AS
ACADEMIC STUDIO

PRACTICE EXAM

Organic Chemistry 1

15 problems · one per page · show all your work

Name _____ Date _____ Score / 15

Before you start

Draw every structure as you work. A molecular model kit helps a lot with chairs and stereochemistry.

How to use this exam

Give yourself about 2 hours and plenty of scratch paper. Work each problem on its own page, then check your answers with the separate answer key.

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PROBLEM 1 OF 15

Functional groups

Name every functional group in aspirin, 2-acetoxybenzoic acid ($CH_3COO–C_6H_4–COOH$).

PROBLEM 2 OF 15

IUPAC naming

Name $CH_3CH(CH_3)CH_2CH(CH_2CH_3)CH_2CH_3$.

PROBLEM 3 OF 15

Resonance

Draw the resonance structures of the acetate ion, CH_3COO^-. Why are both C–O bonds the same length?

PROBLEM 4 OF 15

Acidity and pKa

(a) Rank by acidity: ethanol (pKa 16), acetic acid (pKa 4.8), phenol (pKa 10). (b) Which side does $CH_3COOH + CH_3CH_2O^- \rightleftharpoons CH_3COO^- + CH_3CH_2OH$ favor?

PROBLEM 5 OF 15

Conformations of butane

Looking down the C2–C3 bond of butane, rank these conformations from most to least stable: anti, gauche, eclipsed with CH_3 over H, and eclipsed with CH_3 over CH_3.

PROBLEM 6 OF 15

Chair conformations

In the most stable chair of cis-1-tert-butyl-4-methylcyclohexane, which group is axial?

PROBLEM 7 OF 15

R/S configuration

In a Fischer projection of glyceraldehyde, CHO is on top, CH_2OH is on the bottom, OH is on the right and H is on the left. Is this R or S?

PROBLEM 8 OF 15

Stereoisomers

How many stereoisomers does 2,3-dibromobutane have, and how are they related?

PROBLEM 9 OF 15

SN1, SN2, E1 or E2

Give the main mechanism and product: (a) 1-bromobutane + NaCN in DMSO; (b) 2-bromo-2-methylpropane in methanol, no added base; (c) 2-bromobutane + $NaOCH_2CH_3$ in ethanol, heat; (d) 2-bromo-2-methylpropane + $KOC(CH_3)_3$.

PROBLEM 10 OF 15

SN2 stereochemistry and rate

(R)-2-Bromobutane reacts with NaI in acetone. (a) What is the product? (b) What happens to the rate if [I^-] doubles?

PROBLEM 11 OF 15

Carbocation rearrangement

What is the major product of 3-methyl-2-butanol with HBr?

PROBLEM 12 OF 15

Alkene additions

Give the product of 1-methylcyclohexene with (a) HBr; (b) HBr and peroxides; (c) BH_3·THF, then H_2O_2, NaOH; (d) H_2O, H_2SO_4.

PROBLEM 13 OF 15

Halogen additions

What forms when cyclohexene reacts with (a) Br_2 in CH_2Cl_2 and (b) Br_2 in water?

PROBLEM 14 OF 15

Alkyne reactions

Give the products: (a) 2-butyne + H_2, Lindlar catalyst; (b) 2-butyne + Na, NH_3(l); (c) 1-butyne + H_2O, H_2SO_4, $HgSO_4$; (d) 1-butyne + 9-BBN, then H_2O_2, NaOH.

PROBLEM 15 OF 15

Multistep synthesis

Show how to make 2-methyl-1-propanol, $(CH_3)_2CHCH_2OH$, from 2-methylpropane.