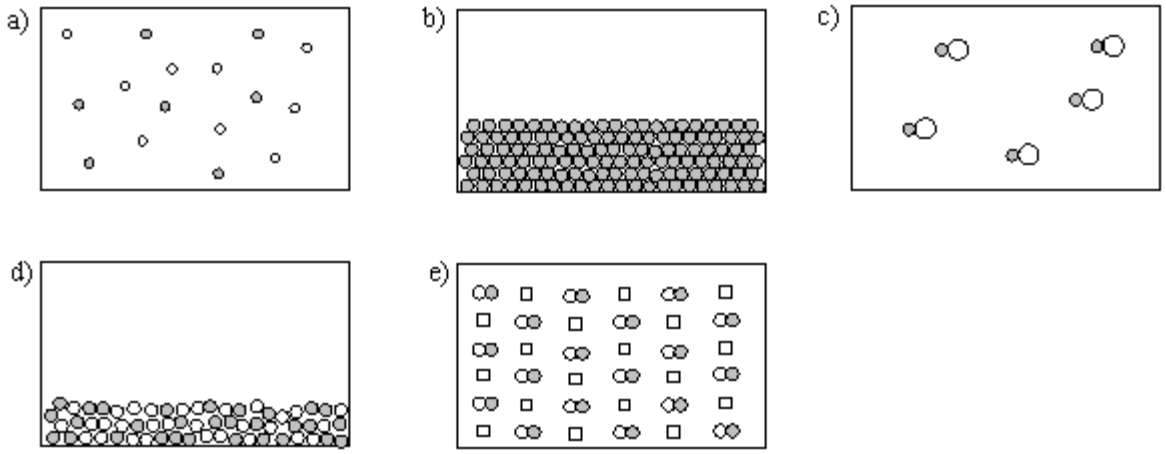
84. An example of a pure substance is
A) elements
B) compounds
C) pure water
D) carbon dioxide
E) all of these

ANS: E DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter MSC: Conceptual

85. A solution is also called a
A) homogeneous mixture
B) heterogeneous mixture
C) pure mixture
D) compound
E) distilled mixture

ANS: A DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter | mixture
MSC: Conceptual

Consider the following choices when answering questions 86-89.




86. Which best represents a homogeneous mixture of an element and a compound?
    A) option a
    B) option b
    C) option c
    D) option d
    E) option e

    ANS: E DIF: Easy REF: 1.9
    KEY: Chemistry | general chemistry | general concepts | matter | mixture
    MSC: Conceptual

87. Which best represents a gaseous compound?
    A) option a
    B) option b
    C) option c
    D) option d
    E) option e

    ANS: C DIF: Easy REF: 1.9
    KEY: Chemistry | general chemistry | general concepts | matter | states of matter
    MSC: Conceptual

88. Which best represents a solid element?
    A) option a
    B) option b
    C) option c
    D) option d
    E) option e

    ANS: B DIF: Easy REF: 1.9
    KEY: Chemistry | general chemistry | general concepts | matter | element
    MSC: Conceptual

89. Which best represents a heterogeneous mixture of two elements?
    A) option a
    B) option b
    C) option c

D) option d
E) option e

ANS: D DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter | mixture
MSC: Conceptual

90. All physical changes are accompanied by chemical changes.

ANS: F DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter MSC: Conceptual

91. Color changes always indicate a chemical change.

ANS: F DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter MSC: Conceptual

92. What are the components of the scientific method?

ANS:
1) Making observations (collecting data)
2) Suggesting a possible explanation (formulating a hypothesis)
3) Doing experiments to test the possible explanation (testing the hypothesis)
Depending on the data from the experiments, the hypothesis may be modified and retested.
See Sec. 1.2 of Zumdahl, *Chemistry*.

DIF: Easy REF: 1.2
KEY: Chemistry | general chemistry | general concepts | scientific method
MSC: Conceptual

93. Garfield (weighing 24 lbs) took a flight to the moon on the space shuttle. As usual, he stuffed himself with lasagna during the entire flight and napped when he wasn't eating. Much to his delight when he got to the moon he found he weighed only 6 lbs. He immediately proclaimed a quick weight loss diet. Explain the fallacy in his reasoning. Assume gravity on the moon to be about one-sixth that of Earth.

ANS:
Garfield (the cartoon cat) may have a different weight on the moon, but he has the same mass. He has apparently forgotten that weight is the response of mass to gravity, and since the moon has a smaller gravitational field his weight there is less.
See Sec. 1.3 of Zumdahl, *Chemistry*.

DIF: Moderate REF: 1.3
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | mass
MSC: Conceptual

94. Contrast the terms precision and accuracy.

ANS:

Precision refers to the agreement among several measurements of the same quantity.
Accuracy refers to the agreement of a measurement with the true value.
Measurements may often be precise without being accurate.
See Sec. 1.4 of Zumdahl, *Chemistry*.

DIF: Easy REF: 1.4
KEY: Chemistry | general chemistry | general concepts | measurement
MSC: Conceptual

95. What data would you need to estimate the money you would spend on gas to drive your car from Los Angeles to Chicago? Provide a sample calculation.

ANS:

Data would include: average price per gallon of gasoline, average MPG of the car, mileage of trip.

$$\$ = \text{miles} \times \frac{\text{gal}}{\text{miles}} \times \frac{\$}{\text{gal}}$$

DIF: Easy REF: 1.6
KEY: Chemistry | general chemistry | general concepts | measurement | factor label method
MSC: Conceptual

96. On a new temperature scale (°Y), water boils at 155.0°Y and freezes at 0.00°Y. Calculate the normal human body temperature using this temperature scale. On the Fahrenheit scale, normal human body temperature is 98.6°F, and water boils at 212.0°F and freezes at 32.0°F.

ANS:
57.3°Y
The formula derived from the data is Y=(155/180)(F-32).

DIF: Difficult REF: 1.7
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | temperature
MSC: Quantitative

97. Explain how Archimedes might have used the concept of density to determine whether the king's crown was pure gold. (density of gold = 19.32 $g/cm^3$)

ANS:
If the density of gold was known to Archimedes, he could weigh the crown to determine its mass and then submerge the crown in water to measure the volume by displacement. By comparing the density of the crown calculated from this data to the known density of gold, he could find out if the crown was made of gold.
Archimedes' Principle is slightly different, and not specifically addressed in this text.
See Sec. 1.8 of Zumdahl, *Chemistry*.

DIF: Moderate REF: 1.8
KEY: Chemistry | general chemistry | general concepts | measurement | SI unit | density

MSC: Conceptual

98. Explain the main differences between a compound and a mixture.

ANS:
A mixture may be separated into pure substances by physical means, while a compound requires chemical means to separate it into elements.
A compound has constant composition (always the same ratio of elements), while a mixture may have varying composition.
See Sec. 1.9 of Zumdahl, *Chemistry*.

DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter | compound; mixture
MSC: Conceptual

99. Give three physical methods used by chemists to separate mixtures and identify the type of mixture best suited for each process.

ANS:
Three common methods are distillation, filtration, and chromatography.
Distillation is useful for mixtures of volatile liquids (or mixtures of gases that can be condensed).
Filtration is useful to separate a mixture of a solid and a liquid.
Chromatography may be used for mixtures of volatile substances (gas chromatography) or soluble substances (paper chromatography).
See Sec. 1.9 of Zumdahl, *Chemistry*.

DIF: Moderate REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter | mixture
MSC: Conceptual

100. Name three methods for the separation of mixtures.

ANS:
Three common methods are distillation, filtration, and chromatography.
See Sec. 1.9 of Zumdahl, *Chemistry*.

DIF: Easy REF: 1.9
KEY: Chemistry | general chemistry | general concepts | matter | mixture
MSC: Conceptual