

Name _____

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

- 1) The ripening of fruit, once picked, is an example of physical change. 1) _____
- 2) An important aim in much chemical work is to use macroscopic measurements in order to gain an understanding of the microscopic world. 2) _____
- 3) The potential energy of a car moving on a level road does not depend on its speed. 3) _____
- 4) When a wooden match burns in air, chemical potential energy is converted to kinetic energy. 4) _____
- 5) When applying the scientific method, it is important to avoid any form of hypothesis. 5) _____
- 6) When applying the scientific method, a model or theory should be based on experimental data. 6) _____
- 7) The numerical value of any temperature expressed in Celsius is always different from the numerical value of the same temperature in kelvin. 7) _____
- 8) The number 6.0448, rounded to 3 decimal places, becomes 6.045. 8) _____
- 9) The number 6.0448, rounded to 2 decimal places, becomes 6.05. 9) _____
- 10) The weight of a coin measured as 1.96235 g on one balance is definitely more accurate than a weight measurement of 1.95 g on another balance. 10) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 11) Which of the following correctly shows how to convert a density of 20.1 g cm⁻³ to units of kg m⁻³? 11) _____
- A)
$$\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{1 \text{ cm}^3}{0.01 \text{ m}^3}$$
- B)
$$\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{(0.01 \text{ cm})^3}{(1 \text{ m})^3}$$
- C)
$$\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{(1 \text{ cm})^3}{(0.01 \text{ m})^3}$$
- D)
$$\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1000 \text{ kg}}{1 \text{ g}} \times \frac{1 \text{ cm}^3}{0.01 \text{ m}^3}$$
- E)
$$\frac{20.1 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ kg}}{1000 \text{ g}} \times \frac{0.01 \text{ cm}^3}{1 \text{ m}^3}$$
- 12) Which one of the following numbers contains a digit or digits which is/are not significant? 12) _____
- A) 20.01 B) 502 C) .0043 D) 970.0 E) .300
- 13) If the price of gold at the morning fixing in London, England was \$11,709 per kg, what would a kilogram of gold have cost in £ (English pounds)? (Assume an exchange rate of \$1.00 = £0.545) 13) _____
- A) £3510 B) £10400 C) £1310 D) £17100 E) £6380
- 14) The result of (3.8621 × 1.5630) - 5.98 is properly written as 14) _____
- A) 0.06.
B) 0.056462.
C) 0.0565.
D) 0.05646.
E) 0.056.
- 15) Given that 1 inch = 2.54 cm, 1 cm³ is equal to 15) _____
- A) 0.0610 in³.
B) 0.394 in³.
C) 0.155 in³.
D) 6.45 in³.
E) 16.4 in³.

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- 16) The speed needed to escape the pull of Earth's gravity is 11.3 km/s. What is this speed in m/s? 16) _____
- A) 1.13×10^2 m/s
 - B) 1.13×10^3 m/s
 - C) 0.0113 m/s
 - D) 1.13×10^{-2} m/s
 - E) 1.13×10^4 m/s
- 17) The distance between carbon atoms in ethylene is 134 picometers. Which of the following expresses that distance in meters? 17) _____
- A) 1.34×10^{-13} m
 - B) 1.34×10^{-7} m
 - C) 1.34×10^{-12} m
 - D) 1.34×10^{-6} m
 - E) 1.34×10^{-10} m
- 18) The average distance from Earth to the Sun is 150 megameters. What is that distance in meters? 18) _____
- A) 1.5×10^{-6} m
 - B) 1.5×10^3 m
 - C) 1.5×10^6 m
 - D) 1.5×10^5 m
 - E) 1.5×10^8 m
- 19) A flask has a mass of 78.23 g when empty and 593.63 g when filled with water. When the same flask is filled with concentrated sulfuric acid, H_2SO_4 , its mass is 1026.57 g. What is the density of concentrated sulfuric acid? (Assume water has a density of 1.00 g/cm³ at the temperature of the measurement.) 19) _____
- A) 1.729 g/cm³
 - B) 0.543 g/cm³
 - C) 1.598 g/cm³
 - D) 1.992 g/cm³
 - E) 1.840 g/cm³
- 20) Which of the following represents the largest volume? 20) _____
- A) 100 mL
 - B) 10 nL
 - C) 1000 pL
 - D) 10,000 μL
 - E) 10 cm³
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- 21) The joule is the S.I. unit of energy, and is equal to $1 \text{ kg m}^2 \text{ s}^{-2}$. The erg is another energy unit, equal to $1 \text{ g cm}^2 \text{ s}^{-2}$. Use unit conversion methods to work out how many ergs are there in 1 joule. 21) _____
- A) 10^7 ergs B) 10 ergs C) 10^5 ergs D) 10^{-1} ergs E) 10^2 ergs
- 22) The S.I. prefix mega- (M) means 22) _____
- A) 10^{-6} . B) 10^{-3} . C) 10^6 . D) 10^9 . E) 10^3 .
- 23) Select the answer that expresses the result of this calculation with the correct number of significant figures and with correct units. 23) _____
- A) 105.2 g/cm^2
 B) $16.18 \text{ cm} \times 9.6114 \text{ g} \div 1.4783 \text{ cm}^2 =$
 C) 72.13 g/cm^2
 D) 105.2 g/cm
 E) 105.2 g/cm^3
- 24) The area of a 3.80 dm diameter pizza is 11.3 dm^2 . Express this area in square centimeters. 24) _____
- A) 1.13 cm^2
 B) 11300 cm^2
 C) 1130 cm^2
 D) 113 cm^2
 E) 113000 cm^2
- 25) Select the answer that expresses the result of this calculation with the correct number of significant figures. 25) _____
- A) 13.36
 B) 13
 C) 13.3568
 D)
$$\frac{13.602 \times 1.90 \times 3.06}{4.2 \times 1.4097} =$$

 E) 13.357
- 26) The density of mercury, the only metal to exist as a liquid at room temperature, is 13.6 g/cm^3 . What is that density in kg/dm^3 ? 26) _____
- A) $13.6 \times 10^{-2} \text{ kg/dm}^3$
 B) $13.6 \times 10^3 \text{ kg/dm}^3$
 C) $13.6 \times 10^{-3} \text{ kg/dm}^3$
 D) $13.6 \times 10^2 \text{ kg/dm}^3$
 E) 13.6 kg/dm^3

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- 27) Which measurement is expressed to 4 significant figures? 27) _____
A) 24.049 cm
B) 82,306 m
C) 62.40 g
D) 0.423 kg
E) 1300 K
- 28) Acetic acid boils at 391.0 K. What is its boiling point in degrees Celsius? 28) _____
A) 382.0 B) 153.4 C) 117.9 D) 103.7 E) 167.7
C C C C C
- 29) A large pizza has a diameter of 3.8 dm. Express this diameter in centimeters. 29) _____
A) 9.3 cm B) 5.9 cm C) 18 cm D) 24 cm E) 38 cm
- 30) Talc is a mineral that has low conductivity for heat and electricity and that is not attacked by acid. It is used as talcum powder and face powder. A sample of talc weighs 35.97 g in air and 13.65 g in mineral oil ($d = 1.75 \text{ g/cm}^3$). What is the density of talc? 30) _____
A) 4.61 g/cm^3
B) 2.82 g/cm^3
C) 1.61 g/cm^3
D) 2.44 g/cm^3
E) 2.63 g/cm^3
- 31) At a pressure of one billionth (10^{-9}) of atmospheric pressure, there are about 2.7×10^{10} molecules in one cubic centimeter of a gas. How many molecules is this per cubic meter? 31) _____
A) 2.7×10^{14}
B) 2.7×10^4
C) 2.7×10^{12}
D) 2.7×10^{16}
E) 2.7×10^8
- 32) Select the answer with the correct number of decimal places for the following sum: 32) _____
 $13.914 \text{ cm} + 243.1 \text{ cm} + 12.00460 \text{ cm} =$
A) 269 cm
B) 269.019 cm
C) 269.0 cm
D) 269.01860 cm
E) 269.0186 cm

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- 33) Acetone, which is used as a solvent and as a reactant in the manufacture of Plexiglas[®], boils at 56.1 C. What is the boiling point in kelvins? 33) _____
A) 329.2 K B) 56.1 K C) 462.4 K D) -217.0 K E) 298.2 K
- 34) The appropriate number of significant figures in the result of 15.234 - 15.208 is 34) _____
A) 1. B) 2. C) 3. D) 4. E) 5.
- 35) A dose of medication was prescribed to be 35 microliters. Which of the following expresses that volume in centiliters? 35) _____
A) 3.5 cL
B) 3.5×10^{-3} cL
C) 3.5×10^{-4} cL
D) 3.5×10^5 cL
E) 3.5×10^4 cL
- 36) Isopropyl alcohol, commonly known as rubbing alcohol, boils at 82.4 C. What is the boiling point in kelvins? 36) _____
A) -190.8 K B) 355.6 K C) 323.6 K D) 387.6 K E) 190.8 K
- 37) The appropriate number of significant figures in the result of 15.234×15.208 is 37) _____
A) 2. B) 4. C) 5. D) 6. E) 3.
- 38) If the density of a certain spherical atomic nucleus is 1.0×10^{14} g cm⁻³ and its mass is 2.0×10^{-23} g, what is its radius in cm? 38) _____
A) 2.0×10^{-37} cm
B) 2.2×10^{-19} cm
C) 3.6×10^{-13} cm
D) 4.8×10^{-38} cm
E) none of the other choices
- 39) Which of the following correctly expresses 52,030.2 m in scientific notation? 39) _____
A) 5.20302×10^4 m
B) 5.203×10^4 m
C) 5.20×10^4 m
D) 5.2×10^4 m
E) 5.20302×10^5 m

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- 40) The mass of a sample is 550 milligrams. Which of the following expresses that mass in kilograms? 40) _____
- A) 5.5×10^8 kg
 - B) 5.5×10^{-1} kg
 - C) 5.5×10^{-4} kg
 - D) 5.5×10^5 kg
 - E) 5.5×10^{-6} kg
- 41) The average distance between the Earth and the Moon is 6100 megameters. Express this distance in kilometers. 41) _____
- A) 6.1×10^3 km
 - B) 6.1×10^5 km
 - C) 6.1×10^7 km
 - D) 6.1×10^4 km
 - E) 6.1×10^6 km
- 42) Which of the following correctly expresses 0.000007913 g in scientific notation? 42) _____
- A) 7.913×10^{-6} g
 - B) 7.913×10^{-9} g
 - C) 7.913×10^6 g
 - D) 7.913×10^{-5} g
 - E) 7.913×10^5 g
- 43) In an average year the American chemical industry produces more than 9.5 million metric tons of sodium carbonate. Over half of this is used in the manufacture of glass while another third is used in the production of detergents and other chemicals. How many kilograms of sodium carbonate are produced annually? 43) _____
- A) 9.5×10^6 kg
 - B) 9.5×10^9 kg
 - C) 9.5×10^{12} kg
 - D) 9.5×10^{15} kg
 - E) 9.5×10^3 kg
- 44) Express 96,342 m using 2 significant figures. 44) _____
- A) 9.6×10^{-4} m
 - B) 9.60×10^4 m
 - C) 96000 m
 - D) 9.60×10^{-4} m
 - E) 9.6×10^4 m

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- 45) Which of the following is an extensive property of oxygen? 45) _____
- A) mass
 - B) boiling point
 - C) density
 - D) average kinetic energy of molecules
 - E) temperature
- 46) During the swing of a frictionless pendulum, what energy form(s) remain constant? 46) _____
- A) potential energy only
 - B) kinetic energy only
 - C) kinetic plus potential energy
 - D) both kinetic energy and potential energy
 - E) none of the other choices remain constant
- 47) Which of the following is a chemical change? 47) _____
- A) carving a piece of wood
 - B) melting wax
 - C) boiling of water
 - D) broiling a steak on a grill
 - E) condensing water vapor into rainfall
- 48) Bud N. Chemist must determine the density of a mineral sample. His four trials yield densities of 4.77 g/cm^3 , 4.67 g/cm^3 , 4.69 g/cm^3 , and 4.81 g/cm^3 . Independent studies found the correct density to be 4.75 g/cm^3 . Which of the following statements represents the best analysis of the data? 48) _____
- A) Bud's equipment is faulty.
 - B) Bud's results have much greater precision than accuracy.
 - C) Bud's results have much greater accuracy than precision.
 - D) Bud's results have low accuracy and low precision.
 - E) Bud's results have high accuracy and high precision.
- 49) Select the best statement. 49) _____
- A) Chemical changes are easily reversed by altering the temperature of the system.
 - B) Chemical changes always produce substances different from the starting materials.
 - C) Chemical changes are accompanied by changes in the total mass of the substances involved.
 - D) Chemical changes provide the only valid basis for identification of a substance.
 - E) Chemical changes are associated primarily with extensive properties.

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- 50) Which state of matter is the most affected by electric or magnetic fields? 50) _____
- A) Gas
 - B) Solid
 - C) Plasma
 - D) Liquid
 - E) None of the states are affected by magnetic or electric fields
- 51) As chief chemist at Superior Analytical Products (SAP) you must design an experiment to determine the density of an unknown liquid to three (3) significant figures. The density is of the order of 1 g/cm^3 . You have approximately 7 mL of the liquid and only graduated cylinders and balances are available for your use. Which of the following combinations of equipment will allow you to meet but not exceed your goal? 51) _____
- A) graduated cylinder with $\pm 0.01 \text{ mL}$ uncertainty; balance with $\pm 0.01 \text{ g}$ uncertainty
 - B) graduated cylinder with $\pm 0.001 \text{ mL}$ uncertainty; balance with $\pm 0.001 \text{ g}$ uncertainty
 - C) graduated cylinder with $\pm 0.1 \text{ mL}$ uncertainty; balance with $\pm 0.1 \text{ g}$ uncertainty
 - D) graduated cylinder with $\pm 0.1 \text{ mL}$ uncertainty; balance with $\pm 0.001 \text{ g}$ uncertainty
 - E) graduated cylinder with $\pm 0.01 \text{ mL}$ uncertainty; balance with $\pm 0.1 \text{ g}$ uncertainty
- 52) Which of the following abbreviations of the given SI base unit is incorrect? 52) _____
- A) second: s
 - B) kelvin: K
 - C) kilogram: kg
 - D) mole: m
 - E) ampere: A
- 53) The symbol for the S.I. base unit of mass is 53) _____
- A) kg.
 - B) g.
 - C) lb.
 - D) metric ton.
 - E) mg.
- 54) Select the best statement about chemistry before 1800. 54) _____
- A) Alchemy focused on objective experimentation rather than mystical explanations of processes.
 - B) Lavoisier's quantitative work on the role of oxygen in combustion was the beginning of modern chemistry.
 - C) Alchemists failed because they did not develop any practical chemical methods.
 - D) The phlogiston theory laid a valuable theoretical basis for modern chemistry.
 - E) The interpretation of data by alchemists was not biased by their overall view of life.
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- 55) A dictionary has the following definition for a word: "a tentative explanation that accounts for a set of facts." Which of the following words best fits that definition? 55) _____
- A) hypothesis
 - B) definition
 - C) theory
 - D) experiment
 - E) law
- 56) A scientist made careful measurements of the pressure and temperature of many different gases. Based on these measurements, he concluded that "the pressure of a fixed amount of gas, measured at constant volume, is directly proportional to its absolute temperature." This statement is best described as a 56) _____
- A) definition.
 - B) experiment.
 - C) law.
 - D) hypothesis.
 - E) theory.
- 57) A detailed explanation of natural phenomena that is generally accepted and has been extensively tested is called a 57) _____
- A) law.
 - B) theory.
 - C) postulate.
 - D) fact.
 - E) hypothesis.
- 58) The S.I. unit of speed (velocity) is 58) _____
- A) m/h.
 - B) m/s.
 - C) km/h.
 - D) km/s.
 - E) none of the other choices.
- 59) Which of the following activities is not a part of good science? 59) _____
- A) designing experiments
 - B) developing a hypothesis
 - C) making quantitative observations
 - D) indulging in speculation
 - E) proposing a theory

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- 60) Which of the following abbreviations of the given SI base unit is incorrect? 60) _____
- A) mole: mol
 - B) second: s
 - C) kilogram: kg
 - D) kelvin: k
 - E) meter: m
- 61) Water vapor is less dense than ice because 61) _____
- A) gaseous molecules have less mass.
 - B) molecules in the gas phase are in constant motion.
 - C) molecules in the gas phase have more kinetic energy than in solids.
 - D) molecules in the gas phase have more space between them than in solids.
 - E) molecules in the gas phase have more potential energy than in solids.
- 62) Select the best statement. 62) _____
- A) Physical changes alter the composition of the substances involved.
 - B) Physical changes may be reversed by changing the temperature.
 - C) Physical changes are usually accompanied by chemical changes.
 - D) Physical properties are not valid characteristics for identifying a substance.
 - E) Physical properties are mostly extensive in nature.
- 63) The difference between a student's experimental measurement of the density of sodium chloride and the known density of this compound reflects the _____ of the student's result. 63) _____
- A) systematic error
 - B) indeterminate error
 - C) accuracy
 - D) precision
 - E) random error
- 64) As part of an experiment to determine the density of a new plastic developed in her laboratory, Sara Ann Dippity measures the volume of a solid sample. Her four trials yield volumes of 12.37 cm^3 , 12.41 cm^3 , 12.39 cm^3 , and 12.38 cm^3 . Measurements of other scientists in the lab give an average volume of 12.49 cm^3 . Which of the following statements represents the best analysis of the data? 64) _____
- A) Sara's results have high precision and high accuracy.
 - B) Sara's results have greater precision than accuracy.
 - C) Sara's results have low precision and high accuracy.
 - D) Sara's results have greater accuracy than precision.
 - E) Sara has been using a faulty instrument to measure the volume.

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- 65) Which one of the following is a "substance" in the sense of the word as used in your textbook? 65) _____
- A) water
 - B) toothpaste
 - C) tap water
 - D) sea water
 - E) air
- 66) Which of the following is not an S.I. base unit? 66) _____
- A) Kelvin
 - B) second
 - C) ampere
 - D) Meter
 - E) gram
- 67) A student makes several measurements of the density of an unknown mineral sample. She then reports the average value of these measurements. The number of significant figures she uses in her result should be a measure of its 67) _____
- A) determinate error.
 - B) accuracy.
 - C) human error.
 - D) systematic error.
 - E) precision.
- 68) You prepare 1000 mL of tea and transfer it to a 1.100 L pitcher for storage. Which of the following statements is true? 68) _____
- A) The pitcher will be filled to 100% of its capacity with no tea spilled.
 - B) The pitcher will be completely filled and a small amount of tea will overflow.
 - C) The pitcher will be completely filled and most of the tea will overflow.
 - D) The pitcher will be filled to about 50% of its capacity.
 - E) The pitcher will be filled to about 90% of its capacity.
- 69) The most significant contribution to modern science made by alchemists was 69) _____
- A) their widespread acceptance of observation and experimentation.
 - B) their systematic method of naming substances.
 - C) their understanding of the nature of chemical reactions.
 - D) their discovery of phlogiston.
 - E) their fundamental work in the transmutation of the elements.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 70) Give an example of a physical property and a chemical property of each of the following: 70) _____
- a. oxygen gas
 - b. octane
 - c. copper

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- 71) Briefly explain the relationship between hypothesis and experiment in the scientific method. 71) _____
- 72) Calculate the numerical part of the conversion factors needed to carry out the following unit conversions: 72) _____
- a. density in g/cm^3 to kg/m^3
 - b. speed in m/s to mm/ns
 - c. area in km^2 to m^2
 - d. area in km^2 to cm^2
 - e. mass/area of aluminum foil in mg/cm^2 to g/m^2
 - f. number of gas molecules per unit volume from $/\text{m}^3$ to $/\text{cm}^3$
 - g. number of bacteria per unit area on a microscope slide from $/\text{mm}^2$ to $/\text{cm}^2$
- 73) Classify the following properties of hydrogen gas as either intensive or extensive. 73) _____
- a. the mass of the gas sample
 - b. the average speed of a molecule in the sample
 - c. temperature
 - d. density
 - e. number of molecules present
- 74) An evacuated 276 mL glass bulb weighs 129.6375 g. Filled with an unknown gas, the bulb weighs 130.0318 g. Calculate the gas density in g/L , and express it with an appropriate number of significant figures. 74) _____
- 75) Write the following numbers and results in scientific notation, with appropriate significant figures. 75) _____
- a. 654
 - b. 1234560
 - c. 0.000000673
 - d. 0.002590
 - e. 200.4
 - f. 260.0
 - g. πr^2 , where $r = 8.7 \text{ cm}$
 - h. $23.24 + 18.6 - 5$

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76) Write the following numbers and results in standard notation, with appropriate significant figures. 76) _____

- a. 7.85×10^{-3}
- b. 7.85×10^4
- c. 5.920×10^3
- d. $7.85 \times 10^{12} \div 10^{10}$
- e. 7.00×10^{-5}
- f. circumference of a circle, $2\pi r$, where $r = 8.7$ cm
- g.

$$\frac{6.626 \times 10^{-34} \times 6.02214 \times 10^{23} \times 2.9979 \times 10^8}{5.23 \times 10^{-6}}$$

77) In each of the sets below, choose the one quantity or number which is exact. 77) _____

- a.
 - i. the human population
 - ii. the distance in light years from the sun to Alpha Centauri, a nearby star
 - iii. the winning time for the 100 m dash in the Olympic Games
- b.
 - i. the weight of a particular one cent coin in g
 - ii. the boiling point of lead, in C
 - iii. the number of cm in 1 yd
- c.
 - i. the measured value of the speed of light ($2.998... \times 10^8$ m/s)
 - ii. π (3.141...)
 - iii. the volume of milk in a 1-gallon jug

Answer Key

Testname: UNTITLED1

- 1) FALSE
 - 2) TRUE
 - 3) TRUE
 - 4) TRUE
 - 5) FALSE
 - 6) TRUE
 - 7) TRUE
 - 8) TRUE
 - 9) FALSE
 - 10) FALSE
 - 11) C
 - 12) C
 - 13) E
 - 14) A
 - 15) A
 - 16) E
 - 17) E
 - 18) E
 - 19) E
 - 20) A
 - 21) A
 - 22) C
 - 23) A
 - 24) C
 - 25) B
 - 26) E
 - 27) C
 - 28) C
 - 29) E
 - 30) B
 - 31) D
 - 32) C
 - 33) A
 - 34) B
 - 35) B
 - 36) B
 - 37) C
 - 38) C
 - 39) A
 - 40) C
 - 41) B
 - 42) A
 - 43) B
 - 44) E
 - 45) A
 - 46) C
 - 47) D
 - 48) C
 - 49) B
 - 50) C
-

Answer Key

Testname: UNTITLED1

- 51) A
- 52) D
- 53) A
- 54) B
- 55) A
- 56) C
- 57) B
- 58) B
- 59) D
- 60) D
- 61) D
- 62) B
- 63) C
- 64) B
- 65) A
- 66) E
- 67) E
- 68) E
- 69) A
- 70) Answers could all be the same, but some possibilities are:
 - a. boiling point, reaction with sodium
 - b. boiling point, reaction with oxygen
 - c. electrical conductivity, reaction with nitric acid
- 71) A hypothesis should be capable of leading to a prediction which is testable by experiment. If the experimental result differs from the prediction, the hypothesis should be modified.
- 72) a. 10^3
 - b. 10^{-6}
 - c. 10^6
 - d. 10^{10}
 - e. 10
 - f. 10^6
 - g. 10^{-2}
- 73) a. E
 - b. I
 - c. I
 - d. I
 - e. E
- 74) 1.43 g/L

Answer Key

Testname: UNTITLED1

- 75) a. 6.54×10^2
b. 1.23456×10^6
c. 6.73×10^{-7}
d. 2.590×10^{-3}
e. 2.004×10^2
f. 2.600×10^2
g. $2.4 \times 10^2 \text{ cm}^2$
h. 3.7×10^1
- 76) a. 0.00785
b. 78500
c. 5920.
d. 785
e. 0.0000700
f. 55 cm
g. 22900
- 77) a. i
b. iii
c. ii