Topics that are included on the test:

Chemical Foundations - the scientific method, units of measurement, uncertainty in measurement, significant figures and operations with significant digits, conversion factors and dimensional analysis, temperature and temperature scales, density, classification of matter, basic structure of the atom, subatomic particles, atoms and ions, an introduction to the periodic table, naming simple compounds.

Mathematical Foundations - scientific notation, solving one-unknown equation, basic operations with fractions and exponents, percentage of a number, simple linear functions.

You can find the Chemistry content in any introductory Chemistry textbook. There is an open access textbook available online at:
https://open.umn.edu/opentextbooks/textbooks/introductory-chemistry

Practice placement test is below.

Chemistry practice placement test

1) A substance that can't be chemically broken down into simpler substances is

A) a homogeneous mixture.
B) an element.
C) a heterogeneous mixture.
D) a compound.
E) an electron.

2) Determine the density of an object that has a mass of 149.8 g and displaces 12.1 mL of water when placed in a graduated cylinder.

A) 8.08 g/mL
B) 1.38 g/mL
C) 12.4 g/mL
D) 18.1 g/mL
E) 11.4 g/mL

3) Read the water level with the correct number of significant figures.

A) 5 mL
B) 5.3 mL
C) 5.32 mL
D) 5.320 mL
E) 5.3200 mL

4) What answer should be reported, with the correct number of significant figures, for the following calculation? (433.621 - 333.9) × 11.900

A) 1.19×10^3
B) 1.187×10^3
C) 1.1868×10^3
D) 1.18680×10^3
E) 1.186799×10^3

5) Which of the following is an example of a chemical change?

A) dry ice sublimes
B) charcoal burning
C) ethanol evaporates
D) ice melting
E) All of the above are examples of chemical change.

6) Which of the following is an example of intensive properties?

A) boiling point
B) height
C) volume
D) None of the above is an example of intensive properties.
E) All of the above are examples of intensive properties.

7) How many significant figures are in the measurement, 0.003800 g?

A) 4
B) 5
C) 6
D) 7
E) 8

8) Round the following number to four significant figures and express the result in standard exponential notation: 442,722

A) 0.4427×10^6
B) 442,700
C) 4.427×10^{-5}
D) 4.427×10^5
E) 44.27×10^4

9) The correct answer (reported to the proper number of significant figures) to the following is:

$$(1612 - 1501) \times (8.56 \times 8.86) = \underline{\qquad}$$

A) 8.42×10^3
B) -1.11×10^5
C) 1.73×10^5
D) 2.05×10^3
E) 1.66×10^4

10) Without using a calculator, solve the following problem:

$$\frac{[(1 \times 10^5) \times (1 \times 10^2)]^2}{(1 \times 10^{-10})}$$

A) 1×10^{-6}
B) 1×10^4
C) 1×10^{24}
D) 1×10^{34}

11) How many mL are in 4.08 L?

A) 4.08×10^{-3} mL
B) 4.08×10^1 mL
C) 4.08×10^3 mL
D) 4.08×10^{-1} mL
E) 4.08×10^6 mL

12) The estimated costs for remodeling the interior of an apartment are: three 1-gallon cans of paint at $13.22 each, two paint brushes at $12.22 each, and $145 for a helper. The total estimated cost with the appropriate significant figures is $_____.

A) 209.10
B) 2.1×10^2
C) 209
D) 2×10^2
E) 209.1

13) Which of the following is a chemical property of aspirin?
A) It does not decompose when protected from moisture.
B) It does not readily dissolve in water.
C) It can be compressed into tablets when mixed with cornstarch.
D) It melts at 135°C.
E) It is a white crystalline solid in pure form at room temperature.

14) A chemist is given an unknown gas sample. Which observation describes a chemical property of the sample?

A) It extinguishes a glowing splint.
B) It has a sharp, stinging odor.
C) It is colorless.
D) Its density is greater than that of air.
E) It weighs 11.2 grams.

15) 1-butanethiol, one of the compounds giving skunks their distinctive odor, freezes at -115.7°C and boils at 98.5°C. What is its phase at 37°C, the normal body temperature of humans?
A) solid
B) liquid
C) gas
D) a mixture of solid and liquid
E) a mixture of liquid and gas

16) Which of the following is a pure substance?

A) root beer
B) bleach
C) eggs
D) gasoline
E) neon

17) Each symbol denotes an element **except**
A) Co
B) CO
C) Cu
D) C
E) Cl

18) Element Z has the following properties:
   a. noncombustible
   b. unreactive
   c. colorless, odorless gas at room temperature
   d. nonconductor of electricity
Element Z can be classified as a _____ and will be found _____ the zigzag line of the periodic table.
A) metal; to the left of
B) metalloid; along side of
C) non-metal; to the right of
D) non-metal; along side of
E) metal; to the right of

19) Which of the following numbers contains **four** significant figures?

A) 230,110
B) 23,011.0
C) 0.23010
D) 0.0230100
E) 0.002301

20) In scientific notation, the number 0.0046 is expressed as

A) 46×10^{-3}.
B) 4.6×10^{-3}.
C) 4.6×10^{-2}.
D) 4.6×10^{-1}.
E) 46×10^{-1}.

21) The molecular model below depicts a molecule composed of carbon (black), oxygen (gray), and hydrogen (white) atoms. What is the correct molecular formula?
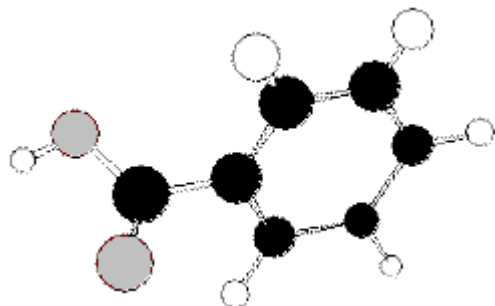
A) CHO
B) $C_6H_6O_2$
C) C_6H_7O
D) C_7H_6O
E) $C_7H_6O_2$

22) If the fuel efficiency of an automobile is 27 miles per gallon, what is its fuel efficiency in kilometers per liter? (1 km = 0.621 mile, 1.000 L = 1.057 quarts, 4 quarts = 1 gallon)

A) 11 km/L
B) 14 km/L
C) 17 km/L
D) 63 km/L
E) 180 km/L

23) What mass of zinc (in kg) is in a 3.50 kg roll of tin foil that is 92.5% tin and 7.5% zinc?

a. 0.26 kg
b. 0.47 kg
c. 0.90 kg
d. 2.1 kg
e. 3.2 kg

24) In which of the following is the metric system prefix *incorrectly* paired with a power of ten?

A) nano- 10^{-9}
B) micro- 10^{-3}
C) deca- 10^{1}
D) giga- 10^{9}
E) kilo – 10^{3}

25) A group of college students donated 136 pints of blood to a local blood bank. How many milliliters of blood did the group of students donate? (2 pints = 1 quart, 1L = 1.06 quarts)

A) 16,700 mL
B) 95,400 mL
C) 32,800 mL
D) 64200 mL
E) 257,000 mL

26) A certain children's fever reducing medicine has a concentration of 250 mg/10 mL. If a child is to receive 2 teaspoons of this medicine, how many mg of medicine is being received in one dose? (1 tsp = 5 mL)
A) 650 mg
B) 275 mg
C) 188 mg
D) 250 mg

27) A pure substance A is found to change upon heating into two new pure substances, B and C. C can be decomposed by chemical means, B cannot be decomposed by chemical means. From this we may conclude that: _____

A) A is an element, B and C are compounds
B) A is a compound, B and C are elements
C) A, B and C are all elements
D) A and C are compounds, B is an element
E) A, B, and C are all compounds

28) What is 135% of 1560

A) 2110
B) 1160
C) 11.60
D) 21.10
E) 2106

29) Solve for x:

$x + 5y = 6$
$x + y = 2$

A) $x = 3$
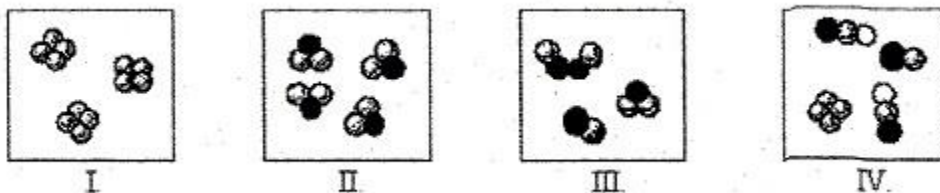B) $x = 1$
C) $x = 2$
D) $x = -1$
E) $x = -2$

30) Solve for x:

$Log_2 x = 6$

A) 32
B) 12
C) 64
D) 10
E) 16

31) Which statement concerning the molecules depicted is *incorrect*?

A) The molecules in box I represent a pure substance.
B) The molecules in box III represent a mixture of elements.
C) The molecules in box II represent a compound composed of two different elements.
D) The molecules in box IV represents two different compounds and an element.

32) Which statement about an atom is *false*?

A) The nucleus is the center region of an atom.
B) The space occupied by the electrons is primarily empty.
C) The nucleus accounts for a small portion of the mass of an atom.
D) The volume occupied by electrons is referred to as an electron cloud.

33)   Adding one neutron to the nucleus of an atom
A) converts it to an isotope of the same element.
B) increases its atomic mass by two units, but does not change its atomic number.
C) increases its atomic number by one unit but does not change its atomic mass.
D) does not change either its atomic number or its atomic mass.
E) converts it to an atom of a different element.

34) An ion with 36 electrons and 34 protons has a net charge of

A) -1
B) -2
C) +1
D) +2
E) 0

35) For which of the following can the composition vary?

A) pure substance
B) element
C) both homogeneous and heterogeneous mixtures
D) homogeneous mixtures
E) heterogeneous mixtures

36)   Which states of matter are significantly compressible?

A) liquids and gases
B) solids only
C) gases only
D) solids and liquids
E) liquids only

37)   Which of the following is a chemical property of sodium chloride?

A) It melts at a very high temperature.
B) It is a solid at room temperature.
C) It dissolves in water.
D) It can be decomposed into sodium metal and chlorine gas.
E) It is not significantly compressible.

38)   Using equation $\dfrac{v_1}{v_2} = \sqrt{\dfrac{M_2}{M_1}}$

   Find v_2 given:
   $v_1 = 354$
   $M_2 = 44.0$
   $M_1 = 16.0$

A) 45569
B) 129
C) 974
D) 213
E) 587

39) Use equation: $u_{av} = \sqrt{\dfrac{3RT}{M}}$

Find **T**, given:
$u_{av} = 489$
$R = 8.314$
$M = 0.0328$

A) 0.643
B) 314
C) 21736
D) 128
E) 44.4

40) A chemical bond formed between two identical atoms is a(an) _____ bond.

A) atomic
B) covalent
C) hydrogen
D) ionic
E) molecular

41) The smallest possible unit of a covalent compound is a(an)

A) atom.
B) cation.
C) formula unit.
D) molecule.
E) polyatomic ion.

42) The covalent bonding model is most useful in describing which of the following compounds?

A) $CoCl_2$
B) $MgCl_2$
C) $NiCl_2$
D) SCl_2
E) none of the above

43) A positively charged particle formed by loss of one or more electrons from an atom is called a(an)
A) anion.
B) cation.
C) isotope.
D) nucleus.
E) proton.

44) When an atom donates an electron, that electron

A) is lost for all time.
B) is acquired by another atom which becomes an anion.
C) is acquired by another atom which becomes a cation.
D) neutralizes a proton to form a neutron.
E) pairs with another electron to form a covalent bond.

45) One characteristic of a cation is that

A) it has more protons than electrons.
B) it has equal numbers of protons and electrons.
C) it has more electrons than protons.
D) the number of neutrons is related to the number of electrons.
E) the relationship between protons and electrons varies with the cation in question.

46) The smallest amount of an element that retains that element's characteristics is the

A) atom.
B) electron.
C) molecule.
D) neutron.
E) proton.

47) Protons possess a _____ charge, and electrons possess a _____ charge.

A) negative, negative
B) negative, positive
C) positive, negative
D) positive, zero
E) zero, positive

48) Adding one proton to the nucleus of an atom

A) converts it to an isotope of the same element.
B) increases its atomic mass by one unit, but does not change its atomic number.
C) increases its atomic number by one unit but does not change its atomic mass.
D) does not change either its atomic number or its atomic mass.
E) converts it to an atom of a different element.

49) Elements in the Periodic Table are arranged according to
A) alphabetical order.
B) atomic number.
C) atomic weight.
D) date of discovery.
E) number of neutrons.

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

44 B
45 A
46 A
47 C
48 E
49 B