Density Lab B Test

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Scioly Summer Study Session

Exploring the World of Science

Directions:

- This test is 90 questions in total. You will be given 50 minutes to complete this test.

- The value of each question is listed to the right of every question. This indicates the number of points each question is worth.

- The answer choices for the multiple choice questions may not use significant figures. Instead of rounding to significant figures in your answer, it is suggested you round to the closest answer choice.

- Write your answers on the answer sheet provided. You may write on the test, but nothing on the test will be graded. Only answers written on the answer sheet will be graded.

- Use 9.81 m/s^2 for acceleration due to gravity.

- You may separate the exam, but you must put it back together in the correct order.

- Tiebreakers are in this order: 77, 81, 74, 75, 72, 53, and 82.

Section A: Multiple Choice

For each of the following questions, choose the best answer choice.

1. Which of the following is not the correct formula for density? Select all that apply. | 0.25 |

    A. volume/mass

    B. mass/molecular weight

    C. mass/volume

    D. moles of solute/mass

2. If gold has a density of 19.3 g/cm^3, what would be the mass of a gold bar that has a volume of 500 mL? | 0.25 |

    A. 9,650 g

    B. 7,650 g

    C. 8,649 g

    D. 8,650 g

3. What is the volume of an aluminum cube that has a mass of 500 g if the density of aluminum is 2.7 g/cm^3? | 0.25 |

    A. 0.0054 cm^3

    B. 185.19 cm^3

    C. 195.19 cm^3

    D. 196.19 cm^3

4. When comparing the density of air to the density of space, what can already be said about the comparison of their densities? | 0.25 |

    A. The density of space is a little less than air.

    B. The density of space is a little higher than air.

    C. The density of space is much higher than air.

    D. The density of space is much less than air.

5. What is the area density in kg/m^2 of a sheet of an aluminum foil sheet that is 5.00 cm x 10.00 cm and weighs 0.6 g? | 0.25 |

    A. 0.012 kg/m^2

    B. 1.2 kg/m^2

    C. 0.12 kg/m^2

    D. 12 kg/m^2

6. If I pour a bag of 50 M&Ms (20 blue, 10 yellow, 10 green, 10 red) into a cylinder with a diameter of 10 cm and a height of 10 cm, what is the number density of the red M&Ms in the cylinder? | 0.25 |

    A. 0.064 red/cm^3

    B. 0.025 red/cm^3

    C. 0.013 red/cm^3

    D. 0.094 red/cm^3

7. In 2017, Charlotte had an estimated population of 859,035 people and has a land area of 799 km^2. What is the population density of Charlotte? | 0.25 |

    A. 1,075.14 people/km^2

B. 1,079.15 people/km^2

C. 1,075.98 people/km^2

D. 1,086.14 people/km^2

8. When the temperature of a gas increases, the volume and average distances traveled by the gas molecules to reach the walls of its container both must increase in order to keep a different variable of a gas constant. Which gas law does this statement connect to? $\boxed{0.5}$

    A. Boyle's Law

    B. Dalton's Law

    C. Charles' Law

    D. Gay-Lussac's Law

9. When solving for V$_1$ in the combined gas law, what is the formula that could used to solve for V$_1$? $\boxed{0.5}$

    A. $\dfrac{T_2V_2T_1}{P_1P_2}$ B. $\dfrac{P_2V_2P_1}{T_1T_2}$ C. $\dfrac{P_2T_2T_1}{P_1V_2}$ D. $\dfrac{P_2V_2T_1}{P_1T_2}$

10. If a gas has a volume 500 mL at a pressure of 270 kPa, then what would be the new volume of the gas in L if it was compressed to 360 kPa if temperature is kept constant? $\boxed{0.5}$

    A. 375 L

    B. 0.375 L

    C. 0.375 mL

    D. 375 mL

11. Assuming constant temperature, what happens to the pressure of a balloon when it pops? $\boxed{0.25}$

    A. It increases.

    B. It decreases.

    C. It stays the same.

    D. The volume decreases.

12. A gas has a volume of 250 mL at 400 mm Hg. If temperature is constant, what would be the new pressure in mm Hg if the volume increases to 350 mL? $\boxed{0.5}$

    A. 285.7 mm Hg

    B. 245.7 mm Hg

    C. .376 mm Hg

    D. 278.7 mm Hg

13. A gas is kept in a closed container at a constant volume. What will happen to the pressure of the gas if the temperature decreases? $\boxed{0.25}$

    A. It will increase.

    B. It will stay the same.

    C. The temperature increases.

    D. It will decrease.

14. If there are 400 mL of O$_2$ gas and 500 mL of CO$_2$ kept in a container at 10 degrees Celsius, then what will be the new volume of the combined gases if the temperature is increased to 362 K? Assume pressure is kept constant. $\boxed{0.5}$

    A. 1,150.63 L

B. 2,145.65 mL

C. 1,165.32 mL

D. 1,150.63 mL

15. If a 36.9 L sample of oxygen gas at 39 degrees Celsius is heated until the sample is 43.7 L in size, what is the current temperature of the oxygen gas in Kelvins? $\boxed{0.5}$

    A. 379.67 K

    B. 369.67 K

    C. 269.67 K

    D. 290.67 K

16. A man blows up a balloon, and increases its volume. Which of the following allows the balloon to float in the air? Be specific with your answer. $\boxed{0.25}$

    A. Air

    B. Water

    C. Mass

    D. Density

17. An irregular object is placed in a cylinder with a diameter of 5 cm with 100 mL of an unknown liquid. A scientist sees that the level of the liquid rises by 2.3 cm. Assuming the object is completely submerged, what is the buoyant force of the liquid on the object if 100 mL of the liquid has a mass of 155 g? $\boxed{1}$

    A. 0.697 N

    B. 0.887 N

    C. 0.787 N

    D. 0.687 N

18. I have 12 L of ammonia (NH_3) gas at 1 atm and 260 K. What would be the number of molecules in the ammonia gas? $\boxed{1}$

    A. 3.385 x 10^{24} molecules

    B. 3.385 x 10^{23} molecules

    C. 1.354 x 10^{23} molecules

    D. 1.354 x 10^{24} molecules

19. An object has a volume of 58,000 cm^3. When placed in water, the buoyant force on the object is..... $\boxed{0.5}$

    A. 568.98 N

    B. 598.98 N

    C. 668.98 N

    D. 560.98 N

20. Given 42.0 g of carbon monoxide (CO) gas at 30 degrees Celsius and 1.2 atmospheres of pressure, calculate the volume of the carbon monoxide gas. The molar mass of carbon monoxide is 28.01 g/mol. $\boxed{1}$

    A. 38.90 L

    B. 43.10 L

    C. 32.19 L

    D. 31.10 L

21. If 9.0 moles of O_2 and 6.0 moles of N_2 are placed in a 40.0 L tank at a temperature of 200 degrees Celsius, what will the pressure of the resulting mixture of gases be in atm? $\boxed{0.5}$

A. 18.47 atm

B. 15.57 atm

C. 14.57 atm

D. 19.47 atm

22. What property of water allows denser objects to float on it in certain situations, such as a paper clip? $\boxed{0.25}$

    A. The surface tension of water.

    B. The boiling point of water.

    C. The fact that water is polar.

    D. The density of water.

23. How many moles of gas occupy 156 L at a pressure of 4.8 atmospheres and a temperature of 222 K? $\boxed{0.5}$

    A. 36.45 moles

    B. 42.08 moles

    C. 82.09 moles

    D. 41.08 moles

24. 165 mL of water and 76 mL of another substance are combined to create a solution with a density of $\boxed{1.25}$ 2.35 g/mL. What is the density of the substance combined with water? What is the mass percent of the substance in the solution?

    A. The density is 5.28 g/mL, while the mass percent is 70.1%.

    B. The density is 5.28 g/mL, while the mass percent is 70.9%.

    C. The density is 5.28 g/mL, while the mass percent is 70.2%.

    D. The density is 6.28 g/mL, while the mass percent is 70.9%.

25. What is the temperature of 83.28 grams of carbon dioxide at a pressure of 1,830 torr contained in a 3.82 $\boxed{0.75}$ L container? Carbon dioxide has a molar mass of 44.01 g/mol.

    A. 59.24 K

    B. 66.24 K

    C. 57.34 K

    D. 54.24 K

26. Calculate the force required to lift a copper block w/ a mass of 1,792 g submerged in a tank full of water. $\boxed{1}$

    A. 156.2 N

    B. 15.62 N

    C. 16.62 N

    D. 25.62 N

27. A solution is prepared by mixing 12 g of a 25% glucose solution with 8.5 g of a 45.5% glucose solution. $\boxed{1}$ What is the mass percent of glucose in this solution?

    A. 35.3%

    B. 40.5%

    C. 33.8%

    D. 33.5%

Section B: Fill in the Blank

Fill in the blank of each following question with the correct word or number.

28. As you go up in the atmosphere, the air pressure _____. $\boxed{0.25}$

29. When air in a closed container is heated, the pressure _____. $\boxed{0.25}$

30. The attractive forces that allow the molecules of a solute and solvent to combine to create a homogeneous solution are called _____. $\boxed{0.75}$

31. If a ball is completely submerged in water versus to be partially submerged, the buoyant force on the ball _____. $\boxed{0.25}$

32. A hydrometer measures _____. $\boxed{0.5}$

33. As you go deeper into the ocean, the pressure _____. $\boxed{0.5}$

34. If the mass of an object decreases by a factor of $\frac{1}{2}$ and the volume decreases by a factor of $\frac{1}{4}$, the density increases by a factor of _____. $\boxed{0.5}$

35. The upward force that is exerted on an object immersed in a fluid is also known as _____. $\boxed{0.5}$

36. If more people live in a city, the population density of the people in the city _____. $\boxed{0.25}$

37. The ideal molar volume of one mole of gas at STP is _____. $\boxed{0.5}$

38. The variable constant in an isobaric system is the _____. $\boxed{0.5}$

39. The unit correcting for the attraction between molecules in the Van Der Waals equation is _____. $\boxed{0.75}$

40. The formula for Pascal's Law is _____. $\boxed{0.5}$

41. According to the kinetic theory of gases, the collisions between gas molecules are _____. $\boxed{0.75}$

42. As the volume of a gas decreases, its pressure increases because the gas molecules make more _____ with the walls of their container. $\boxed{0.5}$

43. The density of an object is _____ than the density of the liquid it is submerged in when the weight of the object is greater than the weight of the liquid displaced. $\boxed{0.25}$

44. Volume is an _____ property of matter. $\boxed{0.25}$

45. The number of particles in one mole of gas is _____. $\boxed{0.5}$

46. In order to calculate the buoyant force on a fully submerged object, you need to know the density of the fluid and the _____ of the object. $\boxed{0.5}$

47. The pressure of any gas at STP conditions is _____. $\boxed{0.25}$

48. 1 bar of pressure is equivalent to _____ kPa. $\boxed{0.5}$

Section C: Matching

Match each term to the statement that best goes with it. Each term is used only once.

A. $kg \times m \times s^{-2}$ E. Avagadro's Law   I. Area Density
B. L^2-atm/mol^2 F. Miscible   J. Number Density
C. L/mol   G. Immiscible
D. Gay-Lussac's Law   H. Linear Density

49. _____ At a constant volume, the pressure and temperature of a gas are directly proportional.   0.5

50. _____ The amount of mass per unit length.   0.25

51. _____ The SI unit for weight in terms of Base SI units.   0.25

52. _____ The unit for the constant a in the Van Der Waals equation.   0.5

53. _____ The unit for the constant b in the Van Der Waals equation.   0.5

54. _____ Insoluble in one another; forms layers.   0.5

55. _____ At the same temperature and pressure, gases have equal numbers of moles with equal volumes.   0.25

56. _____ Soluble in one another; combining to create one homogeneous solution.   0.5

57. _____ The number of countable objects per unit volume.   0.25

58. _____ Also known as surface density.   0.5

Section D: True or False

Write a T if the statement is true, and an F if the statement is false.

59. _____ The molar mass of ethanol is about 46.07 g/mol.   0.5

60. _____ In general, pressure is an extensive property of matter.   0.25

61. _____ Liquid mercury is more dense than water, but water has more surface tension.   0.5

62. _____ Water is more dense than ice because of the hexagon structure of the water molecules that increases the cohesive forces of attraction between the water molecules, increasing the hydrogen bonds.   0.25

63. _____ 760 mm Hg is equivalent to about 1030 mm of water in terms of pressure.   0.25

64. _____ Water is most dense at 277.15 K.   0.5

65. _____ If an object is dropped from the top of a cliff to the ground on Earth or any celestial body for that matter, the acceleration of the object increases going down, but the velocity is constant.   0.25

66. _____ The number of moles of a gas is directly proportional to its pressure.   0.5

Section E: Free Response

**You must use significant figures and metric units in your answers.**

67. Suppose you are given a ceramic bowl that has nothing inside of it, only air. | 1.5 |

    (a) Would this bowl float or sink in water? Explain why.

    (b) If the bowl was filled with water, would it float or sink in water? Explain why.

    (c) Is ceramic itself more dense than water?

68. A Navy soldier is trying to figure out which bullet to use in war. He is given two options: Bullet A and | 1.5 | Bullet B. Bullet A has a diameter of 0.004 mm and Bullet B has a diameter of 0.002 mm.

    (a) Assuming the bullets are the same type, which bullet should the soldier use in war, and why?

    (b) If Bullet A has a circular tip, what is the cross-sectional area of its tip?

    (c) If Bullet B has a circular tip, what is the cross-sectional area of its tip?

69. A tank is filled with oxygen gas, which has a pressure of 25 atm. The tank is then filled with nitrogen | 1 | gas until the total pressure of the tank is 30. atm. If the tank is used until the tank reaches a pressure 7.2 atm, then what is the partial pressure of each gas?

70. Suppose in a fit of rage, a man throws a rock into the ocean. If the rock had a volume of 30 cm^3, and | 0.75 | the density of seawater is 1,025 kg/m^3, then what is the buoyant force on the rock? The density of the rock is greater than water.

71. 50. g of sand (SiO_2) are added to 1 m^3 of water to make a heterogeneous solution. Sand has a density | 3 | of about 1.6 g/cm^3.

    (a) What is the mole fraction of sand in this solution?

    (b) What is the concentration of sand in ppb in this solution?

    (c) What is the volume/volume percent of sand in this solution?

72. 5.0 moles of an unknown gas is kept in a chamber at a temperature of 20°C. The pressure of the gas | 1.5 | is unknown, so the gas was transferred to another chamber at a temperature of 20°C of the same size connected to a manometer filled with liquid mercury (13.56 g/cm^3) the same as the one shown below. The height h as shown in the manometer is 5.57 cm. Assuming that atmospheric pressure is entering the manometer, what is the volume of the unknown gas?
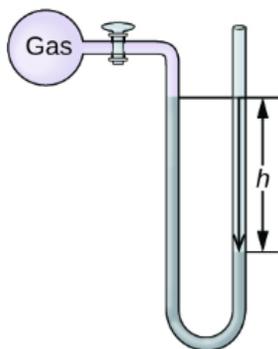
73. According to Johns Hopkins University, as of May 28, 2020 at 10:32 pm, there were approximately | 0.75 | 1,721,753 confirmed coronavirus cases in the US. There are approximately 330,771,096 total people living in the US. Calculate the concentration of the population of those infected in ppm.

74. Molecular dichlorodifluoromethane (CF_2Cl_2) gas is held at a temperature of 76.85 degrees Celsius and a pressure of 1.7 bar. What is the density of this gas in g/mL? $\boxed{1.5}$

75. A container of dry air is held at a temperature of 300. K and a pressure of 44.5 pounds/in^2. The gas constant for dry air, R_d, has a value of 287 J/kg/K. What is the density of this gas in kg/m^3? $\boxed{1.5}$

76. An unknown liquid held in a graduated cylinder has a density of 903 kg/m^3. A spherical ball made of gold with a circumference of 15.7 cm is completely submerged in this unknown liquid. $\boxed{3}$

    (a) What is the apparent weight of the submerged ball?

    (b) What is the magnitude of the buoyant force exerted on the ball?

    (c) If $50. \times 10^{-8}$ g of salt are added for every cubic centimeter of the unknown liquid, what is the concentration of the salt in the solution in ppb?

77. The molality of an aqueous solution of sodium acetate ($C_2H_3NaO_2$) is 2.52 m. $\boxed{6.25}$

    (a) What is the mass fraction of water in this solution?

    (b) What is the concentration of this solution in parts per trillion?

    (c) The density of sodium acetate is about 1.53 g/cm^3. Knowing this information, what is the density of this solution in the base SI unit of density?

    (d) Suppose this solution was poured into a cylinder-shaped container with a height of 20 m. What is the pressure at the bottom of the cylinder-shaped container? Assume atmospheric pressure enters the cylinder-shaped container is exerted on the solution.

    (e) Using the concept of buoyancy and Archimedes' Principle, explain why a block of Styrofoam would be buoyed up when placed in this solution, but a block of silver of the same size would sink.

78. A person has a mass of 80. kg. The area of the person's feet is 0.038 m^2. $\boxed{2.25}$

    (a) What is the weight of the person in N on the moon, which has a gravitational acceleration of about 1.62 m/s^2? What about the mass of the person?

    (b) If the person stands on two feet, what is the value of the pressure which the person exerts on the ground? Why is it easier to stand on two feet than it is to stand on one foot?

    (c) If the person stands on one foot, what is the value of the pressure which the person exerts on the ground. How does the pressure change in comparison to standing on two feet? If the pressure increases, why is this so?

79. In a short paragraph, explain the differences between ideal gas conditions and real gas conditions. $\boxed{1.25}$

80. In one serving size of 9.0 Hershey Kiss pieces (41 g), there is 12 grams of fat and 23 grams of sugar. $\boxed{3}$

    (a) What is the concentration of sugar in 9 Hershey Kiss pieces of chocolate in ppm?

    (b) What is the concentration of fat in 9 Hershey Kiss pieces of chocolate in ppb?

    (c) If the volume of one Hershey Kiss piece is approximately 4.183 cm^3, then what the density of a Hershey Kiss piece?

    (d) Knowing the volume of a Hershey Kiss piece, calculate the mass/volume percent of sugar in a Hershey Kiss piece.

81. A gas is kept at a pressure of 40x kPa, a temperature of 25.5°C, and is kept in a container with a volume of 0.25x L. The number of moles in this gas is 0.01x. $\boxed{4}$

    (a) What is the pressure of this gas in bar?

    (b) What is the volume of this gas in m^3?

    (c) Calculate the molar concentration of this gas in mol/cm^3.

(d) If the mass of this gas is 0.5 g, calculate the molar mass of this gas in mg/mol and the density of this gas in g/mL. About how many times denser is the density of water than the density of this gas?

82. 1.30 L of a 0.400 M aqueous glucose ($C_6H_{12}O_6$) solution is mixed with .50 L of a salt (NaCl) water solution with a molarity of 0.650 to make a homogeneous solution. The densities of glucose and salt are 1.54 g/mL and 2.17 g/mL, respectively. $\boxed{4}$

(a) What is the mass/mass percent of glucose in the combined solution?

(b) What is the density of this combined solution in g/L?

(c) The mole fraction of salt in this solution is.......

(d) Calculate the concentration of salt in this combined solution in ppb.

(e) Suppose 50 mL of apple juice ($\rho = 1.04$ g/mL) were added to the combined solution. By what factor would the density of the solution change? Express your answer as a decimal.

2.0m

4.5m

$V = 0.125m^3$
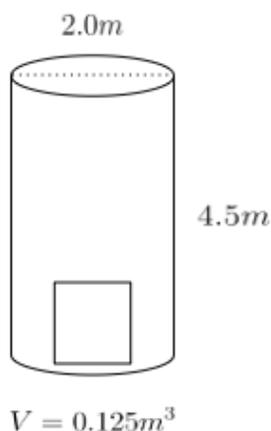
83. Use the diagram above of a cubic block made of copper and cylinder to answer the following questions. $\boxed{1.5}$

(a) If the cylinder is filled with a fluid ($\rho = 1.05$ g/mL), calculate the gauge pressure exerted by the fluid on the block if the pressure at the top of the cylinder is 0.5 kPa.

(b) The fluid in the cylinder is replaced with another fluid of different density. Calculate the hydrostatic pressure exerted by the fluid on the block if the pressure at the top of the cylinder is 15 kPa.

84. If a gas has a volume of 2.2 L at 303 K, what will be the new volume of the gas if the temperature decreases to 292 K? $\boxed{0.5}$

85. 9.5 moles of CO_2 gas are held at STP conditions. $\boxed{1.2}$

(a) Calculate the volume of the CO_2 in m³.

(b) Calculate the mass of the CO_2 in mg.

86. If I have 4.0 moles of nitrogen gas at a temperature of 234.4 K and a pressure of 1.2 bar, what is the volume in cm³ and mass in kg of this gas? $\boxed{1.2}$

87. Calculate the mass percent of Na, H, and O in 5.00 moles of NaOH. $\boxed{1.35}$

88. Calculate the mass of hydrogen gas at 332 K, which has a volume of 1.2 L and pressure of 0.55 bar. $\boxed{1}$

89. If a gas has a volume of 2,256 mL at 398 K, then what will be the new volume if the temperature increases to 422 K? $\boxed{0.5}$

90. A block with a mass of 426.0 g is placed on top of a cylinder with a diameter of 8.0 cm and a height of 15 cm. What is the pressure exerted on this cylinder by the block? $\boxed{0.75}$