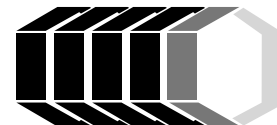




# 2003 U. S. NATIONAL CHEMISTRY OLYMPIAD

## LOCAL SECTION EXAM



Prepared by the American Chemical Society 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 his or her 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. Students should be permitted to use non-programmable calculators. A periodic table and other useful information are provided on page two of this exam booklet for student reference.

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.

Not valid for use as an ACS Olympiad Local Section Exam after April 14, 2003. **STOCK CODE OL03**

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ABBREVIATIONS AND SYMBOLS			
ampere	A	Faraday constant	<i>F</i>
atmosphere	atm	formula molar mass	<i>M</i>
atomic mass unit	u	free energy	<i>G</i>
atomic molar mass	<i>A</i>	frequency	<i>v</i>
Avogadro constant	$N_A$	gas constant	<i>R</i>
Celsius temperature	°C	gram	g
centi- prefix	c	heat capacity	$C_p$
coulomb	C	hour	h
electromotive force	<i>E</i>	joule	J
energy of activation	$E_a$	kelvin	K
enthalpy	<i>H</i>	kilo- prefix	k
entropy	<i>S</i>	liter	L
equilibrium constant	<i>K</i>	milli- prefix	m
		molal	<i>m</i>
		molar	M
		molar mass	<i>M</i>
		mole	mol
		Planck's constant	<i>h</i>
		pressure	<i>P</i>
		rate constant	<i>k</i>
		retention factor	$R_f$
		second	s
		temperature, K	<i>T</i>
		time	<i>t</i>
		volt	V

CONSTANTS
$R = 8.314 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$
$R = 0.0821 \text{ L}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$
$1 F = 96,500 \text{ C}\cdot\text{mol}^{-1}$
$1 F = 96,500 \text{ J}\cdot\text{V}^{-1}\cdot\text{mol}^{-1}$
$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$
$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$
$c = 2.998 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
$0^\circ\text{C} = 273.15 \text{ K}$
$1 \text{ atm} = 760 \text{ mmHg}$

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

## PERIODIC TABLE OF THE ELEMENTS

1A																2	
1											3A	4A	5A	6A	7A	8A	
H 1.008											B 10.81	C 12.01	N 14.01	O 16.00	F 19.00	Ne 20.18	
Li 6.941	Be 9.012											Al 26.98	Si 28.09	P 30.97	S 32.07	Cl 35.45	Ar 39.95
Na 22.99	Mg 24.31	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	Ga 69.72	Ge 72.61	As 74.92	Se 78.96	Br 79.90	Kr 83.80
K 39.10	Ca 40.08	Sc 44.96	Ti 47.88	V 50.94	Cr 52.00	Mn 54.94	Fe 55.85	Co 58.93	Ni 58.69	Cu 63.55	Zn 65.39	Ga 69.72	Ge 72.61	As 74.92	Se 78.96	Br 79.90	Kr 83.80
Rb 85.47	Sr 87.62	Y 88.91	Zr 91.22	Nb 92.91	Mo 95.94	Tc (98)	Ru 101.1	Rh 102.9	Pd 106.4	Ag 107.9	Cd 112.4	In 114.8	Sn 118.7	Sb 121.8	Te 127.6	I 126.9	Xe 131.3
Cs 132.9	Ba 137.3	La 138.9	Hf 178.5	Ta 180.9	W 183.8	Re 186.2	Os 190.2	Ir 192.2	Pt 195.1	Au 197.0	Hg 200.6	Tl 204.4	Pb 207.2	Bi 209.0	Po (209)	At (210)	Rn (222)
Fr (223)	Ra (226)	Ac (227)	Rf (261)	Db (262)	Sg (263)	Bh (262)	Hs (265)	Mt (266)	(269)	(272)	(277)		114 (???)				

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 soft, #2 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. Which anion forms the smallest number of insoluble salts?

- (A)  $\text{Cl}^-$       (B)  $\text{NO}_3^-$       (C)  $\text{CO}_3^{2-}$       (D)  $\text{SO}_4^{2-}$

2. Which piece of apparatus can measure a volume of 25.0 mL most precisely?

- (A) 25 mL beaker      (B) 25 mL conical flask  
(C) 25 mL graduated cylinder      (D) 25 mL pipet

3. How many significant figures should be reported in the answer to the calculation (Assume all numbers are experimentally determined.)

$$\frac{12.501 \times 3.52}{0.0042} + 6.044$$

- (A) 2      (B) 3      (C) 4      (D) 5

4. Five pellets of a metal have a total mass of 1.25 g and a total volume of 0.278 mL. What is the density of the metal in  $\text{g}\cdot\text{mL}^{-1}$ ?

- (A) 0.348      (B) 0.900      (C) 4.50      (D) 22.5

5. What is the color of the flame test for sodium?

- (A) green      (B) red  
(C) violet      (D) yellow

6. When is it acceptable to eat in a chemistry laboratory?

- (A) Anytime when a person is not doing an experiment.  
(B) Whenever there are no hazardous chemicals out.  
(C) If it is necessary to do so in order to keep another appointment.  
(D) Never.

7. Selenium (Se) is similar to sulfur in its properties and francium (Fr) is an alkali metal. What is the formula for francium selenite?

- (A)  $\text{FrSeO}_2$       (B)  $\text{Fr}_2\text{SeO}_4$   
(C)  $\text{Fr}_2\text{SeO}_3$       (D)  $\text{Fr}_2\text{Se}_2\text{O}_3$

8. Calculate the mass percentage of nitrogen in hydrazinium sulfate ( $\text{N}_2\text{H}_5)_2\text{SO}_4$ .

<b>Molar mass, <math>\text{g}\cdot\text{mol}^{-1}</math></b>	
$(\text{N}_2\text{H}_5)_2\text{SO}_4$	162.2

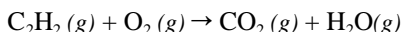
$(\text{N}_2\text{H}_5)_2\text{SO}_4$	162.2
---------------------------------------	-------

- (A) 10.8      (B) 17.3      (C) 34.5      (D) 51.2

9. How many ozone molecules are in 3.20 g of  $\text{O}_3$ ?

- (A)  $4.0 \times 10^{22}$       (B)  $6.0 \times 10^{22}$   
(C)  $1.2 \times 10^{23}$       (D)  $6.0 \times 10^{23}$

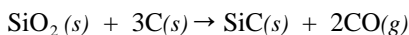
10. Acetylene,  $\text{C}_2\text{H}_2$ , reacts with oxygen according to the unbalanced equation:



What is the  $\text{O}_2/\text{C}_2\text{H}_2$  ratio when this equation is correctly balanced?

- (A) 2/1      (B) 3/1      (C) 4/1      (D) 5/2

11. Silicon carbide, SiC, is produced by heating  $\text{SiO}_2$  and C to high temperatures according to the equation:



How many grams of SiC could be formed by reacting 2.00 g of  $\text{SiO}_2$  and 2.00 g of C?

- (A) 1.33      (B) 2.26      (C) 3.59      (D) 4.00

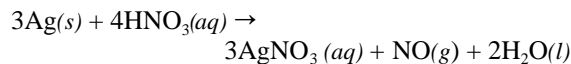
12. A 7.66 g sample of hydrated sodium sulfate,  $\text{Na}_2\text{SO}_4 \cdot x\text{H}_2\text{O}$ , forms 4.06 g of anhydrous  $\text{Na}_2\text{SO}_4$ . What is the value of x?

<b>Molar mass, <math>\text{g}\cdot\text{mol}^{-1}</math></b>	
$\text{Na}_2\text{SO}_4$	142

$\text{Na}_2\text{SO}_4$	142
--------------------------	-----

- (A) 0.2      (B) 3.6      (C) 5      (D) 7

13. Silver metal reacts with nitric acid according to the equation:



What volume of 1.15 M  $\text{HNO}_3(aq)$  is required to react with 0.784 g of silver?

- (A) 4.74 mL      (B) 6.32 mL  
(C) 8.43 mL      (D) 25.3 mL

14. Which solute produces the highest boiling point in a 0.15 m aqueous solution?

- (A)  $\text{CaCl}_2$       (B) NaBr      (C)  $\text{CuSO}_4$       (D)  $\text{CH}_3\text{OH}$

15. A gas has a volume of 6.0 L at a pressure of 0.80 atm. What is the volume if the pressure is changed to 0.20 atm at constant temperature?

(A) 1.5 L (B) 3.0 L (C) 12 L (D) 24 L

16. Which will increase the vapor pressure of a liquid?

1 increase in temperature
2 increase in surface area

(A) 1 only (B) 2 only  
(C) Both 1 and 2 (D) Neither 1 nor 2

17. What pressure (in atm) will be exerted by a 1.00 g sample of methane, CH<sub>4</sub>, in a 4.25 L flask at 115°C?

(A) 0.139 (B) 0.330 (C) 0.467 (D) 7.50

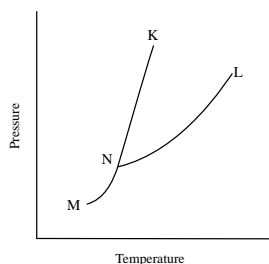
18. The lowest melting points overall occur for members of which class of solids?

(A) ionic (B) metallic  
(C) molecular (D) network covalent

19. What are the strongest intermolecular force between neighboring carbon tetrachloride, CCl<sub>4</sub>, molecules?

(A) dipole-dipole forces (B) dispersion forces  
(C) hydrogen bonds (D) covalent bonds

20. According to the phase diagram shown, where does a mixture of solid and liquid exist at equilibrium?



(A) along line MN (B) along line KN  
(C) along line LN (D) in the region KNL

21. Calculate the amount of energy released when 0.100 mol of diborane, B<sub>2</sub>H<sub>6</sub>, reacts with oxygen to produce solid B<sub>2</sub>O<sub>3</sub> and steam.

$\Delta H_f^\circ$ , (kJ·mol <sup>-1</sup> )	
B <sub>2</sub> H <sub>6</sub> (g)	35
B <sub>2</sub> O <sub>3</sub> (s)	-1272
H <sub>2</sub> O(l)	-285
H <sub>2</sub> O(g)	-241

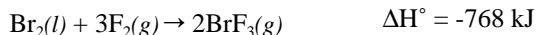
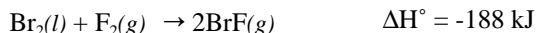
(A) 203 kJ (B) 216 kJ (C) 330 kJ (D) 343 kJ

22. How much heat is required to raise the temperature of 100. g of Fe<sub>2</sub>O<sub>3</sub> from 5.0°C to 25.0°C?

Specific heat, J·g <sup>-1</sup> ·°C <sup>-1</sup>	
Fe <sub>2</sub> O <sub>3</sub>	0.634

(A) 1.58 kJ (B) 1.27 kJ  
(C) 0.845 kJ (D) 0.0634 kJ

23. Given the thermochemical equations:

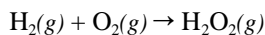


determine  $\Delta H^\circ$  for the reaction



(A) -956 kJ (B) -580 kJ  
(C) -478 kJ (D) -290 kJ

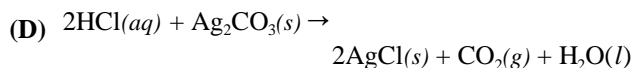
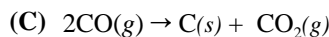
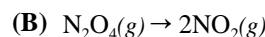
24. Use bond energies to calculate  $\Delta H^\circ$  for the reaction:



Bond Energy, kJ·mol <sup>-1</sup>	
H-H	432
H-O	459
O-O	207
O=O	494

(A) -521 kJ (B) -486 kJ  
(C) -199 kJ (D) 199 kJ

25. Which reaction occurs with a decrease in entropy?



26. A homogeneous liquid reaction mixture is often heated to increase the rate of reaction. This is best explained by the fact that raising the temperature

(A) increases the heat of reaction.  
(B) decreases the energy of activation.  
(C) increases the vapor pressure of the liquid  
(D) increases the average kinetic energy of the reactants.

27. For the reaction,



which relationship is correct?



28. This exothermic reaction is catalyzed by MnO<sub>2</sub>(s).



Which of the following will increase the rate of this reaction?

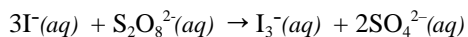
1. Raising the temperature
2. Increasing the surface area of MnO <sub>2</sub> (s)

(A) 1 only (B) 2 only  
(C) Both 1 and 2 (D) Neither 1 and 2

29. Which is constant for different reactant concentrations in a first-order reaction?

- (A) The time required for the concentration of reactants to drop below 0.001 M.  
 (B) The time required for one-half of reactants to disappear.  
 (C) The rate of disappearance of reactants in  $\text{mol}\cdot\text{L}^{-1}\cdot\text{time}^{-1}$ .  
 (D) The rate of formation of products in  $\text{mol}\cdot\text{L}^{-1}\cdot\text{time}^{-1}$ .

30. The reaction,



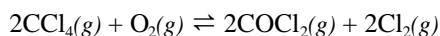
yields the kinetic data in the table.

$[\text{I}^{-}]_0$ ( $\text{mol}\cdot\text{L}^{-1}$ )	$[\text{S}_2\text{O}_8^{2-}]_0$ ( $\text{mol}\cdot\text{L}^{-1}$ )	Relative Rate
0.001	0.001	1
0.002	0.001	2
0.002	0.002	4

What is the rate equation?

- (A)  $\text{Rate} = k[\text{I}^{-}][\text{S}_2\text{O}_8^{2-}]$     (B)  $\text{Rate} = k[\text{I}^{-}]^2[\text{S}_2\text{O}_8^{2-}]$   
 (C)  $\text{Rate} = k[\text{I}^{-}]^3[\text{S}_2\text{O}_8^{2-}]$     (D)  $\text{Rate} = k[\text{I}^{-}]^2[\text{S}_2\text{O}_8^{2-}]^2$

31. For the reaction,



what is the equilibrium expression,  $K_c$ ?

- (A)  $K_c = \frac{[\text{COCl}_2][\text{Cl}_2]}{[\text{CCl}_4][\text{O}_2]}$     (B)  $K_c = \frac{2[\text{COCl}_2][\text{Cl}_2]}{[\text{CCl}_4][\text{O}_2]}$   
 (C)  $K_c = \frac{[\text{COCl}_2][\text{Cl}_2]^2}{[\text{CCl}_4][\text{O}_2]}$     (D)  $K_c = \frac{[\text{COCl}_2]^2[\text{Cl}_2]^2}{[\text{CCl}_4]^2[\text{O}_2]}$

32. For the reaction,



Which change(s) will increase the fraction of  $\text{SO}_3(\text{g})$  in the equilibrium mixture?

- |   |
|---|
| 1. Increasing the pressure<br>2. Increasing the temperature<br>3. Adding a catalyst |
|---|

- (A) 1 only    (B) 3 only  
 (C) 1 and 3 only    (D) 1, 2 and 3

33. What is the  $[\text{H}^+]$  in a 0.10 M solution of ascorbic acid,  $\text{C}_6\text{H}_8\text{O}_6$ ?

$K_a$	
$\text{C}_6\text{H}_8\text{O}_6$	$8.0 \times 10^{-5}$

- (A)  $8.0 \times 10^{-6}$  M    (B)  $2.8 \times 10^{-3}$  M  
 (C)  $4.0 \times 10^{-3}$  M    (D)  $5.3 \times 10^{-3}$  M

34. A 0.10 M solution of which salt is the most acidic?

- (A)  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$     (B) NaCN  
 (C)  $\text{KNO}_3$     (D)  $\text{AlCl}_3$

35. A student is asked to prepare a buffer solution with a pH of 4.00. This can be accomplished by using a solution containing which of the following?

$K_a$	
HNO <sub>2</sub>	$4.5 \times 10^{-4}$
HCN	$4.9 \times 10^{-10}$

- (A) HNO<sub>2</sub> only    (B) HCN only  
 (C) HNO<sub>2</sub> and NaNO<sub>2</sub>    (D) HCN and NaCN

36. A saturated solution of which compound has the lowest  $[\text{Ca}^{2+}]$ ?

$K_{sp}$	
CaF <sub>2</sub>	$4.0 \times 10^{-11}$
CaCO <sub>3</sub>	$8.7 \times 10^{-9}$
Ca(OH) <sub>2</sub>	$8.0 \times 10^{-6}$
CaSO <sub>4</sub>	$2.4 \times 10^{-5}$

- (A) CaF<sub>2</sub>    (B) CaCO<sub>3</sub>    (C) Ca(OH)<sub>2</sub>    (D) CaSO<sub>4</sub>

37. Which reaction occurs at the cathode during the electrolysis of an aqueous solution of KCl?

- (A)  $\text{K}^+(\text{aq}) + \text{e}^- \rightarrow \text{K}(\text{s})$   
 (B)  $2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$   
 (C)  $2\text{Cl}^-(\text{aq}) \rightarrow \text{Cl}_2(\text{g}) + 2\text{e}^-$   
 (D)  $2\text{H}_2\text{O}(\text{l}) \rightarrow \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^-$

38. Correct statements about a voltaic (galvanic) cell include which of the following?

- |   |
|---|
| 1. Oxidation occurs at the anode.<br>2. Electrons flow from the cathode to the anode. |
|---|

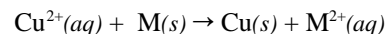
- (A) 1 only    (B) 2 only  
 (C) Both 1 and 2    (D) Neither 1 nor 2

39.  $\text{MnO}_4^- + \text{NO}_2^- + \text{H}^+ \rightarrow \text{Mn}^{2+} + \text{NO}_3^- + \text{H}_2\text{O}$

When this equation is balanced correctly with the smallest integer coefficients, what is the coefficient for  $\text{H}^+$ ?

- (A) 1    (B) 6    (C) 8    (D) 16

40. An electrochemical cell constructed for the reaction:



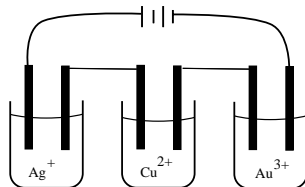
has an  $E^\circ = 0.75$  V. The standard reduction potential for  $\text{Cu}^{2+}(\text{aq})$  is 0.34 V. What is the standard reduction potential for  $\text{M}^{2+}(\text{aq})$ ?

- (A) 1.09 V    (B) 0.410 V  
 (C) -0.410 V    (D) -1.09 V

41. In which case does chromium undergo reduction?

- (A)  $\text{CrO}_3 \rightarrow \text{CrOF}_3$       (B)  $\text{Cr}^{3+} \rightarrow \text{Cr}(\text{OH})_4^-$   
(C)  $2\text{CrO}_4^{2-} \rightarrow \text{Cr}_2\text{O}_7^{2-}$       (D)  $\text{Cr}^{3+} \rightarrow \text{CrO}_4^{2-}$

42. 1.0 M aqueous solutions of  $\text{AgNO}_3$ ,  $\text{Cu}(\text{NO}_3)_2$  and  $\text{Au}(\text{NO}_3)_3$  are electrolyzed in the apparatus shown, so the same amount of electricity passes through each solution. If 0.10 moles of solid Cu are formed how many moles of Ag and Au are formed?



- (A) 0.10 moles Ag, 0.10 moles Au  
(B) 0.05 moles Ag, 0.075 moles Au  
(C) 0.05 moles Ag, 0.15 moles Au  
(D) 0.20 moles Ag, 0.067 moles Au

43. In a hydrogen atom, which transition produces a photon with the highest energy?

- (A)  $n = 3 \rightarrow n = 1$       (B)  $n = 5 \rightarrow n = 3$   
(C)  $n = 12 \rightarrow n = 10$       (D)  $n = 22 \rightarrow n = 20$

44. How many orbitals in a ground state oxygen atom are completely filled?

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

45. Which atom has the smallest first ionization energy?

- (A) Na      (B) K      (C) Mg      (D) Ca

46. The electron configuration of a cobalt atom is  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^2$ .

How many unpaired electrons are present in a gaseous  $\text{Co}^{3+}$  ion in its ground state?

- (A) 6      (B) 4      (C) 2      (D) 0

47. When the atoms; P ( $Z = 15$ ), S ( $Z = 16$ ) and As ( $Z = 33$ ), are arranged in order of increasing radius, what is the correct order?

- (A) P, S, As      (B) As, S, P  
(C) S, P, As      (D) P, As, S

48. The oxide of which element is the most ionic?

- (A) Al      (B) B      (C) C      (D) Si

49. All of the following lists include at least one ionic compound EXCEPT

- (A)  $\text{NO}_2$ ,  $\text{NaNO}_2$ ,  $\text{KNO}_3$       (B)  $\text{CF}_4$ ,  $\text{CaF}_2$ ,  $\text{HF}$   
(C)  $\text{NaCl}$ ,  $\text{MgCl}_2$ ,  $\text{SCl}_2$       (D)  $\text{H}_2\text{S}$ ,  $\text{SO}_2$ ,  $\text{SF}_6$

50. Which species below has the same general shape as  $\text{NH}_3$ ?

- (A)  $\text{SO}_3^{2-}$       (B)  $\text{CO}_3^{2-}$       (C)  $\text{NO}_3^-$       (D)  $\text{SO}_3$

51. When forming covalent bonds, which atom can have more than eight valence electrons?

- (A) H      (B) N      (C) F      (D) Cl

52. Which diatomic molecule has the shortest bond length?

- (A)  $\text{N}_2$       (B)  $\text{O}_2$       (C)  $\text{F}_2$       (D)  $\text{S}_2$

53. Which species is nonpolar?

- (A)  $\text{HCl}$       (B)  $\text{OCl}_2$       (C)  $\text{NCl}_3$       (D)  $\text{CCl}_4$

54. In which species are all the carbon atoms considered to be  $\text{sp}^2$  hybridized?

- (A)  $\text{C}_2\text{H}_2$       (B)  $\text{C}_2\text{H}_4$       (C)  $\text{C}_3\text{H}_8$       (D)  $\text{C}_4\text{H}_{10}$

55. Which formula can be used to represent an alkyne?

- (A)  $\text{C}_n\text{H}_{2n-2}$       (B)  $\text{C}_n\text{H}_{2n}$   
(C)  $\text{C}_n\text{H}_{2n+2}$       (D)  $\text{C}_n\text{H}_{2n+4}$

56. How many different structural isomers exist for dichloropropane,  $\text{C}_3\text{H}_6\text{Cl}_2$ ?

- (A) 4      (B) 5      (C) 6  
(D) some other number

57. All of the formulas below correspond to stable compounds EXCEPT

- (A)  $\text{CH}_2\text{O}$       (B)  $\text{CH}_2\text{O}_2$   
(C)  $\text{CH}_3\text{O}$       (D)  $\text{CH}_4\text{O}$

58. Which of the compounds shown are isomers?

- |   |
|---|
| 1 $\text{CH}_3\text{CH}_2\text{OCH}_3$            |
| 2 $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ |
| 3 $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$    |
| 4 $\text{CH}_2=\text{CHOCH}_3$                    |

- (A) 1 and 3      (B) 1 and 2  
(C) 2 and 3      (D) 1 and 4

59. Which functional group is present in  $\text{CH}_3\text{COOH}$ ?

- (A) aldehyde      (B) carboxylic acid  
(C) alcohol      (D) hydroperoxide

60. How many sigma bonds does a molecule of ethene have?

- (A) 1      (B) 4      (C) 5      (D) 7

**END OF TEST**

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**Olympiad Local Section Exam 2003  
KEY**

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