2004 U. S. NATIONAL CHEMISTRY OLYMPIAD

NATIONAL EXAM Part I

Prepared by the American Chemical Society 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 19, 2004, 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 19, 2004.

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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		

CONS
R = 8.314 J·m
R = 0.0821 L·atm·m
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 = 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																	18 8A
1 **H** 1.008	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	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 pencil. Make a heavy, full mark, but no stray marks. If you decide to change an answer, erase the unwanted mark very
- There is only one correct answer to each question. Any questions for which more than one response has been blackened will **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 element is obtained commercially from seawater?

(A) bromine **(B)** gold

(C) iron **(D)** oxygen

2. Which solution can serve as both reactant and indicator when it is used in redox titrations?

(A) $FeNH_4(SO_4)_2$ **(B)** $KMnO_4$

(C) $H_2C_2O_4$ **(D)** $Na_2S_2O_3$

3. What is formed when a solution of NH_4NO_2 is heated gently?

(A) N_2 and H_2O **(B)** N_2O and H_2O

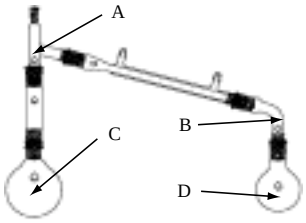
(C) NO and H_2 **(D)** N_2, H_2 and O_2

4. Which method should be used to extinguish burning magnesium metal?

(A) Blanket it with CO_2 **(B)** Blow on it.

(C) Dump sand on it. **(D)** Pour water on it.

5. Which letter indicates where a thermometer should be placed to determine the boiling point of a distillate?



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

6. A 50 mL sample of gas is collected over water. What will be the effect on the calculated molar mass of the gas if the effect of the water vapor is ignored? It will be

(A) high because of the mass of water in the collection flask.

(B) high because of omitting the vapor pressure of the water in the calculation.

(C) low because of the mass of water in the collection flask.

(D) low because of omitting the vapor pressure of the water in the calculation.

7. A 1.871 gram sample of an unknown metallic carbonate is decomposed by heating to form the metallic oxide and 0.656 g of carbon dioxide according to the equation

$$MCO_3(s) \rightarrow MO(s) + CO_2(g)$$

What is the metal?

(A) Ca **(B)** Mn **(C)** Ni **(D)** Zn

8. What is the coefficient for OH^- after the equation

$$\_\ Br_2 + \_\ OH^- \rightarrow \_\ Br^- + \_\ BrO_3^- + \_\ H_2O$$

is balanced with the smallest integer coefficients?

(A) 3 **(B)** 6 **(C)** 12 **(D)** 18

9. An ionic compound contains 29.08% sodium, 40.56% sulfur and 30.36% oxygen by mass. What is the formula of the sulfur-containing anion in the compound?

(A) $S_2O_3^{2-}$ **(B)** $S_2O_4^{2-}$

(C) $S_2O_5^{2-}$ **(D)** $S_2O_6^{2-}$

10. A solution is prepared containing a 2:1 mol ratio of dibromoethane ($C_2H_4Br_2$) and dibromopropane ($C_3H_6Br_2$). What is the total vapor pressure over the solution assuming ideal behavior?

Vapor pressure (mmHg)	
$C_2H_4Br_2$	173
$C_3H_6Br_2$	127

(A) 300 mmHg **(B)** 158 mmHg

(C) 150 mmHg **(D)** 142 mmHg

11. A solution of magnesium chloride that is 5.10% magnesium by mass has a density 1.17 g/mL. How many moles of Cl^- ions are in 300. mL of the solution?

(A) 0.368 **(B)** 0.627 **(C)** 0.737 **(D)** 1.47

12. Which aqueous solution has a freezing point closest to that of 0.30 M $C_{12}H_{22}O_{11}$?

(A) 0.075 M $AlCl_3$ **(B)** 0.15M $CuCl_2$

(C) 0.30 M NaCl **(D)** 0.60 M $C_6H_{12}O_6$

13. An unknown gas is placed in a sealed container with a fixed volume. Which of the characteristics listed change(s) when the container is heated from 25 ˚C to 250 ˚C?

I	The density of the gas
II	The average kinetic energy of the molecules
III	The mean free path between molecular collisions

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

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

14. Which gas has the same density at 546 ˚C and 1.50 atm as that of O_2 gas at STP?

(A) N_2 **(B)** NH_3 **(C)** SO_2 **(D)** SO_3

15. Which plot involving vapor pressure (VP) and absolute temperature results in a straight line?

(A) VP vs T **(B)** VP vs T^{-1}

(C) ln VP vs T **(D)** ln VP vs T^{-1}

16. For a substance with the values of ΔH_{vap} and ΔS_{vap} given below, what is its normal boiling point in ˚C? (ΔH_{vap} = 59.0 kJ·mol^{-1}; ΔS_{vap} = 93.65 J·mol^{-1}·K^{-1})

(A) 357 **(B)** 630 **(C)** 1314 **(D)** 1587

17. What is the order of the boiling points (from lowest to highest) for the hydrogen halides?

(A) HF < HCl < HBr < HI **(B)** HI < HBr < HCl < HF

(C) HCl < HF < HBr < HI **(D)** HCl < HBr < HI < HF

18. Of the three types of cubic lattices, which have the highest and lowest densities for the same atoms?

	Highest	Lowest
(A)	simple cubic	body-centered cubic
(B)	face-centered cubic	simple cubic
(C)	body-centered cubic	face-centered cubic
D)	face-centered cubic	body-centered cubic

19. For which reaction is ΔH (enthalpy change) most nearly equal to ΔE (internal energy change)?

(A) $H_2(g) + 1/2O_2(g) \rightarrow H_2O(g)$

(B) $Cl_2(g) + F_2(g) \rightarrow 2ClF(g)$

(C) $H_2O(l) \rightarrow H_2O(g)$

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

20. Which is the best description of the re[illegible]ween the absolute entropies, S˚, of solid wate[illegible]t 200 K?

(A) S°_{200K} is smaller because entropy decreases[illegible] temperature increases.

(B) S°_{200K} is smaller because the surroundings are mo[illegible] disordered at higher temperatures.

(C) $S^\circ_{100K} = S^\circ_{200K}$ = because water is in the solid phase at both temperatures.

(D) S°_{200K} is larger because the vibration of the molecules increases as temperature increases.

21. For the reaction, $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ which expression gives ΔH?

Bond dissociation energies	kJ·mol^{-1}
C-H	413
C-Cl	328
Cl-Cl	242
H-Cl	431

(A) ΔH = (413 + 328) - (242 + 431)

(B) ΔH = (413 - 328) - (242 - 431)

(C) ΔH = (413 - 242) - (328 - 431)

(D) ΔH = (413 + 242) - (328 + 431)

22. Which phase change for water has positive values for both ΔH˚ and ΔG˚?

(A) (l) → (s) at 250 K **(B)** (l) → (s) at 350 K

(C) (l) → (g) at 350 K **(D)** (l) → (g) at 450 K

23. When solid $CuSO_4$ dissolves in water to make a 1M solution, the temperature of the system increases. When solid NH_4NO_3 dissolves in water to make a 1 M solution, the temperature of the system decreases. Which statement(s) must be correct for these dissolving processes?

I ΔH˚ values for both processes have the same sign.
II ΔG˚ values for both processes have the same sign.

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

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

24. Which set of relationships could apply to the same electrochemical cell?

(A) $\Delta G^\circ > 0; E^\circ = 0$ **(B)** $\Delta G^\circ < 0; E^\circ = 0$

(C) $\Delta G^\circ > 0; E^\circ > 0$ **(D)** $\Delta G^\circ < 0; E^\circ > 0$

25. The rate constant for a reaction is affected by which factors?

I increase in temperature
II concentration of the reactants
III presence of a catalyst

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

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

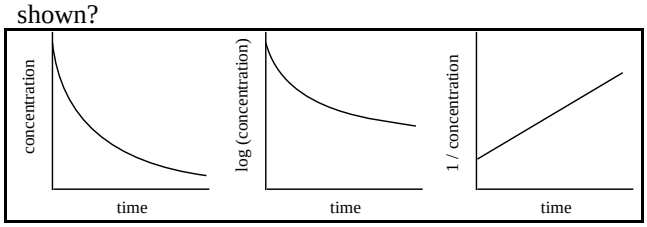
26. The rate data given were obtained for the reaction,
$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$
What is the rate law for this reaction?

NO pressure (atm)	H_2 pressure (atm)	Rate ($atm \cdot sec^{-1}$)
0.375	0.500	6.43×10^{-4}
0.375	0.250	3.15×10^{-4}
0.188	0.500	1.56×10^{-4}

(A) Rate = $k P_{NO}$ **(B)** Rate = $k P_{NO}^2$

(C) Rate = $k P_{NO} P_{H_2}^2$ **(D)** Rate = $k P_{NO}^2 P_{H_2}$

27. What is the order of a reaction that produces the graphs shown?



(A) zero order **(B)** first order

(C) second order **(D)** some other order

28. What is the rate law for the hypothetical reaction with the mechanism shown?

$2A \rightleftharpoons$	intermediate 1	fast equilibrium
intermediate 1 + B $\rightarrow$	intermediate 2	slow
intermediate 2 + B $\rightarrow$	A_2B_2	fast

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

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

29. According to the Arrhenius equation: $k = Ae^{-Ea/RT}$, a plot of ln k against 1/T yields

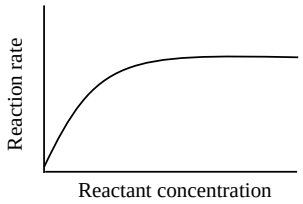
(A) E_a as the slope and A as the intercept

(B) E_a/R as the slope and A as the intercept

(C) E_a/R as the slope and ln A as the intercept

(D) $-E_a/R$ as the slope and ln A as the intercept

30. Curves with the shape shown are often observed for reactions involving catalysts. The level portion of the curve is best attributed to the fact that



(A) product is no longer being formed.

(B) the reaction has reached equilibrium.

(C) all the catalytic sites are occupied.

(D) all the reactant has been consumed.

31. $H_2S(aq) \rightleftharpoons H^+(aq) + HS^-(aq)$
$HS^-(aq) \rightleftharpoons H^+(aq) + S^{2-}(aq)$ K
Given the equilibrium constants provided, w
equilibrium constant for the reaction;
$S^{2-}(aq) + 2H^+(aq) \rightleftharpoons H_2S(aq)$ K = ?

(A) 9.5×10^{-27} **(B)** 9.7×10^{-14}

(C) 9.5×10^{11} **(D)** 1.0×10^{26}

32. Calculate the hydronium ion concentration in 50.0 mL of 0.10 M NaH_2AsO_4.
($K_1 = 6.0 \times 10^{-3}$, $K_2 = 1.1 \times 10^{-7}$ $K_3 = 3.0 \times 10^{-12}$)

(A) 2.4×10^{-2} **(B)** 1.6×10^{-3}

(C) 1.0×10^{-4} **(D)** 2.5×10^{-5}

33. When the acids; $HClO_3$, H_3BO_3, H_3PO_4, are arranged in order of increasing strength, which order is correct?

(A) $H_3BO_3 < H_3PO_4 < HClO_3$

(B) $HClO_3 < H_3BO_3 < H_3PO_4$

(C) $H_3PO_4 < HClO_3 < H_3BO_3$

(D) $H_3BO_3 < HClO_3 < H_3PO_4$

34. A buffer solution results from mixing equal volumes of which solutions?

I 0.10 M HCl and 0.20 M NH_3
II 0.10 M HNO_2 and 0.10 M $NaNO_2$
III 0.20 M HCl and 0.10 M NaCl

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

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

35. A solution is 0.10 M in Ag^+, Ca^{2+}, Mg^{2+}, and Al^{3+} ions. Which compound will precipitate at the lowest $[PO_4^{3-}]$ when a solution of Na_3PO_4 is added?

(A) Ag_3PO_4 ($K_{sp} = 1 \times 10^{-16}$)

(B) $Ca_3(PO_4)_2$ ($K_{sp} = 1 \times 10^{-33}$)

(C) $Mg_3(PO_4)_2$ ($K_{sp} = 1 \times 10^{-24}$)

(D) $AlPO_4$ ($K_{sp} = 1 \times 10^{-20}$)

36. Which salt is significantly more soluble in a strong acid than in water?

(A) PbF_2 **(B)** $PbCl_2$ **(C)** $PbBr_2$ **(D)** PbI_2

37. What is the standard cell potential for the reaction,
$2Cr(s) + 3Sn^{2+}(aq) \rightarrow 3Sn(s) + 2Cr^{3+}(aq)$
given the E° values shown?
$Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$ -0.744 V
$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$ -0.141 V

(A) 0.945 V **(B)** 0.603 V

(C) -0.603 V **(D)** -0.945 V

38. How many electrons are needed in the balanced half-reaction for the oxidation of ethanol to acetic acid?

$$C_2H_5OH \rightarrow CH_3COOH$$

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

39. Which is the weakest oxidizing agent in a 1 M aqueous solution?

(A) $Ag^+(aq)$ **(B)** $Cu^{2+}(aq)$

(C) $H^+(aq)$ **(D)** $Zn^{2+}(aq)$

40. The standard potential for the reaction
$Cl_2(g) + 2Br^-(aq) \dashrightarrow Br_2(l) + 2Cl^-(aq)$
is 0.283 volts. What is the equilibrium constant for this reaction at 25 ˚C?

(A) 1.6×10^{-5} **(B)** 22

(C) 6.1×10^{4} **(D)** 3.8×10^{9}

41. When an aqueous solution of potassium fluoride is electrolyzed, which of the following occurs?

(A) O_2 and H^+ are produced at one electrode and H_2 and OH^- are formed at the other.

(B) O_2 and OH^- are produced at one electrode and H_2 and H^+ are formed at the other.

(C) Metallic K is formed at one electrode and O_2 and H^+ are formed at the other.

(D) Metallic K is produced at one electrode and elemental F_2 is produced at the other.

42. A $CuSO_4$ solution is electrolyzed for 20. minutes with a current of 2.0 ampere. What is the maximum mass of copper that could be deposited?

(A) 0.20 g **(B)** 0.40 g **(C)** 0.79 g **(D)** 1.6 g

43. Which experimental evidence most clearly supports the suggestion that electrons have wave properties?

(A) diffraction

(B) emission spectra

(C) photoelectric effect

(D) deflection of cathode rays by a magnet

44. Which quantum number determines the number of angular nodes in an atomic orbital?

(A) n **(B)** l **(C)** m_l **(D)** m_s

45. Which element exhibits the greatest number of oxidation states in its compounds?

(A) Ca **(B)** V **(C)** Cu **(D)** As

46. Of the elements given, which has the [illegible]ion energy?

(A) N **(B)** P **(C)** S

47. How many unpaired electrons are in a gaseous Fe^{2} its ground state?

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

48. Which species is most likely to lose a positron (β^+)?

(A) $^{12}_{7}N$ **(B)** $^{18}_{8}O$ **(C)** $^{20}_{9}F$ **(D)** $^{20}_{10}Ne$

49. According to the Lewis dot structure shown, what are the formal charges of the O, C and N atoms, respectively, in the cyanate ion?

(A) 0, 0, 0 **(B)** -1, 0, 0

(C) -1, +1, -1 **(D)** +1, 0, -2

50. The hybridization of As in AsF_5 is best described as

(A) sp^3 **(B)** sp^4 **(C)** dsp^3 **(D)** d^2sp^3

51. In which species do the atoms NOT lie in a single plane?

(A) BF_3 **(B)** PF_3 **(C)** ClF_3 **(D)** XeF_4

52. For which compound does the reaction,

$$MCO_3(s) \rightarrow MO(s) + CO_2(g)$$

occur most readily?

(A) $BeCO_3$ **(B)** $MgCO_3$

(C) $CaCO_3$ **(D)** $BaCO_3$

53. The color of $Co(H_2O)_6^{2+}$ is best attributed to electronic transitions

(A) between different n levels in the metal.

(B) between the metal's d orbitals.

(C) from the Co^{2+} ion to water molecules.

(D) during ionization.

54. When the carbon-oxygen bonds in the species; CH_3OH, CH_2O and CHO_2^- are arranged in order of increasing length, which is the correct order?

(A) $CH_3OH < CH_2O < CHO_2^-$

(B) $CH_2O < CH_3OH < CHO_2^-$

(C) $CHO_2^- < CH_3OH < CH_2O$

(D) $CH_2O < CHO_2^- < CH_3OH$

55. How many different trichlorobenzenes, $C_6H_3Cl_3$, can be formed?

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

56. What organic product is formed from the mild oxidation of a secondary alcohol?

(A) acid **(B)** aldehyde

(C) ether **(D)** ketone

57. The compound with the formula, $H_2NCH_2CH_2COOH$, is best classified as a(n)

(A) amide **(B)** amino acid

(C) fatty acid **(D)** nucleic acid

58. The reaction between which pair of reactants occurs the fastest for $[OH^-] = 0.010$ M?

(A) $CH_3CH_2CH_2CH_2Cl + OH^-$

(B) $(CH_3)_3CCl + OH^-$

(C) $CH_3CH_2CH_2CH_2Br + OH^-$

(D) $(CH_3)_3CBr + OH^-$

59. What is the major organic product formed from the reaction of $CH_3CH{=}CH_2$ and HCl?

(A) $CH_3CHClCH_3$ **(B)** $CH_3CH_2CH_2Cl$

(C) $CH_3CHClCH_2Cl$ **(D)** $CH_2ClCH{=}CH_2$

60. Fats and oils are formed from the combination of fatty acids with what other compound?

(A) cholesterol **(B)** glucose

(C) glycerol **(D)** phenol

END OF TEST

National Olympiad 2004
Part 1
KEY

Number	Answer
1.	A
2.	B
3.	A
4.	C
5.	A
6.	D
7.	D
8.	B
9.	A
10.	B
11.	D
12.	A
13.	B
14.	C
15.	D
16.	A
17.	D
18.	B
19.	B
20.	D
21.	D
22.	C
23.	B
24.	D
25.	B
26.	D
27.	C
28.	D
29.	D
30.	C

Number	Answer
31.	D
32.	D
33.	A
34.	B
35.	D
36.	A
37.	B
38.	D
39.	D
40.	D
41.	A
42.	C
43.	A
44.	B
45.	B
46.	C
47.	C
48.	A
49.	D
50.	C
51.	B
52.	A
53.	B
54.	D
55.	C
56.	D
57.	B
58.	D
59.	A
60.	C