SOL Questions – Chapter 1

Each of the following questions below appeared on an SOL Chemistry Exam. For each of the following bubble in the correct answer on your scantron.

1. The following data are obtained in the laboratory:
   (a) The mass of a clean, dry 250 mL beaker
   (b) The mass of the same beaker containing an unknown quantity of magnesium sulfate
The mass of the magnesium sulfate is obtained by subtracting (a) from (b). Which of the following will provide the most accurate results?
a. Measurements should be taken using the same balance.
b. The temperature of the room must remain constant.
c. The barometric pressure should be recorded.
d. A calculator should be used to subtract (a) from (b).

2. Many reactions are taken to completion by heating the reaction mixture in a test tube. Each of the following would be a safe practice *except* —
a. heating the test tube gently to prevent the solution from boiling over
b. pointing the test tube away from others so that no one is injured
c. placing a stopper in the test tube to prevent gas from escaping
d. holding the test tube with test tube clamps to avoid touching hot objects

3. A student conducted an experiment to study the effects of temperature on a chemical reaction. The student's experimental conditions are shown in the chart to the right. Which of the following would improve the student's experimental design?
a. Use the same amount of catalyst in all trials
b. Keep all tubes at 18°C
c. Keep the reaction time constant
d. Decrease the quantity of reactants

	Trial Number			
	1	2	3	4
Temperature	17ºC	18ºC	20ºC	16ºC
Amount of catalyst	1 mg	2 mg	3 mg	4 mg
Amount of A	5 g	5 g	5 g	5 g
Amount of B	7 g	7 g	7 g	7 g
Time for reaction to complete (min)	10	8	5	3

4. A student massed a piece of iron on a balance. The most sensitive beam was marked off in 0.1 g intervals. The student reported the iron's mass 12.34 g. Which of the digits in the measurement is estimated?
a. 1   b. 2   c. 3   d. 4

5. A student measured the temperature of a boiling solution and found it to be 56.0°C at standard pressure. The theoretical temperature of that boiling solution is 55.0°C. What is the percent of error in the student's measurement?
a. 18%   b. 1.8%   c. 0.18%   d. 0.018%

6. How many significant digits are in 0.003450?
a. 3   b. 4   c. 6   d. 7

7. How many different elements are in ammonium hydroxide (NH_4OH)?
a. 2   b. 3   c. 4   d. 7

8. Which of the following pieces of glassware can be used to measure the volume of a liquid with the greatest accuracy?
a. Test tube   b. Beaker   c. Flask   d. Graduated cylinder

9. How is 0.00124 expressed in proper scientific notation?
a. 1.24×10^{-3} b. 0.124×10^{-2} c. 1.24   d. 1.24×10^{3}

10. Which grouping identifies chemical properties?
a. Malleability, ductility, conductivity b. Luster, hardness, texture
c. Combustibility, flammability, reactivity d. Density, melting point, boiling point

Trial	Mass (grams)
1	26.5
2	26.4
3	26.5

11. A student measures the mass of a piece of copper three times and records the results in the table to the left. The actual mass of the copper is 28.7 grams. Which of the following is demonstrated in the student's data?
a. Accuracy b. Continuity c. Precision d. Reliability

12. When examining the physical properties of an unknown substance, which of the following characteristics is unsafe to observe?
a. Color b. Weight c. Form d. Taste

13. To determine the density of corn syrup, a student poured 3.0 mL of the liquid into a 10.0 mL graduated cylinder and massed the cylinder and contents. He determined the density to be 10.5 g/cm^3. The accepted value for the density of corn syrup is 1.38 g/cm^3. The *most* probable cause of error was that —
a. the mass and the volume were multiplied
b. the mass of the cylinder was included in the density formula
c. the graduated cylinder accuracy is only +/-0.5 mL
d. the mass and volume were inverted in the density formula

14. The table to the right lists the melting and boiling points of some metals. Which metal remains liquid over the widest range of temperature?
a. Copper b. Iron
c. Lead d. Platinum

Metal	Melting Point (ºC)	Boiling Point (ºC)
Copper	1083	2595
Iron	1535	3000
Lead	327	1744
Platinum	1769	4530

15. The density of an unknown metal was determined to be 2.85 g/mL. The actual density was 2.70 g/mL. What is the percent error in this determination?
a. 0.056% b. 0.15% c. 5.6% d. 94.4%

16. A student designed this experiment to study the effects of a catalyst on a reaction. The results are listed in a chart to the right. Which trial serves as the experimental control?
a. 1 b. 2 c. 3 d. 4

	Trial Number			
	1	2	3	4
Temperature	18ºC	18ºC	18ºC	18ºC
Amount of catalyst	3 mg	2 mg	1 mg	0 mg
Amount of A	5 g	5 g	5 g	5 g
Amount of B	7 g	7 g	7 g	7 g
Time for reaction to complete (min)	10	10	10	10

17. A student spills a diluted acid solution on his hand. He should —
a. wipe it off with a paper towel b. let it air dry
c. apply a base solution to neutralize it d. rinse it off with running water

18. To remove the sand first and then the salt from a mixture of sand and salt water, one combination of techniques you could use would be to *first* —
a. evaporate and then distill b. evaporate and then condense
c. filter and then evaporate d. filter and then condense

19. The mass of an object was recorded as 9.93 g, 9.90 g, and 10.02 g, using an electronic analytical balance. What is the average of these three masses expressed to the correct number of significant figures?
a. 9.9 g b. 9.95 g c. 10.0 g d. 10.00 g
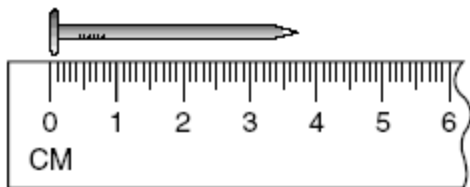
20. What is the first step that should be taken when a caustic chemical gets into a person's eye?
a. Identify the chemical b. Call for an ambulance
c. Flush the affected area with water d. Apply a neutralizing agent

21. According to the data to the right, which of the following represents the average density for sample X using the correct number of significant figures?
a. 1 g/mL
b. 0.8 g/mL
c. 0.81 g/mL
d. 0.821 g/mL

Group	Mass Data for Sample X (g)	Displacement Data for Sample X (mL)
1	2.7	3.4
2	1.20	1.5
3	6.2	7.40

22. For an experiment, 9.7 mL of HCl are needed. What is the best instrument to use for measuring this volume?
a. Beaker
b. Erlenmeyer flask
c. Graduated cylinder
d. Test tube

23. A student used the above ruler to measure the length of a nail. The length of this nail, according to the precision of the ruler, is —
a. 3.5 cm
b. 3.55 cm
c. 3.7 cm
d. 3.75 cm

24. These data show repeated measurements of the same object which has a known mass of 5.38 grams. Which measurement is most accurate?
a. 1
b. 2
c. 3
d. 4

Measurement 1	5.2 g
Measurement 2	5.4 g
Measurement 3	3 g
Measurement 4	2.45 g

25. If a student's hand is accidentally exposed to an acidic solution, what should be done?
a. Rinse the hand in a concentrated base.
b. Rinse the hand in running water.
c. Wrap the hand in paper towels.
d. Cover the hand with oil.

26. A student was instructed to carry out an experiment that illustrates the law of conservation of mass. The teacher indicated that the experiment should be carried out three times. The student plans to report the average of the three results. What can the student do to maximize the reliability of the data collected?
a. Report the result that came closest to the class average.
b. Conduct each trial using the same balance.
c. Report the average of the two most similar values only.
d. Perform each of the trials on different days.

27. A student wanted to obtain a very accurate value for the volume of a piece of steel. He filled a 100.0 cm^3 graduated cylinder to the 50.0 cm^3 mark with water. After he carefully dropped the steel into the cylinder, the water level rose to the 55.6 cm^3 level. He reported the volume of the steel as 5.6 cm^3. How could the student improve the reliability of his analysis?
a. Report the volume as 56 mm^3
b. Fill the graduated cylinder to the 70.0 cm^3 mark before adding the steel
c. Mass the steel and report its density in g/cm^3
d. Repeat the measurement many times and report an average value

28. If a student needed to obtain 8.0 mL of a liquid for an experiment, the appropriate piece of laboratory equipment to use would be a —
a. 50 mL beaker
b. 1.0 mL pipet
c. 50 mL flask
d. 10.0 mL graduated cylinder

29. Which of the following *best* describes why an experiment should be repeated?
a. To organize the data
b. To produce a variety of results
c. To include another variable
d. To verify the observed results

30. Which basic lab technique involves the separation of a mixture's components through differences in particle size?
a. Filtration
b. Extraction
c. Distillation
d. Crystallization

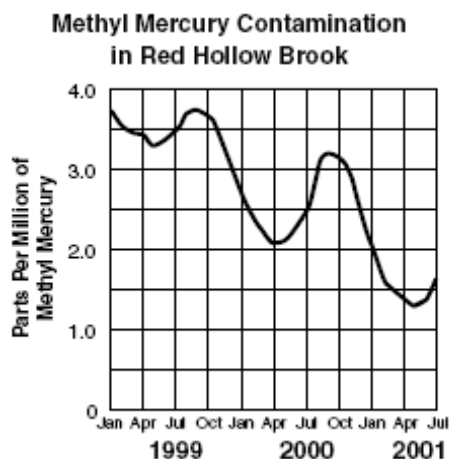31. How should 0.000365 be expressed in proper scientific notation?
a. 3.65×10^4
b. 365
c. 3.65
d. 3.65×10^{-4}

32. A team of chemistry students made the measurements (listed to the right) and density calculations of the same type of material. The accepted value (true value) of the density of the material is 5.72 g/cm³. Which trial has the *least* amount of absolute error?
a. 1   b. 2
c. 3   d. 4

Trial	Mass (g)	Volume (cm³)	Density (g/cm³)
1	14.5	2.52	5.75
2	28.3	4.80	5.90
3	33.1	5.75	5.76
4	55.4	9.62	5.76

MATERIALS SAFETY DATA SHEET

1.PRODUCT IDENTIFICATION
PRODUCT NAME HYDROCHLORIC ACID
FORMULA HCl
FORMULA WT 36.48
EFFECTIVE 08/07/86
REVISION # 02
PRECAUTIONARY LABELING
BAKER SAF-T-DATA (TM) SYSTEM
HEALTH 3 - SEVERE (POISON)
FLAMMABILITY 0 - NONE
REACTIVITY 2 - MODERATE
CONTACT 3- SEVERE (CORROSIVE)
HAZARD RATINGS ARE 0 TO 4
(0 = NO HAZARD; 4 = EXTREME HAZARD)
LABORATORY PROTECTIVE EQUIPMENT
GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
PRECAUTIONARY LABEL STATEMENTS POISON DANGER CAUSES SEVERE BURNS MAY BE FATAL IF SWALLOWED OR INHALED
DO NOT GET IN EYES, ON SKIN, ON CLOTHING. DO NOT BREATHE VAPOR. CAUSES DAMAGE TO RESPIRATORY SYSTEM (LUNGS), EYES AND SKIN. KEEP IN TIGHTLY CLOSED CONTAINER. LOOSEN CLOSURE CAUTIOUSLY. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF SPILL NEUTRALIZE WITH SODA ASH OR LIME AND PLACE IN DRY CONTAINER.

33. If a lab group were using hydrochloric acid to perform a substitution reaction, which precaution would *not* be a concern(use the chart to the left)?
a. Flammability   b. Health
c. Reactivity   d. Contact

34.
First measurement: 6.293 g
Second measurement: 6.294 g
Third measurement: 6.295 g

A student obtained these data after measuring the mass of an object three different times. If the true value of the object's mass is 5.550 g, these data are best described as —
a. precise but not accurate
b. accurate but not precise
c. accurate and precise
d. neither accurate nor precise

Paper
Ink Sample
Solvent

35. The figure to the right shows an experimental setup used to separate the components of a colored ink sample. Which of the following describes this laboratory technique?
a. Chromatography   b. Filtration
c. Decanting   d. Distillation

36. Which of the following best describes sublimation?
a. A solid melting to a liquid
b. A solid melting to a liquid, which then evaporates
c. The movement of gaseous particles so that they fill the space they occupy
d. A solid forming a gas

37. The reaction times for three trials of an experiment are 90.3, 90.2, and 90.5 seconds. Which average time is expressed using the correct number of significant figures?
a. 90.3   b. 90.33   c. 90   d. 90.333

38. What is the name of the lab equipment shown to the right?
a. Watch glass
b. Crucible
c. Beaker
d. Evaporating dish

39. The melting point of a white solid substance was determined in four repeated trials to be 56.0°C, 55.0°C, 57.5°C, 55.5°C. What temperature should be reported as the melting point as a result of these trials?
a. 55.0°C
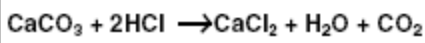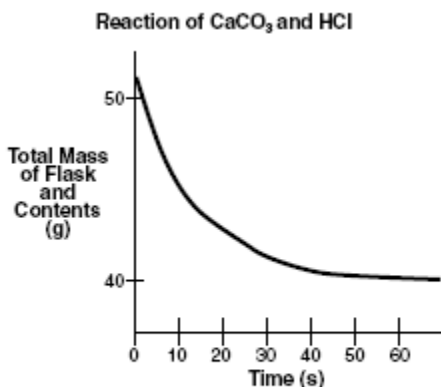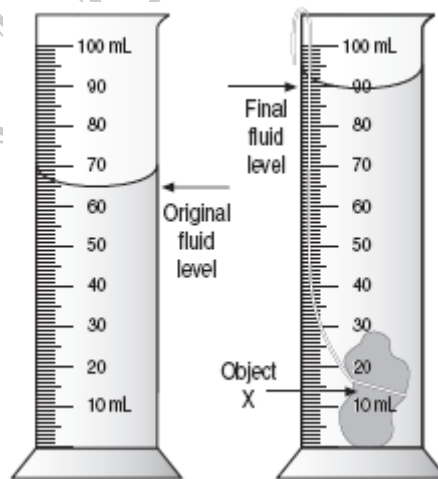b. 55.5°C
c. 56.0°C
d. 57.5°C

Methyl Mercury Contamination in Red Hollow Brook

40. Methyl mercury, found in some stream sediments, is highly toxic to animal life. Using the graphed results of the study shown to the left, the best analysis of the data reveals that the methyl mercury concentration in the stream sediment is —
a. steadily increasing, accelerating in the fall of each year
b. increasing overall but reaches a minimum in the winter
c. constantly declining throughout each month of the year
d. decreasing but reaches a maximum at the end of summer

41. Which of the following is a mixture?
a. Carbon
b. Glucose
c. Distilled water
d. Air

42. What is a possible cause of a large percentage of error in an experiment where MgO is produced from the combustion of magnesium?
a. Not all of the Mg has completely reacted.
b. The same balance was used throughout the experiment.
c. The students were careful in their measurements.
d. The students were careful not to spill the contents.

43. The volume of Object X in the diagram to the right is approximately —
a. 20 mL
b. 25 mL
c. 30 mL
d. 35 mL

Reaction of CaCO₃ and HCl

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

44. Calcium carbonate was placed in a flask on a balance, and dilute hydrochloric acid was added. Carbon dioxide that was produced escaped from the flask. The total mass of the flask and its contents was recorded every 10 seconds. The diagram above shows a plot of the results. Between which of the following times was the reaction the fastest?
a. 0 and 10 seconds
b. 10 and 20 seconds
c. 20 and 30 seconds
d. 30 and 40 seconds

45. How many liters are equivalent to five milliliters?
a. 0.005 L
b. 0.05 L
c. 500 L
d. 5000 L

46. The following data (to the right) were collected. The volume of the gas is known to be 2.20 L. This data reflects —
a. low precision and low accuracy   b. low precision and high accuracy
c. low accuracy and high precision   d. high accuracy and high precision

Trial	Measured Volume (L)
1	5.20
2	5.20
3	5.19
4	5.20
5	5.20

47. Which is the safest practice when heating the contents of a test tube over a flame?
a. Wearing long hair down
b. Having safety goggles within reach
c. Pointing the test tube away from people
d. Keeping the test tube securely stoppered

48. The boiling point of ethanol is 78.3°C. The boiling point of ethanol on the Kelvin scale is approximately —
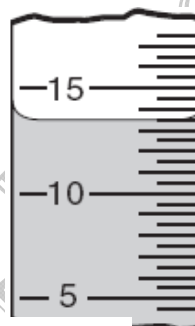a. 26 K   b. 178 K   c. 351 K   d. 451 K

49. Which of these best describes sublimation?
a. A solid changing to a liquid phase
b. A solid changing to a gaseous phase
c. A gas filling the space in its container
d. A liquid taking the shape of its container

50. What is the volume of the liquid in the graduated cylinder?
a. 13.00 mL   b. 13.50 mL
c. 14.00 mL   d. 14.50 mL

Student Measurements of Temperature

	Reading 1 (°C)	Reading 2 (°C)	Reading 3 (°C)
Student 1	78.6	78.5	78.7
Student 2	82.4	80.0	81.4
Student 3	80.0	78.9	81.8
Student 4	80.1	79.9	80.0