ACS USNCO
U.S. National Chemistry Olympiad

2026 U.S. NATIONAL CHEMISTRY OLYMPIAD

LOCAL SECTION EXAM

Prepared by the American Chemical Society Chemistry Olympiad Examinations Task Force

OLYMPIAD EXAMINATIONS TASK FORCE

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DIRECTIONS TO THE EXAMINER

This test is designed to be taken with an answer sheet on which the student records their responses. All answers are to be marked on that sheet, not written in the booklet. Each student should be provided with an answer sheet and scratch paper, both of which must be turned in with the test booklet at the end of the examination. Local Sections may use an answer sheet of their own choice.

The full examination consists of 60 multiple-choice questions representing a fairly wide range of difficulty. A periodic table and other useful information are provided on page two of this exam booklet for student reference.

Only non-programmable calculators are to be used on the ACS Local Section exam. The use of a programmable calculator, cell phone, or any other device that can access the internet or make copies or photographs during the exam is grounds for disqualification.

Suggested Time: 60 questions—110 minutes

DIRECTIONS TO THE EXAMINEE

DO NOT TURN THE PAGE UNTIL DIRECTED TO DO SO.

This is a multiple-choice examination with four choices for each question. There is only one correct or best answer to each question. When you select your choice, blacken the corresponding space on the answer sheet with your pencil. Make a heavy full mark, but no stray marks. If you decide to change your answer, be certain to erase your original answer completely.

ABBREVIATIONS AND SYMBOLS					
amount of substance	n	Faraday constant	F	molar mass	M
ampere	A	free energy	G	mole	mol
atmosphere	atm	frequency	ν	Planck's constant	h
atomic mass unit	u	gas constant	R	pressure	P
Avogadro constant	N_A	gram	g	rate constant	k
Celsius temperature	°C	hour	h	reaction quotient	Q
centi– prefix	c	joule	J	second	s
coulomb	C	kelvin	K	speed of light	c
density	d	kilo– prefix	k	temperature, K	T
electromotive force	E	liter	L	time	t
energy of activation	E_a	measure of pressure	mm Hg	vapor pressure	VP
enthalpy	H	milli– prefix	m	volt	V
entropy	S	molal	m	volume	V
equilibrium constant	K	molar	M		

CONSTANTS
$R = 8.314$ J mol^{-1} K^{-1}
$R = 0.08314$ L bar mol^{-1} K^{-1}
$F = 96{,}500$ C mol^{-1}
$F = 96{,}500$ J V^{-1} mol^{-1}
$N_A = 6.022 \times 10^{23}$ mol^{-1}
$h = 6.626 \times 10^{-34}$ J s
$c = 2.998 \times 10^{8}$ m s^{-1}
0 °C = 273.15 K
1 atm = 1.013 bar = 760 mm Hg
Specific heat capacity of H_2O = 4.184 J g^{-1} K^{-1}

EQUATIONS

$$E = E^{\circ} - \frac{RT}{nF}\ln Q \qquad \ln K = \left(\frac{-\Delta H^{\circ}}{R}\right)\left(\frac{1}{T}\right) + \text{constant} \qquad \ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

PERIODIC TABLE OF THE ELEMENTS

1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 **H** 1.008	2 2A																2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											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	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.97	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** 95.95	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	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	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)	89 **Ac** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **Ds** (281)	111 **Rg** (272)	112 **Cn** (285)	113 **Nh** (286)	114 **Fl** (289)	115 **Mc** (289)	116 **Lv** (293)	117 **Ts** (294)	118 **Og** (294)

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** 231.0	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** **(262)**

DIRECTIONS

- When you have selected your answer to each question, blacken the corresponding space on the answer sheet using a pencil. Make a heavy, full mark, but no stray marks. If you decide to change an answer, erase the unwanted mark very carefully.
- There is only one correct answer to each question. Any questions for which more than one response has been blackened **will not be counted**.
- Your score is based solely on the number of questions you answer correctly. **It is to your advantage to answer every question.**

1. How many atoms are there in 0.300 mol of potassium nitrate, KNO_3 (M = 101.11)?

(A) 1.79×10^{21} **(B)** 1.81×10^{23}

(C) 5.42×10^{23} **(D)** 9.03×10^{23}

2. A student isolates 22.0 g of ethyl bromide, C_2H_5Br (M = 108.96), from the reaction of 34.0 g of ethyl alcohol (M = 46.07) with 59.0 g of phosphorus tribromide (M = 270.67) according to the balanced reaction below. What is the percent yield of the reaction?

$3\ C_2H_5OH(l) + PBr_3(l) \rightarrow 3\ C_2H_5Br(l) + H_3PO_3(s)$

(A) 27.4% **(B)** 30.9% **(C)** 64.7% **(D)** 92.6%

3. A 25.00 mL sample of aqueous HCl is titrated with 0.150 M NaOH, which requires adding 18.75 mL of the NaOH solution to reach the equivalence point. What is the concentration of chloride ion in the final solution?

(A) 0.0643 M **(B)** 0.0750 M

(C) 0.112 M **(D)** 0.200 M

4. A colorless liquid hydrocarbon contains carbon and hydrogen in a 6.0 : 1 ratio by mass. Which is its molecular formula?

(A) CH **(B)** CH_2

(C) C_5H_{10} **(D)** C_6H_6

5. Mixing equal volumes of 0.15 M $Ba(NO_3)_2$ and 0.20 M NaF causes the precipitation of insoluble barium fluoride. In which are the concentrations of ions in the supernatant listed in increasing order?

(A) $[Ba^{2+}] < [F^-] < [NO_3^-] < [Na^+]$

(B) $[Ba^{2+}] < [F^-] < [Na^+] < [NO_3^-]$

(C) $[F^-] < [Ba^{2+}] < [NO_3^-] < [Na^+]$

(D) $[F^-] < [Ba^{2+}] < [Na^+] < [NO_3^-]$

6. A solution of which compound, at a concentration of 25 g L^{-1}, has the lowest freezing point?

(A) $NaBrO_3$ **(B)** $KBrO_3$

(C) Na_2SeO_4 **(D)** K_2SeO_4

7. A 0.01 M solution of a metal salt forms white precipitates when mixed with equal volumes of 0.01 M Na_2CO_3 and 0.01 M Na_2SO_4, but no precipitate with 0.01 M NaOH. What is the metal salt?

(A) $MgCl_2$ **(B)** $ZnCl_2$

(C) $AgNO_3$ **(D)** $BaCl_2$

8. A new balance is tested with replicate measurements of a standard 50.00 g mass, and gives readings of 49.31 g, 49.31 g, 49.29 g, and 49.30 g. Which description best characterizes the new balance?

(A) Low accuracy and low precision

(B) Low accuracy and high precision

(C) High accuracy and low precision

(D) High accuracy and high precision

9. Oxalate ion, $C_2O_4^{2-}$, can be quantitated by titration with potassium permanganate in acidic solution. Which is used to identify the endpoint?

(A) A persistent pink color from permanganate

(B) A persistent pink color from Mn^{2+}

(C) A persistent pink color from added phenolphthalein

(D) Bubbles of CO_2 are no longer observed

10. The number of moles of a weak monoprotic acid is determined by titrating with standardized NaOH solution to a phenolphthalein endpoint. The procedure calls for the acid to be dissolved in 50 mL of distilled water. What error would be introduced by using 75 mL of distilled water instead?

(A) The number of moles would increase significantly.

(B) The number of moles would decrease significantly.

(C) The number of moles would not be significantly affected.

(D) The number of moles would be decreased by the change if the indicator concentration is low but increased if the indicator concentration is high.

11. Solutions of which metal salt give a yellow flame test?

(A) Na **(B)** K **(C)** Cu **(D)** Ba

12. The concentration of which salt would be most difficult to measure using UV-visible spectroscopy?

(A) $NaMnO_4$ **(B)** $KClO_4$

(C) $Co(NO_3)_2$ **(D)** $CuCl_2$

13. A gas mixture containing 160 parts per million by volume of H_2S in Ne has a total pressure of 725 mmHg. What is the partial pressure of H_2S?

(A) 0.069 mmHg **(B)** 0.12 mmHg

(C) 0.16 mmHg **(D)** 0.20 mmHg

14. Which gas has the highest root-mean-square velocity at 298 K?

(A) CO **(B)** CO_2 **(C)** CH_4 **(D)** CF_4

15. Which statement describes a change when a pure solid melts spontaneously?

(A) The entropy decreases.

(B) The free energy increases.

(C) The vapor pressure increases.

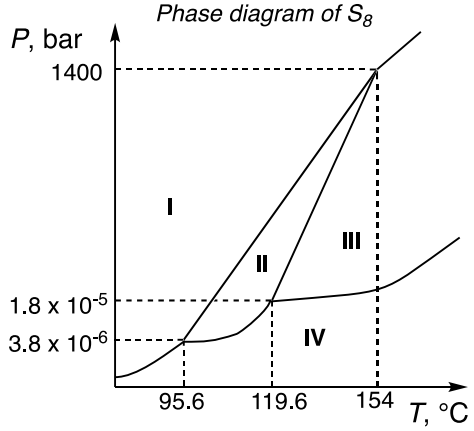
(D) The process is endothermic.

16. Which compound has the highest vapor pressure at 25 °C?

(A) $CH_3CH_2CH_2OH$ **(B)** $CH_3CH_2OCH_3$

(C) $CH_3CHOHCH_3$ **(D)** $HOCH_2CH_2OH$

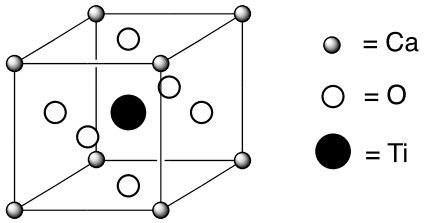
17. Sulfur has two stable solid phases, monoclinic and orthorhombic sulfur. Which regions of the phase diagram correspond to these two solid phases?



(A) **I** and **II** **(B)** **I** and **IV**

(C) **II** and **III** **(D)** **II** and **IV**

18. The mineral perovskite has the cubic unit cell shown below, with the oxygens occupying the centers of the faces, the titanium in the center, and the calciums on the corners of the cube. What is the formula of perovskite?



(A) $CaTiO_3$ **(B)** Ca_2TiO_4

(C) $CaTi_2O_4$ **(D)** Ca_8TiO_6

19. What is the standard enthalpy change for the reaction of ClF with F_2 to form ClF_3? (All species are in the gas phase.)

$2\ ClF + O_2 \rightarrow Cl_2O + F_2O$ $\quad \Delta H° = 168$ kJ mol^{-1}

$2\ ClF_3 + 2\ O_2 \rightarrow Cl_2O + 3\ F_2O$ $\quad \Delta H° = 350$ kJ mol^{-1}

$2\ F_2 + O_2 \rightarrow 2\ F_2O$ $\quad \Delta H° = -45$ kJ mol^{-1}

$ClF + F_2 \rightarrow ClF_3$ $\quad \Delta H° =$???

(A) –46 kJ mol^{-1} **(B)** –69 kJ mol^{-1}

(C) –114 kJ mol^{-1} **(D)** –136 kJ mol^{-1}

20. At 25 °C, the standard free energy change for the gas-phase reaction of hydrogen and nitrogen to form NH_3 is –33.0 kJ mol^{-1}.

$N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$ $\quad \Delta G° = -33$ kJ mol^{-1}

Under what circumstances is $\Delta G > 0$ at 298 K?

(A) Partial pressures of N_2 and H_2 = 0.1 bar, partial pressure of NH_3 = 10 bar

(B) Partial pressures of N_2 and H_2 = 10 bar, partial pressure of NH_3 = 0.1 bar

(C) All partial pressures = 1×10^{-2} bar

(D) Under no possible circumstances

21. In a coal-fired power plant, coal is burned to generate heat that boils water. 2.5 kg of coal is burned to heat 500.0 kg of water at 95 °C, ultimately converting 30.0 kg to steam. Which type of coal was burned? (For liquid water near 100 °C , $C_p = 4.21$ kJ kg^{-1} K^{-1} and $\Delta H°_{vap} = 2260$ kJ kg^{-1}.)

(A) Lignite, $\Delta H°_{combustion} = 15 - 20$ kJ g^{-1}

(B) Sub-bituminous, $\Delta H°_{combustion} = 23 - 28$ kJ g^{-1}

(C) Bituminous, $\Delta H°_{combustion} = 26 - 30$ kJ g^{-1}

(D) Anthracite, $\Delta H°_{combustion} = 30 - 33$ kJ g^{-1}

22. In a vacuum calorimetry experiment, high-energy plasma discharges between Ti(*s*) electrodes are used to electrolyze water in dilute KOH(*aq*). During an experiment, the electrical input is 500. kJ and the calorimeter records 610. kJ of heat release into the surroundings. Which best explains this experimental result?

(A) The electrodes undergo partial oxidation, an additional reaction not accounted for in electrolysis.

(B) The system's large specific heat capacity increases the total heat registered per unit of electrical energy.

(C) The overall process is endothermic, so the surroundings must release heat to maintain equilibrium.

(D) The entropy increase from gas formation causes the system to do work, resulting in additional temperature rise.

23. The standard enthalpy of combustion of ethyne can be estimated from the tabulated bond dissociation enthalpies (BDE) shown below to be –982 kJ mol^{-1}. The experimental $\Delta H°_{\text{combustion}}$ is –1256 kJ mol^{-1}. Which is the best explanation for the discrepancy?

Bond	**BDE** (kJ mol^{-1})
C≡C	839
C−H	412
O=O	498
C=O	741
O–H	463

$C_2H_2(g) + 2.5\ O_2(g) \rightarrow 2\ CO_2(g) + H_2O(g)$

$\Delta H°_{\text{expt}} = -1256$ kJ mol^{-1}

(A) The tabulated C–H BDE does not account for the unusual strength of the bond formed to the *sp*-hybridized carbon in C_2H_2.

(B) The tabulated O=O BDE does not account for the unusual weakness of the bond in dioxygen due to its paramagnetism.

(C) The tabulated C=O BDE does not account for the stabilization due to electronic delocalization in carbon dioxide.

(D) The tabulated O–H BDE does not account for the stabilization due to hydrogen bonding in water.

24. For which reaction is $\Delta S° > 0$?

(A) $P_4(s) \rightarrow 4\ P(s, \text{red})$

(B) $CO_2(s) \rightarrow CO_2(g)$

(C) $3\ O_2(g) \rightarrow 2\ O_3(g)$

(D) $2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g)$

25. Nitrogen dioxide decomposes to nitric oxide and oxygen according to the following reaction:

$$2\ NO_2(g) \rightarrow 2\ NO(g) + O_2(g)$$

If $\Delta[NO_2]/\Delta t$ is –0.0024 M s^{-1}, what is $\Delta[O_2]/\Delta t$?

(A) –0.0048 M s^{-1} **(B)** –0.0012 M s^{-1}

(C) 0.0048 M s^{-1} **(D)** 0.0012 M s^{-1}

26. For the reaction below, initial rate data appear in the table. What is the rate law for the reaction?

$$2\ A(aq) + B(aq) \rightarrow C(aq) + D(aq)$$

Experiment	$[A]_0$, M	$[B]_0$, M	Initial rate, M s^{-1}
1	0.10	0.10	0.086
2	0.20	0.10	0.342
3	0.20	0.20	0.344

(A) Rate = $k[A][B]$ **(B)** Rate = $k[A]^2$

(C) Rate = $k[A]^2[B]$ **(D)** Rate = $k[A][B]^2$

27. Two reactions have the same rate constant at 300.0 K. Reaction 1 has an activation energy of 48.2 kJ/mol, while reaction 2 has an activation energy of 20.0 kJ/mol. What is k_1/k_2 at 320.0 K?

(A) 0.493 **(B)** 0.844

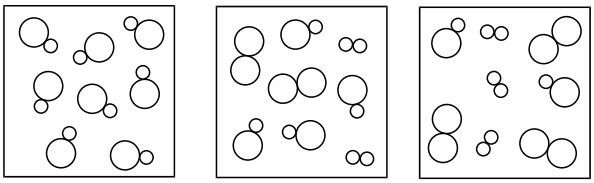
(C) 1.18 **(D)** 2.03

28. The reaction between A and B has the rate law Rate = $k[A][B]$. A reaction is conducted with $[A]_0 = 0.0245$ M and $[B]_0 = 3.24 \times 10^{-5}$ M, and the natural logarithm of the concentration of [B] is plotted as a function of time in seconds. The plot is linear, with a slope of -3.96×10^{-4}. What is the value of k?

(A) 3.96×10^{-4} M^{-1} s^{-1} **(B)** 1.62×10^{-2} M^{-1} s^{-1}

(C) 12.2 M^{-1} s^{-1} **(D)** 499 M^{-1} s^{-1}

29. In the depiction of an irreversible chemical reaction shown below, the large circles represent atoms of element A and the small circles represent atoms of element B. At $t = 0$, only compound AB is present. The rate law of the reaction is Rate = $k[AB]^2$. What is the value of t in the third panel?



(A) 30 min **(B)** 40 min

(C) 50 min **(D)** 60 min

30. The chlorination of ethene is proposed to occur by the following mechanism:

$C_2H_4 + Cl_2 \rightarrow C_2H_4Cl^+ + Cl^-$ (Step 1)

$C_2H_4Cl^+ + Cl^- \rightarrow C_2H_4Cl_2$ (Step 2)

Which step could possibly be rate-determining, given a rate law of Rate = $k[C_2H_4][Cl_2]$?

(A) Step 1 only

(B) Step 2 only

(C) Either Step 1 or Step 2

(D) Neither Step 1 nor Step 2

31. The reaction of nitrogen and hydrogen to form ammonia is maintained at equilibrium in a rigid container at fixed temperature:

$$N_2(g) + 3\ H_2(g) \rightleftharpoons 2\ NH_3(g)$$

Helium gas is introduced into the system, causing the total pressure to increase by a factor of two. How will the equilibrium for the reaction shift?

(A) It will be unaffected.

(B) It will shift to the left.

(C) It will shift to the right.

(D) The direction that the equilibrium will shift depends on whether the reaction is endothermic or exothermic.

32. Cacodylic acid, $(CH_3)_2AsO(OH)$, has a pK_a of 6.25. At what concentration of cacodylic acid would a solution of it have a pH = 4.00?

(A) 1.0×10^{-4} M **(B)** 3.2×10^{-4} M

(C) 5.6×10^{-3} M **(D)** 1.8×10^{-2} M

33. The decomposition of PCl_5 is endothermic. Which change will result in an increase in the value of K_{eq}?

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g) \qquad \Delta H° > 0$$

I. Increasing temperature II. Increasing volume

(A) I only **(B)** II only

(C) Both I and II **(D)** Neither I nor II

34. What concentration of carbonate ion must be achieved to precipitate 99.99% of the silver ion from a 0.100 M solution of silver nitrate? The K_{sp} of Ag_2CO_3 is 8.1×10^{-12}.

(A) 8.1×10^{-10} M **(B)** 8.1×10^{-7} M

(C) 1.3×10^{-4} M **(D)** 8.1×10^{-2} M

35. What is the pH after 0.100 mol of NaOH is added to 250.0 mL of 0.300 M H_3PO_4? For H_3PO_4, pK_{a1} = 2.12, pK_{a2} = 7.21, and pK_{a3} = 12.38.

(A) 1.82 **(B)** 2.24

(C) 6.73 **(D)** 6.91

36. Zinc hydroxide is a sparingly soluble compound (K_{sp} = 4.5×10^{-17}) that dissolves in strongly basic solution due to the formation of the $Zn(OH)_4^{2-}$ complex ion (K_f = 5.0×10^{14}). What is the minimum concentration of sodium hydroxide needed in 1.0 L of a solution which could be added to 0.10 mol $Zn(OH)_2$ to fully dissolve it?

(A) 2.1 M **(B)** 2.3 M

(C) 4.2 M **(D)** 4.6 M

37. What is the oxidizing agent in the following reaction?

$$Fe(CN)_6^{3-} + Co(CN)_5^{3-} + CN^- \rightarrow Fe(CN)_6^{4-} + Co(CN)_6^{3-}$$

(A) $Fe(CN)_6^{3-}$ **(B)** $Co(CN)_5^{3-}$

(C) CN^- **(D)** $Co(CN)_6^{3-}$

38. What are the oxidation states of N in NH_4NO_3?

(A) Both are –3

(B) Both are +1

(C) One is –1 and one is +1

(D) One is –3 and one is +5

39. A 0.4679 g sample of iron-containing ore is dissolved in acid and the iron reduced to the +2 oxidation state. The solution is titrated with 0.03930 M $KMnO_4$, requiring 26.82 mL to reach the equivalence point. What is the percentage by mass of iron in the ore?

(A) 12.58% **(B)** 29.43%

(C) 62.91% **(D)** 72.36%

40. Ships sometimes have strips of titanium welded to their steel hulls to protect them from corrosion. Which is the best explanation for this protective action?

(A) Ti is more easily oxidized than Fe.

(B) Ti and Fe form an alloy that stabilizes the Fe.

(C) Ti^{2+} has a more positive reduction potential than Fe^{2+}.

(D) The Ti and Fe form a galvanic cell with Ti being reduced.

41. Hypophosphorous acid (H_3PO_2) disproportionates in acidic solution to give phosphine (PH_3) and phosphorous acid (H_3PO_3). What ratio of PH_3 : H_3PO_3 is produced?

(A) 1 : 1 **(B)** 1 : 2 **(C)** 2 : 3 **(D)** 3 : 2

42. A solution containing 0.0100 mol of silver nitrate and 0.0100 mol copper(II) nitrate is electrolyzed with a current of 0.170 A for 152 minutes. What mass of metal is deposited on the cathode?

(A) 1.12 g **(B)** 1.27 g

(C) 1.38 g **(D)** 1.73 g

43. Which species has the largest ionic radius?

(A) F^- **(B)** Na^+ **(C)** Mg^{2+} **(D)** Al^{3+}

44. Which set of quantum numbers is not possible for an electron?

(A) $n = 1, l = 1, m_l = 0, m_s = +1/2$

(B) $n = 2, l = 1, m_l = 1, m_s = -1/2$

(C) $n = 3, l = 2, m_l = -2, m_s = +1/2$

(D) $n = 4, l = 0, m_l = 0, m_s = +1/2$

45. For which gas-phase atoms are the 4*s* orbitals lower in energy than the 3*d* orbitals?

I. H II. K

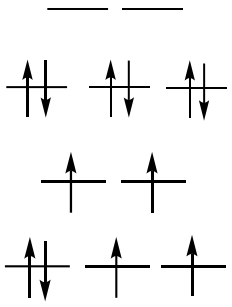
(A) I only **(B)** II only

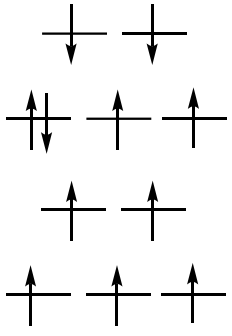
(C) Both I and II **(D)** Neither I nor II

46. Which element has the largest first ionization energy?

(A) F **(B)** Ne **(C)** Cl **(D)** Ar

47. Which best describes the distribution of electrons among the 3*d* orbitals in $Fe(H_2O)_6^{2+}$ in its most stable state?

(A) 

(B) 

(C)

(D)

48. An isotope of phosphorus undergoes β^- decay to give which daughter nucleus?

(A) ^{27}Al **(B)** ^{29}Si **(C)** ^{31}P **(D)** ^{33}S

49. In which are the species arranged in increasing order of N-O bond length?

(A) $NO^+ < NO < NO_3^-$ **(B)** $NO^+ < NO_3^- < NO$

(C) $NO < NO^+ < NO_3^-$ **(D)** $NO_3^- < NO^+ < NO$

50. Which statement does not accurately describe σ and π bonding?

(A) σ bonds have no nodes containing the internuclear axis, while π bonds have one node containing the internuclear axis.

(B) σ and π bonds are of similar strength in homodiatomic molecules containing elements of the second and third period.

(C) Triple bonds in heterodiatomic molecules of the second and third period elements consist of one σ and two π bonds.

(D) Formaldehyde, H_2CO, has three σ bonds and one π bond.

51. What is the bond order in superoxide ion, O_2^-?

(A) 1.0 **(B)** 1.5 **(C)** 2.0 **(D)** 2.5

52. Which is the best description of the geometry of $XeOF_4$?

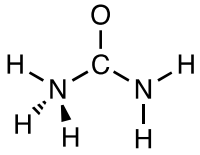
(A) Square pyramidal with the oxygen axial

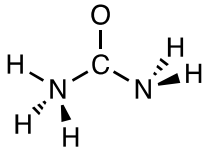
(B) Square pyramidal with the oxygen equatorial

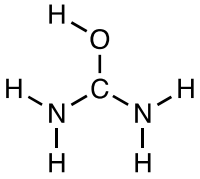
(C) Trigonal bipyramidal with the oxygen axial

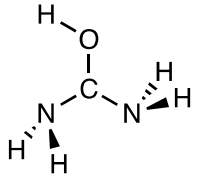
(D) Trigonal bipyramidal with the oxygen equatorial

53. Which is the best description of the arrangement of the atoms in space in the protonated urea ion, $H_5CN_2O^+$?

(A) 

(B) 

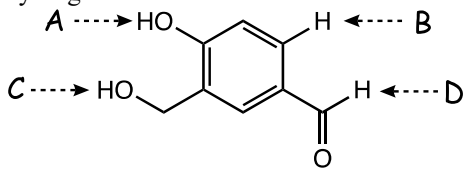
(C) 

(D) 

54. How many stereoisomers are there of the square planar complex (en)PtClBr (en = 1,2-ethylenediamine, $H_2NCH_2CH_2NH_2$)?

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4

55. Which hydrogen is most acidic?



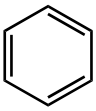
(A) A **(B)** B **(C)** C **(D)** D

56. In which compound are the carbon atoms not coplanar in the most stable conformation?

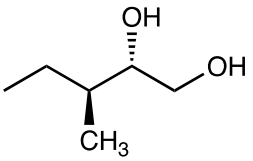
(A) 

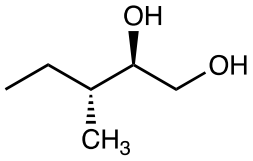
(B) 

(C) 

(D) 

57. What is the relationship between the two structures?





(A) Constitutional isomers **(B)** Diastereomers

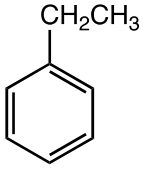
(C) Enantiomers **(D)** Identical

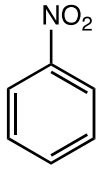
58. What functional group is formed by the reaction of a Grignard reagent with an aldehyde?

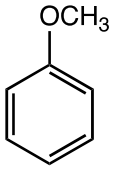
(A) Ester **(B)** Ketone

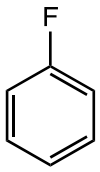
(C) Secondary alcohol **(D)** Tertiary alcohol

59. Which compound undergoes electrophilic aromatic substitution under the mildest conditions?

(A) 

(B) 

(C) 

(D) 

60. Which class of enzyme catalyzes the reaction of two molecules to form a larger product, usually using ATP as an energy source?

(A) Helicase **(B)** Ligase

(C) Protease **(D)** Racemase

END OF TEST

Olympiad 2026
USNCO Local Section Exam
KEY

Number	Answer	Number	Answer
1.	D	31.	A
2.	B	32.	D
3.	A	33.	A
4.	C	34.	D
5.	D	35.	D
6.	C	36.	B
7.	D	37.	A
8.	B	38.	D
9.	A	39.	C
10.	C	40.	A
11.	A	41.	B
12.	B	42.	B
13.	B	43.	A
14.	C	44.	A
15.	D	45.	B
16.	B	46.	B
17.	A	47.	C
18.	A	48.	D
19.	C	49.	A
20.	A	50.	B
21.	D	51.	B
22.	A	52.	A
23.	C	53.	C
24.	B	54.	A
25.	D	55.	A
26.	B	56.	B
27.	D	57.	C
28.	B	58.	C
29.	D	59.	C
30.	C	60.	B