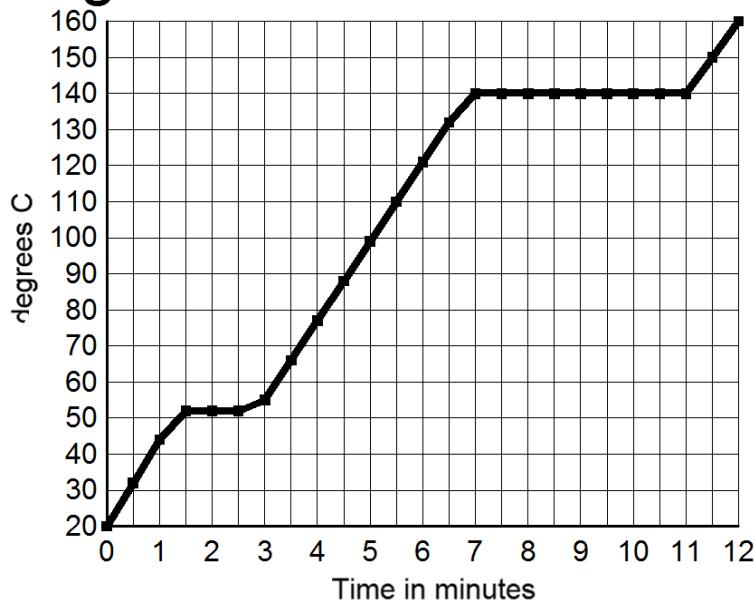


Questions 1 to 58 must be answered on the Scantron sheets.

Base your answers to questions 1 to 5 on the heating curve for a pure substance that is shown below.

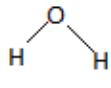
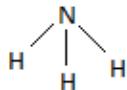
4.0 grams heated at 20. J/minute



1. The freezing point of the substance is closest to
A) 0°C B) 20°C C) 52°C D) 140°C
2. At a temperature of 100°C this substance is
A) solid and liquid B) liquid only C) liquid and gas D) gas only
3. How long does it take to boil all of the substance, once the boiling point has been reached?
A) 4 minutes B) 7 minutes C) 11 minutes D) 13 minutes
4. The experiment is repeated using 8.0 grams of substance instead of 4.0 grams.
The substance would begin to melt at a temperature of A) 20°C B) 40°C
C) 50°C D) 100°C
5. As the substance is heated between the 8 minute mark and the 11 minute mark, its average kinetic energy
A) decreases B) increases C) remains the same
6. A sample of a metal is found to have a volume of 3.5 mL. It is then weighed, and its mass is found to be 31.36 grams. What is the density of the metal **to the correct number of significant figures?** A) 9.0 g/mL B) 8.96 g/mL C) 8.960 g/mL D) 89.6 g/mL
7. The metal used in question 6 is most likely to be A) Fe B) Cu C) Mg D) Mn

8. An orbital is a region in space where there is a high probability of finding
A) an electron B) a proton C) a positron D) a neutron
9. Which statement about subatomic particles is correct?
A) a neutron has a negative charge B) a proton has a mass of zero
C) a neutron has no charge D) a proton has a negative charge
10. A positive ion **must** contain A) an equal number of protons and electrons
B) more neutrons than protons C) fewer electrons than protons
D) more electrons than protons
11. The valence electrons of a gallium atom in the ground state are located in the
A) first shell B) second shell C) third shell D) fourth shell
12. The modern periodic table lists elements in order of
A) atomic number B) atomic mass C) ionization energy D) oxidation state
13. What is the total number of electron pairs shared between the two atoms in a N₂ molecule?
A) 1 B) 2 C) 3 D) 6
14. An experiment is performed using the following steps.
1. Copper (II) sulfate is dissolved in water to form a blue solution of CuSO₄.
2. When sodium hydroxide, NaOH is added to the solution, a green precipitate of copper (II) hydroxide forms.
3. The solution is filtered, and the copper(II) hydroxide is separated from the solution.
- Which of these steps involved a **chemical** change?
A) step 1 only B) step 2 only C) step 1 and step 2 only D) all three steps
15. When an atom of chlorine gains an electron, the atom becomes a
A) negative ion with a radius smaller than the radius of the atom
B) negative ion with a radius larger than the radius of the atom
C) positive ion with a radius smaller than the radius of the atom
D) positive ion with a radius larger than the radius of the atom
16. Which electron configuration represents an excited state?
A) 2-1 B) 2-7-4 C) 2-8-7 D) 2-4
17. What is the total number of neutrons in an atom of C-14? (¹⁴C)
A) 6 B) 8 C) 10 D) 14
18. Which element is ductile and a good conductor of electricity at STP?
A) neon B) sulfur C) gold D) iodine
19. Which element is considered a metalloid? A) S B) Zn C) Ga D) Rn

20. The temperature of a sample of water changes from 10°C to 50°C when the sample absorbs 418 joules of heat. What is the mass of the sample?
 A) 0.25 g B) 2.5g C) 250 g D) 10 g
21. At room temperature, ammonia does not behave like an ideal gas. Ammonia would most resemble an ideal gas if the temperature was
 A) increased, while the pressure was decreased
 B) decreased while the pressure was decreased C) increased while the pressure was increased
 D) decreased while the pressure was increased
22. Ammonia does not behave like an ideal gas at room temperature because of
 A) ionic bonds between ammonia molecules B) hydrogen bonds between ammonia molecules
 C) the small size of ammonia molecules D) covalent bonds within ammonia molecules
23. Which molecule has a nonpolar covalent bond?



24. At STP, 4.00 liters of Ne gas contains the same number of molecules as
 A) 2.00 liters of Ar gas B) 4.00 liters of CO₂ gas C) 6.00 liters of Cl₂ gas
 D) 8.00 liters of CH₄ gas
25. A sample of Ar gas at 300. K is found to have a pressure of 2.00 atm. in a volume of 4.00 liters. At constant temperature, the gas is expanded to a volume of 16.0 liters. What is the new pressure? A) 0.500 atm. B) 600. atm. C) 2.00 atm. D) 4.00 atm.
26. What is the vapor pressure of propanone when the temperature is 60°C?
 A) 82 kPa B) 115 kPa C) 133 kPa D) 41 kPa
27. Liquids with comparatively high vapor pressures would tend to have comparatively
 A) high boiling points and strong attractions B) low boiling points and weak attractions
 C) low boiling points and strong attractions D) high boiling points and weak attractions
28. Sublimation is best described as
 A) an endothermic physical change
 B) an endothermic chemical change C) an exothermic physical change
 D) an exothermic chemical change
29. A certain element, X, forms an ionic compound with oxygen in a one to one ratio - XO. Element X might be
 A) K B) Al C) Sr D) N

30. A certain atom has 16 protons and 17 neutrons. Which is the correct symbol for that atom? A) ^{33}Cl B) ^{34}Cl

31 to 35 are based on the following 4 elements: A) Ca B) Ga C) Ge D) Br

31. Which has 3 valence electrons?

32. Which is the most active metal?

33. Which is a liquid at room temperature?

34. Which has the lowest ionization energy?

35. Which has the strongest attraction for shared electrons?

36. The compound H_2Se is bent, so that the two hydrogen atoms are about 90° apart. The compound XeF_2 is linear, so that the two fluorines are 180° apart. Based on this information we would conclude that A) both molecules are polar
B) both molecules are non polar C) H_2Se is polar, but XeF_2 is non polar
D) XeF_2 is polar but H_2Se is non polar

37. Which of the following substances is the best conductor of electricity in the solid state?

- A) S B) I_2 C) Sr D) Xe

38. Which has the highest melting point? A) CCl_4 B) KCl C) I_2 D) $\text{C}_6\text{H}_{12}\text{O}_6$

39-42 Base your answers on the following molecules:

- A) CH_4 B) NH_3 C) CO_2 D) H_2O

39. The molecule is tetrahedral

40. The molecule is linear

41. The molecule is a dipole because of its pyramidal shape

42. Of these four molecules, contains the bonds that are the most highly polar.

43. How many electrons would completely fill the third principal energy level?

- A) 2 B) 8 C) 16 D) 18

44. Elements in the same group generally have the same

- A) atomic radius B) ionization energy C) number of protons
D) number of valence electrons

45. Which element is most similar chemically to Br?

A) Hg B) Kr C) I D) S

46. The element in each period that has the lowest ionization energy is
A) a noble gas B) a halogen C) an alkali metal D) a transition metal
47. Which element often reacts by losing electrons from **2** principal energy levels?
A) Al B) Ge C) Br D) V
48. All of the elements in period 4 have A) 4 valence electrons B) 4 occupied shells
C) oxidations states of +4 D) oxidation states of -4
49. How much heat is required to convert 20.0 grams of ice to 20.0 grams of water at 0°C ?
A) 400 joules B) 6.68 kilojoules C) 668 joules D) 45.2 kilojoules
50. Which ion has the smallest radius? A) F⁻ B) Na⁺ C) Mg²⁺ D) Ca²⁺

Increases, decreases, remains the same. Note that these questions have only three choices

51. As the pressure on the surface of a liquid decreases, the boiling point of the liquid
A) decreases B) increases C) remains the same
52. As the atomic number increases in group 18, the strength of the attractions between the molecules
A) decreases B) increases C) remains the same
53. As the atomic radii of the elements in group 1 increase, the chemical activities of the elements
A) decreases B) increases C) remains the same
54. As a sample of water boils at constant pressure, the average kinetic energy of the water
A) decreases B) increases C) remains the same
55. As the temperature of a liquid substance increases, the vapor pressure of the substance
A) decreases B) increases C) remains the same

Choices for 56 to 58

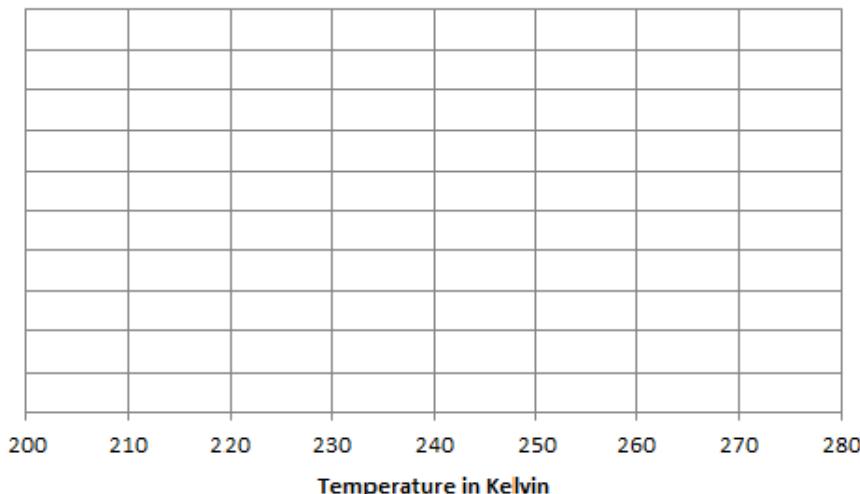
A) Sugar, C₁₂H₂₂O₁₁ B) Sodium oxide, Na₂O C) Iron, Fe D) none of these

56. A liquid at room temperature
57. Conducts electricity in the liquid state, but NOT in the solid state
58. A molecular solid

Name _____ Class _____

The table below lists the vapor pressure of propane, C₃H₈ at various temperatures.

temperature	Pressure
Kelvin	Kilopascals
200	23.7
210	40.2
220	64.9
230	100.5
240	150.2
250	217.3
260	305.4
270	418.7



59. Draw a graph of the vapor pressure vs. temperature for propane, based on the data in the table above. Choose an appropriate scale for your Y axis, and properly label the axis. The X axis is already done for you. Carefully enter all 8 points on your graph, and circle them. Connect the points .
 60. What is the approximate normal boiling point of propane?
 61. What state is propane in at room temperature and standard pressure? Explain how you know.
 62. Use your graph to estimate the vapor pressure of propane at -10°C.
- VP = _____ kPa
63. A sample of oxygen gas has a volume of 4.00 liters at a temperature of 25°C, and a pressure

of 4.00 atm. The gas expands to 10.0 liters, and its temperature changes. The new pressure is 1.00 atm.

A. Set up the equation that you will use to find the new temperature, substituting in the correct data.

B. Find the new temperature in Kelvin

C. Find the new temperature in degrees C.

64. When a 100. gram sample of lead, Pb, at 20.0°C absorbs 530. joules of heat, the temperature of the lead goes up to 60.0°C.

A. Write the equation that will allow you to find the specific heat of lead in joules/g .

B. Solve the equation to find the specific heat of lead.

65. Draw dot structures for each of the following compounds:

A. CaO B. PH₃ C. CBr₄ D. I₂

E. Which of the **molecular** substances is a dipole? Explain your answer.

66. Provide the correct chemical formula for each of the following:

A. Calcium nitrate _____

B. Iron (III) sulfate _____

C. nitrogen trichloride _____

D. Aluminum sulfide _____

67. Provide the correct name for the following substances:

A. P_2O_5 _____

B. Na_2CO_3 _____

C. Fe(OH)_3 _____

Extra Credit

I. Draw the dot structure for the compound C_3H_4

II. How many unpaired electrons are there on a cobalt atom?
Explain how you got your answer.

III. What is the minimum pressure in atmospheres that would be required to keep propane in the liquid state at 270 K?