2005 U. S. NATIONAL CHEMISTRY OLYMPIAD

NATIONAL EXAM PART 1

Prepared by the American Chemical Society Olympiad Examinations Task Force

OLYMPIAD EXAMINATIONS TASK FORCE

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DIRECTIONS TO THE EXAMINER–PART I

Part I of this test is designed to be taken with a Scantron® answer sheet on which the student records his or her responses. Only this Scantron sheet is graded for a score on **Part I**. Testing materials, scratch paper, and the Scantron sheet should be made available to the student *only* during the examination period. All testing materials including scratch paper should be turned in and kept secure until April 27, 2005, after which tests can be returned to students and their teachers for further study.

Allow time for the student to read the directions, ask questions, and fill in the requested information on the Scantron sheet. The answer sheet must be completed using a pencil, not pen. When the student has completed **Part I**, or after **one hour and thirty minutes** has elapsed, the student must turn in the Scantron sheet, **Part I** of the testing materials, and all scratch paper.

There are three parts to the National Olympiad Examination. You have the option of administering the three parts in any order, and you are free to schedule rest-breaks between parts.

Part I	**60 questions**	**single-answer multiple-choice**	**1 hour, 30 minutes**
Part II	**8 questions**	**problem-solving, explanations**	**1 hour, 45 minutes**
Part III	**2 lab problems**	**laboratory practical**	**1 hour, 30 minutes**

A periodic table and other useful information are provided on page 2 for student reference. Students should be permitted to use non-programmable calculators.

DIRECTIONS TO THE EXAMINEE–PART I

DO NOT TURN THE PAGE UNTIL DIRECTED TO DO SO. Answers to questions in **Part I** must be entered on a Scantron answer sheet to be scored. Be sure to write your name on the answer sheet; an ID number is already entered for you. **Make a record of this ID number because you will use the same number on both Parts II and III.** Each item in **Part I** consists of a question or an incomplete statement that is followed by four possible choices. Select the single choice that best answers the question or completes the statement. Then use a pencil to blacken the space on your answer sheet next to the same letter as your choice. You may write on the examination, but the test booklet will not be used for grading. Scores are based on the number of correct responses. When you complete **Part I** (or at the end of one hour and 30 minutes), you *must* turn in all testing materials, scratch paper, and your Scantron answer sheet. Do not forget to turn in your U.S. citizenship statement before leaving the testing site today.

Not valid for use as an USNCO Olympiad National Exam after April 26, 2005.

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

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

EQUATIONS

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

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** 78.96	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	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 (269)	111 (272)	112 (277)		114 (2??)				

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 solution produces a black precipitate when added to an aqueous copper(II) solution?

(A) NH_3 **(B)** $(NH_4)_2S$

(C) K_2SO_4 **(D)** NaOH

2. Which oxide is the best reducing agent?

(A) CO_2 **(B)** NO_2 **(C)** SiO_2 **(D)** SO_2

3. Solutions of which ion produce a red color when vaporized in a Bunsen burner flame?

(A) calcium **(B)** potassium

(C) sodium **(D)** zinc

4. Which procedure for dispensing a liquid with a volumetric pipet is correct?

(A) Draw the liquid up to the line on the pipet using a pipet bulb. Squeeze the bulb to force all the liquid in the pipet into the receiving container.

(B) Introduce the liquid into the top end of the pipet until it is filled to the line. Allow the liquid to drain into the desired container. Blow on the pipet to release the last drop.

(C) Draw the liquid above the line on the pipet using a pipet bulb. With a finger on the top of the pipet allow the curve of the meniscus to drop to the line. Place the tip of the pipet against the side of the receiving container and allow the liquid to drain.

(D) Draw the liquid above the line on the pipet by sucking on the open end of the pipet. Place a thumb on the top of the pipet and allow the curve of the meniscus to drop to the line. Allow the liquid to drain into the receiving container pipet against its side.

5. Which physical characteristic distinguishes copper from brass (an alloy of copper and zinc)?

(A) Brass is a liquid at room temperature and copper is not.

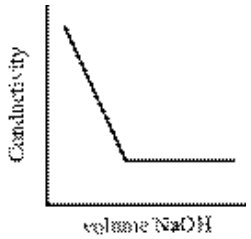
(B) Brass is much less dense than copper.

(C) Brass is attracted to a magnet but copper is not.

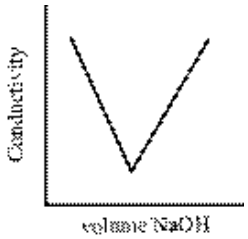
(D) Brass is a much poorer electrical conductor than copper.

6. Which diagram best represents the change in electrical conductivity of a solution of acetic acid as a solution of sodium hydroxide is added?

(A)



(B)



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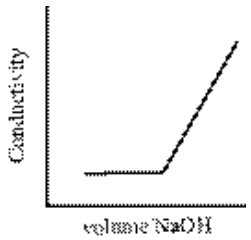

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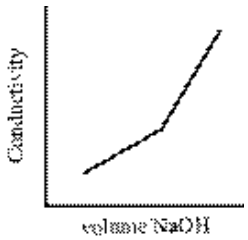


7. Methylamine, CH_3NH_2, reacts with O_2 to form CO_2, N_2, and H_2O. What amount of O_2 (in moles) is required to react completely with 1.00 mol of CH_3NH_2?

(A) 2.25 **(B)** 2.50 **(C)** 3.00 **(D)** 4.50

8. Iodine adds to the double bonds in fatty acids (one iodine molecule per double bond). How many double bonds are in a molecule of arachidonic acid (Molar mass = 304.5 g/mol) if 0.125 g of the acid require 0.417 g of iodine?

(A) 2 **(B)** 3 **(C)** 4 **(D)** 8

9. The solubility of a gas in a liquid increases when which of the following increases?

I. pressure of the gas
II. temperature of the liquid

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

(C) both I and II **(D)** neither I nor II

10. A mineral containing only manganese and oxygen contains 69.6% Mn by mass. What is its empirical formula?

(A) MnO **(B)** Mn_2O_3

(C) Mn_3O_4 **(D)** MnO_2

11. Toluene, C_7H_8, is added to gasoline to increase its octane rating. What is the volume ratio of air to toluene vapor to burn completely to form CO_2 and H_2O? (Assume air is 20% O_2 by volume.)

(A) 9/1 **(B)** 11/1 **(C)** 28/1 **(D)** 45/1

12. Acidified solutions of dichromate ion, $Cr_2O_7^{2-}$, oxidize Fe^{2+} to Fe^{3+}, forming Cr^{3+} in the process. What volume of 0.175 M $K_2Cr_2O_7$ in mL is required to oxidize 60.0 mL of 0.250 M $FeSO_4$?

(A) 14.3 **(B)** 28.6 **(C)** 42.9 **(D)** 85.7

13. Which property is the same for 1.0 g samples of H_2 and CH_4 in separate 1.0 L containers at 25 ˚C?

(A) pressure

(B) number of molecules

(C) average molecular velocity

(D) average molecular kinetic energy

14. When CsI, SiO_2, CH_3OH and C_3H_8 are listed in order of increasing melting point, which is the correct order?

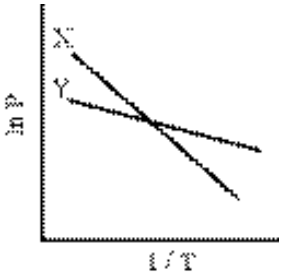
(A) CsI, SiO_2, CH_3OH, C_3H_8

(B) CH_3OH, C_3H_8, CsI, SiO_2

(C) CH_3OH, C_3H_8, SiO_2, CsI

(D) C_3H_8, CH_3OH, CsI, SiO_2

15. According to the graph (ln vapor pressure vs 1/T) what can be concluded about the enthalpies of vaporization (ΔH_{vap}) of liquids X and Y?



(A) $\Delta H_{vap}X > \Delta H_{vap}Y$

(B) $\Delta H_{vap}X = \Delta H_{vap}Y$

(C) $\Delta H_{vap}X < \Delta H_{vap}Y$

(D) No conclusions can be drawn about the relative ΔH_{vap} values from this diagram.

16. An unknown gas effuses through a pin-hole in a container at a rate of 7.2 mmol/s. Under the same conditions gaseous oxygen effuses at a rate of 5.1 mmol/s. What is the molar mass (in g/mol) of the unknown gas?

(A) 16 **(B)** 23 **(C)** 45 **(D)** 64

17. When NaF, MgO, KCl and CaS are listed in order of increasing lattice energy, which order is correct?

(A) MgO, NaF, KCl, CaS **(B)** CaS, MgO, KCl, NaF

(C) KCl, CaS, NaF, MgO **(D)** KCl, NaF, CaS, MgO

18. When compared to most other substances of similar molar mass the values of which properties of liquid H_2O are unusually large?

I.	boiling point
II.	specific heat capacity
III.	surface tension

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

(C) II and III only **(D)** I, II and III

19. Calculate ΔH° for the reaction;
$TiCl_4(g) + 2H_2O(l) \rightarrow TiO_2(s) + 4HCl(g)$

ΔH_f° kJ/mol	
$TiCl_4(g)$	–763
$H_2O(l)$	–286
$TiO_2(s)$	–945
HCl(g)	–92

(A) –264 kJ **(B)** 12 kJ

(C) 22 kJ **(D)** 298 kJ

20. Use bond energies to estimate the value of ΔH° for the reaction;
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

Bond Energies kJ/mol	
H-H	436
H-N	386
N-N	193
N=N	418
N≡N	941

(A) –995 kJ **(B)** –590 kJ

(C) –67 kJ **(D)** 815 kJ

Questions 21. and 22. should be answered using this thermochemical equation;

$$\mathbf{N_2(g) + 2O_2(g) \rightarrow 2NO_2(g) \quad \Delta H_{rxn} > 0}$$

21. Which relationship is correct for this reaction at a pressure of 1 atm?

(A) $\Delta E_{rxn} > \Delta H_{rxn}$ **(B)** $\Delta E_{rxn} < \Delta H_{rxn}$

(C) $\Delta E_{rxn} = \Delta H_{rxn} + \Delta S_{rxn}$ **(D)** $\Delta E_{rxn} = \Delta H_{rxn} - \Delta S_{rxn}$

22. Under what temperature conditions is this reaction spontaneous at standard pressure?

(A) at low temperatures only

(B) at high temperatures only

(C) at all temperatures

(D) at no temperature

23. Diethyl ether has a normal boiling point of 35.0 °C and has an entropy of vaporization of 84.4 J/mol·K. What is its enthalpy of vaporization?

(A) 0.274 J/mol **(B)** 2.41 J/mol

(C) 3.65 J/mol **(D)** 26.0 kJ/mol

24. A 9.40 g sample of KBr is dissolved in 105 g of H_2O at 23.6 °C in a coffee cup. Find the final temperature of this system. Assume that no heat is transferred to the cup or the surroundings.

Solution Properties	
Molar mass KBr	119 g/mol
ΔH_{soln} KBr	19.9 kJ/mol
C_p solution	4.184 J/g°C

(A) 20.0 °C **(B)** 20.3 °C

(C) 26.9 °C **(D)** 27.2 °C

25. For the reaction A → B which is first order in A, which of the following change as the concentration of A changes?

I.	rate
II.	rate constant
III.	Half–life

(A) I only **(B)** III only

(C) II and III only **(D)** I, II and III

26. The equation and rate law for the gas phase reaction between NO and H_2 are;
$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$
$Rate = k[NO]^2[H_2]$
What are the units of k if time is in seconds and the concentration is in moles per liter?

(A) $L \cdot s \cdot mol^{-1}$ **(B)** $L^2 \cdot mol^{-2} \cdot s^{-1}$

(C) $mol \cdot L^{-1} \cdot s^{-1}$ **(D)** $mol^2 \cdot L^{-2} \cdot s^{-1}$

27. At a given temperature a first-order reaction has a rate constant of 3.33×10^{-3} s^{-1}. How much time is required for the reaction to be 75% complete?

(A) 100 s **(B)** 210 s **(C)** 420 s **(D)** 630 s

28. Most reactions occur more rapidly at high temperatures than at low temperatures. This is consistent with an increase in which property at higher temperatures?

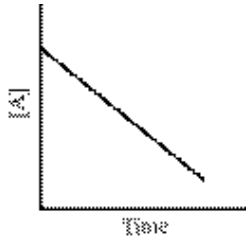
I.	activation energy
II.	collision energy
III.	rate constant

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

(C) I and III only **(D)** II and III only

29. Which graph is diagnostic of an irreversible second order reaction A → B?

(A)



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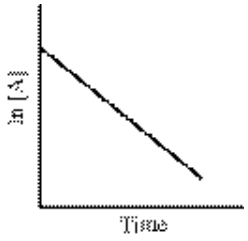

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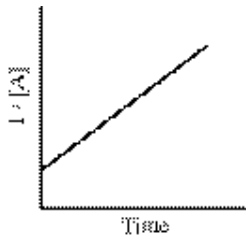

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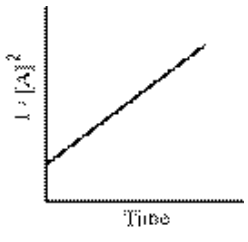


30. The reaction; $2NO(g) + 2H_2(g) \rightarrow 2H_2O(g) + N_2(g)$ obeys the rate equation $Rate = k[NO]^2[H_2]$
This mechanism has been proposed:

1. $2NO(g) \rightarrow N_2O_2(g)$
2. $N_2O_2(g) + H_2(g) \rightarrow 2HON(g)$
3. $HON(g) + H_2(g) \rightarrow H_2O(g) + HN(g)$
4. $HN(g) + HON(g) \rightarrow N_2(g) + H_2O(g)$

Which step of the mechanism is the rate-determining step?

(A) step 1 **(B)** step 2

(C) step 3 **(D)** step 4

31. For the hypothetical equilibrium reactions;
$A \rightleftharpoons B$ $K = 2.0$
$B \rightleftharpoons C$ $K = 0.010$
What is the value of K for the reaction;
$2C \rightleftharpoons 2A$?

(A) 2500 **(B)** 50 **(C)** 25 **(D)** 4.0×10^{-4}

32. For which reaction is $K_p = K_c$?

I.	$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O(g)$
II.	$C(s) + O_2(g) \rightleftharpoons CO_2(g)$
III.	$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

(A) II only **(B)** III only

(C) I and III only **(D)** II and III only

33. What is the pH of a 0.010 M solution of a weak acid HA that is 4.0% ionized?

(A) 0.60 **(B)** 0.80 **(C)** 2.80 **(D)** 3.40

34. Given the acid ionization constants, when the conjugate bases are arranged in order of increasing base strength, which order is correct?

Acid Ionization Constant, K_a	
HClO	3.5×10^{-8}
$HClO_2$	1.2×10^{-2}
HCN	6.2×10^{-10}
$H_2PO_4^-$	6.2×10^{-8}

(A) ClO_2^-, ClO^-, HPO_4^{2-}, CN^-

(B) ClO_2^-, HPO_4^{2-}, ClO^-, CN^-

(C) CN^-, HPO_4^{2-}, ClO^-, ClO_2^-

(D) CN^-, ClO^-, HPO_4^{2-}, ClO_2^-

35. Calculate the concentration of hydrogen ion in mol/L of a 0.010 M solution of NH_4Cl.

Base Ionization Constant, K_b	
NH_3	1.8×10^{-5}

(A) 4.2×10^{-4} **(B)** 2.4×10^{-6}

(C) 1.8×10^{-7} **(D)** 5.6×10^{-12}

36. For the reaction;

$PbI_2(s) \rightleftharpoons Pb^{2+}(aq) + 2I^-(aq)$ $K_{sp} = 8.4\times10^{-9}$

What is the concentration of Pb^{2+} in mol/L in a saturated solution of PbI_2 in which $[I^-] = 0.01$ M?

(A) 8.4×10^{-7} **(B)** 8.4×10^{-5}

(C) 1.3×10^{-3} **(D)** 2.0×10^{-3}

37. Which statement is correct about the electrochemical cell represented here? $Ag \mid Ag^+ \parallel NO_3^-, NO \mid Pt$

(A) NO undergoes oxidation at the anode.

(B) The major purpose of the Pt is to act as a catalyst.

(C) The Ag electrode decreases in mass as the cell operates.

(D) The voltage of the cell can be increased by doubling the size of the Ag electrode.

38. The overall reaction for the lead storage battery when it discharges is;

$Pb(s) + PbO_2(s) + 4H^+(aq) + 2SO_4^{2-}(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

I.	$PbSO_4$ is formed only at the cathode.
II.	The density of the solution decreases.

Which statement(s) correctly describe(s) the battery as it discharges?

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

(C) both I and II **(D)** neither I nor II

39. The standard reduction potential for $H^+(aq)$ is 0.00 V. What is the reduction potential for a 1×10^{-3} M HCl solution?

(A) 0.355 V **(B)** 0.178 V

(C) –0.178 V **(D)** –0.355 V

40. What is the approximate value of the equilibrium constant, K_{eq}, at 25 °C for the reaction;

$3Ag^+(aq) + Cr(s) \rightarrow Cr^{3+}(aq) + 3Ag(s)$

Standard Reduction Potential, V	
$Ag^+(aq) + e^- \rightarrow Ag(s)$	+0.80
$Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$	–0.74

(A) 10^{22} **(B)** 10^{26} **(C)** 10^{33} **(D)** 10^{78}

41. Which products are formed by the electrolysis of an aqueous solution of $AlCl_3$?

I. Al(s) **II.** $Cl_2(g)$ **III.** $H_2(g)$ **IV.** $O_2(g)$

(A) I and III only **(B)** I and IV only

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

42. A current of 0.20 amps is passed through an aqueous solution of nickel(II) nitrate for 45.0 minutes. What mass of Ni metal (in grams) will be deposited?

(A) 0.16 **(B)** 0.22 **(C)** 0.33 **(D)** 0.66

43. How many orbitals are in an atomic sublevel with $l = 3$?

(A) 3 **(B)** 5 **(C)** 7 **(D)** 9

44. A ground state gaseous atom of which element has the greatest number of unpaired electrons?

(A) As **(B)** Br **(C)** Ge **(D)** Se

45. An atom of which element has the highest **second** ionization energy?

(A) Na **(B)** Mg **(C)** Al **(D)** K

46. Which of these properties increase across the period from Na to Cl?

I.	atomic radius
II.	density
III.	electronegativity

(A) I only **(B)** III only

(C) I and II only **(D)** II and III only

47. For the elements in group 14 (C to Pb), which property increases with increasing atomic number?

(A) melting points

(B) covalent radius

(C) magnitude of stable oxidation state

(D) ability to form chains of atoms with themselves

48. What mode of radioactive decay is most likely for the isotope $^{20}_{11}Na$?

(A) alpha **(B)** beta

(C) gamma **(D)** electron capture

49. Oxygen gas is paramagnetic. This observation is best explained by

(A) resonance.

(B) the Lewis structure of O_2.

(C) the molecular orbital description of O_2.

(D) the hybridization of atomic orbitals in O_2.

50. What is the geometry of the iodine atoms in the I_3^- ion?

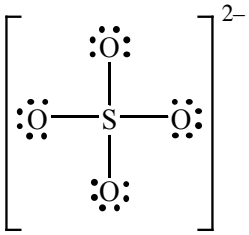
(A) bent **(B)** linear

(C) T-shaped **(D)** triangular

51. Which species has a dipole moment other than zero?

(A) BrF_3 **(B)** CF_4 **(C)** SbF_5 **(D)** SF_6

52. In the Lewis structure what are the formal charges on the sulfur and oxygen atoms, respectively?



(A) 0, 0 **(B)** –2, 0 **(C)** +2, –1 **(D)** +6, –2

53. How many different isomers exist for the octahedral complex $[Co(NH_3)_4Cl_2]^+$?

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

54. Which order is correct when the species are arranged in order of increasing average N-O bond length?

(A) NO_3^-, NO_2^-, NO^+ **(B)** NO^+, NO_3^-, NO_2^-

(C) NO_2^-, NO_3^-, NO^+ **(D)** NO^+, NO_2^-, NO_3^-

55. All of the classes of compounds contain at least one oxygen atom EXCEPT

(A) esters **(B)** aldehydes

(C) ethers **(D)** alkynes

56. What is the most characteristic reaction of benzene?

(A) addition **(B)** polymerization

(C) reduction **(D)** substitution

57. Which organic acid is the strongest?

(A) HCOOH **(B)** CH_3COOH

(C) $ClCH_2COOH$ **(D)** $ClCH_2CH_2COOH$

58. How many structurally isomeric alcohols have the formula C_4H_9OH?

(A) one **(B)** two **(C)** three **(D)** four

59. Which compound can exist as two optical isomers?

(A) ClHC = CHCl **(B)** meta-$C_6H_4Cl_2$

(C) CH_2ClBr **(D)** $CH_3CH(Cl)CH_2CH_3$

60. Which type of dietary fat is currently considered the least harmful?

(A) monounsaturated fat **(B)** polyunsaturated fat

(C) saturated fat **(D)** trans fat

END OF TEST

NATIONAL OLYMPIAD PART I
2005
KEY

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