



NATIONAL SCIENCE LEAGUE – 2015

CHEMISTRY CONTEST

- ANSWER KEY -

Note: Students should use only the Periodic Table provided with this test.

SAMPLE

1. _____ D _____
2. _____ D _____
3. _____ C _____
4. _____ A _____
5. _____ A _____
6. _____ D _____
7. _____ B _____
8. _____ A _____
9. _____ B _____
10. _____ C _____
11. _____ C _____
12. _____ C _____
13. _____ A _____
14. _____ B _____
15. _____ D _____
16. _____ C _____
17. _____ D _____
18. _____ A _____
19. _____ B _____
20. _____ C _____

21. _____ B _____
22. _____ B _____
23. _____ C _____
24. _____ D _____
25. _____ D _____
26. _____ C _____
27. _____ B _____
28. _____ A _____
29. _____ B _____
30. _____ C _____
31. _____ B _____
32. _____ A _____
33. _____ B _____
34. _____ D _____
35. _____ D _____
36. _____ C _____
37. _____ B _____
38. _____ B _____
39. _____ A _____
40. _____ D _____

NATIONAL SCIENCE
CHEMISTRY

Directions: On the answer sheet, write the letter of the choice that best answers or completes the question.

1. Which of the following is an example of a pure substance?
a. Al
b. HNO₃
c. CO₂
d. all of these
2. Water boiling is a
a. chemical change because gas is given off.
b. physical change because the water disappears.
c. chemical change because energy is needed for the process to occur.
d. physical change because the water vapor is chemically the same as the liquid.
3. The state of matter with a definite volume and shape is
a. gas.
b. liquid.
c. solid.
d. all of these.
4. How many significant figures are in the number 0.0001402?
a. 4
b. 6
c. 7
d. 8
5. Calculate the answer to the following using significant figures.

$$\frac{2.1 + 4.43}{3.112} + 1.113$$

- a. 3.2
b. 3.21
c. 3.211
d. 3.2113
6. Express 1209500000 in standard scientific notation.
a. 12095.0 x 10⁵
b. 1209.5 x 10⁶
c. 12.0950 x 10⁸
d. 1.2095 x 10⁹
7. What mass of solute is contained in 254 mL of a 0.563 M CaCl₂ solution?
a. 0.00129 g
b. 15.9 g
c. 24.3 g
d. 50.1 g
8. What is the coefficient of CO₂ when the following reaction is balanced using smallest whole numbers?
$$\text{C}_3\text{H}_8 (\text{g}) + \text{O}_2 (\text{g}) \rightarrow \text{CO}_2 (\text{g}) + \text{H}_2\text{O} (\text{g})$$

a. 3
b. 6
c. 9
d. 12
9. Calculate the number of ions when 5.91 grams of NaCl are dissolved in water.
a. 6.09 x 10²²
b. 1.22 x 10²³
c. 2.08 x 10²³
d. 4.16 x 10²³
10. Which of the following is a characteristic of metals?
a. poor conductors of electricity
b. dull appearance
c. tend to lose electrons in chemical reactions
d. often form covalent bonds by bonding with each other

11. The correct name for CuO is
- Copper oxide .
 - Copper monoxide .
 - Copper (II) oxide .
 - Copper (III) oxide .
12. How many oxygen atoms are in $Mg_3(PO_4)_2$?
- 4
 - 6
 - 8
 - 12
13. Which of the following are incorrectly paired?
- Pb, a transition metal
 - K, an alkali metal
 - Mg, an alkaline earth metal
 - Ne, a noble gas
14. Which of the following represent a set of isotopes? Atomic nuclei containing:
- 10 protons and 10 neutrons
 - 11 protons and 10 neutrons
 - 10 protons and 11 neutrons
 - 12 protons and 10 neutrons
 - 11 protons and 11 neutrons
- I, II, and IV
 - I and III
 - III and V
 - I, II, and IV
15. $^{16}_8O^{2-}$ has
- 8 protons, 16 neutrons and 8 electrons .
 - 16 protons, 8 neutrons and 8 electrons .
 - 8 protons, 8 neutrons and 6 electrons .
 - 8 protons, 8 neutrons and 10 electrons .
16. Who conducted the gold foil experiment leading to the nuclear model of the atom?
- J.J. Thompson
 - John Dalton
 - Ernest Rutherford
 - Dmitri Mendeleev
17. In the following reaction, $C(s) + O_2(g) \rightarrow CO_2(g)$, carbon
- is the electron acceptor.
 - is reduced.
 - is the oxidizing agent.
 - is the reducing agent.
18. Which of the following is NOT a strong acid?
- HF
 - HCl
 - HBr
 - HI
19. The interaction between NaCl solute particles and water molecules which causes the salt to ionize in water is called
- lattice energy .
 - hydration .
 - coagulation .
 - polarization .
20. You have exposed electrodes of a light bulb in a solution. The light bulb is on. Which of the following could be in the solution lighting the bulb?
- $C_6H_{12}O_6$
 - pure water
 - KCl
 - C_2H_5OH

21. What would happen to a gas sample in a closed container if the temperature is increased while its volume is decreased?
- the pressure would decrease
 - the pressure would increase
 - the pressure would remain the same
 - the average kinetic energy of the molecules would decrease
22. Which of the following gases has the highest average velocity at 25°C ?
- Cl₂
 - He
 - CH₄
 - NH₃
23. The temperature of a 2.0 L inflatable toy changes from 10°C to 20°C. What will be the volume of the toy at the new temperature if the pressure remains constant?
- 1.0 L
 - 1.93 L
 - 2.07 L
 - 4.0 L
24. Consider three 1-Liter flasks at STP. Flask A contains N₂, Flask B contains CO₂ and Flask C contains He. Which flask contains the largest number of molecules?
- Flask A
 - Flask B
 - Flask C
 - All have the same number of molecules
25. How much energy is needed to raise 10.0 mL of water 5.00°C?
- 2.09 J
 - 12.0 J
 - 50.0 J
 - 209 J
26. Consider the following reaction:
- $$\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}) \quad \Delta H = -286 \text{ kJ}$$
- What energy change occurs when 1.50 moles of H₂ reacts?
- 191 kJ are released
 - 191 kJ are absorbed
 - 429 kJ are released
 - 429 kJ are absorbed
27. Order the elements F, O, Cl in order of INCREASING atomic radii.
- O, F, Cl
 - F, O, Cl
 - Cl, F, O
 - F, Cl, O
28. The element with the electron configuration 1s²2s²2p⁶3s²3p⁶4s²3d¹⁰4p⁵ belongs to which group on the periodic table?
- halogens
 - alkali metals
 - transition metals
 - noble gases
29. When a hydrogen electron makes a transition from n=4 to n=1, which of the following is true?
- energy is absorbed
 - energy is emitted
 - the energy remains the same
 - the electron gains energy
30. When ignited, Copper burns with a blue-green flame. The wavelength given off by this flame is GREATER than that of
- orange light,
 - radio waves,
 - ultraviolet light,
 - micro waves,
31. What is the correct molecular structure for the water molecule?
- linear
 - bent
 - trigonal planar
 - tetrahedral

PERIODIC TABLE OF THE ELEMENTS

National Science Olympiad

Chemistry Contest

1 H 1.008	Alkaline earth metals										Halogens					2 He 4.003	
3 Li 6.941	4 Be 9.012	Transition Metals										5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	71 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0	89 Ac** (227)	104 Unk (261)	105 Unp (262)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Une (267)									

Metals Nonmetals

*Lanthanides (Rare Earths)

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

**Actinides (Transuranium)