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create book study mcats chapter 1 nomenclature 1.1 iupac naming conventions 1.2
hydrocarbon alcohol 1.3 aldehyde ketone 1.4 carboxylic acid derivative 1.5 summary
functional group chapter 2 isomer 2.1 structural isomer 2.3 relative absolute configuration
chapter 3 bonding 3.1 atomic orbital quantum number 3.2 molecular orbital chapter 4
analyzing organic reaction 4.1 acid basis 4.2 nucleophile electrophile leaving group 4.3
oxidation reduction reaction 4.5 step problem solving chapter 5 alcohols 5.1 description
property 5.2 reaction alcohol 5.3 reaction phenol chapter 6 aldehyde ketone electrophilicity
oxidation 6.1 description property 6.2 nucleophilic addition reaction 6.3 oxidation reduction
reaction chapter 7 aldehydes ketones ii enolates 7.1 general principle 7.2 enolate chemistry
7.3 aldol condensation chapter 8 carboxylic acid 8.1 description property 8.2 reaction
carboxylic acid chapter 9 carboxylic acid derivative 9.1 amide ester anhydride 9.2 reactivity
principle 9.3 nucleophilic acyl substitution reaction chapter 10 nitrogen- phosphorus- 10.1
amino acid peptide protein 10.2 synthesis α amino acid 10.3 phosphorus contain compound

chapter 11 spectroscopy 11.1 infrared spectroscopy 11.2 ultraviolet spectroscopy 11.3 nuclear magnetic resonance spectroscopy chapter 12 separation purification 12.1 solubility base method alexander stone macnow md kelly kyker snowman ms kaplan mcat faculty m. dominic eggert reviewer editor elmar r. aliyev james burns jonathan cornfield alisha maureen crowley brandon deason md nikolai dorofeev md benjamin downer ms colin doyle christopher durland m. dominic eggert marilyn engle eleni m. eren raef ali fadel elizabeth flagge adam grey tyra hall pogar phd scott huff samer t. ismail elizabeth a. kudlaty ningfei li john p. mahon matthew a. meier nainika nanda caroline nkemdilim opene kaitlyn e. prenger uneeb qureshi derek rusnak ma kristen l. russell bela g. starkman phd michael paul tomani ms lauren k. white nicholas m. white allison ann wilkes ms kerranna williamson mba tony yu

thank tim eich samantha fallon owen farcy dan frey robin garmise rita garhaffner joanna graham adam grey allison harm beth hoffberg aaron lemon strauss keith lubeley diane mcgarvey petros minasi camellia mukherjee denise pangia john polstein deeangelee pooran kublall md mph rochelle rothstein md larry rudman sylvia tidwell scheuring carly schnur karin tucker lee weiss

countless project possible getting start checklist register free online asset include length test science review video additional practice create study calendar ensure complete content review sufficient practice test day finish chapter online practice chapter check table content register mcat set aside time prep sure rest application personal statement recommendation material ready moment admire complete checklist business preppe exam start long fruitful journey wear white coat proudly wear white coat hopefully motivation read book want healer go medical school likely familiar importance mcat medical school admission holistic review process put additional weight experience extracurricular activity personal attribute fact remain gpa mcat score remain important component application portfolio early admission process additional point score mcat push thousand student make attractive applicant mcat

simply obstacle overcome opportunity school strong student future leader medicine kaplan
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question stem suggest concept state question stem identify answer choice accurate application skill 1 question particularly prominent discrete question associate passage question opportunity gain quick point test day know science concept attach question test day 35 question science section skill 1 sample skill 1 question stem proponent james lange theory emotion interpret finding study cite passage following accurately describe function fsh human menstrual cycle product reaction 1 reaction 2 combine solution result reaction form ionic bond maintain following force skill 2 scientific reasoning problem solving mcat science section course test straightforward science knowledge skill 2 question common way kaplan critical thinking question skill 2 question require following reason scientific principle theory model analyze evaluate scientific explanation prediction evaluate argument cause consequence bring theory observation evidence draw conclusion recognize scientific finding challenge invalidate scientific theory model determine use scientific formula solve problem skill 1 question think step problem skill 2 question step problem difficult skill 2 question require step question require wide spectrum reasoning skill include integration multiple fact passage combination multiple science content area prediction experiment result skill 2 question tend ask science content actually mention example question describe result experiment ask predict result second experiment actually tell underlie scientific principle work question difficulty figure principle apply order correct answer test day 45 question science section skill 2 question

answer test day 45 question science section skill 2 question sample skill 2 question stem following experimental condition likely yield result similar figure 2 follow conclusion support information passage likely cause anomalous result find impact person chest quickly reduce volume lung 70 initial value allow air escape mouth percentage force outward air pressure increase 2 cm² portion

inner surface skill 3 reasoning design execution research mcat interested ability critically

appraise analyze research important day day task physician question experimental research design question skill 3 short skill 3 question require following identify role theory past finding observation scientific identify testable research question hypothesis distinguish sample population distinguish result support generalization population identify independent dependent variable reason feature research study suggest association variable causal relationship temporality random assignment identify conclusion support research result determine implication result real world situation reason ethical issue scientific research year aamc receive input medical school require practical research skill mcat test taker skill 3 question response demand skill unique outside knowledge need answer skill 3 question teach undergraduate course instead research design principle need answer question learn gradually science class especially laboratory work complete note skill 3 comprise 10 question science section test day sample skill 3 question stem dependent variable study describe passage major flaw method measure disease susceptibility experiment 1 follow procedure important experimenter follow order study maintain proper randomized sample research subject researcher like test hypothesis individual urban area adulthood likely car live urban area birth follow study well test hypothesis skill 4 data base statistical reasoning lastly science section mcat test ability analyze visual numerical result experiment study data statistical analysis question skill 4 question require use analyze interpret datum figure graph table evaluate representation sense particular scientific observation datum use measure central tendency mean median mode measure dispersion range interquartile range standard deviation describe datum reason random systematic error reason statistical significance uncertainty interpret statistical significance level interpret confidence interval use datum explain relationship variable use datum answer research question draw conclusion skill 4 include mcat physician researcher spend time examine result study study important legitimate conclusion sound judgment base datum mcat test skill 4 science section graphical representation datum chart bar graph numerical one table list result summarize sentence paragraph form test day

10 question science section skill 4 question sample skill 4 question stem accord information passage inverse conclusion well support finding display figure medical test rare type heavy metal poisoning return positive result 98 affect individual 13 unaffected individual following type error prevalent fourth trial experiment

1 run yield result 54 compliance following true discuss sir test mcat daunting prospect give nature skill tend conversation abstract practice able identify skill quickly able apply proper strategy solve problem test day need quick reference remind sir guideline help skill 1 science knowledge question ask remember science content skill 2 critical thinking question ask remember science content apply novel situation answer question cleverly combine multiple content area time skill 3 experimental research design question ask let forget science content insight experimental research method involve skill 4 data statistical analysis question ask let forget science content accurately read graph table moment conclusion extrapolation base information present critical analysis reasoning skills cars critical analysis reasoning skills cars section mcat test discrete family textual reasoning skill familiesth require high level reasoning skill 1 foundation comprehension 30 question 2 reasoning text 30 question 3 reasoning text 40 question skill test humanities- social sciences- theme passage approximately 5 7 question passage let depth look skill bullet point specific objective cars take directly official guide mcat exam description behavior mean sample question stem write kaplan foundation comprehension questions skill ask basic fact simple inference passage question similar see reading comprehension section standardized exam like sat ® act ® foundations comprehension question require understand basic component text infer meaning rhetorical device word choice text structure admittedly cover wide range potential question type include main idea detail inference definition context question find correct answer foundations comprehension question follow basic understanding passage point view author occasionally voice passage sample foundations comprehension question stem main idea author primary purpose passage detail base information second paragraph follow accurate summary opinion

hold scattered detail accord passage follow false literary review 1920s inference implication)—which following phrase passage suggestive author personal bias narrative record history inference assumption)—in put argument passage author likely assume

record history inference assumption)—in put argument passage author likely assume definition context word obscure paragraph 3 reference historian action nearly mean reason text foundation comprehension question usually depend interpret single piece information passage understand passage reasoning text question require thought ask identify purpose particular piece information context passage ask piece information relate reasoning text question require integrate different component text draw relevant word question skill ask detail relate true author cars section ask judge certain part passage judge author question fall reasoning text skill ask identify authorial bias evaluate credibility cite source determine logical soundness argument identify importance particular fact statement context passage search relevant evidence passage support give conclusion category include function strengthen weaken passage question smattering related rare sample reasoning text question stem function author discussion effect socioeconomic status social mobility primarily serve follow strengthen weaken passage)—which follow fact passage prominent piece evidence favor author conclusion strengthen weaken passage)—based role play author argument possessed consider reasoning text distinguish factor reasoning text question title skill word question test skill large share cars section question skill introduce completely new situation present passage question ask determine influence reasoning text question require apply extrapolate idea passage new context assess impact introduce new factor information condition idea passage reasoning text skill divide apply strengthen weaken passage question rarely appear question type sample reasoning text question stem apply document locate demonstrate berlioz intend include chorus 700 grande messe des morts author likely respond apply follow good example virtuous rebellion define passage strengthen weaken passage)—suppose jane austen write letter sister strong character force circumstance confront basic question society

live relevance strengthen weaken passage)—which follow sentence add end passage weaken author conclusion paragraph foundations comprehension skill cars section test reading skill build grade school albeit context challenging doctorate level passage skill reasoning text reason text mcat

challenging doctorate level passage skill reasoning text reason text mcat demand understand deep structure passage argument advanced level course test tight timing restriction 102 second question include time spend read passage quick reference guide cars skill foundations comprehension question ask understand passage main idea passage particular detail true author reasoning text question ask logical relationship idea argued author thesis reasoning text question ask principle passage apply new situation new piece information influence argument section mcat score 118 132 median approximately 125 mean total score range 472 528 median 500 peculiar number aamc stress scale emphasize importance central portion score distribution student score 125 section 500 total put undue focus high end note wrong answer penalty mcat select answer question guess aamc release 2018–2020 correlation scale score percentile show follow page note percentile scale adjust renormalize time shift slightly year year percentile rank update release aamc 1 year source aamc 2021 summary mcat total section scores access december 2021 <https://www.aamc.org/services/mcat-admissions-information> score reporting include end section test mcat policies procedures strongly encourage download late copy mcat ® essentials available aamc website ensure late information registration test day policy procedure document update annually brief summary important rule provide way register mcat online access aamc registration system www.aamc.org/mcat able access site approximately month test day aamc designate registration zones”—gold silver bronze register gold zone opening registration approximately month test day provide flexibility low test fee silver zone run approximately week test day flexibility high fee bronze zone run approximately week test day flexibility high fee fee fee assistance program fap payment test registration mastercard visa describe early fee register

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push exam aamc offer fee assistance program fap student financial hardship help reduce cost
take mcats american medical college application service

amcas ® application information fap find www.aamc.org/students/applying/fap test day
require present qualify form id generally current driver license united states passport
sufficient consult aamc website list qualify criterion register care spell name middle name
suffix prefix require verify test day precisely appear id failure provide id test center difference
spelling registration id consider receive refund exam test day registration identity datum
collect include digital palm vein scan test day photo digitization valid id signature testing
center use metal detection wand ensure prohibit item bring testing room prohibited item
include electronic device include watch timer calculator cell phone form record equipment
food drink include water cigarette smoking paraphernalia hat scarf religious purpose book
note study material require medical device insulin pump pacemaker apply accommodate
testing break allow access food drink electronic device include testing center video
surveillance aamc potential violation testing security lightly line know rule break student
disability medical condition apply accommodate testing documentation disability condition
require request month approve reason recommend begin process apply accommodate
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significantly examinee agreement sign beginning exam specifically prohibit discuss disclose exam content aamc know seek individual violate agreement retain right prosecute individual discretion mean circumstance discuss exam person phone individual include kaplan post information question exam content facebook student doctor network online social media permit comment general exam experience include feel exam overall individual section fine line summary certain discuss aspect test let silly facebook post stop doctor deserve score typically release approximately month test day release stagger afternoon evening end 5 p.m. eastern standard time mean examinee receive score exactly time score report include scale score section 118 132 total combine score 472 528 score give confidence interval section confidence interval approximately give score ± 1 total score approximately give score ± 2 give correspond percentile rank section score aamc contact information question contact mcats team association american medical colleges mcats resource center association american medical colleges kaplan mcats review project begin shortly release preview guide mcats 2015 exam 2nd edition thorough analysis staff psychometrician able analyze relative yield different topic mcats begin construct table content book kaplan mcats review series dedicated staff 30 writer 7 editor 32 proofreader work 5,000 combined hour produce book format book heavily influence weekly meeting kaplan learning science team year book create number opportunity expansion improvement occur current edition represent culmination wisdom accumulate time frame include new feature design improve reading learning experience text book submit publication april 2022 update date visit www.kaptest.com/retail-book- question content present email kaplanmcatsfeedback@kaplan.com question relate content email booksupport@kaplan.com book vet round review end information present book true accurate good knowledge feedback help improve prep material notify inaccuracy error book send email kaplanmcatsfeedback@kaplan.com

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kaplan 1 choice mcat prep book design help review organic chemistry topic cover mcat understand content review matter thorough sufficient preparation mcat mcat test science knowledge critical reading reasoning problem solving skill assume simply memorize content book earn high score test day maximize score improve reading test taking skill mcat style question practice test beginning section find short list objective describe skill cover section learning objective text develop conjunction kaplan learning science team design specifically focus attention task concept likely mcat learning objective function means guide study indicate information relationship focus section start section read learning objective carefully allow assess exist familiarity content provide goal orient focus studying experience mcat concept checks end section find open ended question use assess mastery material mcat concept checks introduce numerous conversation kaplan learning science team research demonstrate repeatedly introspection self analysis improve mastery retention recall material complete mcat concept checks ensure get key point section move science mastery assessments beginning chapter find 15 mcat style practice question design help assess understanding chapter begin read chapter guidance provide assessment determine good way review chapter base personal strength weakness question science mastery assessments focus scientific inquiry reasoning skills knowledge scientific concepts principles occasional question fall second fourth sir scientific reasoning problem solving data base statistical reasoning respectively addition online resource find test like passage set cover content study ensure apply knowledge way mcat expect following guide type sidebar find kaplan mcat organic chemistry review bridge sidebar create connection science topic appear multiple chapter kaplan mcat review key concept sidebar draw attention important takeaway give topic offer synopsis overview complex information understand sure grasp key concepts give subject mcat expertise sidebar point information test mcat offer key strategy point test taking tip apply test day mnemonic sidebar present memory device help recall real world sidebar illustrate

sidebar present memory device help recall real world sidebar illustrate concept text relate practice medicine world large information need know test day topic real world sidebar excellent example concept appear passage discrete stand question mcat book cover information present kaplan mcat review series cover list official mcat content list topic list cover level detail common undergraduate postbaccalaureate class consider prerequisite mcat note premedical class include topic discuss book depth book additional exposure science content bad thing content knowledge expect walk test day cover chapter profile page chapter represent holistic look content chapter include pie chart text information pie chart analysis base directly datum release aamc rough estimate importance chapter relation book text portion chapter profiles include aamc content category cover chapter reference directly aamc mcat exam content listing available testmaker website new high yield badge scatter section chapter 1.1 amino acid find note terminology stereochemistry amino structure amino amino acid abbreviation 1.2 acid base chemistry titration amino acid 1.3 peptide bond formation peptide bond formation peptide bond hydrolysis 1.4 primary secondary 1.5 tertiary quaternary folding solvation acid find chapter 1.1 badge represent 100 topic test aamc word accord testmaker experience resource high yield badge mean question test day book contain thorough glossary index easy navigation end book write margin draw diagram highlight key point necessary help high score look forward work achieve dream doctor deserve study book addition provide good practice question test strategy kaplan team learn scientist dedicate research test good method get study time tip improve retention review multiple topic study session

counterintuitive we're practice skill time order improve skill research show weave topic lead increase learning consideration mcat include topic single question study integrated manner effective way prepare test customize content draw attention difficult critical content ensure overlook read read section good way visual highlight tab use stickie work recommend highlight important difficult section text selective highlighting 10 percent text give chapter

great emphasize part text over- highlight opposite effect repeat topic time people try
memorize concept repeat succession research show retention improve space repeat time mix
order study content example try read chapter different order second time revisit practice
question answer incorrectly new sequence information review recently help well understand
question solution struggle past moment reflect finish read section time stop think read jot
thought margin note content important topic come mind read associate learning memory
fantastic way retain information work answer question answer question moment think step
take arrive solution lead answer choose understand step take help good decision answer
future question addition resource locate text additional online resource await
www.kaptest.com/booksonline sure log advantage free practice additional resource note
access online resource limit original owner book year medical school frenzied experience
student meet requirement rigorous work schedule student learn prioritize time fall hopelessly
surprise mcat test specifically design predict success medical school high speed time intensive
test mcat demand excellent time management skill endurance grace pressure test prepare
have solid plan attack stick key give confidence structure need create study plan good time
create study plan beginning mcat preparation use calendar want start purchase planner print
free calendar internet use build calendar app smart device track interactive online calendar
pick option practical likely use consistently calendar able start plan study schedule following
step 1 fill obligation choose day write school extracurricular work obligation class session
work shift meeting attend

school extracurricular work obligation class session work shift meeting attend add personal
obligation appointment lunch date family social time etc make appointment calendar hang
friend go movie strange plan social activity advance help achieve balance personal
professional obligation life get busy have happy balance allow focused productive come time
study stay well- rounded neglect important addition schedule personal professional obligation
plan time take time important study kaplan recommend take day week ideally study obligation

minimum study 2 add study block obligation establish calendar framework add study block obligation keep study schedule consistent possible day week study time day official test ideal promote recall possible fit study block studying efficient possible block short frequent period study time week learning perspective study hour day day week valuable study hour day week specifically kaplan recommend study long hour sitting hour block plan minute break hour use break seat quick stretch snack drink clear mind minute break 50 minute studying sound like lot break allow deal distraction rest brain 50 minute study block remain fully engaged completely focused 3 add length practice test want add length practice test want test early prep spread remain length practice test evenly test date stagger test way allow form baseline comparison determine area focus right away provide realistic feedback prep perform test day plan calendar aim finish length practice test majority studying week test day allow spend final week complete brief review know online resource find sample study calendar different test day timeline use starting point sample calendar include focus need area fit timeline test day need customize study calendar need step total time spend study week depend schedule personal prep need time test day recommend spend range 300–350 hour prepare take official mcat way break study hour day day week month approach study day week hour day

day day week month approach study day week hour day study long period time time study week matter plan ensure complete practice feel completely comfortable mcat content good sign ready test day begin earn goal score consistently practice study mcat cover large material study test day initially daunting combat tip control studying time control content practice require mcat break content specific goal week instead attempt approach test goal want increase overall score 5 point big abstract difficult measure small scale reasonable goal read chapter day week goal like overwhelming help break studying manageable piece book information familiar probably see content careful familiarity subject necessarily translate knowledge mastery subject assume recognize concept actually know apply quickly appropriate level passively read book instead read actively use free margin space jot

important idea draw diagram chart read highlighting excellent tool use sparingly highlight sentence active reading color frequently stop ask question read e.g. main point fit overall scheme thing thoroughly explain make connection focus grand scheme ensure know essential content prepare level critical thinking require mcat focus area great opportunity limit have minimal time prepare test day focus big area opportunity area opportunity topic area highly test master likely will time detailed note page book instead use result practice material determine area big opportunity seek take length test sure performance report well identify area opportunity skim content matter demonstrate proficiency pause read thoroughly look unfamiliar particularly difficult begin science mastery assessment beginning chapter question correct reasonable time able quickly skim chapter question prove difficult need spend time read chapter certain subsection chapter thoroughly practice review tracking leave time review practice question length test tempt practice push ahead cover new material quickly possible fail schedule ample time review actually throw away great opportunity improve performance brain rarely remember see carefully review question solve explanation

performance brain rarely remember see carefully review question solve explanation process retrieve information reopen reinforce connection build brain build long- term retention repeatable skill set exactly need beat review note specific reason miss question get wrong guess spreadsheet like add miss sheet wimis complete practice periodically review wimis identify pattern consistently miss question certain content area fall testmaker trap mcat prep adjust study plan base available study time result review strength weakness likely change course prep address area important score shift focus area change help review make length test include miss sheet template sure check video resource online syllabus miss read scope study overlook aspect study environment learning actually occur study home student choice problem arise environment chief distraction studying mentally drain process time pass distraction tempting escape route considerable willpower reason stay focused hard need instead study home head library quiet coffee shop new location possible eliminate usual

distraction promote efficient studying instead study home course entire day stay library hour effective studying enjoy rest day mcat matter study practice like test day possible require official test snack chew gum study block turn music television phone practice computer online resource simulate computer base test environment complete practice question work scratch paper noteboard sheet write directly print material will option test day memory tie sense test like studying environment easy test day recall information put work learn pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz

spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read corresponding subchapter relevant content subchapter question review question get correct ensure thinking match explanation review concept summary end chapter 1 follow list correct common name ethanal methanal ethanol respectively a. acetaldehyde formaldehyde ethyl alcohol b. ethyl alcohol propionaldehyde isopropyl alcohol c.

ethyl alcohol formaldehyde acetaldehyde d. isopropyl alcohol ethyl alcohol formaldehyde 2 following consider terminal functional group iii carboxylic acid a. b. iii c. iii d. ii iii 3 prefix drop parent root molecule c. propanoic acid d. propanoic anhydride 4 high priority functional group molecule d. alkyl chain 5 iupac following structure end suffix c. -oic acid 6 possibility correctly

number carbon backbone molecule a. numbering scheme 1 b. numbering scheme 2 c. numbering scheme 1 2 equivalent correct d. numbering scheme 1 2 equivalent incorrect 7 proper structure 2,3 dihydroxybutanedioic acid 8 common name aldehyde carboxylic acid contain carbon start prefix 9 iupac follow structure 10 iupac follow structure 11 iupac follow structure start 12 nadh coenzyme release high energy electron electron transport chain know nicotinamide adenine dinucleotide diphosphopyridine nucleotide functional group exist molecule a. b. ii c. ii d. ii iii 13

pyruvic acid end product glycolysis commonly call acetylformic acid base common structure pyruvic acid 14 follow common name carboxylic acid i. acetic anhydride ii formic acid iii methyl formate a. ii b. iii c. ii iii d. ii iii 15 consider 2,3 diethylpentane base structure imply correct iupac molecule answer key follow page chapter 1.1 iupac naming conventions 1.2 hydrocarbon alcohols alkenes alkynes 1.3 aldehyde ketones 1.4 carboxylic acid derivative 1.5 summary functional groups content chapter relevant 4 question organic chemistry mcat chapter cover material follow aamc content 5d structure function reactivity biologically relevant walk pharmacy look headache find entire aisle drug purpose advil aleve motrin tylenol ibuprofen naproxen acetaminophen aspirin list distinct drug united states uncommon drug know generic brand name multiple brand market medication medical student know doctor order atorvastatin 40 mg qd patient tell take lipitor daily doctor generic sufficiently unambiguous specify give compound true pharmaceutical industry medication usually large organic compound functional group numerous chiral center chemist need able describe compound innumerable chemistry specific set rule name describe compound design chapter examine step name compound practice apply example compound end chapter discuss common functional group test day relate nomenclature hierarchy note learn nomenclature number compound include ether epoxide amine imine sulfonic acid organic chemistry course restrict content chapter functional group expect identify test day accord aamc mcat include standalone nomenclature organic chemistry question compound question probably

remember class nomenclature foundation entire subject organic chemistry lose point test day
nomenclature cold 1.1 iupac naming conventions chapter 1.1 able identify parent carbon
chain complex molecule describe number integrate chemical nomenclature apply step iupac
nomenclature molecule nomenclature important prerequisite answer organic chemistry
question test day know chemical compound question ask hard answer right important
understand iupac common nomenclature handle naming system easily translate question
stem focus find correct answer

naming system easily translate question stem focus find correct answer let begin examine
iupac naming convention highlight specific compound functional group nomenclature test
mcats provide question stem answer choice different format example question stem iupac
reactant answer choice product structure leave figure structure reactant reaction taking
primary goal international union pure applied chemistry iupac naming system create
unambiguous relationship structure compound convention establish iupac distinct compound
iupac naming system greatly simplify chemical naming understand rule match name structure
ease 1 identify long carbon chain contain high order functional group call parent chain
determine root mind double triple bond carbon consider identify high order functional group
examine priority functional group chapter mind high priority functional group oxidize carbon
provide suffix step sound easy careful molecule draw way long carbon chain immediately
obvious chain equal length substitute chain get priority parent chain figure 1.1 show
hydrocarbon long chain label figure 1.1 find long carbon chain 2 number chain order
appropriately compound need number carbon chain show figure 1.2 convention carbon
number 1 close high priority functional group functional group priority number chain number
substitute carbon low possible figure 1.2 number long carbon chain high priority functional
group low possible number substituent priority figure number low possible discuss functional
group commonly test mcats review table functional group order priority mind oxidized carbon
high priority molecule oxidation state increase bond heteroatom atom carbon hydrogen like

oxygen nitrogen phosphorus halogen decrease bond hydrogen like straight chain ring
number start point great substitution continue direction give low number high priority
functional group somewhat counterintuitively tie assign priority molecule double triple bond
double bond take precedence 3 substituent substituent

functional group parent chain substituent place beginning compound prefix follow long chain
remember high priority functional group determine suffix compound parent chain carbon
chain substituent name like alkane suffix yl replace ane prefix n figure 1.3 n propyl simply
indicate normal—in word straight chain alkane. fi prefix present safe assume alkane
substituent normal specify figure 1.3 common normal alkyl substituents bond right
substituent connect parent figure 1.4 example alternative alkyl substituent look like figure 1.4
common alternative alkyl substituents bond right substituent connect multiple substituent
type use prefix di tri tetra indicate fact prefix include directly substituent 4 assign number
substituent pair substituent name correspond number parent chain multiple substituent type
di tri tetra prefix previously note carbon number designation carbon 5 complete names begin
name substituent alphabetical order substituent precede number note prefix like di tri tetra
hyphenated prefix like n tert t ignore alphabetize nonhyphenated root include modifier like iso
neo cyclo-.

number separate comma word hyphen finally finish backbone chain include suffix functional
group high priority figure 1.5 show example entire hydrocarbon name figure 1.5 example
complete iupac mcat concept check 1.1 assess understanding material 1 list step iupac
nomenclature 2 circle highlight parent chain following 3 circle substituent follow molecule
molecule solution concept check give chapter mcat organic chemistry review find near end
chapter concept check locate follow concept summary 1.2 hydrocarbon alcohol chapter 1.2
able predict structure hydrocarbon alcohol molecule give simple molecular formula C_9H_{20}
differentiate geminal vicinal diol recall common name key compound 2 propanol apply priority

rule name molecule multiple functional group hydrocarbon compound contain carbon hydrogen atom alcohol hand contain oh group lend additional reactivity section explore naming hydrocarbon alcohol alkane simple hydrocarbon molecule formula $C_nH_{(2n+2)}$ name compound methane carbon ethane carbon propane carbon butane carbon alkane carbon simple naming pattern greek root describe number carbon follow ane 5 12 greek root pent hex hept oct non dec undec dodec-. example alkane show table 1.1 table 1.1 example alkanes halogens common substituent alkane alkyl halide indicate prefix fluoro chloro bromo iodo-.

alkene alkynes mcat explicitly test reaction alkene alkyne suffix ene yne signify double triple bond respectively mind compound common name vital know common name test day likely encounter double bond context unsaturated fatty acid biochemical compound double triple bond name like substituent indicate lower- number carbon involve bond number precede molecule 2 butene place near suffix but- 2 ene correct multiple multiple bond numbering generally separate suffix 1,3 butadiene alcohol name replace e end correspond alkane suffix ol chain number carbon attach hydroxyl group —oh get low possible number multiple bond present hydroxyl group take precedence multiple bond high oxidation state carbon alcohol high priority functional group name hydroxyl substituent hydroxy figure 1.6 demonstrate alcohol iupac name figure 1.6 name alcohol alcohol oxidized multiple bond priority nomenclature indicate suffix ol mcat use common name alcohol molecule later alcohol include ethyl alcohol isopropyl alcohol know common name refer vicinal diol vicinity adjacent carbon geminal diol like gemini twin pair alcohol refer common name iupac name version naming alkyl group follow word alcohol example include ethyl alcohol ethanol isopropyl alcohol 2 propanol alcohol hydroxyl group call diol glycol indicate suffix diol entire hydrocarbon preserve diol add name diol number hydroxyl group example ethane-1,2 diol ethane molecule hydroxyl group carbon molecule know common ethylene glycol diol hydroxyl group carbon call geminal diol diol hydroxyl group adjacent carbon call vicinal diol geminal diol hydrate commonly see spontaneously dehydrate lose water molecule produce carbonyl compound

functional group $C=O$. mcat

concept check 1.2 assess understanding material 1 fill correct name alkane list compound describe give molecular formula straight chain alkane formula refer draw alternative iupac straight chain 2 molecule double bond adjacent alcohol functional group precedence naming 3 follow compound geminal diol vicinal diol 4 common name 2 propanol ethanol 1.3 aldehyde ketone chapter 1.3 able distinguish aldehyde ketone recall common name methanal ethanal propanal propanone determine high priority functional group complex molecule apply appropriate prefix suffix name molecule contain aldehyde ketone group aldehyde ketone class molecule contain carbonyl group carbon double bonded oxygen aldehyde ketone differ placement carbonyl group aldehyde chain- terminate mean appear end parent chain ketone find middle carbon chain aldehyde ketone leave group connect carbonyl carbon connect alkyl chain case aldehyde hydrogen atom examine later carboxylic acid derivative contain leave group connect carbonyl carbon aldehyde carbonyl group find end carbon chain terminal functional group take precedence generally attach carbon number 1 aldehyde name replace e parent alkane suffix al aldehyde position 1 usually case need include number chemical figure 1.7 show iupac nomenclature figure 1.7 name aldehydes carbonyl group aldehyde usually receive number terminal functional group case alcohol important know common name iupac name common aldehyde ketone sure know formaldehyde acetaldehyde methanal ethanal propanal refer exclusively common name formaldehyde acetaldehyde propionaldehyde iupac name molecule show figure 1.8 figure 1.8 common names aldehydes ketone contain carbonyl group middle carbon chain case assign number carbonyl carbon name ketone propanone ketone carbon 2 default ketone name replace e parent alkane suffix name compound sure carbonyl low possible number high priority group ketone commonly name list alkyl group alphabetical order follow ketone ethylmethylketone acetone small possible ketone molecule figure 1.9 include iupac common name number ketone figure 1.9 name ketone common name include sugar classify aldose aldehyde sugar ketose ketone

common name include sugar classify aldose aldehyde sugar ketose ketone sugar understand nomenclature help identify structure sugar physical property carbohydrate structure discuss chapter 4 mcat biochemistry review complex molecule high priority group take precedence carbonyl aldehyde ketone substituent prefix oxo-.

reference carbonyl oxygen apply ketone aldehyde ketone indicate prefix keto-. convention mcat name carbon relative carbonyl group convention carbon adjacent carbonyl carbon indicate alpha α move away carbonyl successive carbon refer beta β gamma γ delta δ carbon apply side carbonyl fashion carbon side ketone consider alpha carbon important discuss α hydrogen acidity chapter 7 mcat organic chemistry review mcat concept check 1.3 assess understanding material 1 difference aldehyde ketone 2 suffix aldehyde ketone carbonyl group name substituent substituent prefix substituent prefix 3 fill common name follow chart 4 molecule double bond aldehyde alcohol functional group determine suffix 1.4 carboxylic acid derivatives chapter 1.4 able common carboxylic acid derivative include ester amide differentiate common carboxylic acid derivative carboxylic acid contain carbonyl group $C=O$ hydroxyl group $-OH$ terminal carbon carboxylic acid like aldehyde terminal functional group associate carbon usually number 1 oxidized functional group appear mcat bond oxygen carbon dioxide bond oxygen contain oxidized carbon carboxylic acid high priority functional group mcat test nomenclature group name substituent prefix carboxylic acid name replace e end parent alkane suffix oic acid common name carboxylic acid fairly mcat formic acid common methanoic acid acetic acid ethanoic acid propionic acid propanoic acid compound show figure 1.10 sure know common name iupac name test day figure 1.10 name carboxylic acid carboxylic acid group receive number terminal functional group common name include notice common name similar aldehyde carboxylic acid remember formaldehyde formic acid refer molecule methane parent alkane acetaldehyde acetic acid contain ethane parent alkane help consolidate information carboxylic acid derivative final category functional group include

ester amide anhydride ester common carboxylic acid derivative compound hydroxyl group
—oh replace alkoxy group —or r hydrocarbon chain ester nomenclature base naming
convention carboxylic acid term alkyl esterifying group think term adjective describe ester
base identity alkyl r

group think term adjective describe ester base identity alkyl r group second term parent acid
oate replace oic acid suffix example methanoic acid formic acid form butyl methanoate
exposure butanol appropriate reaction condition example ester nomenclature show figure
1.11 figure 1.11 name ester group bond directly ester oxygen name substituent group
carboxylic acid derivative include amide amide hydroxyl group replace amino group nitrogen
contain group compound complex amino nitrogen bond zero alkyl group amide name
similarly ester suffix amide substituent attach nitrogen atom label capital n indicate group
bond parent molecule nitrogen atom substituent include prefix compound number example
amide nomenclature include figure 1.12 figure 1.12 name amides group bond directly amide
nitrogen name substituent prefix n number final group carboxylic acid derivative anhydride
formation anhydride carboxylic acid molecule water molecule remove anhydride cyclic result
intramolecular dehydration dicarboxylic acid anhydride name replace acid anhydride
correspond carboxylic acid anhydride form type carboxylic acid anhydride symmetrical
carboxylic acid name suffix acid anhydride add example anhydride show figure 1.13 figure
1.13 name anhydrides phthalic anhydride succinic anhydride give example cyclic anhydride
name need memorize hydro prefix mean water prefix mean remember anhydride water
molecule remove formation mcat concept check 1.4 assess understanding material 1 name
ester amide anhydride derivative pentanoic acid assume r group ester —ch₃ amide
unsubstitute 2 following compound 1.5 summary functional group chapter 1.5 able apply
appropriate prefix suffix common organic functional group high yield badge section indicate
content frequently test mcat functional group priority correlate oxidation state carboxylic acid
high priority alkane low table 1.2 list functional group need know mcat order priority prefix

suffix carboxylic acid high priority functional group mcat nomenclature use suffix functional group high priority group molecule group substituent prefix table 1.2 major functional groups carbamoyl amido oxo keto note alkene alkyne consider tie priority

carbamoyl amido oxo keto note alkene alkyne consider tie priority cyclic compound alkene high priority work nomenclature able navigate mcat organic chemistry question ease confidence remember mcat question ask reaction laboratory technique translate compound question stem necessary step answer cover important functional group take note order priority group come name compound remember common name important mcat iupac name know key know language organic chemistry learn property molecule chapter focus reaction functional group laboratory technique subsequent chapter mcat organic chemistry review content test knowledge critical thinking skill complete test like passage set online iupac naming conventions international union pure applied chemistry iupac designate standard name chemical compound step process find long carbon chain compound contain high priority functional group call parent second number chain way high priority functional group receive low possible number group determine suffix molecule substituent prefix multiple substituent single type receive prefix denote present di tri tetra fourth assign number substituent depend carbon bond finally complete alphabetize substituent

separate number comma word hydrocarbon alcohols alkanes hydrocarbon double triple bond general formula C_nH_{2n+2} alkane name accord number carbon present follow suffix ane alkane methane CH_4 ethane C_2H_6 propane C_3H_8 butane C_4H_{10} large alkane use greek root number pentane hexane heptane octane alkene alkyne contain double triple bond respectively alkene name substitute ene suffix number double bond lower number carbon alkyne substitute yne numbering alcohol contain hydroxyl OH group substitute hydrogen hydrocarbon chain alcohol name substitute suffix ol prefix hydroxy high priority group present alcohol high priority double triple bond common name alcohol include carbon chain

follow word alcohol example ethyl alcohol compound ethanol diol contain hydroxyl group
term geminal carbon vicinal adjacent carbon aldehyde ketones aldehydes ketone contain
carbonyl group carbon double-bond oxygen aldehyde carbonyl group terminal carbon attach
hydrogen atom aldehyde name suffix al prefix oxo high priority group present common name
aldehyde include formaldehyde methanal acetaldehyde ethanal propionaldehyde propanal
ketone carbonyl group nonterminal carbon ketone name suffix share prefix oxo high priority
group present ketone indicate prefix keto-. common name ketone construct name alkyl group
alphabetically add ketone example 2 butanone call ethylmethylketone acetone significant
small ketone iupac carbonyl contain compound aldehyde ketone carboxylic acid derivative
create lettering scheme carbon carbon adjacent carbonyl carbon α carbon carboxylic acids
derivatives carboxylic acid high priority functional group contain bond oxygen hydroxyl group
carbonyl group carboxylic acid terminal derivative occur molecule carboxylic acid name suffix
oic acid rarely name prefix common name carboxylic acid follow trend aldehyde formic acid
methanoic acid acetic acid ethanoic acid propionic acid propanoic acid ester carboxylic acid
derivative

oh replace alkoxy group ester use suffix oate prefix alkoxycarbonyl-. common name ester
derive alcohol carboxylic acid synthesis amide replace hydroxyl group carboxylic acid amino
group substitute amide use suffix amide prefix carbamoyl amido-. substituent attach amide
nitrogen designate anhydride form carboxylic acid dehydration symmetric acid asymmetric
different acid cyclic intramolecular reaction dicarboxylic anhydride name suffix anhydride
place acid anhydride form carboxylic acid name alphabetical order word summary functional
groups functional group arrange order priority follow carboxylic acid > anhydride > ester >
amide > aldehyde > ketone > alcohol > alkene alkyne > alkane answer concept check 1 1 find
long carbon chain compound highest-order functional group 2 number chain 3 substituent 4
assign number substituent 5 complete note possible answer long chain include question ask
circle substituent order determine substituent necessary identify parent chain begin

identifying the long carbon chain contain high priority functional group molecule contain alkyl functional group alkyl functional group priority parent chain long continuous carbon chain seven carbon parent chain identify substituent circle name show number chain right left ensure substituent small possible locant number substituent name number complete alphabetize substituent remember di ignore 4 ethyl-2,3 dimethylheptane iupac straight-alternative structure alternative structure alternative structure butane hydrocarbon large butane branched appearance shorten parent chain example isobutane properly name methylpropane

show branched hydrocarbon correct number carbon multiple bond ring correct 2 alcohol precedence carbon attach high oxidation state 3 diol alcohol hydroxyl group geminal diol hydroxyl group carbon gemini derive latin paired twin vicinal diol hydroxyl vicinity adjacent carbon vicinus derive latin neighbor compound show geminal diol 4 isopropyl alcohol ethyl alcohol respectively 1 aldehyde carbonyl group end chain ketone carbonyl group middle carbon chain way think carbonyl carbon aldehyde bond hydrogen atom carbonyl carbon ketone bond carbon 2 aldehyde refer suffix al ketone give suffix carbonyl group aldehyde ketone label oxo substituent ketone call keto 4 ketone aldehyde precedence alcohol hydrocarbon chain functional group high priority determine suffix aldehyde chain- terminate carbon number 1 aldehyde determine suffix name compound 1 ester derivative methyl pentanoate amide pentanamide anhydride pentanoic anhydride 2 3 methyl-2 oxopentanoic acid science mastery assessment common ethanal acetaldehyde common methanal formaldehyde common ethanol ethyl alcohol isopropyl alcohol common 2 propanol propionaldehyde common propanal aldehyde carboxylic acid characterize position end carbon backbone consider terminal group result carbon attach usually if designate carbon 1 ketone internal definition carbon carbonyl high priority functional group molecule carboxyl group component backbone provide suffix molecule molecule 2 methyl-3 oxopropanoic acid molecule feature anhydride group hydrocarbon chain provide parent root mind carbonyl

group present leave group large functional group carboxylic acid anhydride ester amide take priority carbonyl group molecule propanoic anhydride functional group present

carboxylic acid high priority compound end oic acid suffix denote alcohol b ketone d alkyne low priority carboxylic acid mcat test nomenclature halide ether note low priority carboxylic acid oxidize group molecule 3 ethyl-4 methylhexane 2,3 diethylpentane name alkane locate long carbon chain 6 carbon 5 carbon numbering system alkyl group low possible number know iupac butanedioic acid backbone word carbon backbone carboxylic acid end add hydroxyl group carbon 2 3 yield correct structure form prefix share common name methanoic acid formic acid methanal formaldehyde task name compound identify long carbon chain case long chain seven carbon parent alkane end heptane b d eliminate sure carbon number substituent position number small possible compound methyl group minimize position number require number chain right left methyl group attach carbon 2 5 correct iupac 2,5 dimethylheptane c incorrect

position number substituent minimize begin find long carbon chain non alkyl group need worry group priority number carbon low possible combination number give substituent substituent organize alphabetically numerically know right away c d incorrect hydroxyl group high priority methyl group know number carbon chain hydroxyl group receive low possible position molecule 2- methyl-2 butanol start prefix 2 methyl suffix amide nicotinamide indicate compound contain amide functional group prefix diphospho indicate phosphate group know prefix phospho chapter recognize nucleotide mention compound contain sugar phosphate group nitrogenous base structure nad⁺ oxidize form nadh show use acetylformic acid figure functional group prefix acet refer carbon unit carbon carbonyl group think acetic acid acetic anhydride acetaldehyde carbonyl carbon point attachment functional group formic acid single carbon carboxylic acid acetylformic acid acetyl group directly attach formic acid show b show acetic acid vinegar c show glucose d show formic acid acetic anhydride common ethanoic

anhydride methyl formate common methyl methanoate infer common root form ester suffix
oate shorten ate pronunciation purpose formic acid common methanoic acid carboxylic acid
derivative draw molecule long carbon chain substituent low possible carbon number actually
different choose original correct iupac molecule 3 ethyl-4 methylhexane consult online
resource additional organic chemistry chapter 4 analyze organic reactions organic chemistry
chapter 5 organic chemistry chapter 6 aldehydes ketone organic chemistry chapter 8 organic
chemistry chapter 9 carboxylic acid derivative organic chemistry chapter 10 nitrogen-
phosphorus contain compound pre med know feeling content know mcat know important
high yield badge book help identify important topic science mastery assessment tool mcat
prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter
base personal strength weakness worry skip mean study later prep complete length test
uncover specific piece content need review come chapter appropriate use assessment answer
0-7 question correctly spend 1 hour

appropriate use assessment answer 0-7 question correctly spend 1 hour read chapter limited
note follow review quiz question ensure understand solve answer 8-11 question correctly
spend 20-40 minute review quiz question begin question miss read note correspond
subchapter question answer correctly ensure thinking match explanation understand choice
correct incorrect answer 12-15 question correctly spend 20 minute review question quiz miss
include quick read correspond subchapter relevant content subchapter question review
question get correct ensure thinking match explanation review concept summary end chapter
1 follow optical activity c. solution contain 1 m r)-2 butanol 2 m s)-2- d. solution contain 2 m r)-2
butanol 2 m s)-2- 2 stereoisomer exist follow aldehyde 3 following compound optically inactive
4 cholesterol show contain chiral center 5 isomer follow compound stable d. equally stable 6
follow reaction result a. retention relative configuration change b. change relative absolute
configuration c. retention relative absolute configuration d. retention absolute configuration
change

7 following molecule consider c. meso compound d. structural isomer 8 + -glyceraldehyde)-glyceraldehyde refer r s form 2,3 dihydroxypropanal respectively molecule consider c. meso compound d. structural isomer 9 consider e)-2 butene z)-2 butene pair type(s isomer i. cis trans isomer a. b. ii c. ii d. iii 10 3 methylpentane hexane relate c. constitutional isomer d. conformational isomer 11 r)-2 chloro-(s)-3 bromobutane s)-2 chloro-(s)-3- c. meso compound d. molecule 12 scientist take solution unknown pure dextrorotatory organic molecule place test tube diameter 1 cm observe plane polarized light rotate 12° condition specific rotation molecule 13 omeprazole proton pump inhibitor commonly gastroesophageal reflux disease omeprazole racemic mixture go patent pharmaceutical company begin manufacture esomeprazole s)-enantiomer omeprazole give 1 m solution omeprazole esomeprazole solution(s likely exhibit optical activity a. omeprazole b. esomeprazole c. omeprazole esomeprazole d. omeprazole esomeprazole 14 2r,3s)-2,3 dihydroxybutanedioic acid 2s,3r)-2,3-dihydroxybutanedioic acid

i. meso compound ii molecule a. b. iii c. ii d. iii 15 methyl group butane 120° apart see newman projection molecule a. high energy gauche form b. low energy stagger form c. middle energy eclipse form d. high energy eclipse form chapter 2.1 structural isomer 2.3 relative absolute configuration e z form r s form content chapter relevant 12 question organic chemistry mcat chapter cover material following aamc content 1d principle bioenergetic fuel molecule metabolism 5b nature molecule intermolecular interaction 5c separation purification method 5d structure function reactivity biologically relevant important way distinguish molecule identify isomer compound molecular formula different structure mind isomerism describe relationship child sibling molecule isomer molecule isomer chapter learn identify relationship describe similarity difference isomer figure 2.1 show isomer class learn relate feel free come figure reference read detailed explanation figure 2.1 flowchart isomer relationships isomer molecular formula different structure 2.1 structural isomers chapter 2.1 able describe

share unique property structural isomer explain physical chemical property identify structural isomer structural isomer similar isomer fact thing structural isomer call constitutional isomer share molecular formula mean molecular weight aside similarity structural isomer widely varied different chemical physical property example different structural isomer C_6H_{14} show figure 2.2 molecule look completely different number carbon hydrogen atom figure 2.2 structural constitutional isomer C_6H_{14} ft physical chemical property prime mcats material test context isomerism physical property characteristic process change composition matter melting point boiling point solubility odor color density chemical property reactivity molecule molecule result change chemical composition organic chemistry chemical property compound generally dictate functional group physical property change composition matter example include melting point boiling point solubility odor color density chemical property reactivity molecule result change composition generally attributable functional group mcats concept check 2.1 assess understanding material 1 property property structural isomer common 2 compound cyclopropanol 2

1 property property structural isomer common 2 compound cyclopropanol 2 propanol acetone prop-2-ene-1-ol structural isomer 3 physical property example physical property 4 chemical property chapter 2.2 able differentiate conformational configurational distinguish enantiomer diastereomer identify enantiomer diastereomer meso convert newman 3d molecular projection like structural isomer isomer matter stereoisomer chemical formula unlike structural isomer stereoisomer share atomic connectivity word structural backbone stereoisomer differ atom arrange space wedge dash pattern isomer structural isomer fall category large distinction class conformational configurational isomer conformational isomer conformer differ rotation single σ bond configurational isomer interconvert break isomer conformational isomer similar conformational isomer fact molecule different point natural rotation single σ bond double bond hold molecule specific position explain cis trans isomer later single bond free rotate conformational isomer arise fact vary degree rotation single bond

create different level strain conformation easy molecule depict newman projection molecule visualize line extend carbon carbon bond axis classic example demonstrate conformational isomerism straight chain butane show figure 2.3 figure 2.3 newman projection butane depiction different atom position point view c-2 c-3 bond axis butane stable conformation occur methyl group contain c-1 c-4 orient 180° away position minimal steric repulsion atom electron cloud far apart possibly atom happy low energy state overlap atom line sight c-2 c-3 molecule say staggered conformation specifically call anti conformation large group antiperiplanar plane opposite side energetically favorable type staggered conformation type staggered conformation call gauche occur large group 60° gauche unsophisticated awkward methyl group stand close group group eclipse completely line like solar lunar convert anti gauche conformation molecule pass eclipse conformation methyl group 120° apart overlap hydrogen atom adjacent carbon methyl group directly overlap 0° separation molecule say totally eclipse high energy state totally eclipse conformation favorable energetically large group synperiplanar plane different stagger eclipse conformation demonstrate

energetically large group synperiplanar plane different stagger eclipse conformation demonstrate figure 2.3 2.4 compound large butane conformation decide relative position large substituent give carbon carbon bond figure 2.4 stability straight chain conformational isomer degree measurement indicate angle large substituent carbon carbon bond figure 2.5 show plot potential energy vs. degree rotation bond c-2 c-3 butane show relative minimum maximum potential energy molecule conformation remember molecule want low energy state possible high energy time molecule spend energetically unfavorable state figure 2.5 potential energy vs. degree rotation c-2 c-3 bond butane notice anti staggered isomer g low energy totally eclipsed isomer d high conformational interconversion barrier small anti staggered butane totally eclipsed butane easily overcome room temperature low temperature conformational interconversion dramatically slow molecule possess sufficient energy cross energy barrier rotate happen molecule absolute zero cycloalkane fairly stable compound fairly

unstable depend ring strain ring strain arise factor angle strain torsional strain nonbonded strain refer steric strain angle strain result bond angle deviate ideal value stretch compress torsional strain result cyclic molecule assume conformation eclipse gauche interaction nonbonded strain van der waals repulsion result nonadjacent atom group compete space nonbonded strain dominant source steric strain flagpole interaction cyclohexane boat conformation alleviate strain cycloalkane attempt adopt nonplanar conformation cyclobutane pucker slight v shape cyclopentane adopt call envelope conformation cyclohexane undoubtedly must exist mainly conformation call chair boat twist- skew boat form cycloalkane show figure 2.6 figure 2.6 conformation cycloalkanes stable conformation cyclohexane chair conformation minimize type strain hydrogen atom perpendicular plane ring stick call axial parallel stick call equatorial axial equatorial orientation alternate ring wedge c-1 axial group dash c-2 axial wedge c-3 axial cyclohexane undergo chair flip chair form convert process cyclohexane molecule briefly pass fourth conformation call half chair conformation chair flip axial group equatorial equatorial group axial dash remain dash

flip axial group equatorial equatorial group axial dash remain dash wedge remain wedge interconversion slow bulky group attach ring tert- butyl group classic example bulky group must substitute ring bulky group favor equatorial position reduce nonbonded strain flagpole interaction axial group molecule show figure 2.7 figure 2.7 axial equatorial position cyclohexane chair flip axial component equatorial vice versa component point wedge remain component point dash ring substituent prefer chair form determine large group prefer equatorial position ring associate nomenclature group locate ring molecule call cis opposite side ring call trans show figure 2.8 term molecule double bond explain later chapter figure 2.8 nomenclature ring multiple unlike conformational isomer interconvert simple bond rotation configurational isomer change form break reform covalent bond category configurational isomer enantiomer diastereomer enantiomer diastereomer consider optical isomer different spatial arrangement group molecule affect rotation plane polarize light object consider chiral

mirror image superimpose original object imply molecule lack internal plane symmetry
chirality think handedness fact easy visualization chirality think pair hand show figure 2.9
essentially identical left hand able fit right handed glove achiral object mirror image
superimpose example fork identical mirror image figure 2.9 hand example chiral structure
hand nonsuperimposable mirror image chirality = handedness mcat concept test carbon atom
different substituent carbon asymmetrical core optical activity know chiral center mention
early chiral center lack plane symmetry example c-1 carbon atom 1 bromo-1 chloroethane
different substituent show figure 2.10 molecule chiral superimposable figure 2.10 enantiomer
1 bromo-1 chloroethane carbon different substituent think molecule nonsuperimposable
mirror image call enantiomer molecule relate diastereomer molecule chiral share connectivity
mirror image differ multiple chiral center alternatively carbon atom different substituent 1,1
dibromoethane plane symmetry achiral simple 180 ° rotation vertical axis show figure 2.11
allow compound superimpose mirror image figure 2.11 rotation achiral molecule enantiomer
nearly identical physical property chemical

2.11 rotation achiral molecule enantiomer nearly identical physical property chemical property
rotate plane polarized light opposite direction react differently chiral environment enantiomer
nonsuperimposable mirror image connectivity opposite configuration chiral center molecule
enantiomer identical physical chemical property notable exception optical activity reaction
chiral rotation plane polarize light test organic chemistry question polarization light fair game
physics question sure review light polarization discuss chapter 8 mcat physics math review
compound optically active ability rotate plane polarize light ordinary light unpolarized mean
consist wave vibrate possible plane perpendicular direction propagation polarizer allow light
wave oscillate particular direction pass produce plane polarize light show figure 2.12 figure
2.12 polarizer optical activity refer rotation plane polarize light chiral molecule molecular level
enantiomer rotate plane polarize light magnitude opposite direction mirror image assume
concentration path length equal compound rotate plane polarize light right clockwise

dextrorotatory d- label + compound rotate light left counterclockwise levorotatory l- label
direction rotation determine structure molecule determine experimentally relate absolute
configuration molecule rotation depend number molecule light wave encounter depend factor
concentration optically active compound length tube light pass chemist set standard condition
concentration 1 dm 10 cm length compare optical activity different compound rotation
measure different concentration and fi tube length convert standardized specific rotation
system label optical activity use d- + refer clockwise rotation plane polarized light l- refer
counterclockwise rotation plane polarized light confuse d- l- label carbohydrate amino acid
base absolute configuration glyceraldehyde r s refer absolute configuration determine
structure optical activity consistently align system α specific rotation degree α_{obs} observe
rotation degree c concentration l path length dm + enantiomer present equal concentration
form racemic mixture solution rotation cancel optical activity observe enantiomerism
analogous handedness racemic mixture equivalent ambidexterity solution possess
handedness overall rotate plane polarized racemic mixture display optical activity fact
enantiomer identical

plane polarized racemic mixture display optical activity fact enantiomer identical physical
chemical property prompt question racemic mixture separate the mixture constituent
isomer answer lie relationship enantiomer diastereomer react enantiomer single enantiomer
compound definition lead diastereomer imagine example enantiomer contain chiral carbon
compound label + react + enantiomer compound product result + + , + product differ chiral
center necessarily diastereomer diastereomer different physical property explore
momentarily difference enable separate product common laboratory technique crystallization
filtration distillation separate diastereomer react regenerate original enantiomer
diastereomer non mirror image configurational isomer diastereomer occur molecule
stereogenic center differ center term diastereomer encompass stereoisomer enantiomer
molecule n chiral center 2^n possible stereoisomer compound chiral carbon atom maximum

possible stereoisomer show figure 2.13 figure 2.13 2^n possible stereoisomer n = chiral center
stereoisomer chiral center enantiomer = ii iii iv

pair combination image ii mirror image enantiomer similarly iii iv

enantiomer iii stereoisomer mirror image diastereomer notice combination non mirror image
stereoisomer diastereomer iv ii iii ii iv diastereomer different chemical property behave
similarly particular reaction functional group different arrangement space consistently
different physical property diastereomer rotate plane polarized light know specific rotation
diastereomer give indication specific rotation diastereomer stark contrast enantiomer equal
magnitude rotation opposite direction cis trans isomer call geometric isomer specific subtype
diastereomer substituent differ position immovable bond double bond ring structure
cycloalkane rotation bond greatly restrict simple compound substituent immovable bond use
term cis trans substituent immovable bond molecule consider cis opposite side consider trans
show figure 2.8 early complicated compound polysubstituted double bond e)/(z nomenclature
instead describe section mcat date science possible old term concept test day important know
current cis trans isomer old geometric isomer molecule optical activity chiral center lack plane
symmetry plane symmetry exist molecule optically active possess chiral center plane
symmetry occur chiral center chiral center molecule chiral center internal plane symmetry call
meso compound example show figure 2.14 figure 2.14 example meso compound show image
d- l tartaric acid optically active meso tartaric acid plane symmetry optically active mean meso
tartaric acid chiral carbon atom molecule display optical activity meso compound essentially
molecular equivalent racemic mixture meso compound half mirror image optically active mcat
concept check 2.2 assess understanding material 1 difference conformational configurational
2 consider pair following molecule pair enantiomer diastereomer 3 meso compound 4
complete newman projection following compound 2.3 relative absolute configuration chapter
2.3 able cis trans e z molecule appropriate nomenclature apply cahn ingold prelog priority rule

molecule configuration stereoisomer refer spatial arrangement atom group molecule relative configuration chiral molecule configuration relation chiral molecule chemical interconversion use relative configuration determine molecule enantiomer diastereomer molecule hand absolute conformation chiral molecule describe exact spatial arrangement atom group independent

conformation chiral molecule describe exact spatial arrangement atom group independent molecule e z form e z nomenclature compound polysubstituted double bond recall simple double bond contain compound use cis trans system determine e)/(z designation start identify high priority substituent attach double bonded carbon cahn ingold prelog priority rule priority assign base atom bond double bonded carbon high atomic number high priority atomic number equal priority determine atom outward whichever group contain atom high atomic number give priority tie remain atom group compare descend atomic number order tie break alkene name z german zusammen high priority substituent carbon double bond e entgegen opposite opposite side show figure 2.15 figure 2.15 e z designation alkenes z = z ame e = e"pposite r s form r s nomenclature chiral stereogenic center molecule set sequence determine absolute step 1 assign priority cahn ingold prelog priority rule describe early assign priority substituent look atom directly attach chiral center high atomic number take priority low atomic number atomic number equal priority determine combination atom attach atom double bond count individual bond atom tie encounter work outward stereocenter tie break example show figure 2.16 figure 2.16 apply cahn ingold prelog priority rule determine absolute configuration assign priority high atomic number assign priority look atom attach chiral carbon group high atomic number atom high priority system determine priority e z form r s form step 2 classic version arrange space orient molecule dimensional space atom low priority usually hydrogen atom molecule way think arrange point view line sight proceed bond asymmetrical carbon atom chiral center substituent low priority substituent high priority radiate central carbon come page show figure 2.17 figure 2.17 place low priority group step 2

modified version invert difficult visualize rotate dimensional structure simplify process
remember simple rule time group switch chiral carbon stereochemistry invert

remember simple rule time group switch chiral carbon stereochemistry invert logic simply
switch low priority group group molecule substituent project page proceed step 3 keep mind
change molecule opposite configuration use modify step need remember switch final answer
r s s r strategy commonly use fischer diagram describe step 3 draw circle imagine draw circle
connect substituent number 1 2 3 pay attention low priority group skip project directly page
circle draw counterclockwise asymmetric atom call s latin sinister left clockwise call r rectus
right show figure 2.18 remember correct stereochemistry modify version step 2 figure 2.18
draw circle determine absolute configuration counterclockwise = s clockwise = r clockwise
arrangement like turn steering wheel clockwise make car turn right chirality center r
determine absolute configuration chiral center 1 assign priority atomic number 2 arrange
molecule low priority substituent invert stereochemistry switch substituent 3 draw circle
molecule high low priority 1 2 3 4

clockwise = r counterclockwise = s step 4 write r)/(s designation determine write r s
parenthesis separate rest hyphen compound chiral center location specify number precede r s
parenthesis hyphen mcat way represent dimensional molecule fischer projection system
horizontal line indicate bond project plane page wedge vertical line indicate bond go plane
page dash point intersection line represent carbon atom determine configuration fischer
projection follow rule list sure low priority group project page benefit fischer projection low
priority group molecule project page advantage manipulate fischer projection change
compound mention switch substituent chiral carbon invert stereochemistry r s s r rotate
fischer projection plane page 90 ° invert stereochemistry molecule extension interchange pair
substituent revert compound original stereochemistry rotate fischer projection plane page
180 ° retain stereochemistry molecule manipulation show figure 2.19 figure 2.19 manipulation

fischer projections determine r)/(s designation fischer projection compound follow rule describe previously low priority group point point page get couple different trick help determine right stereochemistry determine option prefer fischer projection r)/(s designation stick efficient consistent method use interchangeably option 1 0 switch ahead determine order substituent normal draw circle 1 2 3

remember number 4 count skip right determine order obtain r)/(s designation true designation opposite obtain option 2 1 switch swap low priority group group vertical axis obtain r)/(s designation true designation opposite find option 3 2 switch method start option 2 move low priority group correct position switch group switch molecule designation initial molecule hold substituent place rotate order mcat concept check 2.3 assess understanding material 1 priority assign cahn ingold prelog priority rule 2 following compound e z nomenclature 3 fischer projection manipulation list stereochemistry retain invert switch pair substituent switch pair substituent rotate molecule 90° rotate molecule 180° chapter see different molecule derive molecular formula information go essential mcat question isomerism single organic chemistry question encounter compound come different possible isomer need prepare differentiate find correct answer chapter explore organic molecule hold discussion hybridize orbital resonance review content test knowledge critical thinking skill complete test like passage set online structural isomer share molecular formula different physical chemical property conformational isomer differ rotation single σ bond stagger conformation group 60° apart see newman projection anti staggered molecule large group 180° apart strain minimize gauche stagger molecule large group 60° apart eclipsed conformation group directly see newman projection totally eclipsed conformation large group directly strain maximize strain cyclic molecule come angle strain create stretch compress angle normal size torsional strain eclipse conformation nonbonded strain interaction substituent attach nonadjacent carbon cyclic molecule usually adopt nonplanar shape minimize strain substituent attach cyclohexane classify axial stick plane molecule equatorial

plane molecule axial substituent create nonbonded strain cyclohexane molecule multiple substituent large substituent usually equatorial position minimize configurational isomer interchange break enantiomer nonsuperimposable mirror image opposite stereochemistry chiral carbon chemical physical property rotation plane- polarize light reaction chiral environment optical activity refer ability molecule rotate plane- polarize light d-

optical activity refer ability molecule rotate plane- polarize light d- + molecule rotate light right l- molecule rotate light left racemic mixture equal concentration enantiomer optically active enantiomer rotation cancel meso compound internal plane symmetry optically inactive side molecule cancel diastereomer non mirror image stereoisomer differ chiral center different chemical cis trans isomer subtype diastereomer group differ position immovable bond double bond cycloalkane chiral center different group attach central relative absolute configurations relative configuration give stereochemistry compound comparison molecule absolute configuration give stereochemistry compound have compare molecule absolute configuration use cahn ingold prelog priority rule priority give look atom connect chiral carbon double bonded carbon whichever high atomic number get high priority tie move outward chiral carbon double bonded carbon tie break alkene z high priority substituent double bond e opposite side stereocenter configuration determine put low priority group draw circle group 1 2 3 descend priority circle clockwise stereocenter r

counterclockwise stereocenter s vertical line fischer diagram plane page dash horizontal line come plane page wedge switch pair substituent fischer diagram invert stereochemistry chiral center switch pair retain rotate fischer diagram 90° invert stereochemistry chiral center rotate 180° retain stereochemistry answer concept check 1 structural isomer share molecular formula necessarily 2 cyclopropanol acetone prop-2 ene-1 ol structural isomer chemical formula C_3H_6O . 2 propanol chemical formula C_3H_8O . 3 physical property aspect compound play role change chemical composition example include melting point boiling point solubility odor

color density 4 chemical property aspect compound change chemical composition organic chemistry chemical property usually dictate reactivity functional group 1 conformational isomer stereoisomer molecular connectivity different point rotation single bond configurational isomer stereoisomer differ molecular 2 enantiomer nonsuperimposable mirror image mean molecule mirror image different superimposable mirror image represent object molecule left right nonsuperimposable mirror image enantiomer true right left combination diastereomeric pair differ stereocenter 3 meso compound contain chiral center internal plane symmetry mean molecule overall achiral rotate plane polarized light 1 priority assign atomic number atom connect stereocenter double bond carbon high atomic number get high priority tie work outward stereocenter double bonded carbon tie break 2 high priority functional group alkene long carbon chain contain double bond carbon long root pent suffix ene substituent chlorine methyl number chain double bond low possible number case left right bring give 1 chloro-2,3 dimethyl-1 pentene possible configuration double bond determine e)/(z designation start identify high priority substituent attach double bonded carbon chlorine butyl group high priority substituent opposite side double bond addition opposite end double bond molecule e)-1 chloro- 3 switch pair substituent invert stereochemistry switch pair retain rotate molecule 90° invert stereochemistry rotate 180° retain science mastery assessment racemic mixture 2 butanol consist equimolar amount r)-2

butanol s)-2 butanol r)-2 butanol molecule rotate plane polarize light direction s)-2 butanol rotate angle opposite direction result net rotation polarized light observe maximum number stereoisomer compound equal 2^n n number chiral carbon compound molecule c-1 aldehydic carbon chiral c-5 attach hydrogen atom chiral center 23 = answer choice example meso compound compound contain chiral center internal plane symmetry owe internal plane symmetry molecule achiral optically inactive b enantiomer certainly optical activity d contain chiral carbon internal plane symmetry optically active consider chiral center carbon different substituent stereocenter molecule mark asterisk carbon chiral reason bond hydrogen

participate double bond count bond atom molecule chair conformation equatorial methyl group tran axial methyl hydrogen compete space hydrogen attach ring conformation ensure steric strain stable diaxial methyl group hydrogen close hydrogen ring cause great steric strain c incorrect unstable boat conformation relative configuration retain bond stereocenter break position group chiral carbon maintain absolute configuration retain reactant product r compound nonsuperimposable mirror image analysis bit easy rotate structure ii 180° look like structure iii structure iii clearly opposite stereochemistry chiral center mean enantiomer b incorrect diastereomer stereoisomer mirror image c incorrect meso compound contain plane symmetry molecule d incorrect structural isomer compound molecular formula different atomic connection connectivity molecule mean stereoisomer structural isomer + -glyceraldehyde)-glyceraldehyde r)- s)-2,3- dihydroxypropanal enantiomer enantiomer nonsuperimposable mirror image chiral center c-2 opposite absolute configuration molecule e)-2 butene call trans-2 butene z)-2 butene call cis-2 butene cis trans isomer remember cis trans isomer subtype diastereomer position substituent differ immovable bond diastereomer molecule non mirror image stereoisomer molecule atomic connectivity enantiomer mirror image molecular formula different atomic connectivity 3 methylpentane hexane constitutional isomer molecule stereoisomer nonsuperimposable mirror image diastereomer note molecule differ chiral carbon remember equation specific rotation example $\alpha_{\text{obs}} + 12^\circ$ remember dextrorotatory clockwise rotation consider positive

$\alpha_{\text{obs}} + 12^\circ$ remember dextrorotatory clockwise rotation consider positive path length measure decimeter calculate specific rotation specific rotation calculate racemic mixture like omeprazole contain equimolar amount enantiomer observe optical activity enantiomer cause rotation opposite direction effect cancel esomeprazole contain enantiomer cause rotation plane polarized light draw structure name describe molecule happen meso compound contain plane symmetry compound enantiomer superimposable mirror image nonsuperimposable mirror image compound well term meso-2,3- butane position methyl group 120° apart eclipse

conformation moderate energy high totally eclipse conformation methyl group 0° apart
consult online resource additional equation remember 2.1 specific rotation biochemistry
chapter 1 amino acid peptide protein biochemistry chapter 4 carbohydrate structure function
general chemistry chapter 3 bonding chemical interaction organic chemistry chapter 3 organic
chemistry chapter 4 analyze organic reaction physics math chapter 8 light optic pre med know
feeling content know mcats know important high yield badge book help identify important
topic science mastery assessment tool mcats prep arsenal quiz take online resource guidance
help ensure spend appropriate time chapter base personal strength weakness worry skip
mean study later prep complete length test uncover specific piece content need review come
chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter
limited note follow review quiz question ensure understand solve answer 8–11 question
correctly spend 20–40 minute review quiz question begin question miss read note correspond
subchapter question answer correctly ensure thinking match explanation understand choice
correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss
include quick read corresponding subchapter relevant content subchapter question review
question get correct ensure thinking match explanation review concept summary end chapter
1 principal energy level subshell 2 following compound possess σ d. contain σ bond 3 carbon
atom participate double bond carbon contain orbital a. hybridization s orbital

participate double bond carbon contain orbital a. hybridization s orbital p orbital b.
hybridization s orbital p orbital c. hybridization s orbital p orbital d.

unhybridized s character 4 hybridization carbon nitrogen atom cn a. sp^3 sp^3 respectively b.
 sp^3 sp respectively c. sp sp^3 respectively d. sp sp respectively 5 follow hybridization atom BeH_2
6 atomic orbital combine form i. bond molecular orbital ii. antibond molecular orbital iii
hybridize orbital a. b. iii c. ii d. ii iii 7 molecular orbital contain maximum a. electron b. electron
c. electron d. $2n^2$ electron n principal quantum number combine atomic orbital 8 π bond form

follow orbital a. s orbital b. p orbital c. s- p orbital d. sp² hybridize orbital 9 σ bond π bond present follow a. σ bond π bond b. σ bond π bond c. σ bond π bond d. σ bond π bond 10 ch bond ch₄ point vertex tetrahedron indicate hybridization carbon atom methane 11 single bond strong π bond i. π bond great orbital overlap ii s orbital overlap p orbital iii sp³ hybridization unstable a. b. ii c. iii d. ii iii 12 p character bond form carbon atom hcn 13 resonance structure describe i. hybrid possible structure contribute electron ii potential arrangement electron molecule iii single form molecule take a. b. ii c. ii d. ii iii 14

electron know n = 4 shell l = 2 subshell possible combination quantum number electron 15 compare single bond triple bond c. few σ bond d. rigid chapter 3.1 atomic orbital quantum number 3.2 molecular orbital σ π bond content chapter relevant 3 question organic chemistry mcat chapter cover material follow aamc content 4e atom nuclear decay electronic structure atomic chemical 5b nature molecule intermolecular interaction understanding nomenclature compound relate ready start examine real nature chemical bonding bonding determine atom come form molecule govern way molecule interact molecule organic chemistry study carbon carbon contain compound make carbon special simple answer carbon unique bonding property carbon tetravalent mean form bond atom allow massive versatility require form foundation biomolecule life versatility compound fact carbon locate near center periodic table form bond different element moderate electronegativity addition carbon atom fairly small bond form strong stable remember type chemical bond ionic electron transfer atom result ion hold electrostatic interaction second covalent electron share atom organic chemistry deeply root covalent bonding 3.1 atomic orbital quantum number chapter 3.1 able describe quantum number n l ml m provide range possible value quantum bonding occur outermost electron shell atom understanding bonding contingent understand organization electron atom quantum number discuss detail chapter 1 mcat general chemistry review briefly summarize quantum number n l ml describe size shape number orientation atomic orbital element possess principal quantum number n correspond energy level give electron atom essentially

measure size small number close shell nucleus low energy possible value n range 1 mcat
test n - value 7 recall chapter 1 mcat general chemistry review quantum number describe
location electron atom electron unique combination quantum number accord pauli exclusion
principle electron shell subshell subshell describe azimuthal quantum number l range $0 \leq l \leq n-1$

give energy shell l value 0 1 2 3 correspond s p d f subshell respectively principal quantum
number energy increase azimuthal quantum number increase subshell orbital orbital describe
magnetic quantum number m_l range $-l \leq m_l \leq l$ give subshell type atomic orbital specific shape
describe probability find electron give region space s orbital spherical symmetrical center
nucleus p orbital compose lobe locate symmetrically nucleus contain node area probability
find electron zero nucleus picture p orbital dumbbell position different orientation x- y- z axis
sense p orbital p subshell l value 1 possible value m_l 1 0 -1 shape s- p orbital show figure 3.1 d
orbital compose symmetrical lobe contain node d orbital clover- shaped fifth look like donut
wrap center p- orbital thankfully multiple complex shape d- f orbital rarely encounter organic
chemistry orbital hold electron distinguish spin quantum number m_s value $m_s = \pm \frac{1}{2}$ figure 3.1
atomic orbital mcat concept check 3.1 assess understanding material 1 summarize quantum
number entry complete clarification 1 3.2

molecular orbital chapter 3.2 able describe stability energy bonding antibonding orbital
explain addition double triple bond affect electron density molecular orbital molecule order
different orbital type base strength atomic orbital combine form molecular orbital molecular
orbital obtain mathematically add subtract wave function atomic orbital mathematic combine
wave function outside scope mcat question ask visualization molecular orbital show figure 3.2
sign wave function low energy stable bond orbital produce sign different high energy stable
antibonding orbital produce figure 3.2 molecular orbitals molecular orbital bonding antibonding
depend sign atomic orbital form head head tail to- tail overlap atomic orbital result σ bond
sigma σ bond form head head tail tail overlap atomic orbital bonding far common organic

compound mcat σ π bond molecular orbital form head head tail tail overlap figure 3.2 result bond call sigma σ bond single bond σ bond accommodate electron p orbital line parallel fashion electron cloud overlap bond molecular orbital call pi π bond form demonstrate figure 3.3 π bond exist σ bond double bond σ bond π bond form triple bond unlike single bond allow free rotation atom bond axis double triple bond hinder rotation effect lock atom position figure 3.3 pi π bond electron density exist plane molecule restrict rotation important remember π bond exist independently σ bond formation σ bond p orbital adjacent carbon parallel position form π bond bond form atom short overall bond length double bond short single bond triple bond short double bond short bond hold atom closely strong long bond short bond require energy break double bond strong single bond overall individual π bond weak σ bond possible break bond double bond leave single bond intact happen organic chemistry cis trans isomer interconvert conformation break single bond require far energy double bond consist σ bond π bond triple bond consist

double bond consist σ bond π bond triple bond consist σ bond π bond π bond weak σ bond strength additive make double triple bond strong overall single bond discuss previously double triple bond freely rotate like single bond double bond compound stiff molecule partial double bond character structure resonance restrict free rotation result rigid structure protein exhibit kind limit rotation resonance amide linkage adjacent amino acid mcat concept check 3.2 assess understanding material 1 stable bond orbital antibond orbital high energy 2 difference observe molecule contain double bond compare molecule contain single bond 3 rank following orbital decrease order strength σ bond π bond double bond triple bond chapter 3.3 able recall percentage s character present give hybridization level sp^2 describe relationship electron density resonance identify hybridization atom complex molecule carbon electron configuration $1s^2 2s^2 2p^2$ need electron complete octet $2s^2 2p^6$ typical molecule form carbon methane CH_4 experimentation show σ bond methane equivalent inconsistent know asymmetrical distribution carbon valence electron electron 2s orbital p_x orbital p_y orbital

and the p_z orbital apparent discrepancy account theory orbital hybridization hybrid orbital form mix different type orbital molecular orbital use advanced mathematic merge p- orbital s orbital result show figure 3.4 form identical sp³ orbital new hybridized shape figure 3.4 sp³ hybridize orbitals atom orbital tetrahedral geometry unhybridized p orbital form π bond orbital point vertex tetrahedron minimize repulsion explain carbon prefer tetrahedral geometry hybridization accomplish promote 2 electron 2p_z orbital show figure 3.5 produce valence orbital electron mathematically mix model hybrid orbital figure 3.5 hybridization carbon orbital hybridization way make bond central atom equivalent sp³ orbital reason tetrahedral shape hallmark carbon contain mcAT test s character certain hybrid orbital answer question simply need determine type hybridization exist use solve problem example sp³ orbital s- p orbital bond 25 s character 75 p character carbon

p orbital bond 25 s character 75 p character carbon bond sp³ hybridization possibility s orbital mix p orbital sp² hybridize orbital form show figure 3.6 orbital 33 s character 67 p character figure 3.6 sp² hybridize orbitals molecule orbital trigonal planar geometry unhybridized p orbital form π bond hybridization see alkene p orbital carbon leave unhybridized orbital participate π bond sp² orbital orient 120 ° apart allow maximum separation know unhybridized p orbital involve π component double bond hybrid orbital ethene sp² hybridize orbital participate ch bond hybrid orbital line π bond form σ component c = c double bond form triple bond need p orbital form π bond p orbital combine s orbital form sp orbital show figure 3.7 orbital 50 s character 50 p character orbital orient 180 ° apart explain linear structure molecule contain sp hybridize carbon π bond carbon atom form triple bond like ethyne carbon different atom form double bond row like carbon dioxide case molecule linear sp hybridize carbon figure 3.7 sp hybridized orbital molecule orbital linear geometry unhybridized p- orbital form π bond resonance delocalization electron occur molecule conjugate bond conjugation require alternate single multiple bond pattern align number unhybridized p orbital backbone molecule π electron delocalize p orbital system add stability

molecule resonance structure draw transient form molecule take show figure figure 3.8
resonance form carbonate form equal stability contribute equally true electron density
molecule form sort equilibrium electron density distribute make true form hybrid resonance
structure show ozone figure 3.9 figure 3.9 structure ozone true electron density ozone
resonance form create 1.5 bond oxygen leave oxygen charge stability resonance form differ
true electron density favor stable form particular resonance structure favor lack formal charge
form octet highly electronegative atom like oxygen nitrogen stabilization positive negative
charge induction aromaticity favor certain

oxygen nitrogen stabilization positive negative charge induction aromaticity favor certain
mcats concept check 3.3 assess understanding material 1 s character sp - sp^2 - sp^3 hybridize
orbital 2 resonance structure true electron density compound relate resonance structure
ability carbon form single double triple bond form σ multiple π bond form hybrid orbital give
rise entire branch chemistry life earth think chapter bit brief specific bonding fall domain
general chemistry solid grasp orbital bonding difficult explain organic reaction test mcats focus
seven chapter avoid compartmentalize information learn course study bonding play role
general chemistry organic chemistry biochemistry test chemical physical foundations
biological systems section biological biochemical foundations living systems section subject
science blend seemingly complicated beautifully simple picture universe soon integrate
knowledge accumulate manageable rewarding studying review content test knowledge critical
thinking skill complete test like passage set online atomic orbitals

quantum quantum number describe size shape orientation number atomic orbital element
possess principal quantum number n describe energy level shell electron reside indicate
distance nucleus electron possible value range 1 . azimuthal quantum number l determine
subshell electron reside possible value range 0 $n - 1$ theft subshell indicate letter $l = 0$
correspond s 1 p 2 d 3 f. magnetic quantum number m_l determine orbital electron reside

possible value range $l + 1$ to l . different orbital different shape s orbital spherical p orbital dumbbell shaped locate x- y- z axis spin quantum number m describe spin electron possible value $\pm \frac{1}{2}$ bond orbital create head head tail tail overlap atomic orbital sign energetically favorable antibonding orbital create head head tail tail overlap atomic orbital opposite sign single bond sigma σ bond contain electron double bond contain σ bond pi π bond π bond create sharing electron unhybridized p orbital align triple bond contain σ bond π bond multiple bond flexible single bond rotation permit presence π bond multiple bond short strong single bond individual π bond weak σ bond sp^3 hybridize orbital 25 s character 75 p character form tetrahedral geometry 109.5° bond angle carbon single bond sp^3 hybridize sp^2 hybridize orbital 33 s character 67 p character form trigonal planar geometry

120° bond angle carbon double bond sp^2 hybridize sp hybridize orbital 50 s character 50 p character form linear geometry 180° bond angle carbon triple bond double bond sp hybridize resonance describe delocalization electron molecule conjugate bond conjugation occur single multiple bond alternate create system unhybridized p orbital backbone molecule π electron delocalize resonance increase stability molecule resonance form contribute true electron density molecule stable resonance form contribute resonance form favor lack formal charge form octet electronegative atom stabilize charge induction aromaticity answer concept check 1 0 to $n - 1$ $l + 1$ to l 1 bonding orbital stable antibonding orbital antibonding orbital high energy bonding orbital 2 difference bond length short double bond single bond energy high double bond single molecular rigidity high double bond single 3 triple bond $>$ double bond $>$ σ bond $>$ π bond remember individual π bond weak σ bond bond strength additive double bond strong single triple bond strong 1 sp orbital 50 s character 50 p character sp^2 orbital 33 s character 67 p character sp^3 orbital 25 s character 75 p character 2 resonance structure differ placement electron hybridize p orbital require bond conjugation delocalize electron molecule true electron density weight average resonance structure give compound favor stable structure science mastery assessment energy subshell principle quantum number follow $s < p < d < f$

single bond σ bond double triple bond contain σ bond π bond respectively compound CH_4 C_2H_2 C_2H_4 contain single bond contain σ bond carbon double bond sp^2 hybridization occur s orbital hybridize p orbital form sp^2 - hybridize orbital p orbital carbon atom remain unhybridized take formation π bond double bond unhybridized p orbital unhybridized s orbital eliminate d carbon nitrogen atom connect triple bond CN CN : triple bonded atom sp hybridize s orbital hybridize p orbital

triple bonded atom sp hybridize s orbital hybridize p orbital form sp hybridize orbital remain unhybridized p orbital formation π bond beryllium electron valence shell bond hydrogen require hybridize orbital mean hybridization sp note presence single bond mean hybridization sp^3 useful assumption carbon apply beryllium small number valence electron unhybridized p orbital beryllium BeH_2 take linear geometry characteristic sp hybridized orbital atomic orbital combine form molecular orbital atomic orbital sign add head head tail- tail form bond molecular orbital atomic orbital opposite sign add head head tail tail form antibond molecular orbital atomic orbital hybridize form sp^3 sp^2 sp orbital like atomic orbital molecular orbital contain maximum electron opposite spin $2n^2$ rule d refer total number electron exist give energy shell π bond form parallel overlap unhybridized p orbital electron density concentrate bonding axis σ bond hand form head head overlap s orbital hybridize orbital σ bond density electron concentrate nucleus single bond σ bond double bond σ π bond question single bond σ bond double bond σ bond π bond give total σ bond π bond correct answer bond point vertex tetrahedron mean angle bond 109.5° characteristic sp^3 orbital carbon atom CH_4 sp^3 hybridize bond strength determine degree orbital overlap great overlap great bond strength π bond weak single bond significantly overlap unhybridized p orbital π bond parallel orientation s orbital hybrid orbital σ bond sp^3 hybridize orbital stable evidence number carbon atom hybridization form stable compound carbon bond hydrogen cyanide HCN triple bond triple bond require unhybridized p orbital carbon sp hybridize sp hybridize orbital 50 s character 50 p character resonance structure describe arrangement electron

molecule different resonance structure derive move electron unhybridized p orbital molecule contain conjugate bond molecule contain multiple resonance structure usually stable resonance structure necessarily common form molecule take eliminate statement iii

resonance structure necessarily common form molecule take eliminate statement iii
statement reverse terminology resonance structure electron density molecule weight average possible resonance structure way electron $n = 4$ shell $l = 2$ subshell different value m_l 2 1 0 1
2 orbital electron positive negative spin $5 \times 2 = 10$ possible combination quantum number electron π bond permit free rotation unlike σ bond make triple bond rigid single bond triple bond strong short bond single bond eliminate b single triple bond contain σ bond eliminate c consult online resource additional biochemistry chapter 1 amino acid peptide protein general chemistry chapter 1 general chemistry chapter 3 bonding chemical interaction general chemistry chapter 4 compound stoichiometry organic chemistry chapter 2 organic chemistry chapter 11 analyze organic reaction pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question get correct ensure thinking match explanation review concept summary end chapter 1 following lewis basis a. b. ii c. ii iii d. ii iii

2 rank follow order decrease nucleophilicity aprotic solvent RO^- RCOOH ROH HO^- a. $\text{RCOOH} > \text{ROH} > \text{RO}^- > \text{HO}^-$ b. $\text{HO}^- > \text{ROH} > \text{RO}^- > \text{RCOOH}$ c. $\text{RO}^- > \text{HO}^- > \text{ROH} > \text{RCOOH}$ d. $\text{RCOOH} > \text{RO}^- > \text{HO}^- > \text{ROH}$ 3 rank follow order decrease electrophilicity CH_3OH CH_3OCH_3 CH_3Cl CH_3I a. $\text{CH}_3\text{I} > \text{CH}_3\text{OH} > \text{CH}_3\text{Cl} > \text{CH}_3\text{OCH}_3$ b. $\text{CH}_3\text{OCH}_3 > \text{CH}_3\text{Cl} > \text{CH}_3\text{I} > \text{CH}_3\text{OH}$ c. $\text{CH}_3\text{OCH}_3 > \text{CH}_3\text{Cl} > \text{CH}_3\text{I} > \text{CH}_3\text{OH}$ d. $\text{CH}_3\text{OH} > \text{CH}_3\text{OCH}_3 > \text{CH}_3\text{Cl} > \text{CH}_3\text{I}$ 4 rank follow order decrease leaving group ability H_2O HO^- Br^- H^- a. $\text{H}_2\text{O} > \text{Br}^- > \text{HO}^- > \text{H}^-$ b. $\text{H}_2\text{O} > \text{HO}^- > \text{Br}^- > \text{H}^-$ c. $\text{HO}^- > \text{Br}^- > \text{H}_2\text{O} > \text{H}^-$ d. $\text{HO}^- > \text{H}^- > \text{H}_2\text{O} > \text{Br}^-$ 5 rank follow order decrease oxidation state amine carboxylic acid aldehyde alkane a. aldehyde amine alkane carboxylic acid b. carboxylic acid aldehyde amine alkane c. carboxylic acid amine aldehyde alkane d. alkane amine aldehyde carboxylic acid 6 step grignard reaction acidification alkoxide ion protonate form final alcohol product reaction alkoxide ion act a. lewis base b. brønsted lowry base lewis base c. brønsted lowry base lewis acid d. brønsted lowry base 7 2 butanol treat dichromate reaction a. reduction result formation butene b. oxidation result formation butanoic acid c. oxidation result formation butanone d. reaction occur 8 1 hexanol treat pyridinium chlorochromate end product d. hexanoic acid 9 $\text{S}_\text{N}1$ reaction order kinetic a. rate limit step step occur reaction b. rate limit step involve molecule c. rate limit step d. reaction involve molecule 10 protic solvent following halogen 11 compound undergo oxidation pcc 12 following substrate rapidly undergo $\text{S}_\text{N}2$ reaction pair appropriate nucleophile 13 following solvent useful 14 aldehyde generally reactive equivalent ketone nucleophile likely difference a. steric hindrance b. leaving group ability c. resonance stabilization d. electron withdrawing character 15 conversion carboxylic acid derivative possible nucleophilic reaction a.

carboxylic acid ester b. ester carboxylic acid c. anhydride amide d. ester anhydride analyze organic reaction chapter 4.1 acid base acid base strength common functional group 4.2 nucleophile electrophile leaving group nucleophilic substitution reaction 4.3 oxidation reduction reaction oxidize agent reaction reduce agent reaction 4.5 step problem solve content chapter relevant 5 question organic chemistry mcats chapter cover material following aamc content 1a

structure function protein constituent amino 4e atom nuclear decay electronic structure
atomic chemical 5a unique nature water solution 5d structure function reactivity biologically
relevant sit solve mcat organic chemistry problem overwhelming particularly reactant reagent
new reaction page like stage magic fun watch control force outside knowledge good news
organic chemistry magic govern set rule understand happen simple chapter aspect determine
complex reaction proceed brief look functional group reactivity arm knowledge lie simple
sequential step use determine reaction place chapter 5 10 mcat organic chemistry review
focus application principle different functional group look pattern reaction continue prepare
test day tool hand mcat know trick chapter vital understand reaction chapter book chapter
5-10 material directly test mcat topic organic chemistry sure know 4.1 acid basis chapter 4.1
able recall importance amphoteric specie common amphoteric describe meaning pka pkb
value relation acid base recall common functional group act acid basis acid base reaction
proceed product form conjugate base acid conjugate acid base weak original reactant
acidbase reaction acid base react result formation conjugate base acid conjugate acid base
reaction proceed long reactant reactive strong product form discuss acid base definition
strength follow section mcat concern broad lewis brønstedlowry definition acid basis lewis
definition concern transfer electron formation coordinate covalent bond brønstedlowry
definition focus proton transfer lewis acid define electron acceptor formation covalent bond
lewis acid tend electrophile touch section lewis acid vacant p orbital accept electron pair
positively polarize atom

acid vacant p orbital accept electron pair positively polarize atom acid basis critically important
material organic chemistry biochemistry general chemistry extensive coverage acid basis
chapter 10 mcat general chemistry lewis base define electron donor formation covalent bond
lewis basis tend nucleophile touch section lewis basis lone pair electron donate anion carry
negative charge lewis acid basis interact form coordinate covalent bond covalent bond
electron bond come start atom lewis base show figure 4.1 figure 4.1 lewis acid base reaction

brønsted lowry definition acid species donate proton H^+ base species accept proton molecule like water ability act brønstedlowry acid basis make amphoteric water act acid donate proton base conjugate base OH^- .

water act base accept proton acid conjugate acid H_3O^+ degree molecule act acid base dependent property solution water act base acidic solution acid basic solution example amphoteric molecule include $\text{Al}(\text{OH})_3$ acid base strength acid dissociation constant K_a measure strength acid solution dissociation acid $\text{HA} \rightleftharpoons \text{H}^+ + \text{A}^-$ equilibrium constant give $\text{p}K_a$ calculate acidic molecule small negative $\text{p}K_a$ basic molecule large $\text{p}K_a$ acid $\text{p}K_a < 2$ consider strong acid dissociate completely aqueous solution weak organic acid $\text{p}K_a$ value 2-20 $\text{p}K_a$ value common functional group show table 4.1 table 4.1 $\text{p}K_a$ value common functional group generally bond strength decrease periodic table acidity increase electronegative atom high acidity trend oppose low bond strength take common functional group mcat α hydrogen carbonyl compound deserve special note α hydrogen connect α carbon carbon adjacent carbonyl enol form carbonyl contain carbanion stabilize resonance acidic hydrogen easily lose great depth enolate chemistry chapter 7-9 mcat organic chemistry common functional groups apply acid base rule directly functional group appear mcat functional group act acid include alcohol aldehyde ketone α carbon carboxylic acid carboxylic acid derivative compound easy target basic nucleophilic reactant readily accept amine amide main functional group act basis eye compound formation peptide bond nitrogen atom amine form coordinate covalent bond donate lone pair lewis acid mcat concept check 4.1 assess understanding material 1 acidbase reaction proceed base strength reactant product 2 mean molecule amphoteric biologically relevant molecule characteristically amphoteric 3 $\text{p}K_a$ define low $\text{p}K_a$ indicate 4 functional group classically act acid basis 4.2 nucleophile electrophile leave chapter 4.2 able distinguish nucleophile electrophile lewis acid basis compare nucleophilicity main trend describe relationship electrophile leaving group identify trait increase electrophilicity recall trait good leaving group nucleophile tend lone pair π bond form covalent bond electrophile test day look

carbon hydrogen oxygen nitrogen lone pair minus sign lone

day look carbon hydrogen oxygen nitrogen lone pair identify nucleophile
reaction organic chemistry divide group oxidation/reduction reaction
nucleophile/electrophile reaction nucleophile electrophile leaving group particularly important
reaction alcohol carbonyl containing compound look depth later chapter let look term define
nucleophile define nucleophile lone pair π bond form new bond electrophile note
nucleophilicity basicity appear similar definition true good nucleophile tend good basis
distinction nucleophile strength base relative rate reaction common electrophile kinetic
property base strength relate equilibrium position reaction thermodynamic property common
example nucleophile show figure 4.2 figure 4.2 example nucleophile long nucleophilic atom
basic nucleophile reactive hold compare atom row periodic table proceed column periodic
table nucleophilicity determine major factor charge nucleophilicity increase increase electron
density negative charge electronegativity nucleophilicity decrease electronegativity increase
atom likely share electron density steric hindrance bulky molecule nucleophilic solvent protic
solvent hinder nucleophilicity protonate nucleophile hydrogen bonding solvent consideration
worth spend bit time polar protic solvent nucleophilicity increase periodic table polar aprotic
solvent nucleophilicity increase periodic table example type solvent show figure 4.3 figure 4.3
example polar protic polar aprotic solvent give test day assume reaction occur polar solvent
polar solvent protic aprotic dissolve nucleophile assist reaction electron move organic
chemistry move electron common reaction perform nonpolar halogen good example effect
solvent nucleophilicity protic solvent nucleophilicity decrease order $I > Br > Cl > F$ proton solution
attract nucleophile F^- conjugate base HF weak acid form bond proton solution able access
electrophile react with conjugate base HI strong acid affect proton solution react electrophile
aprotic solvent with nucleophilicity decrease order

$F > Cl > Br > I$ proton way attack nucleophile aprotic solvent nucleophilicity relate directly basicity

use nonpolar solvent nucleophile electrophile reaction reactant polar dissolve will use nonpolar solvent type reaction need nucleophile dissolve charge molecule polar nature polar solvent require dissolve nucleophile like dissolve like example strong nucleophile include HO^- CN^- NH_3 fair nucleophile H_2O ROH RCOOH weak weak nucleophile far functional group amine group tend good nucleophile electrophile define electron love specie positive charge positively polarize atom accept electron pair form new bond nucleophile definition bring mind lewis acid distinction nucleophile basis electrophilicity kinetic property acidity thermodynamic property practically electrophile act lewis acid reaction great degree positive charge increase electrophilicity carbocation electrophilic carbonyl carbon comparison electrophile draw figure 4.4

additionally nature leave group influence electrophilicity specie orbital well leave group likely reaction happen orbital present incoming nucleophile bond electrophile displace leave group figure 4.4 comparison electrophilicityff electrophilicity acidity effectively identical property come reactivity alcohol aldehyde ketone carboxylic acid derivative act acid act electrophile good target nucleophilic attack carboxylic acid derivative rank electrophilicity anhydride reactive follow carboxylic acid ester amide practical term mean derivative high reactivity form derivative low reactivity vice versa similar acidbase reaction describe previously leave group molecular fragment retain electron heterolysis heterolytic reaction essentially opposite coordinate covalent bond formation bond break electron give product good leave group able stabilize extra electron weak basis stable extra set electron good leave group logic conjugate basis strong acid like Br^- Cl^- tend good leave group leave group ability augment resonance inductive effect electron withdraw group help delocalize stabilize alkane hydrogen ion serve leave group form reactive strongly basic anion think leave group nucleophile serve opposite function substitution reaction weak base leave group replace strong base nucleophile nucleophilic substitution reactions nucleophilic substitution reaction perfect example demonstrate nucleophileelectrophile reaction $\text{S}_\text{N}1$ $\text{S}_\text{N}2$ reaction nucleophile form bond

substrate carbon leave group like acid base reaction nucleophilic attack occur reactant reactive product nucleophile reactive leave group unimolecular nucleophilic substitution $\text{S}_{\text{N}}1$ reaction contain step step rate limiting step leave group leave generate positively charge carbocation nucleophile attack carbocation result substitution product mechanism show figure 4.5 figure 4.5 mechanism $\text{S}_{\text{N}}1$ reaction step 1 formation carbocation rate limiting step 2 nucleophilic substituted carbocation stable alkyl group act electron donor stabilize positive charge formation carbocation rate limit step rate reaction depend concentration substrate rate = $k[\text{R-L}]$ R-L alkyl group contain leave group order reaction accelerate formation carbocation increase rate $\text{S}_{\text{N}}1$ reaction $\text{S}_{\text{N}}1$ reaction pass planar intermediate nucleophile attack product usually racemic mixture incoming nucleophile attack carbocation result varied stereochemistry

usually racemic mixture incoming nucleophile attack carbocation result varied stereochemistry bimolecular nucleophilic substitution $\text{S}_{\text{N}}2$ reaction contain step nucleophile attack compound time leave group leave reaction step concerted reaction reaction call bimolecular single rate limit step involve molecule $\text{S}_{\text{N}}2$ reaction nucleophile actively displace leave group backside attack occur nucleophile strong substrate sterically hinder substitute carbon reactive $\text{S}_{\text{N}}2$ reaction note opposite trend $\text{S}_{\text{N}}1$ reaction step mechanism show figure figure 4.6 mechanism $\text{S}_{\text{N}}2$ reaction single step $\text{S}_{\text{N}}2$ reaction involve react specie substrate alkyl halide tosylate mesylate nucleophile th concentration role determine rate rate = $k[\text{Nu:}][\text{R-L}]$ $\text{S}_{\text{N}}2$ reaction accompany inversion relative configuration like umbrella turn inside blustery day position substituent substrate carbon invert nucleophile leave group priority respective molecule inversion correspond change absolute configuration R S vice versa example stereospecific reaction configuration reactant determine configuration product reaction mechanism mcat concept check 4.2 assess understanding material 1 definition nucleophile electrophile differ lewis base acid 2 rank following molecule order increase nucleophilicity methoxide t butoxide isopropanolate ethoxide 3 nucleophile leaving group relate order

substitution reaction proceed 4 trend increase electrophilicity 5 feature good leave group 4.3
oxidation reduction reaction chapter 4.3 able recall common oxidize agent characteristic good
recall common reduce agent characteristic good order give list molecule oxidize oxidize
important class reaction oxidation reduction redox reaction oxidation state reactant change
oxidation state indicator hypothetical charge atom bond completely ionic oxidation state
calculate molecular formula molecule example carbon methane CH_4 oxidation state 4
hydrogen oxidation state +1 reduced form carbon carbon dioxide CO_2 oxygen atom oxidation
state 2 carbon oxidation state +4 oxidized form carbon ion oxidation state simply charge Na^+
 S^{2-} oxidation state +1 2 respectively carboxylic acid oxidized aldehyde ketone imine turn
oxidized alcohol alkyl halide amine organize different functional group level level 0 bond
heteroatom alkane level 1 alcohol alkyl halide amine level

bond heteroatom alkane level 1 alcohol alkyl halide amine level 2 aldehyde ketone imine level
3 carboxylic acid anhydride ester amide level 4 bond heteroatom carbon dioxide will need
know assign oxidation state organic chemistry know definition oxidation reduction oxidation
refer increase oxidation state mean loss electron organic chemistry easy view oxidation
increase number bond oxygen heteroatom atom carbon hydrogen reduction refer decrease
oxidation state gain electron organic chemistry easy view reduction increase number bond
hydrogen oxidize agent reactions mention oxidation refer increase oxidation state oxidation
carbon atom occur bond carbon atom atom electronegative carbon replace bond atom
electronegative carbon practice usually mean decrease number bond hydrogen increase
number bond carbon nitrogen oxygen halide then oxidize agent element compound
oxidation-reduction reaction accept electron species oxidize agent gain electron say reduce
good oxidize agent high affinity electron O_2 O_3 Cl_2 unusually high oxidation state like Mn^{7+} +
permanganate Cr^{6+} + chromate primary alcohol oxidize level aldehyde oxidize form carboxylic
acid reaction commonly proceed way carboxylic acid strong oxidize agent chromium trioxide
 CrO_3 sodium potassium dichromate $\text{Na}_2\text{Cr}_2\text{O}_7$ $\text{K}_2\text{Cr}_2\text{O}_7$ stop aldehyde level specific reagent

pyridinium chlorochromate pcc secondary alcohol oxidize ketone number oxidation reaction relevant oxidize agent show figure 4.7 note goal point memorization reaction recognition theme oxidation reaction tend feature increase number bond oxygen oxidize agent contain metal bond large number oxygen figure 4.7 oxidation reaction common oxidizing reducing agent reaction conversely reduction refer decrease oxidation state reduction carbon occur bond carbon atom atom electronegative carbon replace bond atom electronegative carbon practice usually mean increase number bond hydrogen decrease number bond carbon nitrogen oxygen halide good reduce agent include sodium magnesium aluminum zinc low electronegativity ionization energy metal hydride NaH CaH_2 LiAlH_4 NaBH_4 good reduce agent contain H^- ion note common oxidize reduce agent include transition metal transition metal different oxidation state

reduce agent include transition metal transition metal different oxidation state low ionization energy presence d orbital allow accept electron easily transition metal periodic trend discuss chapter 2 mcat general chemistry review aldehyde ketone reduce primary secondary alcohol respectively reaction exergonic exceedingly slow catalyst amide reduce amine LiAlH_4 reduce agent reduce carboxylic acid primary alcohol ester pair alcohol example reduction reaction show figure 4.8 focus memorization recognize reduction reaction tend feature increase number bond hydrogen reduce agent contain metal bond large number figure 4.8 reduction reaction common reduce mcat concept check 4.3 assess understanding material 1 characteristic good oxidize agent list example common oxidize agent 2 characteristic good reduce agent list example common reduce agent 3 list following carbon contain compound oxidize carbon reduce methane carbon dioxide ketone alcohol chapter 4.4 able describe type compound likely undergo $\text{S}_\text{N}1$ $\text{S}_\text{N}2$ reaction identify reactive center carbonyl contain compound key skill recognize reaction occur recognize reactive region molecule preferential reaction functional group presence functional group term site reactive site molecule depend type chemistry occur redox reagent describe early tend act high priority functional group

molecule alcohol carboxylic acid reduce agent likely act carboxylic acid alcohol reaction involve nucleophile electrophile reaction tend occur high priority functional group contain oxidize carbon oxidized functional group reactive nucleophile electrophile oxidation reduction reaction nucleophile look good electrophile oxidized carbon electronegative group large partial positive charge experience carboxylic acid derivative target nucleophile follow aldehyde ketone follow alcohol amine aldehyde generally reactive nucleophile ketone steric hindrance common reactive site mcat carbon carbonyl find carboxylic acid derivative aldehyde ketone carbonyl contain compound carbon carbonyl acquire positive polarity electronegativity oxygen carbonyl carbon electrophilic target nucleophile α hydrogen acidic regular ch bond resonance stabilization enol form deprotonate easily strong base form enolate show figure 4.9 enolate strong nucleophile alkylation result good electrophile available figure

4.9 enolate strong nucleophile alkylation result good electrophile available figure 4.9 enol enolate form ketone second reactive site consideration substrate carbon substitution reaction $\text{S}_{\text{N}}1$ reaction overcome barrier carbocation stability prefer tertiary secondary carbon reactive site secondary primary $\text{S}_{\text{N}}2$ reaction big barrier steric hindrance methyl primary carbon prefer secondary than tertiary carbon will react mechanism reaction steric hindrance describe prevention reaction particular location molecule size substituent group example $\text{S}_{\text{N}}2$ reaction will occur tertiary substrate characteristic steric protection useful tool synthesis desire molecule prevention formation alternative product effectively bulky group impossible nucleophile reach reactive electrophile make nucleophile likely attack region way steric come play protection leave group temporarily mask reactive leave group sterically bulky group synthesis example reduction molecule contain carboxylic acid aldehyde ketone result reduction functional group prevent aldehyde ketone convert nonreactive acetal ketal serve protect group reaction proceed reaction show figure 4.10 protective reaction reversible reduction alcohol tert butyl ether figure 4.10 protection ketone conversion worry overwhelming preview later chapter set rule easy understand chemical reaction proceed feel

free come chapter later remind rule apply board read chapter aldehyde mix diol equivalent alcohol form acetal ketone mix diol equivalent alcohol form ketal acetal ketal chemistry discuss chapter 6 mcat organic chemistry mcat concept check 4.4 assess understanding material 1 reactive center carbonyl contain compound 2 pair reactant undergo S_N1 quickly 3 following electrophile favorable S_N2 4.5 step problem solving chapter 4.5 able list step solve organic chemistry reaction predict reaction proceed give study organic chemistry mcat permit simply not reaction mechanism involved step mechanism ask trend problem solve step chapter play rule hand apply knowledge systematic way simplify organic chemistry reaction appear mcat step describe step 1 know nomenclature start understand reaction occur product form vital know compound iupac common name refer have trouble nomenclature sure review chapter 1 mcat

name refer have trouble nomenclature sure review chapter 1 mcat organic chemistry review step 2 identify functional group look organic molecule reaction functional group molecule functional group act acid basis oxidized carbon functional group act goodthfi nucleophile electrophile leave group step help define category reaction occur give functional group step 3 identify reagent step determine property reagent reaction acidic basic suggestive particular reaction good nucleophile specific solvent good oxidize step 4 identify reactive functional identify functional group compound reagent present step relatively quick remember oxidize carbon tend reactive nucleophileelectrophile reaction oxidationreduction reaction note presence protect group exist prevent particular functional group step 5 identify step reaction reaction involve acid base step usually protonation deprotonation reaction involve nucleophile step generally nucleophile attack electrophile form bond reaction involve oxidize reduce agent oxidize functional group oxidize reduce accordingly know react think reaction protonation deprotonation functional group increase reactivity nucleophile attack carbon respond avoid have bond leave group leave double bond reduce single bond like opening carbonyl step 6 consider reaction stereospecific stereoselective possibility consider predict product

stereospecificity consider configuration reactant necessarily lead specific configuration product see S_N2 reaction stereoselectivity hand occur reaction configuration product readily form product characteristic stereoselectivity see reaction different product possess different trait affect relative stability product major product generally determine difference strain stability molecule strained molecule significant angle torsional nonbonded strain likely form molecule significant source strain product conjugation alternate single multiple bond significantly stable apply rule novel reaction focus decision- make element process able apply logic reaction appear test day start series reaction involve ethyl 5 oxohexanoate react 1,2 ethanediol p toluenesulfonic acid benzene second lithium aluminum hydride tetrahydrofuran follow heat acidic workup intermediate final product let step 1 let draw reactant reaction condition 2 molecule alkane backbone ketone ester carbonyl carbon electrophilic target nucleophile carbonyl oxygen reduce

ketone ester carbonyl carbon electrophilic target nucleophile carbonyl oxygen reduce acidic α hydrogen 3 reaction diol commonly protect group aldehyde ketone diol nucleophile lone pair oxygen hydroxyl group second reaction reduce agent organic solvent finally acidic workup remove protect group start hint happen 4 reaction ketone ester carbonyl highly reactive functional group react 5 diol good nucleophile contain

lone pair oxygen atom hydroxyl group presence diol hint protect ketone carbonyl diol commonly function give intermediate ketone carbonyl replace protect diether second reaction able proceed ester $LiAlH_4$ strong reduce agent reaction reduction carbonyl way alcohol final reaction protect group remove acidic workup leave original ketone 6 product intermediate stereoselectivity will consideration let come intermediate protective diether ketone carbonyl second reduction ester alcohol protect group present final product ethanol react acidic solution potassium dichromate end product let step 1 let draw molecule 2 molecule alkane backbone primary alcohol alcohol good nucleophile oxidize hydroxyl group act leave group

especially get 3 reagent dichromate good oxidize agent 4 alcohol carbon likely react 5 primary product primary alcohol strong oxidant like dichromate carboxylic acid possible product aldehyde trip remember primary alcohol oxidize aldehyde reagent specifically designate purpose like pyridinium chlorochromate pcc start ethanol obtain ethanoic acid acetic acid reaction dichromate 6 stereospecificity consideration will change outcome reaction primary product reaction ethanoic acid determine product reaction 2 amino-3 hydroxypropanoic acid 2,6 diaminohexanoic acid aqueous solution let step time 1 let draw molecule 2 molecule carboxylic acid acidic hydrogen electrophilic carbonyl carbon amino group then nucleophilic molecule hydroxyl group second additional amino group long alkane chain 3 additional reagent list property reactant determine reaction 4 molecule act nucleophile reaction electrophile reactive specie likely nucleophilic amino group attack electrophilic carbonyl carbon 5 step reaction nucleophilic attack amino group electrophilic carbonyl carbon carbon bond carbonyl group open hydroxyl group carboxylic acid poor leaving group proton rearrangement molecule turn hydroxyl group water improve leaving group ability carbonyl reform kick water molecule leaving group 6 ask hydroxyl group 2 amino-3- hydroxypropanoic acid react remember oxidize group tend reactive carboxylic acid significantly oxidized hydroxyl group question consider amino group 2,6- diaminohexanoic acid react question well answer retrospectively case amino group close

acid react question well answer retrospectively case amino group close carbonyl react result product stabilize reaction look familiar 2 amino-3 hydroxypropanoic acid 2,6 diaminohexanoic acid serine lysine respectively reaction form peptide bond treat generic amino acid reaction work problem handle use method read chapter learn specific mechanism touch sure come rule apply novel reaction mcat concept check 4.5 assess understanding material 1 step solve organic chemistry reaction 2 reaction condition list determine reaction proceed chapter outline framework think organic chemistry question mcat discuss type reaction property likely occur selective rule help work reaction unfamiliar finally framework test example problem

order cement application framework mind tackle revisit rule method continue work different functional group reaction chapter review content test knowledge critical thinking skill complete test like passage set online acids bases lewis acid electron acceptor vacant orbital positively polarize atom lewis basis electron donor lone pair electron anion brønsted lowry acid proton donor brønsted lowry basis proton acceptor amphoteric molecule act acid basis depend reaction condition water common example amphoteric acid dissociation constant K_a measure acidity equilibrium constant correspond dissociation acid H_a proton H^+ conjugate base pK_a negative logarithm K_a low negative pK_a indicate strong acid pK_a decrease periodic table electronegativity alcohol aldehyde ketone carboxylic acid carboxylic acid derivative common acidic functional group α hydrogen hydrogen connect α carbon carbon adjacent carbonyl acidic amine amide common basic functional group nucleophile electrophile leaving groups nucleophile nucleus lone pair π bond increase electron density carry negative nucleophilicity similar basicity nucleophilicity kinetic property basicity thermodynamic charge electronegativity steric hindrance solvent amino group common organic nucleophile electrophile electron lone pair contain positive charge positively polarize positive compound electrophilic alcohol aldehyde ketone carboxylic acid derivative act electrophile leave group molecular fragment retain electron good leave group stabilize additional charge resonance induction weak basis conjugate basis

group stabilize additional charge resonance induction weak basis conjugate basis strong acid good alkanes hydrogen ion leave group form reactive anion unimolecular nucleophilic substitution S_N1 reaction proceed step leave group leave form carbocation ion positively charge carbon atom second step nucleophile attack planar carbocation lead racemic mixture product S_N1 reaction prefer substitute carbon alkyl group donate electron density stabilize positive charge carbocation rate S_N1 reaction dependent concentration substrate rate = $k[R]$ bimolecular nucleophilic substitution S_N2 reaction proceed concerted step nucleophile attack time leave group nucleophile perform backside attack lead inversion stereochemistry absolute

configuration changed—(r s vice versa incoming nucleophile leave group priority molecule S_N2 reaction prefer substitute carbon alkyl group create steric hindrance inhibit nucleophile access electrophilic substrate carbon rate S_N2 reaction dependent concentration substrate nucleophile rate =

$k[nu:][rl$

oxidation state atom charge bond completely ionic CH_4 low oxidation state carbon reduce CO_2 high oxidize carboxylic acid carboxylic acid derivative oxidized functional group follow aldehyde ketone imine follow alcohol alkyl halide amine oxidation increase oxidation state assist oxidize oxidize agent accept electron reduce process high affinity electron unusually highthft oxidation state contain metal large number primary alcohol oxidize aldehyde pyridinium chlorochromate pcc carboxylic acid strong oxidize agent like chromium trioxide CrO_3 sodium potassium dichromate $Na_2Cr_2O_7$ $K_2Cr_2O_7$ secondary alcohol oxidize ketone oxidize aldehyde oxidize carboxylic acid oxidize reduction decrease oxidation state assist reduce reduce agent donate electron oxidize process low electronegativity ionization energy contain metal large number hydride aldehyde ketone carboxylic acid reduce alcohol lithium aluminum hydride $LiAlH_4$ amide reduce amine $LiAlH_4$ ester reduce pair alcohol $LiAlH_4$ nucleophileelectrophile oxidationreduction reaction tend act high priority oxidize functional group use steric hindrance property selectively target functional group primarily react protect diol protect group aldehyde ketone alcohol protect conversion tert butyl ether step problem solving 1 know nomenclature 2 identify functional group 3 identify reagent 4 identify reactive functional group(s 5 identify step reaction 6 consider stereoselectivity answer concept check 1 acidbase reaction proceed acid base react form conjugate product weak reactant 2 amphoteric specie act acid base water bicarbonate dihydrogen phosphate common amphoteric specie biological system 3 $pK_a = \log K_a$ K_a equilibrium constant dissociation acid pK_a indicate acid strength strong acid low negative pK_a 4 alcohol aldehyde ketone carboxylic

acid carboxylic acid derivative act acid amine amide act 1 nucleophilicity electrophilicity base relative rate reaction kinetic property acidity basicity measure position equilibrium protonation deprotonation reaction thermodynamic property 2 t butoxide < isopropanolate < ethoxide < methoxide main determinant nucleophilicity charge negative = well nucleophile electronegativity electronegative = bad nucleophile steric hindrance large = bad nucleophile solvent protic solvent protonate hydrogen bond

large = bad nucleophile solvent protic solvent protonate hydrogen bond nucleophile decrease reactivity nucleophile attack atom oxygen differ bulkiness molecule steric hindrance effective 3 substitution reaction proceed nucleophile strong base reactive leave group 4 great positive charge increase electrophilicity well leave group increase electrophilicity make reaction likely 5

good leave group stabilize extra electron result heterolysis weak basis conjugate basis strong acid good leave group resonance stabilization inductive effect electron withdraw group improve leave group ability 1 good oxidize agent high affinity electron high oxidation state example include O_2 O_3 Cl_2 permanganate dichromate chromate pyridinium chlorochromate compound

contain metal large number oxygen atom 2 good reduce agent low electronegativity ionization energy contain hydride ion h example include sodium magnesium aluminum zinc sodium hydride NaH calcium dihydride CaH_2 lithium aluminum hydride $LiAlH_4$ sodium trihydride borohydride $NaBH_4$ compound contain metal large number hydride 3 carbon dioxide carboxylic acid ketone alcohol methane 1 reactive center carbonyl carbon electrophilic α hydrogen acidic 2 S_N1 reaction likely occur tertiary carbon carbocation easily stabilize reaction tertiary carbon contain good leaving group second reaction secondary carbon contain good leaving group reaction proceed quickly 3 S_N2 reaction easily inhibit steric hindrance fluoride small methyl difluoride molecule suitable S_N2 1 1 know nomenclature 2 identify functional

group 3 identify reagent 4 identify reactive functional group(s) 5 identify step reaction 6 consider stereoselectivity 2 reagent reactant property functional group reactant acidbase nucleophileelectrophile determine outcome science mastery assessment NH_3 H_2O lewis basis nitrogen oxygen donate lone pair Ag^+ lewis acid accept lone pair remember good nucleophile tend lone pair π bond negatively charge polarize alkoxide hydroxide OH^- anion strong nucleophile alcohol ROH carboxylic acid RCOOH weak nucleophile alkyl group alkoxide anion donate additional electron density make reactive hydroxide ion carboxylic acid contain electron withdraw oxygen atom alcohol make nucleophilic good electrophile positively charge polarize tertiary carbocation positive charge make electrophilic CH_3Cl CH_3OH polarize leave group differ Cl^- weak base OH^- HCl strong acid H_2O Cl^- stable solution OH^- increase electrophilic reactivity CH_3Cl CH_3OH CH_3OCH_3 stable leave group CH_3O^- significantly electrophilic good leave group weak basis conjugate strong acid leave group stable leave molecule H_2O far stable leave group extremely unreactive leave molecule heterolysis Br^- conjugate base HBr HO^- conjugate base water HBr strong acid water Br^- well leave group HO^- .

finally hydride H^- poor leave group extremely unstable solution carboxylic acid second oxidized form carbon carbon dioxide oxidized carboxylic acid carbon atom bond oxygen aldehyde carbon atom bond oxygen amine carbon atom bond nitrogen alkane carbon bond carbon hydrogen reaction alkoxide anion accept proton mean molecule act brønsted lowry base accept proton alkoxide anion donate lone pair electron form coordinate covalent bond incoming hydrogen ion way alkoxide anion act lewis base observation support 2 butanol secondary alcohol oxidation strong oxidize agent like dichromate result ketone butanone pyridinium chlorochromate weak oxidize agent oxidize alcohol aldehyde strong oxidize agent require convert primary alcohol carboxylic acid $\text{S}_\text{N}1$ reaction order nucleophilic substitution reaction call order rate limit step involve molecule true explain $\text{S}_\text{N}1$ reaction fi order kinetic rate limit step $\text{S}_\text{N}2$ reaction step reaction $\text{S}_\text{N}2$ reaction second order kinetic order c true statement explain reaction order finally d incorrect rate limit step reaction overall involve

protic solvent proton solution attach nucleophile decrease nucleophilicity large nucleophile strong conjugate acid strong nucleophile option give strong nucleophile likely associate proton solution primary secondary alcohol oxidize pcc central carbon atom form additional bond oxygen lose bond hydrogen justify d right answer choice tertiary alcohol b ketone c carboxylic acid oxidize pcc central carbon molecule make bond carbon oxygen atom readily form bond oxygen steric hindrance slow $\text{S}_\text{N}2$ pathway molecule fast react sterically hinder reactivity trend base steric hindrance methyl > primary > secondary note

tertiary substrate hinder react $\text{S}_\text{N}2$ molecule primary substrate sterically hinder react rapidly $\text{S}_\text{N}2$ pathway additionally molecule good leaving group trend good substrate rapid $\text{S}_\text{N}2$ note c depict primary substrate molecule good leaving group c eliminate choice b d eliminate molecule secondary substrate carry nucleophile electrophile reaction nucleophile able dissolve solvent nucleophile nearly polar carry charge polar solvent prefer reaction hexane nonpolar solvent useful aldehydes alkyl group connect carbonyl carbon ketone create steric hindrance ketone lower reactivity nucleophile ketone reactive carbonyl carbon positive charge character additional alkyl group donate electron density opposite d)—which decrease electrophilicity compound remember hierarchy reactivity carboxylic acid derivative dictate reactive nucleophilic attack order high low anhydride > carboxylic acid ester > amide practical term mean derivative high reactivity form derivative low reactivity vice versa nucleophilic attack ester result correspond anhydride anhydride reactive ester consult online resource additional equation remember 4.1 acid dissociation constant 4.2 definition pK_a $\text{pK}_\text{a} = \log K_\text{a}$ general chemistry chapter 5 general chemistry chapter 10 acid bases general chemistry chapter 11 organic chemistry chapter 1 organic chemistry chapter 5 organic chemistry chapter 7 aldehyde ketone ii pre med know feeling content know mcats know important high yield badge book help identify important topic science mastery assessment tool mcats prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific

piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read

spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question get correct ensure thinking match explanation review concept summary end chapter 1 alcohol high boiling point analogous a. oxygen atom alcohol short bond length b. hydrogen bonding present alcohol c. alcohol acidic analogous hydrocarbon d.

alcohol oxidize ketone 2 tertiary alcohol oxidize difficulty a. hydrogen attach carbon hydroxyl b. hydrogen attach α carbon c. tertiary alcohol contain hydroxyl group polarization d. relatively inert 3 iupac molecule 4 iupac molecule 5 follow correctly list methanol isobutyl alcohol propanol decrease boiling point a. methanol > isobutyl alcohol > propanol b. isobutyl alcohol > methanol > propanol c. isobutyl alcohol > propanol > methanol d. methanol > propanol > isobutyl alcohol 6 follow correctly list hexanol phenol cyclohexanol increase acidity hydroxyl hydrogen a. phenol < hexanol < cyclohexanol b. cyclohexanol < hexanol < phenol c. cyclohexanol < phenol < hexanol d. phenol < cyclohexanol < hexanol 7 follow convert $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ a. b. ii c. iii d. ii iii 8 follow convert cyclohexanol i. chromium trioxide ii pyridinium chlorochromate iii sodium dichromate a. b. ii c. iii d. ii iii 9 successfully convert 3 phenylpropanol 3 phenylpropanoic acid jones oxidation require oxidize agent a. dilute sulfuric acid b. dilute sodium hydroxide c. anhydrous condition d. high temperature 10 treat 2 methyl-1 propanol methylsulfonyl chloride base follow reaction pyridinium chlorochromate final step strong acid end product c. 2 methylpropanoic acid 11 reaction 1 phenylethanone

ethylene glycol know ethane-1,2 diol aqueous H_2SO_4 result formation a. ketal b. carboxylic acid c. aldehyde d. hemiacetal 12 treatment molecule CrO_3 appropriate reaction condition yield following molecule d. 2

phenylethanoic acid 13 order convert phenol hydroxyquinone step oxidation reduction require a. 1 oxidation step b. 2 oxidation step c. 1 reduction step d. 2 reduction step 14 conversion ubiquinone ubiquinol require type 15 following convert cyclic acetal carbonyl dialcohol a. aqueous acid chapter 5.1 description property 5.2 reaction alcohols mesylate tosylate 5.3 reaction phenol quinone hydroxyquinone content chapter relevant 13 question organic chemistry mcat chapter cover material follow aamc content 5d structure function reactivity biologically relevant alcohol probably popular chemical encounter organic chemistry ethanol popular human 10,000 year human animal know seek rotten fruit ferment contain moderate level ethanol note talk consume alcohol refer exclusively ethanol grain alcohol fact consume alcohol drastically negative effect methanol wood alcohol example oxidize body formic acid extremely toxic optic nerve retina cause blindness ingest isopropyl alcohol commonly antiseptic cause severe central nervous system depression organic chemistry purpose course restrict type alcohol synthetically 5.1 description property chapter 5.1 able predict relative pK_a value give alcohol order alcohol base boiling point alcohol important group compound see mcat protic solvent reactant product prime example hydrogen bonding alcohol general formula R-OH functional group OH refer hydroxyl group alcohol name iupac system replace e ending root alkane ending ol alcohol high priority functional group carbon atom attach receive low possible number example show figure 5.1 figure 5.1 iupac name alcohols alternatively common naming practice alkyl group derivative follow alcohol show figure 5.2 figure 5.2 common names alcohols alcohol high priority group name substituent prefix hydroxy-. finally hydroxyl group attach aromatic ring show figure 5.3 compound call phenol hydroxyl hydrogen phenol particularly acidic resonance phenol ring benzene ring contain substituent relative position indicate group adjacent carbon call ortho simply o-.

group separate carbon call meta m-. group opposite side ring

call para figure 5.3 phenol aromatic alcohols aromatic alcohol call phenol possible resonance ring lone pair oxygen atom hydroxyl group hydrogen alcohol acidic prominent property alcohol capable intermolecular hydrogen bonding result significantly high melting boiling point analogous hydrocarbon show figure 5.4 figure 5.4 intermolecular hydrogen bonding alcohol molecule hydroxyl group great degree hydrogen bonding evident boiling point show figure figure 5.5 boiling point alcohol boiling point increase significantly additional hydroxyl group permit hydrogen bonding hydrogen bonding occur hydrogen atom attach highly electronegative atom like nitrogen oxygen fluorine hydrogen bonding result extreme polarity bond case hydroxyl group electronegative oxygen atom pull electron density away electronegative hydrogen atom generate slightly positive charge hydrogen slightly negative charge oxygen partially positive hydrogen molecule electrostatically attract partially negative oxygen molecule generate noncovalent bonding force know hydrogen bond hydrogen bonding cause increase melting point boiling point solubility water hydroxyl hydrogen weakly acidic alcohol dissociate proton alkoxide ion way water dissociate proton hydroxide ion table 5.1 give pka value hydroxyl- remember chapter 10 mcat general chemistry review $pK_a = -\log K_a$ strong acid high K_a value low pka value phenol small pka acidic alcohol list table 5.1 table 5.1 pka value hydroxyl contain compound $HO + H^+ \rightleftharpoons C_2H_5O + H^+ \rightleftharpoons PRO + H^+ \rightleftharpoons t\text{-}BuO + H^+ \rightleftharpoons CF_3CH_2O + H^+ \rightleftharpoons PhO + H^+$ look table 5.1 hydroxyl hydrogen phenol acidic alcohol aromatic nature ring allow resonance stabilization negative charge oxygen stabilize anion like alcohol phenol form intermolecular hydrogen bond relatively high melting boiling point phenol slightly soluble water owe hydrogen bonding phenol derivative phenol acidic nonaromatic alcohol form salt inorganic basis presence substituent ring significant effect acidity boiling point melting point phenol compound electron withdraw substituent increase acidity electron donate group decrease acidity charge like spread possible acidity decrease alkyl group attach electron donate destabilize alkoxide anion resonance

decrease alkyl group attach electron donate destabilize alkoxide anion resonance electron withdraw group stabilize alkoxide anion make alcohol acidic trend see table 5.1 presence alkyl group nonaromatic alcohol produce acidic molecule alkyl group donate electron density destabilize negative charge additionally alkyl group help stabilize positive charge explain substitute carbocation high stability substitute carbocation mcat concept check 5.1 assess understanding material 1 low pka ethanol p ethylphenol 2 rank follow decrease boiling point 1 pentanol 1 hexanol 1,6- 5.2 reaction alcohol chapter 5.2 able predict reaction primary secondary alcohol strong recall reagent(oxidize primary alcohol aldehyde explain purpose mesylate tosylate group describe process protect aldehyde ketone main reaction mcat alcohol include oxidation preparation mesylate tosylate protection carbonyl alcohol oxidation alcohol produce product primary alcohol oxidize aldehyde pyridinium chlorochromate pcc athft mild anhydrous oxidant show figure 5.6 reactant stop primary alcohol convert aldehyde pcc lack water necessary hydrate easily hydrate aldehyde oxidize agent aldehyde rapidly hydrate form geminal diol 1,1 diol easily oxidize carboxylic acid figure 5.6 oxidation primary alcohol aldehyde pyridinium chlorochromate pcc secondary alcohol oxidize ketone pcc strong oxidize agent tertiary alcohol oxidize oxidized break carbon carbon bond alcohol readily oxidize

carboxylic acid oxidize agent pcc oxidize primary alcohol oxidation primary alcohol strong oxidize agent like chromium(vi produce carboxylic acid process chromium(vi reduce chromium(iii common example chromium contain oxidize agent include sodium potassium dichromate salt $\text{Na}_2\text{Cr}_2\text{O}_7$ $\text{K}_2\text{Cr}_2\text{O}_7$ strong oxidize agent fully oxidize primary alcohol carboxylic acid secondary alcohol ketone example show figure 5.7 figure 5.7 oxidation secondary alcohol ketone dichromate salt finally strong chromium contain oxidize agent chromium trioxide CrO_3 dissolve dilute sulfuric acid acetone call jones oxidation show figure 5.8 expect reaction oxidize primary alcohol carboxylic acid secondary alcohol ketone figure 5.8 jones oxidation primary alcohol oxidize carboxylic acid CrO_3 mesylate tosylate hydroxyl group alcohol fairly

poor leaving group nucleophilic substitution reaction protonate react form well leaving group call
 mesylate tosylate mesylate compound contain functional group SO_3CH_3 derive
 methanesulfonic acid anionic form show figure 5.9 figure 5.9 structure mesylate anion
 mesylates prepare methylsulfonyl chloride alcohol presence base tosylate contain functional
 group $\text{SO}_3\text{C}_6\text{H}_4\text{CH}_3$ derive toluenesulfonic acid compound produce reaction alcohol p
 toluenesulfonyl chloride form ester toluenesulfonic acid tosylate show figure 5.10 figure 5.10
 structure tosylate addition make hydroxyl group alcohol well leaving group nucleophilic
 substitution reaction mesyl tosyl group serve protect group want alcohol react group
 protective react reagent attack alcohol especially oxidize agent react alcohol form mesylate
 tosylate perform multistep reaction desire product derive alcohol alcohol protect group
 functional group example aldehyde ketone react equivalent alcohol diol dialcohol form acetal
 primary carbon or group hydrogen atom ketal secondary carbon or group carbonyl reactive
 strong reduce agent like lithium aluminum hydride LiAlH_4 acetal ketal hand react LiAlH_4 acetal
 ketal functionality protect aldehyde ketone reaction reduce functionality molecule acetal ketal
 revert carbonyl aqueous acid step call deprotection reaction show figure 5.11 figure 5.11
 protection ketone ketal formation dialcohol mcat concept check 5.2 assess understanding
 material 1 happen primary secondary alcohol respectively presence

assess understanding material 1 happen primary secondary alcohol respectively presence
 strong oxidize agent 2 product 1 butanol treat pcc chromium 3 purpose mesylate tosylate 4
 aldehyde ketone protect alcohol 5.3 reaction phenol chapter 5.3 able recall process production
 quinone identify property ubiquinone allow function electron carrier reaction phenol proceed
 similar fashion reaction alcohol discuss previously hydrogen hydroxyl group phenol
 particularly acidic oxygen contain anion resonance- stabilize ring quinone hydroxyquinone
 treatment phenol oxidize agent produce compound call quinone 2,5 cyclohexadiene-1,4 dione
 show figure 5.12 figure 5.12 oxidation p benzenediol hydroquinone quinone quinones name
 indicate position carbonyl numerically add quinone parent phenol conjugate ring system

molecule resonance stabilize electrophile remember necessarily aromatic lack classic aromatic conjugate ring structure quinone aromatic ring case quinone serve electron acceptor biochemically specifically electron transport chain photosynthesis aerobic respiration vitamin k1 common quinone 2 methyl-3-[(2e)-3,7,11,15- tetramethylhexadec-2 en-1 yl]naphthoquinone show figure 5.13 molecule call phyloquinone important photosynthesis carboxylation clotting factor blood vitamin k2 similarly correspond class molecule call menaquinone figure 5.13 phyloquinone vitamin k1 phyloquinone menaquinone common name vitamin k1 vitamin k2 respectively molecule fat soluble vitamin play role carboxylation clotting factor ii vii ix x protein c s blood function fat soluble vitamin explore chapter 5 mcat biochemistry review molecule oxidize form class molecule call hydroxyquinone hydroxyquinone share ring carbonyl backbone quinone differ addition hydroxyl group hydroxyquinone biological activity synthesis medication classic example show figure 5.14 figure 5.14 2 hydroxy-1,4 benzoquinone note subtle difference terminology figure 5.12 figure 5.14 hydroquinone benzene ring hydroxyl group hydroxyquinone contain carbonyl variable number hydroxyl group resonance hydroxyquinone behave like quinone electron- donate group make slightly electrophilic reactive name compound position hydroxyl group indicate number total number hydroxyl group indicate prefix di tri substituent hydroxy-.

example show figure 5.15 figure 5.15 example hydroxyquinone tetrahydroxybenzoquinone b 5 hydroxynaphthoquinone ubiquinone example biologically active quinone ubiquinone call coenzyme q vital electron carrier associate complexes ii iii electron transport chain ubiquinone oxidized form molecule take physiologically reduce ubiquinol acceptance electron show figure 5.16 oxidation reduction capacity allow molecule perform physiological function electron transport figure 5.16 ubiquinone coenzyme q ubiquinol ubiquinone oxidize form pick electron convert reduce form ubiquinol coenzyme q play role complexes ii iii

electron transport chain complex iii main player q cycle contribute formation proton motive

force inner mitochondrial membrane respiratory complex discuss chapter 10 mcat
biochemistry review long alkyl chain molecule allow lipid soluble allow act electron carrier
phospholipid bilayer biological molecule undergo oxidation reduction reaction normal
function include nadh fadh₂ nadph molecule accept donate electron readily similar
ubiquinone discuss thoroughly chapter 9 10 mcat biochemistry mcat concept check 5.3 assess
understanding material 1 quinone generally produce 2 hydroxyquinone produce 3 chemical
property ubiquinone allow carry biological alcohol particular favorite mcat test maker get look
unique property stem hydrogen bonding important ability alcohol alcohol oxidize aldehyde
ketone carboxylic acid depend substitution alcohol strength oxidize agent point forward
oxidation reduction important reaction functional group alcohol participate nucleophilic
substitution reaction facilitate convert alcohol mesylate tosylate finally phenol oxidize
counterpart quinone hydroxyquinone involve number biochemical pathway particular utility
see process require rapid oxidation reduction photosynthesis electron transport chain chapter
explore oxygen contain compound recognize chapter specific order mcat organic chemistry
review functional group oxidized reactive look aldehyde ketone deprotonated form enol
enolate explore carboxylic acid derivative amide ester review content test knowledge critical
thinking skill complete test like passage set online description property alcohol general form
roh name suffix ol high priority give prefix phenol benzene ring hydroxyl group name relative
position hydroxyl group ortho adjacent carbon meta separate carbon para opposite side ring
alcohol hydrogen bond raise boiling melting point relative correspond alkane hydrogen
bonding increase solubility alcohol phenol

acidic alcohol aromatic ring delocalize charge conjugate base electron donate group like alkyl
group decrease acidity destabilize negative charge electron withdraw group electronegative
atom aromatic ring increase acidity stabilize negative charge reaction alcohols primary alcohol
oxidize aldehyde pyridinium chlorochromate pcc oxidize way carboxylic acid strong oxidize
agent secondary alcohol oxidize ketone common alcohol convert mesylate tosylate well leave

group nucleophilic substitution reaction mesylate contain functional group SO_3CH_3 derive methanesulfonic acid tosylate contain functional group $\text{SO}_3\text{C}_6\text{H}_4\text{CH}_3$ derive toluenesulfonic acid aldehyde ketone protect convert acetal ketal equivalent alcohol dialcohol react carbonyl form acetal primary carbon or group hydrogen atom ketal secondary carbon or group functional group compound react especially reduction effect newly form acetal ketal acetal ketal convert carbonyl catalytic acid call deprotection reaction phenol quinone synthesize oxidation phenol quinone resonance stabilize electrophile vitamin K1 phyloquinone vitamin K2 menaquinone example biochemically relevant quinone hydroxyquinone produce oxidation quinone add variable number hydroxyl group ubiquinone coenzyme Q biologically active quinone act electron acceptor complexes II III electron transport chain reduce ubiquinol answer concept check 1 phenol like p ethylphenol increase acidity resonance electron withdraw character phenol aromatic ring p ethylphenol strong acid ethanol 2 1,6 hexanediol high boiling point molecule hydroxyl moiety hydrogen bonding 1- hexanol boiling point 1 pentanol have low boiling point 1 hexanol high boiling point 1 pentanol long hydrocarbon chain increase van der Waals 1 presence strong oxidize agent primary alcohol completely oxidize carboxylic acid secondary alcohol oxidize ketone 2 react 1 butanol PCC result aldehyde 1 butanal chromium trioxide strong oxidize agent produce carboxylic acid butanoic acid 3

mesylate tosylate convert alcohol well leave group particularly useful nucleophilic substitution reaction increase stability product protect group reagent especially oxidize agent react alcohol react 4 aldehyde ketone react equivalent alcohol diol form acetal ketal acetal ketal reactive aldehyde ketone especially reduce agent protect functional group react acetal ketal revert carbonyl catalytic acid 1 quinone produce oxidation phenol 2 hydroxyquinone produce oxidation quinone add variable number additional hydroxyl group 3 ubiquinone conjugate ring stabilize molecule accept electron additionally long alkyl chain molecule allow lipid solubility allow molecule function science mastery assessment alcohol high boiling point analogous hydrocarbon result polarize OH bond oxygen partially negative hydrogen partially

positive enable oxygen atom alcohol molecule attract hydrogen form hydrogen bond heat require overcome hydrogen bond increase boiling point analogous hydrocarbon form hydrogen bond vaporize low temperature irrelevant oxygen bond length factor determine substance boiling point c d true statement irrelevant boiling point determination tertiary alcohol oxidize extreme condition substrate carbon spare hydrogen alcohol oxidation involve removal hydrogen carbon instead bond oxygen hydrogen present carbon carbon bond cleave require great deal energy occur extreme condition b incorrect alcohol carbonyl contain compound properly describe carbonyl contain compound unable form enolate c incorrect hydroxyl group tertiary carbon polarize d false statement

tertiary alcohol involve reaction $\text{S}_{\text{N}}1$ reaction remember diol name parent alkane position alcohol indicate end suffix diol carbon chain carbon hydroxyl group carbon 1 2 propane-1,2 diol molecule phenol hexanol cyclic group aromatic double bond single bond methyl group separate hydroxyl carbon carbon make molecule m methylphenol equal boiling point increase increase size alkyl chain increase van der waals attraction isobutyl alcohol large alkyl chain high boiling point methanol small chain low phenol significantly acidic hydroxyl hydrogen alcohol resonance stabilization conjugate base acidic hydroxyl hydrogen acidity hexanol cyclohexanol close hydroxyl hydrogen hexanol slightly acidic ring structure cyclohexanol slightly electron donate make hydroxyl hydrogen slightly acidic $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ 1 propanol primary alcohol desired end product $\text{CH}_3\text{CH}_2\text{CHO}$ propanal aldehyde available option reactant capable oxidize primary alcohol aldehyde pyridinium chlorochromate pcc chromic trioxide dichromate salt oxidize primary alcohol carboxylic acid cyclohexanol secondary alcohol oxidize agent list convert ketone acidic condition provide dilute sulfuric acid require complete jones oxidation reaction carry aqueous condition eliminate c heat speed reaction high temperature require reaction eliminate d methylsulfonyl chloride serve protect group alcohol convert mesylate react reagent continue normally oxidation reaction keep alcohol react protect group remove strong acid resultant product initial reactant oxidation product b c reduction product

d form reaction create ketal step protection aldehyde ketone dialcohol jones oxidation convert primary alcohol carboxylic acid original react molecule reaction proceed correct reaction use strong oxidize agent will stop aldehyde b reaction ketone c start primary alcohol order convert phenol hydroxyquinone convert quinone oxidation step second oxidation step require oxidize quinone hydroxyquinone reaction convert ubiquinone ubiquinol reduction reaction ketone reduce hydroxyl group acetal convert carbonyl dialcohol treatment aqueous acid final step alcohol protect group call deprotection consult online resource additional biochemistry chapter 5 lipid structure function general chemistry chapter 8 gas phase organic chemistry chapter 1 organic chemistry

chapter 8 gas phase organic chemistry chapter 1 organic chemistry chapter 4 analyze organic reaction organic chemistry chapter 6 aldehydes ketone organic chemistry chapter 8 aldehydes ketone electrophilicity oxidation pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question get correct ensure thinking match explanation review concept summary end chapter 1 following true respect carbonyl a. carbonyl carbon electrophilic b.

carbonyl oxygen electron withdraw c. resonance structure functional group place positive

charge carbonyl carbon d. π electron mobile pull carbonyl 2 order following compound increase boiling point butane butanol butanone a. butanol < butane < butanone b. butane < butanone < butanol c. butanone < butane < butanol d. butane < butanol < butanone 3 product reaction 4 product reaction 5 product reaction 6 product reaction 7 product reaction benzaldehyde excess ethanol $\text{CH}_3\text{CH}_2\text{OH}$ presence anhydrous 8 hemiacetal hemiketal usually react form acetal ketal difficult isolate hemiacetal i. molecule unstable ii hydroxyl group rapidly protonate lose water acidic condition leave reactive iii molecule extremely basic react rapidly a. b. ii c. ii iii d. ii iii 9 hemiacetal central carbon bond a. OH or H b. H or R c. OH or R d. or R 10 reaction hydrogen cyanide butyraldehyde ethylmethylketone compound come from major product a. butyraldehyde hydrogen cyanide b. ethylmethylketone butyraldehyde c. hydrogen cyanide ethylmethylketone d. reaction occur 11

following describe(pyridinium chlorochromate i. oxidant form aldehyde primary alcohol ii oxidant completely oxidize primary alcohol iii oxidant completely oxidize secondary alcohol a. b. ii c. iii d. ii iii 12 form geminal diol follow attack a. hydrogen peroxide c. potassium dichromate 13 reaction ammonia glutaraldehyde a. imine b. cyanohydrin c. semicarbazone d. hydrazone 14 follow reduce ketone 15 imine naturally tautomerize form answer key follow page aldehyde ketone electrophilicity oxidation chapter 6.1 description property 6.2 nucleophilic addition reaction acetal hemiacetal imine enamine 6.3 oxidation reduction reaction oxidation aldehyde reduction hydride reagent content chapter relevant 8 question organic chemistry mcat chapter cover material follow aamc content 5d structure function reactivity biologically relevant chapter focus important functional group mcat carbonyl aldehyde ketone functional group highlight lot common contain carbonyl double bond carbon oxygen difference attach carbonyl carbon the carbonyl group common functional group organic chemistry reason carbonyl component different functional group addition aldehyde ketone carbonyl find carboxylic acid ester amide anhydride compound importantly carbonyl

unique ability behave nucleophile condensation reaction electrophile nucleophilic addition reaction chapter investigate overall property aldehyde ketone oxidation reduction reaction electrophilic property follow chapter investigate nucleophilic property enolate 6.1 description property chapter 6.1 able aldehyde ketone proper suffix describe reactivity carbonyl carbon recognize common reaction form aldehyde predict boiling point compound base aldehyde terminal functional group ketone hand internal terminal functional ketone alkyl group bond carbonyl aldehyde alkyl group hydrogen mean carbonyl ketone terminal group aldehyde like organic compound aldehyde ketone strong smell compound volatile carbonyl find spice include cinnamon cinnamaldehyde vanilla vanillin cumin cuminaldehyde dill carvenone ginger zingerone notice common name pattern help form see formic acid carbon carboxylic acid acet see carbon compound acetylene acetic acid acetyl coa aldehyde name replace e end alkane suffix al common name aldehyde show figure 6.1 formaldehyde acetaldehyde propionaldehyde butyraldehyde

common name aldehyde show figure 6.1 formaldehyde acetaldehyde propionaldehyde butyraldehyde valeraldehyde aldehyde name substituent use prefix figure 6.1 name aldehydesffi aldehyde attach ring suffix carbaldehyde instead show figure 6.2 figure 6.2 name cyclic aldehydes ketone name replace e suffix name ketone common name alkyl group name alphabetically follow ketone ketone name substituent use prefix oxo keto-.

figure 6.3 show example ketone figure 6.3 name ketone dipole moment carbonyl group increase intermolecular force boiling point aldehyde ketone relative alkane significant impact hydrogen bonding see alcohol physical property aldehyde ketone govern presence carbonyl group dipole carbonyl strong dipole alcohol double bond oxygen electron withdraw single bond oxygen hydroxyl group solution dipole moment associate polar carbonyl group increase intermolecular attraction cause elevation boiling point relative parent alkane aldehyde ketone dipole polar alcohol elevation boiling point alcohol hydrogen bonding present reaction

aldehyde ketone act electrophile make good target nucleophile electron- withdraw property
carbonyl oxygen leave partial positive charge carbon show figure 6.4 generally aldehyde
reactive nucleophile ketone steric hindrance few electron donate alkyl group figure 6.4
polarity carbonyl group carbonyl carbon common electrophile test day remember group
dipole moment oxygen electronegative pull electron away carbon make carbon electrophilic
good target nucleophile aldehyde ketone produce mechanism aldehyde obtain partial
oxidation primary alcohol pyridinium chlorochromate pcc $\text{C}_5\text{H}_5\text{NH}[\text{CrO}_3\text{Cl}]$ strong oxidant
aldehyde continue oxidize carboxylic acid ketone obtain oxidation secondary alcohol perform
reagent range sodium potassium dichromate salt $\text{Na}_2\text{Cr}_2\text{O}_7$ $\text{K}_2\text{Cr}_2\text{O}_7$ chromium trioxide CrO_3
pcc oxidize secondary alcohol concern oxidize far reaction stop ketone mcat concept check 6.1
assess understanding material 1 following compound 2 give alkane aldehyde alcohol equal
length carbon chain high boiling point 3 carbon carbonyl electrophilic nucleophilic 4 method
form aldehyde ketone 6.2 nucleophilic addition reaction chapter 6.2 able predict product react
aldehyde ketone alcohol presence absence acidic condition recall functional group form
nitrogen contain derivative react aldehyde ketone predict product reaction HCN aldehyde
ketone include reactivity product follow reaction general reaction mechanism nucleophilic
addition carbonyl important reaction mechanism mcat reaction aldehyde ketone complex
molecule share general reaction mechanism memorize reaction individually focus overall
pattern learn particular reaction exemplify see $\text{C}=\text{O}$ bond polarize partial positive charge
carbonyl carbon partial

$\text{C}=\text{O}$ bond polarize partial positive charge carbonyl carbon partial negative charge oxygen make
carbonyl carbon electrophile ripe nucleophilic attack memorize reaction help question right
mcat understand trend overarching concept allow answer question correctly carbonyl carbon
great target nucleophilic attack reaction chapter nucleophile attack form covalent bond
carbon break π bond carbonyl electron π bond push oxygen atom oxygen happily accept extra
electron electronegativity break π bond form tetrahedral intermediate time carbonyl open ask

reform carbonyl good leave group present case aldehyde ketone carbonyl reform generally o accept proton solvent form hydroxyl group result alcohol good leave group present case carboxylic acid derivative carbonyl double bond reform push leave group figure 6.5 show reaction mechanism nucleophilic addition figure 6.5 nucleophilic addition reaction mechanism nucleophile attack carbonyl carbon open carbonyl carbonyl reform good leave group o protonate generate presence water aldehyde ketone react form geminal diol 1,1 diol show figure 6.6 case nucleophilic oxygen water attack electrophilic carbonyl carbon hydration reaction normally proceed slowly increase rate add small catalytic acid base figure 6.6 hydration reaction carbonyl hydrate water protonate result geminal diol acetal hemiacetal similar reaction occur aldehyde ketone treat alcohol equivalent alcohol nucleophile reaction add aldehyde ketone product hemiacetal hemiketal respectively show figure 6.7 hemiacetal hemiketal recognize retention hydroxyl group halfway step hemi prefix endpoint basic condition figure 6.7 hemiacetal formation oxygen alcohol function nucleophile attack carbonyl carbon generate hemiacetal equivalent alcohol add reaction proceed completion result formation acetal ketal show figure 6.8 reaction proceed nucleophilic substitution reaction S_N1 catalyze anhydrous acid hydroxyl group hemiacetal hemiketal protonate acidic condition lose molecule water carbocation form equivalent alcohol attack carbocation result formation acetal ketal acetal ketal comparatively inert frequently protect group carbonyl functionality molecule protect group easily convert carbonyl aqueous acid figure 6.8 acetal ketal formation hemiacetal hemiketal form hydroxyl group protonate

6.8 acetal ketal formation hemiacetal hemiketal form hydroxyl group protonate release molecule water alcohol attack form acetal ketal formation hemiacetal hemiketal alcohol nucleophile carbonyl carbon electrophile formation acetal ketal alcohol nucleophile carbocation carbon carbonyl carbon electrophile imines enamines nitrogen nitrogen base functional group act good nucleophile lone pair electron nitrogen react readily electrophilic carbonyl aldehyde ketone simple case ammonia add carbon atom water lose produce imine

compound nitrogen atom double bond carbon atom reaction show figure 6.9 small molecule lose formation bond molecule example condensation reaction nitrogen replace carbonyl oxygen example nucleophilic substitution common ammonia derivative react aldehyde ketone hydroxylamine H_2NOH hydrazine H_2NNH_2 semicarbazide $\text{H}_2\text{NNHC(O)NH}_2$ form oxime hydrazone figure 6.9 imine formation ammonia add carbonyl result elimination water generation imine imine related compound undergo tautomerization form enamine contain double bond nitrogen contain group analogous keto enol tautomerization carbonyl compound explore chapter 7 mcAT organic chemistry reaction HCN nucleophile carbonyl carbon hydrogen cyanide HCN classic nucleophile mcAT HCN triple bond electronegative nitrogen atom render relatively acidic pK_a 9.2 hydrogen dissociate nucleophilic cyanide anion attack carbonyl carbon atom show figure 6.10 reaction aldehyde ketone produce stable compound call cyanohydrin oxygen reprotonate cyanohydrin gain stability newly form C-C bond figure 6.10 cyanohydrin formation cyanide function nucleophile attack carbonyl carbon generate mcAT concept check 6.2 assess understanding material 1 aldehyde ketone react equivalent alcohol occur different react equivalent acidic condition aldehyde ketone + 1 equivalent alcohol aldehyde ketone + 2 equivalent alcohol 2 nitrogen nitrogen contain derivative react aldehyde ketone type reaction happen functional group 3 HCN react aldehyde ketone functional group produce product stable 6.3 oxidation reduction reaction chapter 6.3 able recall common oxidize reduce agent aldehyde ketone predict product redox reaction involve aldehyde aldehyde occupy middle oxidation reduction spectrum oxidized alcohol oxidized carboxylic acid ketone hand oxidized secondary carbon oxidation aldehyde

oxidized carboxylic acid ketone hand oxidized secondary carbon oxidation aldehyde aldehyde oxidize form carboxylic acid oxidize agent strong PCC perform reaction example include potassium permanganate KMnO_4 chromium trioxide CrO_3 silver(I) oxide Ag_2O hydrogen peroxide H_2O_2 show figure 6.11 figure 6.11 aldehyde oxidation oxidize agent turn aldehyde carboxylic acid PCC anhydrous strong oxidize past point aldehyde reduction hydride reagent

aldehyde ketone undergo reduction form alcohol perform hydride reagent common see mcat
lithium aluminum hydride LiAlH_4 sodium borohydride NaBH_4 mild condition need reaction
show figure 6.12 figure 6.12 ketone reduction ketone easily reduce respective alcohol hydride
reagent mcat concept check 6.3 assess understanding material 1 functional group form
aldehyde oxidize common oxidize agent assist reaction 2 functional group form aldehyde
ketone reduce common reduce agent assist 3 chemistry student react butanone butanal pcc
 KMnO_4

expect product reaction chapter examine property aldehyde ketone specifically take look
reactivity carbonyl carbon nucleophilic addition reaction examine aldehyde ketone oxidize
reduce carbonyl common reaction site biosynthetic process help explain importance mcat
follow chapter continue exploration aldehyde ketone look chemistry enolate nucleophilic
review content test knowledge critical thinking skill complete test like passage set online
resource description property aldehyde terminal functional group contain carbonyl bond
hydrogen nomenclature use suffix *-al* prefix *oxo-*.

ring indicate suffix ketone internal functional group contain carbonyl bond alkyl chain
nomenclature use suffix prefix *oxo* *keto-*. reactivity carbonyl $\text{C}=\text{O}$ dictate polarity double bond
carbon partial positive charge carbonyl contain compound high boiling point equivalent
alkane dipole interaction alcohol high boiling point carbonyl hydrogen bonding aldehyde
ketone commonly produce oxidation primary secondary alcohol respectively weak anhydrous
oxidize agent like pyridinium chlorochromate pcc synthesize aldehyde reaction continue
oxidize level carboxylic oxidize agent ketone dichromate chromium trioxide pcc ketone oxidize
functional group secondary carbon nucleophilic addition reaction nucleophile attack form
bond carbonyl carbon electron π bond push oxygen atom good leave group aldehyde ketone
carbonyl remain open protonate form alcohol good leave group carboxylic acid derivative
carbonyl reform kick leave group hydration reaction water add carbonyl form geminal

equivalent alcohol react aldehyde nucleophilic addition hemiacetal form reaction occur ketone hemiketal form equivalent alcohol react hemiacetal nucleophilic substitution acetal form reaction occur hemiketal ketal form nitrogen nitrogen derivative react carbonyl form imine oxime hydrazone semicarbazone imine tautomerize form enamine hydrogen cyanide react carbonyl form cyanohydrin aldehyde oxidize carboxylic acid oxidize agent like KMnO_4 CrO_3 Ag_2O H_2O_2 reduce primary alcohol hydride reagent LiAlH_4 NaBH_4 ketone oxidize reduce secondary alcohol hydride reagent answer concept checks 1 molecule left butanone molecule right 2 alkane low boiling point follow aldehyde alcohol boiling point aldehyde elevate dipole boiling point alcohol elevate hydrogen bonding 3 carbon carbonyl electrophilic partially positively charge oxygen highly electron withdraw 4 aldehyde form oxidation primary alcohol produce weak anhydrous oxidize agent like PCC oxidize fully carboxylic acid ketone form oxidation secondary alcohol method ozonolysis friedel crafts acylation outside scope mcat 1 equivalent alcohol aldehyde ketone form hemiacetal hemiketal respectively equivalent alcohol reaction run completion form acetal 2 reaction occur condensation reaction small molecule lose nucleophilic substitution reaction reaction result formation imine

small molecule lose nucleophilic substitution reaction reaction result formation imine nitrogen- contain derivative oxime hydrazone semicarbazone 3 HCN react aldehyde ketone cyanohydrin produce stable product 1 oxidize aldehyde yield carboxylic acid common oxidize agent include KMnO_4 CrO_3 Ag_2O H_2O_2 2 reduce aldehyde ketone yield alcohol certain condition test mcat aldehyde ketone reduce way alkane common reduce agent include LiAlH_4 NaBH_4 3 butanone react PCC KMnO_4 ketone oxidize common oxidize reagent break carbon carbon bond butanal oxidize KMnO_4 form

butanoic acid react PCC strong science mastery assessment reactivity carbonyl attribute difference electronegativity carbon oxygen atom electronegative oxygen atom attract bond electron electron withdraw carbonyl carbon electrophilic resonance structure carbonyl push π

electron oxygen result positively charge carbonyl assume length carbon chain remain alkane
 consistently low boiling point boiling point ketone elevate dipole carbonyl boiling point alcohol
 elevate hydrogen bonding reaction ketone equivalent alcohol produce hemiketal or group
 oh group alkyl group attach carbon ketal or group r group b hemiacetal oh group or
 group r group hydrogen atom draw d ketone note hemiketal unstable compound react rapidly
 second equivalent alcohol form ketal acidic condition aldehyde ketone react ammonia
 nitrogen base derivative form imine compound double bond carbon nitrogen aldehyde easily
 oxidize correspond carboxylic acid KMnO_4 aldehyde reduce alcohol c molecule react d
 aldehyde oxidize CH_2 group remove LiAlH_4 reduce aldehyde primary alcohol ketone
 secondary alcohol reaction ketone convert secondary alcohol excess ethanol present product
 reaction aldehyde ethanol acetal benzaldehyde convert hemiacetal show c proceed
 completion acetal b incorrect presence benzene ring final product hemiacetal hemiketal
 usually short lived oh group rapidly protonate acidic condition lose water leave carbocation
 susceptible attack alcohol alcohol add acetal ketal stable newly add group likely protonated
 leave compare oh hemiacetal molecule equivalent alcohol add carbonyl or carbonyl oxygen
 protonate oh alkyl group r hydrogen atom h parent aldehyde b describe acetal c hemiketal
 d ketal aldehyde ketone list reactive strongly nucleophilic hydrogen cyanide aldehyde slightly
 reactive nucleophile ketone steric reason aldehyde HCN form major product pcc mild
 anhydrous oxidant oxidize primary alcohol aldehyde secondary alcohol ketone strong oxidize
 alcohol aldehyde carboxylic acid hydration reaction water add carbonyl form geminal diol
 compound hydroxyl group carbon hydrogen peroxide potassium dichromate oxidize agent
 convert aldehyde carboxylic acid ethanol react carbonyl compound form acetal ketal excess
 ethanol available

ethanol react carbonyl compound form acetal ketal excess ethanol available ammonia NH_3
 react aldehyde like glutaraldehyde form imine condensation substitution reaction $\text{C}=\text{O}$
 carbonyl replace $\text{C}=\text{N}$ bond hydride like LiAlH_4 NaBH_4 reduce agent reduce aldehyde ketone

alcohol reagent list oxidize agent act ketone tautomerization double bond carbon nitrogen imine move lie carbon result enamine compound double bond amine consult online resource additional biochemistry chapter 4 carbohydrate structure function general chemistry chapter 11 organic chemistry chapter 1 organic chemistry chapter 4 analyze organic reaction organic chemistry chapter 7 aldehydes ketones ii organic chemistry chapter 8 aldehydes ketones ii pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question get correct ensure thinking match explanation review concept summary end chapter 1 product reaction 2 reaction example 3 following reaction produce compound a. $\text{CH}_3\text{CHO} + \text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ b. $\text{CH}_3\text{COCH}_3 + \text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ c. $\text{CH}_3\text{CH}_2\text{COCH}_3 + \text{CH}_3\text{CHO}$ d. $\text{CH}_3\text{CH}_2\text{CHO} + \text{CH}_3\text{CH}_2\text{CHO}$

4 equilibrium keto enol tautomer lie far keto i. keto form thermodynamically stable ii enol form low energy iii enol form thermodynamically stable a. b. iii c. ii d. ii iii 5 aldol condensation example reaction type(s iii nucleophilic addition a. b. iii c. ii iii d. ii iii 6 hydrogen follow molecule 7 react ammonia NH_3 200 ° c enolate carbonyl contain compound predominate a. kinetic enolate b. thermodynamic enolate c. enolate present roughly equal d. enolate reaction condition form 8 following compound reactive 9 α hydrogen ketone acidic i. resonance stabilization ii electron withdraw property alkyl group iii electronegative carbonyl oxygen a. b.

iii c. ii iii d. ii iii 10 follow consider tautomer imine 11 succinaldehyde treat lithium diisopropylamide i. nucleophilic ii nucleophilic iii generate carbanion a. b. ii c. iii d. ii iii 12 follow well describe final product aldol c. α β unsaturated carbonyl d. β γ unsaturated carbonyl 13 benzaldehyde react acetone act a. benzaldehyde addition strong acid b. benzaldehyde reaction strong base c. acetone addition strong acid d. acetone reaction strong base 14 3 hydroxybutanal form reaction a. methanol diethyl ether b. ethanal base acid c. butanal strong acid d.

methanal ethanal catalytic base 15 catalytic production dihydroxyacetone glyceraldehyde 3 phosphate 2 hydroxy-3 oxopropyl dihydrogen phosphate phosphonoxy(methyl)oxolan-2-yl]methyl dihydrogen phosphate type reaction a. aldol condensation b. retro aldol reaction d. nucleophilic attack aldehyde ketones ii chapter 7.1 general principle acidity α hydrogen 7.2 enolate chemistry kinetic thermodynamic enolate 7.3 aldol condensation retro aldol reaction content chapter relevant 6 question organic chemistry mcat chapter cover material following aamc content 5d structure function reactivity biologically relevant previous chapter take look key property reaction aldehyde ketone molecule highly predictable chemistry center electrophilic positively charge carbonyl carbon sure test day chapter look property aldehyde ketone focus reactivity α hydrogen carbonyl contain compound acidity α hydrogen allow aldehyde ketone act electrophile nucleophile serve function reaction worry we'll review tip understand aldehyde ketone react 7.1 general principle chapter 7.1 able explain acidic nature α hydrogen aldehyde ketone compare acidity α hydrogen aldehyde describe relationship steric hindrance reactivity previous chapter focus electronegativity oxygen atom carbonyl pull electron away carbonyl carbon make partially positively charge chapter electron- withdraw characteristic oxygen bond focus α - carbon aldehyde ketone acidity α hydrogen α carbon adjacent carbonyl carbon hydrogen connect α carbon term α hydrogen induction oxygen pull electron density ch bond weaken make relatively easy deprotonate α carbon aldehyde ketone show figure 7.1 acidity α hydrogen augment resonance stabilization conjugate base

specifically α hydrogen remove extra electron remain resonate α carbon carbonyl carbon carbonyl oxygen increase stability enolate intermediate describe section resonance negative charge distribute electronegative oxygen atom electron- withdraw oxygen atom help stabilize carbanion molecule negatively charge carbon atom basic solution α - hydrogen easily deprotonate figure 7.1 deprotonation α carbon form electron withdraw group like oxygen stabilize organic anion electron donate group like alkyl group destabilize organic α hydrogen ketone tend slightly acidic aldehyde electron donate property additional alkyl group

tend slightly acidic aldehyde electron donate property additional alkyl group ketone property reason alkyl group help stabilize carbocation case destabilize carbanion reaction aldehyde slightly reactive nucleophile ketone steric hindrance ketone arise additional alkyl group ketone contain nucleophile approach ketone aldehyde order react additional alkyl group ketone way single hydrogen aldehyde make high energy crowded intermediate step remember high energy intermediate mean reaction likely ketone slightly likely react nucleophile aldehyde extra alkyl group destabilize carbanion increase steric hindrance mcat concept check 7.1 assess understanding material 1 α hydrogen aldehyde ketone acidic 2 low pka 3 pentanone pentanal 3 steric hindrance affect relative reactivity aldehyde 7.2 enolate chemistry chapter 7.2 able predict role enolate carbanion reaction describe condition favor keto enol form identify thermodynamically favor tautomer aldehyde acidity α hydrogen aldehyde ketone exist solution mixture isomer familiar keto form enol form enol form get presence carbon carbon double bond en component alcohol ol component isomer differ placement proton double bond call tautomer equilibrium tautomer lie far keto keto isomer solution process interconvert keto enol tautomer show figure 7.2 call enolization generally tautomerization extension aldehyde ketone chiral α carbon rapidly racemic mixture keto enol form interconvert phenomenon know figure 7.2 enolization tautomerization left keto form thermodynamically favor enol form right aldehyde ketone exist traditional keto form $C=O$ common enol tautomer enol = ene + ol deprotonated enolate form act nucleophile note

tautomer resonance structure differ connectivity atom enol important intermediate reaction aldehyde ketone enolate carbanion result deprotonation α - carbon strong base describe early common strong basis include hydroxide ion lithium diisopropyl amide LDA potassium hydride KH 1,3 dicarbonyl particularly acidic carbonyl delocalize negative charge form enolate carbanion form nucleophilic carbanion react readily electrophile example shortly aldol condensation example type reaction Michael addition show figure 7.3 carbanion attack α β -unsaturated carbonyl

addition show figure 7.3 carbanion attack α β - unsaturated carbonyl compound molecule multiple bond α - β carbon carbonyl figure 7.3

Michael addition base deprotonate α carbon make good nucleophile b carbanion attack double bond result Michael addition reaction proceed show resonance stabilization intermediate well understand resonance form molecule able predict specific location molecule reaction occur kinetic thermodynamic enolate give ketone different alkyl group α hydrogen form enolate form carbon carbon double bond carbonyl carbon substitute carbon show figure 7.4 equilibrium form dictate kinetic thermodynamic control reaction kinetically control product form rapidly stable form double bond substitute α carbon expect product form removal α hydrogen substitute α carbon offer steric hindrance thermodynamically control product form slowly stable feature double bond form substitute α carbon accordingly form removal α hydrogen substitute α carbon figure 7.4 kinetic thermodynamic enolate kinetic enolate form quickly stable thermodynamic enolate product favor different condition kinetic product favor reaction rapid irreversible low temperature strong sterically hinder base reaction reversible kinetic product revert original reactant react form thermodynamic product thermodynamic product favor high temperature slow reversible reaction weak enol tautomer carbonyl enamine tautomer imine imine compound contain C = N bond nitrogen imine bond alkyl group substituent tautomerization movement hydrogen double bond imine convert enamine show

figure 7.5 figure 7.5 enamination tautomerization right imine form thermodynamically favor enamine form left mcat concept check 7.2 assess understanding material 1 tautomer 2 tautomer aldehyde ketone thermodynamically favor keto enol 3 role enolate carbanion play organic reaction nucleophile electrophile oxidize agent reduce agent 4 follow reaction product kinetic enolate thermodynamic condition favor formation 7.3 aldol condensation chapter 7.3 able identify specie act nucleophile electrophile aldol describe condition reactant product involved retro aldol list reaction type associate aldol condensation aldol condensation vital reaction mcat reaction follow general mechanism nucleophilic addition carbonyl previously describe case aldehyde ketone act electrophile keto form nucleophile enolate form end result formation carbon carbon aldol condensation nucleophilic addition reaction

end result formation carbon carbon aldol condensation nucleophilic addition reaction see carbonyl compound carbonyl contain compound act nucleophile show figure 7.6 acetaldehyde ethanal treat catalytic base enolate ion produce enolate nucleophilic enol negatively charge figure 7.6 aldol condensation step 1 form aldol enolate ion form attack carbonyl carbon form aldol nucleophilic enolate ion react electrophilic carbonyl group acetaldehyde molecule key reaction specie flask product 3 hydroxybutanal example aldol molecule contain aldehyde alcohol functional group note mechanism call aldol reaction reactant ketone strong base high temperature dehydration occur e1 e2 mechanism kick water molecule form double bond produce α β unsaturated carbonyl show figure 7.7 figure 7.7 aldol condensation step 2 dehydration aldol oh remove water dehydration form double bond aldol condensation useful use type aldehyde ketone multiple aldehyde ketone easily control act nucleophile act electrophile mixture product result prevent molecule α hydrogen α carbon quaternary like reaction refer condensation reaction molecule join loss small molecule type reaction dehydration reaction small molecule lose retro aldol reaction bond break α β - carbon carbonyl form aldehyde ketone aldehyde ketone retro aldol reaction reverse reaction call retro aldol reaction push reaction retro aldol direction aqueous base add heat apply retro aldol reaction

useful break bond α β th carbon carbonyl show figure 7.8 reaction facilitate intermediate stabilize enolate form forward figure 7.8 retro aldol reaction bond α - β carbon carbonyl break mcat concept check 7.3 assess understanding material 1 follow reaction aldehyde treat catalytic base enolate ion form enolate react aldehyde molecule lead aldol condensation identify nucleophile electrophile aldol condensation 2 retro aldol reaction condition favor retro aldol 3 aldol condensation classify category reaction list reaction type provide short description second chapter

aldehyde ketone take look important resonance structure carbonyl aldehyde ketone allow high electronegativity oxygen atom carbonyl make carbonyl carbon electrophilic weaken ch bond α carbon deprotonation α carbon result enolate nucleophilic version carbonyl contain compound carbonyl carbon dictate electrophilic chemistry carbonyl α - carbon acidic hydrogen dictate nucleophilic chemistry carbonyl aldehyde ketone carbonyl contain compound course carboxylic acid derivative include ester anhydride amide chemistry control carbonyl critical difference aldehyde ketone carboxylic acid derivative absence presence leave group aldehyde ketone lack leave group carboxylic acid carboxylic acid derivative leave group vary degree stability chapter explore chemistry interesting group review content test knowledge critical thinking skill complete test like passage set online carbon adjacent carbonyl carbon term α carbon hydrogen attach α carbon call α hydrogen α hydrogen relatively acidic remove strong electron withdraw oxygen carbonyl weaken ch bond α carbon enolate result deprotonation stabilize resonance carbonyl ketone reactive nucleophile steric hindrance α carbanion destabilization presence additional alkyl group crowd transition step increase energy alkyl group donate electron density carbanion make stable aldehyde ketone exist traditional keto form $C=O$ common enol form $C=C-OH$ = double bond + hydroxyl tautomer isomer interconvert move hydrogen double bond keto enol form tautomer enol form deprotonate form enolate enolate good nucleophile michael addition enolate attack α β unsaturated carbonyl create bond kinetic enolate favor fast irreversible reaction low temperature strong

sterically hinder basis thermodynamic enolate favor slow reversible reaction high temperature weak small basis enamine tautomer imine like enol enamine aldol condensation aldehyde ketone act nucleophile electrophile result formation carbon carbon bond new molecule call aldol aldol contain aldehyde alcohol functional group nucleophile enolate form deprotonation electrophile aldehyde ketone form keto condensation reaction occur molecule aldol form dehydration reaction loss water molecule occur result α β unsaturated carbonyl retro aldol reaction reverse aldol

result α β unsaturated carbonyl retro aldol reaction reverse aldol condensation retro aldol reaction catalyze heat base reaction bond α - β carbon answers concept checks 1 α hydrogen aldehyde ketone acidic deprotonate easily inductive effect resonance effect electronegative oxygen atom pull electron density ch bond weaken deprotonate resonance stabilization negative charge α carbon carbonyl carbon electron withdraw carbonyl oxygen increase stability 2 α hydrogen aldehyde slightly acidic ketone electron donate characteristic second alkyl group ketone extra alkyl group destabilize carbanion slightly disfavor loss α hydrogen ketone compare aldehyde pentanal strong acid 3 pentanone low pka 3 steric hindrance reason aldehyde slightly reactive ketone additional alkyl group get way make high energy crowded intermediate 1 tautomer isomer interconvert movement hydrogen double bond 2 keto form thermodynamically favor 3 enolate carbanion act nucleophile 4 product double bond substitute α carbon kinetically control product product show right thermodynamically control product double bond form substitute α carbon product left kinetic enolate form rapidly interconvert thermodynamic form give time kinetic form favor fast irreversible reaction strong sterically hinder base low temperature thermodynamic form hand favor slow reversible reaction weak small basis high temperature 1 aldol condensation reaction enolate carbanion deprotonated aldehyde ketone act nucleophile keto form aldehyde ketone act electrophile 2 retro aldol reaction reverse aldol reaction instead bond α β carbon carbonyl break favor addition base heat reaction bond α β carbon carbonyl break 3 aldol condensation

condensation reaction molecule join form single molecule loss small molecule dehydration reaction molecule water lose nucleophile electrophile reaction nucleophile push electron pair form bond electrophile science mastery assessment mole aldehyde react mole alcohol nucleophilic addition reaction form product call hemiacetal hemiacetal oh group or group hydrogen atom r group attach carbon atom tautomerization interconversion isomer hydrogen double bond move keto enol tautomer aldehyde ketone common example tautomer

bond move keto enol tautomer aldehyde ketone common example tautomer see test day note equilibrium lie left keto form stable esterification formation ester carboxylic acid alcohol elimination c reaction reactant remove new multiple bond introduce dehydration d reaction molecule water eliminate reaction list answer choice example aldol condensation presence base α hydrogen abstract aldehyde form enolate ion $\text{CH}_3\text{CHCHO}]^-$. enolate ion attack carbonyl group aldehyde molecule $\text{CH}_3\text{CH}_2\text{CHO}$ form picture aldol keto enol equilibrium lie far keto keto form significantly thermodynamically stable enol form thermodynamic stability stem fact oxygen electronegative carbon keto tautomer put electron density oxygen enol tautomer enol tautomer thermodynamically stable high energy keto tautomer aldol condensation dehydration reaction molecule water lose nucleophilic addition reaction nucleophilic enolate attack bond carbonyl carbon hydrogen carbon carbonyl mean particularly acidic inductive effect oxygen atom carbonyl resonance stabilization anion carbonyl group high temperature weak base like NH_3 thermodynamic enolate favor reaction proceed slowly weak base give kinetic enolate time interconvert stable aldehydes generally reactive ketone additional alkyl group ketone sterically hinder alkyl group electron donate destabilize carbanion intermediate eliminate b d carbonyl carbon highly electrophilic alkane lack significant electrophilicity eliminate c α carbon deprotonate negative charge resonance stabilize electronegative carbonyl oxygen electron withdraw alkyl group actually electron donate destabilize carbanion intermediate invalidate statement ii answer choice nitrogen contain functional group enamine

tautomer imine imine contain double bond carbon nitrogen enamine contain double bond carbon amine succinaldehyde aldehyde ketone α hydrogen treat strong base like lithium diisopropylamide LDA form nucleophilic enolate carbanion aldol condensation contain main step step α - carbon aldehyde ketone deprotonate generate enolate carbanion carbanion attack aldehyde ketone generate aldol second step aldol dehydrate form double bond double bond α - β carbon molecule α β unsaturated carbonyl benzaldehyde lack α proton react base form nucleophilic enolate carbanion acetone act nucleophile b eliminate order

form nucleophilic enolate carbanion acetone act nucleophile b eliminate order perform reaction aldol condensation acetone react strong base strong acid order extract α - hydrogen form enolate anion act nucleophile example aldol condensation stop aldol formation dehydration aldol form strong base reaction halt addition acid butanal strong acid describe c likely deprotonate gain hydroxyl group methanol diethyl ether reactive diethyl ether strong base abstract α hydrogen eliminate reaction aldehyde methanal ethanal catalytic base form 3 hydroxypropanal dehydrate form propenal 3 hydroxybutanal nomenclature question need able draw mcat discern form ketone aldehyde single molecule hallmark reverse aldol reaction breakage carbon carbon bond form aldehyde ketone aldol condensation expect form single product combine aldehyde ketone dehydration reaction c release water molecule break apart large organic molecule small molecule nucleophilic attack d feature formation bond nucleophile electrophile expect break apart large organic molecule small molecule note simply note reactant product present reaction sufficient determine answer consult online resource additional general chemistry chapter 5 organic chemistry chapter 4 analyze organic reaction organic chemistry chapter 6 aldehyde ketone organic chemistry chapter 8 organic chemistry chapter 9 carboxylic acid derivative organic chemistry chapter 10 nitrogen- phosphorus contain compound pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal

strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly

match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question get correct ensure thinking match explanation review concept summary end chapter 1 compound expect decarboxylate 2 carboxylic acid high boiling point correspond alcohol primarily a. molecular weight increase additional carboxyl b. ph compound low c. acid salt soluble water

d. hydrogen bonding strong alcohol 3 following carboxylic acid acidic 4 following molecule classify soap 5 final product follow reaction 6 carboxylic acid react reagent addition acid form following compound 7 reduction carboxylic acid lithium aluminum hydride yield final product a. aldehyde b. ester c. ketone d. alcohol 8 follow true respect micelle a. interior hydrophilic b. structure hydrophobic c. compose short chain fatty acid polar head d. dissolve nonpolar molecule deep core 9 presence acid catalyst major product butanoic acid 1 pentanol b. butyl pentanoate d. pentyl butanoate 10 α hydrogen carboxylic acid i. acidic hydroxyl hydrogen ii acidic hydroxyl hydrogen iii

relatively acidic organic compound a. b. ii c. iii d. ii iii 11 reaction formic acid sodium borohydride yield final product a. aldehyde b. carboxylic acid c. ketone d. alcohol 12 intramolecular reaction 5 aminopentanoic acid nucleophilic acyl substitution result a(n d.

carboxylic acid 13 butanoic anhydride produce reaction butanoic acid following compound a. butanoic acid b. ethanoic acid 14 nucleophilic acyl substitution favor i. basic solution ii acidic solution iii leave group strong basis a. b. ii c. ii d. ii iii 15 reaction ammonia caprylic acid find coconut produce a(n d. water molecule chapter 8.1 description property 8.2 reaction carboxylic acid synthesis carboxylic acid nucleophilic acyl substitution content chapter relevant 9 question organic chemistry mcat chapter cover material follow aamc content 5d structure function reactivity biologically relevant carboxylic acid carbonyl hydroxyl group reactive organic molecule encounter test day chapter molecule react acid suggest nucleophile electrophile integral biological process carboxylic acid find soap oil preservative skin care product clothing importantly mcat amino acid carboxylic acid strong unpleasant odor example acetic acid ethanoic acid main ingredient vinegar propionic acid propanoic acid give swiss cheese smell butyric acid butanoic acid find rancid butter body odor make carboxylic acid interesting versatile acid like away proton particularly remain negative charge resonate oxygen atom make anion stable make carboxylic acid acidic compound encounter organic chemistry pka value 3 6 compare alcohol average pka 17 carboxylic acid excellent hydrogen bonding result large intermolecular force high boiling point finally carboxylic acid ubiquitous nature synthesize live organism 8.1 description property chapter 8.1 able explain underlie cause relatively high acidity carboxylic predict effect additional substituent acidity rank acidity comparable carboxylic acid base structure carboxylic acid contain carbonyl group hydroxyl group bond carbon bond oxygen atom oxidize functional group encounter organic chemistry

carboxylic acid terminal group iupac system nomenclature carboxylic acid name add suffix oic acid parent root carboxylic acid high priority functional group true carbonyl carbon carbon number 1 figure 8.1 show example figure 8.1 iupac name carboxylic acid like functional group carboxylic acid name common name note common prefix example figure 8.2 figure 8.2 iupac common name carboxylic acid common prefix aldehyde carboxylic acid form carbon acet propion cyclic carboxylic acid name list cycloalkane suffix carboxylic acid salt carboxylic acid

name begin cation follow acid ending oate replace oic acid typical example show figure 8.3
figure 8.3 cyclic carboxylic acid carboxylic acid salt finally dicarboxylic acid carboxylic acid
group end molecule common biological system small dicarboxylic acid oxalic acid carbon
straight- chain dicarboxylic acid malonic succinic glutaric adipic pimelic acid iupac name suffix
dioic acid ethanedioic acid propanedioic acid butanedioic acid pentanedioic acid hexanedioic
acid heptanedioic acid figure 8.4 show example figure 8.4 iupac common names dicarboxylic
physical property carboxylic acid similar aldehyde ketone

contain carbonyl group additional hydroxyl group permit carboxylic acid hydrogen bond
provide acidic hydrogen participate reaction carboxylic acid polar contain carbonyl group form
hydrogen bond contain hydrogen bond electronegative atom case hydroxyl oxygen carboxylic
acid display particularly strong intermolecular attraction hydroxyl oxygen carbonyl oxygen
participate hydrogen bonding result carboxylic acid tend form dimer pair molecule connect
hydrogen bond multiple hydrogen bond elevate boiling melting point carboxylic acid past
correspond alcohol boiling point increase increase molecular weight hydroxyl hydrogen
carboxylic acid acidic result negative charge remain hydrogen remove resonance stabilization
occur electronegative oxygen atom delocalization negative charge result stable carboxylate
anion demonstrate figure 8.5 figure 8.5 carboxylate anion stability negative charge
deprotonation stabilize resonance carboxylic acid polar form hydrogen bond acidity
resonance stabilization enhance addition electronegative group great ability delocalize stable
conjugate base easy proton leave strong acid carboxylic acid relatively acidic pka value order
4.8 ethanoic acid 4.9 propanoic acid mind acidic organic compound compare strong acid like
hcl $pK_a = 8.0$ $pK_a = 1.99$ remember low pK_a value indicate strong substituent carbon atom
near carboxyl group influence anion stability affect acidity group like NO_2 halide electron-
withdraw increase acidity contrast NH_2 OCH_3 electron- donate group destabilize negative
charge decrease acidity compound close substituent group carboxyl group great effect
dicarboxylic acid $COOH$ group influence $COOH$ group carboxylic acid electron withdraw

electronegative oxygen atom contain net result dicarboxylic acid acidic analogous monocarboxylic acid proton remove molecule carboxylate anion form result immediate decrease acidity remain carboxylic acid make sense second group deprotonate create doubly charge species negative charge repel instability second proton actually acidic hard remove analogous proton monocarboxylic acid β dicarboxylic acid dicarboxylic acid carboxylic acid position β carbon word carboxylic acid separate single carbon compound notable high acidity α hydrogen locate carbon carboxyl group pka 914 loss acidic hydrogen

locate carbon carboxyl group pka 914 loss acidic hydrogen atom produce carbanion stabilize electron withdraw effect carboxyl group show figure 8.6 figure 8.6 acidity α hydrogen β dicarboxylic acid note α hydrogen acidic hydroxyl hydrogen hydroxyl group leave protonate example demonstration purpose hydroxyl hydrogen acidic proton carboxylic acid 1,3 dicarbonyl α hydrogen note apply α hydrogen β diketone β ketoacid β dialdehyde molecule share 1,3 dicarbonyl structure show figure 8.7 figure 8.7 general structure 1,3 dicarbonyl compound mcat concept check 8.1 assess understanding material 1 cause relatively high acidity carboxylic acid 2 monocarboxylic acid dicarboxylic acid dicarboxylic acid deprotonate acidic 3 effect additional substituent acidity carboxylic 8.2 reaction carboxylic acid chapter 8.2 able recall reactant type acyl substitution reaction form major carboxylic acid derivative amide ester describe mechanism nucleophilic acyl substitution identify condition lead spontaneous decarboxylation carboxylic acid predict product acyl substitution reaction property carboxylic acid highly reactive number different category important reaction describe synthesis carboxylic acids describe early chapter

carboxylic acid prepare oxidation aldehyde primary alcohol oxidant dichromate salt $\text{Na}_2\text{Cr}_2\text{O}_7$ $\text{K}_2\text{Cr}_2\text{O}_7$ chromium trioxide CrO_3 potassium permanganate KMnO_4 show figure 8.8 oxidize agent work remember secondary tertiary alcohol oxidize carboxylic acid bond carbon figure 8.8 synthesis carboxylic acid oxidation method generate carboxylic acid include

organometallic reagent grignard reagent hydrolysis nitrile CN outside scope mcat
nucleophilic acyl substitution reaction carboxylic acid derivative participate proceed single
mechanism nucleophilic acyl substitution mechanism similar nucleophilic addition aldehyde
ketone discuss chapter 6 7 mcat organic chemistry review key difference focus existence leave
group carboxylic acid derivative case open carbonyl nucleophilic attack form tetrahedral
intermediate carbonyl reform kick leave group reaction show figure 8.9 figure 8.9 nucleophilic
acyl substitution step 1 nucleophilic addition step 2 elimination leave group reformation
carbonyl reaction nucleophilic molecule replace leave group acyl derivative acyl derivative
encompass molecule carboxylic acid derive carbonyl include carboxylic acid amide ester
anhydride reaction favor good leave group remember weak basis conjugate basis strong acid
good leave group reaction favor acidic basic condition alter reactivity electrophile carboxylic
acid convert amide incoming nucleophile ammonia NH_3 amine show figure 8.10 carry acidic
basic solution drive reaction forward figure 8.10 formation amide nucleophilic acyl learn acyl
derivative organic chemistry class acyl halide nitrile official content list mcat restrict focus
carboxylic acid amide ester anhydrides.ffi amides name replace oic acid suffix amide parent
carboxylic acid alkyl group nitrogen place beginning prefix n.

amide exist resonance state delocalization electron occur oxygen nitrogen atom show figure
8.11 figure 8.11 resonance amides resonance carbonyl lone pair nitrogen stabilize bond
restrict motion amide cyclic call lactam name replace oic acid lactam name indicate specific
carbon bond cyclization compound example show figure 8.12 figure 8.12 example lactams
protonate $\text{C}=\text{O}$ make electrophilic carbon ripe nucleophilic attack ester hybrid carboxylic acid
ether ROR' react carboxylic acid alcohol acidic condition

show figure 8.13 esterification condensation reaction water product acidic solution carbonyl
oxygen protonate enhance polarity bond place additional positive charge carbonyl carbon
increase susceptibility nucleophilic attack condensation reaction occur rapidly primary alcohol

figure 8.13 esterification reaction carboxylic acid alcohol ester name manner salt carboxylic acid example ester show reaction figure 8.13 common ethyl acetate iupac ethyl ethanoate ester cyclic call lactone name replace oic acid lactone example show figure 8.14 figure 8.14 example lactones anhydride form condensation carboxylic acid name replace acid end parent carboxylic acid anhydride cyclic linear example condensation molecule ethanoic acid form ethanoic anhydride show figure 8.15 like reaction anhydride formation occur nucleophilic acyl substitution figure 8.15 synthesis anhydride carboxylic acid carboxylic acid reduce primary alcohol use lithium aluminum hydride LiAlH_4 aldehyde intermediate form course reaction reduce alcohol reaction occur nucleophilic addition hydride carbonyl group reaction mechanism show figure 8.16 figure 8.16 reduction carboxylic acid primary alcohol reaction occur nucleophilic addition hydride proceed aldehyde intermediate carboxylic acid reduce LiAlH_4 reactive lithium aluminum hydride strong reduce agent successfully reduce carboxylic acid gentle reduce agent like sodium borohydride NaBH_4 strong reduce carboxylic acid decarboxylation common biochemical pathway body pyruvate dehydrogenase complex describe chapter 10 mcat biochemistry review carry decarboxylation pyruvate help form acetyl coa feed citric acid cycle decarboxylation describe complete loss carboxyl group carbon dioxide common way getting rid carbon parent chain 1,3 dicarboxylic acid β keto acid spontaneously decarboxylate heat condition carboxyl group lose replace hydrogen electrophile nucleophile molecule reaction proceed six- membered ring transition state show figure 8.17 enol initially form destruction ring tautomerize stable keto form figure 8.17 decarboxylation carboxylic acid loss CO_2 intramolecular reaction proceed six- membered ring transition state product tautomerize enol stable keto form long chain carboxylic acid react sodium potassium hydroxide salt form process call saponification occur mix fatty acid lye

salt form process call saponification occur mix fatty acid lye sodium potassium hydroxide result formation salt know soap soap solvate nonpolar organic compound aqueous solution contain nonpolar tail polar carboxylate head show figure 8.18 figure 8.18 carboxylic acid salt

soap place aqueous solution soap molecule arrange spherical structure call micelle show figure 8.19 polar head face outward solvate water nonpolar hydrocarbon chain orient inside sphere protect solvent nonpolar molecule grease dissolve hydrocarbon interior spherical micelle micelle dissolve water polarity exterior surface formation phospholipid bilayer micelle liposome contingent bipolar nature carboxylic acid long hydrocarbon chain structure discuss chapter 5 mcat biochemistry review figure 8.19 soap micelle polar head interact hydrophilic environment nonpolar tail orient interior micelle mcat concept check 8.2

assess understanding material 1 derivative list nucleophile form derivative acyl substitution reaction cyclic form functional group form reaction cyclic form 2 briefly describe mechanism nucleophilic acyl substitution reaction 3 result butanoic acid react sodium borohydride lithium aluminum hydride lithium aluminum hydride 4 condition carboxylic acid spontaneously acid important concept mcat test general chemistry organic chemistry biochemistry underlie concept subject stable conjugate base likely proton leave stability determine factor periodic trend electronegativity induction size anion resonance understand effect major key success test day reaction carboxylic acid particular dictate polarity carbonyl group conjunction ability hydroxyl group act leave group allow diversity reaction nucleophilic acyl substitution reduction lithium aluminum hydride decarboxylation saponification review content test knowledge critical thinking skill complete test like passage set online description property

carboxylic acid contain carbonyl hydroxyl group connect carbon terminal group carboxylic acid indicate suffix oic acid salt name suffix oate dicarboxylic acid dioic acid carboxylic acid polar hydrogen bond result high boiling point exist dimer solution acidity carboxylic acid enhance resonance oxygen atom acidity enhance substituent electron- withdraw decrease substituent electron- β dicarboxylic acid like 1,3 dicarbonyl compound α hydrogen highly acidic reaction carboxylic acids carboxylic acid oxidation primary alcohol aldehyde oxidize agent like potassium permanganate KMnO_4 dichromate salt $\text{Na}_2\text{Cr}_2\text{O}_7$ $\text{K}_2\text{Cr}_2\text{O}_7$ chromium

nucleophilic acyl substitution common reaction carboxylic nucleophile attack electrophilic carbonyl carbon open carbonyl form tetrahedral intermediate carbonyl reform kick leave group nucleophile ammonia amine amide form amide give suffix amide cyclic amide call nucleophile alcohol ester form ester give suffix oate cyclic ester call lactone nucleophile carboxylic acid anhydride form linear cyclic anhydride give suffix carboxylic acid reduce primary alcohol strong reduce agent like lithium aluminum hydride LiAlH_4 aldehyde intermediate form reduce sodium borohydride NaBH_4 common reduce agent organic reaction strong reduce β dicarboxylic acid β keto acid undergo spontaneous decarboxylation heat lose carbon carbon dioxide reaction proceed membered cyclic intermediate mix long chain carboxylic acid fatty acid strong base result formation salt soap process call soap contain hydrophilic carboxylate head hydrophobic alkyl chain tail soap organize hydrophilic environment form micelle micelle dissolve nonpolar organic molecule interior solvate water exterior shell

hydrophilic answers concept checks 1 carboxylic acid particularly acidic electron- withdraw oxygen atom functional group high stability carboxylate anion resonance stabilize delocalization electronegative oxygen atom 2 dicarboxylic acid acidic second carboxyl group electron withdraw contribute high stability anion loss hydrogen monocarboxylic acid acidic deprotonated dicarboxylic acid carboxylate anion electron donate destabilize product second deprotonation step result 3 electron withdraw substituent anion stable increase acidity electron donate substituent hand destabilize anion cause carboxylic acid acidic close substituent carboxylic acid molecule strong effect form reaction cyclic ammonia NH_3 amine carboxylic acid 2 nucleophilic acyl substitution substitution attack nucleophile leave group acyl compound include carboxylic acid amide ester anhydride nucleophile attack open carbonyl form tetrahedralthff intermediate carbonyl reform kick leave group reaction favor acidic basic condition 3 sodium borohydride strong reduce carboxylic acid reaction lithium aluminum hydride strong reduce carboxylic acid primary alcohol 4 1,3 dicarboxylic acid spontaneously

decarboxylate heat stable cyclic intermediate step science mastery assessment compound β keto acid carbonyl functional group β - position carboxyl group decarboxylation occur β keto acid β dicarboxylic acid form cyclic transition state permit simultaneous hydrogen transfer loss carbon dioxide b diketone single carboxyl group c γ - δ dicarboxylic acid respectively decarboxylate difficulty boiling point compound depend strength attractive force molecule alcohol carboxylic acid major form intermolecular attraction hydrogen bonding hydrogen bonding strong carboxylic acid compare alcohol carboxylic acid polar carbonyl contribute hydrogen bonding addition hydroxyl group strong hydrogen bond elevate boiling point carboxylic acid compare alcohol boiling point depend molecular weight case difference molecular weight insignificantff compare effect hydrogen bonding b c true explain difference boiling point acidity carboxylic acid significantly increase presence highly electronegative functional group electron withdraw effect increase stability carboxylate anion favor proton dissociation effect increase number electronegative group chain increase increase distance acid functionality electronegative group decrease answer halogen bond small

distance acid functionality electronegative group decrease answer halogen bond small distance carboxyl group compare answer soap salt carboxylate anion long hydrocarbon tail b salt anionic compound d sodium acetate salt contain long hydrocarbon tail need consider soap jones reagent chromium trioxide aqueous sulfuric acid oxidize agent oxidize primary alcohol directly carboxylic acid reagent strong oxidant aldehyde incorrect remember pyridinium chlorochromate pcc common oxidize agent convert alcohol aldehyde progress carboxylic acid d dicarboxylic acid form functional group end molecule reagent attack attack inert alkane c represent reduction oxidation carboxylic acid convert alkene reagent ester form nucleophilic acyl substitution reaction alcohol amide b form nucleophilic acyl substitution reaction ammonia alcohol d form variety reduce agent notably lithium aluminum hydride form alkene carboxylic acid reduce alcohol transform alkene elimination second step addition lithium aluminum hydride LiAlH_4 lah strong reduce agent lah completely reduce carboxylic acid

primary alcohol aldehyde intermediate product reaction incorrect compound create reduction
carboxylic acid micelle self assemble aggregate soap interior compose long hydrocarbon fatty
tail dissolve nonpolar molecule outer surface cover carboxylate group make overall structure
water soluble soap general salt long chain hydrocarbon carboxylate head group reaction
describe esterification nucleophilic oxygen atom 1 pentanol attack electrophilic carbonyl
carbon butanoic acid ultimately displace water form pentyl butanoate acid catalyst regenerate
1 pentanol release proton reverse carbon chain consider butyl tail esterifying group ether
form condition b c α hydrogen carboxylic acid relatively acidic far organic compound
resonance stabilization hydroxyl hydrogen significantly acidic able share negative charge
result

deprotonation electronegative oxygen atom

functional group reaction formic acid simple carboxylic acid sodium borohydride mild reduce
agent result reaction result maintenance carboxylic acid sodium borohydride mild reduce
carboxylic acid produce primary alcohol lithium aluminum hydride strong reduce agent 5
aminopentanoic acid contain carboxylic acid amine molecule undergo intramolecular
nucleophilic acyl substitution form cyclic amide molecule call lactam lactone b cyclic ester
amide butanoic anhydride anhydride butane r group anhydride produce reaction carboxylic
acid loss water molecule butanoic anhydride produce reaction molecule butanoic acid
nucleophilic acyl substitution favor basic solution make nucleophile nucleophilic acidic
solution make electrophile electrophilic good leave group strong basis good leave group weak
basis base caprylic acid carboxylic acid reaction carboxylic acid ammonia NH_3 produce amide
option list instead look type reaction occur production amide carboxylic acid ammonia occur
condensation reaction molecule water remove leave group consult online resource additional
biochemistry chapter 1 amino acid peptide protein biochemistry chapter 5 lipid structure
function organic chemistry chapter 1 organic chemistry chapter 4 analyze organic reaction

organic chemistry chapter 6 aldehyde ketone organic chemistry chapter 9 carboxylic acid derivative carboxylic acid derivative pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read correspond subchapter

minute review question quiz miss include quick read correspond subchapter relevant content subchapter question review question get correct ensure thinking match explanation review concept summary end chapter 1 follow good method produce a. react propanoic acid methanol presence b. react methanoic acid propanol presence c. react propanoic anhydride aqueous base d. react propanoic acid aqueous base 2 product(s reaction 3 following undergo fischer esterification 4 acyl compound list contain six- membered ring b. cyclohexane carboxylic acid d. anhydride form intramolecular ring closure 5 follow reactive a. propyl ethanoate b. propanoic acid d. propanoic anhydride 6 succinic anhydride show form succinic acid butanedioic acid a. catalytic acid b. catalytic base 7 following react readily carboxylic acid form amide 8 propanamide treat water product(b. propanoic acid c. equal concentration propanamide propanoic acid d. propyl propanoate 9 β lactam i. cyclic form reactive type carboxylic acid ii reactive straight chain counterpart iii molecule high level ring strain a. b. ii c. ii iii d. ii iii

10 acid catalyze conversion propyl ethanoate benzyl ethanoate likely 11 reaction show important breakdown polypeptide favor condition a. mild heat b. acid environment c. anhydrous environment d. nonpolar solvent 12 positive charge molecule show great stability positive charge straight chain alkane version molecule property explain effect a. steric hindrance b. nitrogen electronegativity 13 molecule show i. synthesizable γ hydroxycarboxylic acid ii lactone iii form ester a. b. ii c. ii iii d. ii iii 14 reactant combine butanol form butyl a. CH_3CO_2 catalytic acid b. $\text{CH}_3\text{CH}_2\text{CO}_2$ catalytic acid c. $\text{CH}_3\text{CH}_2\text{CONH}_2$ catalytic acid d. CH_3CONH_2 catalytic acid 15 esterification reaction carry water a. carboxylic acid ester generally insoluble water b. polar nature water overshadow polar nature leave group c. extensive hydrogen bonding water interfere nucleophilic addition mechanism d. water molecule

hydrolyze desire product parent carboxylic acid answer key follow page carboxylic acid derivative chapter 9.1 amide ester anhydride 9.2 reactivity principle relative reactivity derivative strain cyclic derivative 9.3 nucleophilic acyl substitution reaction hydrolysis amide content chapter relevant 11 question organic chemistry mcat chapter cover material following aamc content 1a structure function protein constituent amino 5d structure function reactivity biologically relevant see previous chapter carbonyl susceptible attack water amine carbonyl contain compound enol enolate form reaction result formation carboxylic acid derivative focus chapter describe carboxylic acid derivative appear mcat amide ester anhydride molecule replace $-\text{OH}$ carboxyl group leave group $-\text{NR}_2$ $-\text{OR}$ $-\text{OCOR}$ th respectively react similar way carboxylic acid functional group critical biochemical process condensation reaction molecule combine form loss small molecule water case carboxylic acid derivative form mechanism 9.1 amide ester anhydride chapter 9.1 able apply rule name carboxylic acid derivative include nomenclature cyclic version molecule describe condensation reaction amide ester anhydride carboxylic acid derivative form condensation reaction carboxylic acid reaction combine molecule lose small molecule case small molecule water create hydroxyl group carboxylic acid hydrogen associate carboxylic acid derivative describe section focus relevant nucleophile form

derivative nomenclature functional group section focus directly relative reactivity compound
amide compound general formula $RCONR_2$ name replace oic acid suffix amide alkyl substituent
nitrogen atom list prefix location specify letter n-.

figure 9.1 show example figure 9.1 name amides amides form condensation reaction
carboxylic acid derivative ammonia amine amide generally synthesize reaction carboxylic acid
derivative ammonia amine note loss hydrogen nucleophile require reaction place primary
secondary amine undergo reaction cyclic amide call lactam name accord carbon atom bond
nitrogen β lactam contain bond β - carbon nitrogen γ lactam contain bond γ carbon nitrogen
forth structure lactam show figure figure 9.2 example lactams amides participate hydrogen
bonding depend number alkyl group bond boiling point low level boiling point carboxylic acid
ester dehydration synthesis product carboxylic acid derivative alcohol name place esterifying
group substituent bond oxygen prefix suffix oate replace oic acid example show figure 9.3
mention chapter ethyl acetate derive condensation acetic acid ethanol call ethyl ethanoate
accord iupac nomenclature figure 9.3 name esters esters form condensation reaction
carboxylic acid anhydride alcohol acidic condition mixture carboxylic acid alcohol condense
ester reaction call fischer esterification show figure 9.4 ester obtain reaction anhydride figure
9.4 fischer esterification cyclic ester call lactone name manner lactam precursor acid molecule
include example show figure 9.5 figure 9.5 example lactone lack hydrogen bonding ester
usually low boiling point related carboxylic acid triacylglycerol storage form fat body ester
long- chain carboxylic acid fatty acid glycerol 1,2,3 propanetriol saponification process fat
hydrolyze basic condition produce soap saponification triacylglycerol show figure 9.6
subsequent acidification soap regenerate fatty acid figure 9.6 saponification triacylglycerol
treat triacylglycerol $NaOH$ produce fatty acid salt soap glycerol anhydride usually form
condensation reaction anhydride call acid anhydride condensation dimer carboxylic acid
molecule general formula $RC(O)OC(O)R$. symmetrical anhydride name substitute

word anhydride word acid carboxylic acid anhydride asymmetrical simply chain alphabetically follow anhydride show figure 9.7 phthalic succinic anhydride cyclic anhydride arise intramolecular condensation dehydration diacid structure need memorize recognize cyclic anhydride figure 9.7 name anhydride acid anhydride synthesize mention previously condensation reaction carboxylic acid molecule water lose condensation show figure 9.8 figure 9.8 synthesis anhydride carboxylic acid condensation molecule carboxylic acid come lose molecule water formation certain cyclic anhydride form simply heat carboxylic acid show figure 9.9 reaction drive forward increase stability newly form ring anhydride five- six-membered ring easily anhydride formation hydroxyl group —COOH act nucleophile attack carbonyl —COOH figure 9.9 intramolecular anhydride formation heat increase stability newly form ring drive intramolecular ring formation reaction forward anhydride high boiling point relate carboxylic acid base solely great weight mcat concept check 9.1 assess understanding material 1 carboxylic acid derivative list relevant nucleophile react carboxylic acid generate derivative derivative suffix derivative cyclic form form COOH 2 definition condensation reaction 9.2 reactivity principle chapter 9.2 able order carboxylic acid derivative include anhydride ester amide base reactivity explain relatively high rate hydrolysis β lactam identify property carboxylic acid derivative cause reactivity differ consider reactivity carboxylic acid derivative nucleophilic attack anhydride reactive follow ester carboxylic acid amide regardless carboxylic acid derivative hand rule govern reactivity molecule relative reactivity derivative nucleophilic substitution reaction reactivity carbonyl determine substituent anhydride reactive follow ester essentially tie carboxylic acid finally amide explain structure molecule anhydride resonance stabilization electron withdraw oxygen atom electrophilic ester comparison lack electron-withdraw carbonyl oxygen slightly reactive finally amide electron donate amino group reactive steric hindrance worth keep mind consider reactivity steric hindrance describe reaction proceed size substituent good example $\text{S}_\text{N}2$ reaction occur tertiary carbon effect sound detrimental advantage example want push reaction $\text{S}_\text{N}1$ direction $\text{S}_\text{N}2$ use tertiary substrate way synthetically creation protect

sn1 direction sn2 use tertiary substrate way synthetically creation protect group see chapter 6
mcats organic chemistry review aldehyde ketone readily react strong reduce agent like LiAlH_4
prevent react aldehyde ketone equivalent alcohol produce nonreactive acetal ketal complete
rest desire reaction regenerate carbonyl aqueous acid context carboxylic acid derivative size
substitution leave group affect ability nucleophile access carbonyl carbon affect reactivity
derivative nucleophilic acyl substitution steric hindrance control reaction occur molecule
protect group hard nucleophile oxidize agent reduce agent access react electronic effect
consider organic chemistry mcats come play consider carboxylic acid derivative induction refer
distribution charge σ bond electron attract atom electronegative generate dipole σ bond
electronegative atom acquire slightly positive charge electronegative atom acquire slightly
negative charge effect relatively weak get increasingly weak move away molecule
electronegative atom effect responsible dipole character carbonyl group increase dipole
character susceptibility nucleophilic attack carboxylic acid contain additional oxygen atom
leave group explain overall relative reactivity anhydride ester amide nucleophilic attack
anhydride electron withdraw group leave significant partial positive charge electrophilic
carbon effect small amide nitrogen electronegative oxygen dipole strong resonance
conjugation affect reactivity molecule conjugation refer presence alternate single multiple
bond setup imply atom involve bond sp^2 - sp hybridize unhybridize p orbital p orbital align
delocalize π electron resonance form cloud electron density plane molecule type electron
sharing commonly demonstrate benzene show figure 9.10 figure 9.10 conjugation benzene
parallel unhybridized p orbital combine form delocalize electron cloud plane molecule
carbonyl contain compound conjugation establish carbonyl group α β unsaturated carbonyl
enone common example show figure 9.11 figure 9.11 conjugation carbonyl contain induction
distribution charge σ bond conjugation resonance powerful effect occur system alternate
single multiple bond type electron sharing make stable compound compound multiple
resonance structure characteristic allow stabilization positive charge nucleophile bond make

compound susceptible nucleophilic attack antibiotic family contain

nucleophile bond make compound susceptible nucleophilic attack antibiotic family contain β lactam include penicillin family cephalosporin carbapenem monobactam bacteria develop β lactamase break β lactam ring resistance mechanism antibiotic β - lactam give β lactamase inhibitor increase strain cyclic derivative lactam lactone cyclic amide ester respectively certain lactam lactone reactive hydrolysis contain strain β lactam example membered cyclic amide highly reactive significant ring strain membered ring torsional strain eclipse interaction angle strain compress normal sp^3 angle 109.5° molecule core structure antibiotic family show figure 9.12

ring strain reactivity increase fusion second ring membered structure β lactam force trigonal pyramidal bond geometry nitrogen atom ring reduce resonance make hydrolysis likely figure 9.12 penicillin β lactam contain antibiotic mcat concept check 9.2

assess understanding material 1 rank follow molecule decrease reactivity or— acetamide acetic anhydride ethyl acetate 2 responsible increase rate hydrolysis β lactam 3 property account difference reactivity see anhydride ester amide nucleophile 9.3 nucleophilic acyl substitution chapter 9.3 able describe mechanism transesterification reaction explain strong acid strong base condition impact mechanism hydrolysis amide identify nucleophile electrophile nucleophilic acyl substitution reaction seemingly infinite number reaction carboxylic acid derivative participate small group reaction appear mcat observe reaction common carboxylic acid carbonyl- contain compound property discuss determine way reaction proceed carboxylic acid nucleophilic acyl substitution involve nucleophilic attack carbonyl carbon displacement leave group carboxylic acid derivative participate nucleophilic substitution reaction different relative rate specifically anhydride reactive nucleophile follow ester finally amide example formation amide nucleophilic substitution reaction ammonia

carboxylic acid derivative example show figure 9.13 nucleophilic substitution reaction cleavage reaction split anhydride reaction ammonia act nucleophile carbonyl carbon act electrophile carboxylic acid leave group figure 9.13 nucleophilic acyl substitution anhydride amide carboxylic acid alcohol act nucleophile anhydride nucleophilic substitution reaction result formation ester carboxylic acid show figure 9.14 figure 9.14 nucleophilic acyl substitution anhydride ester carboxylic acid anhydride revert carboxylic acid expose water show figure 9.15 reaction useful anhydride symmetric form mixture figure 9.15 nucleophilic acyl substitution anhydride alcohol act nucleophile displace esterify group ester process call transesterification reaction ester simply transform show figure 9.16 figure 9.16 nucleophilic acyl substitution transesterification different alcohol chain swap esterifying group position hydrolysis amides amides hydrolyze highly acidic condition nucleophilic substitution acidic condition allow carbonyl oxygen protonate make molecule susceptible nucleophilic attack water molecule product reaction carboxylic acid ammonia surprise reverse condensation reaction amide form reaction show figure 9.17 figure 9.17 nucleophilic acyl substitution amide carboxylic acid strong acid base need catalyze hydrolysis amide normally stable hydrolysis occur condition basic reaction similar acid catalyze reaction carbonyl oxygen

occur condition basic reaction similar acid catalyze reaction carbonyl oxygen protonate nucleophile hydroxide ion product reaction deprotonated carboxylate anion mcat concept check 9.3 assess understanding material 1 formation amide ammonia anhydride serve nucleophile electrophile 2 product transesterification reaction isopropyl butanoate ethanol 3 strongly acidic strongly basic condition catalyze hydrolysis amide strongly acidic condition strongly basic condition sure notice chapter cover reaction happen wide variety context mcat test maker want memorize possible reaction simply want truly understand trend underlie reason reaction sure know order reactivity derivative anhydride amide learn special reaction ester amide study amide pay right away explore amino acid nitrogen- phosphorus contain compound review content test knowledge critical thinking skill complete test like passage set

online amide esters anhydrides amides condensation product carboxylic acid ammonia amine
amide give suffix amide alkyl group substitute amide write beginning prefix n-.

cyclic amide call lactam lactam name greek letter carbon form bond nitrogen β lactam γ
lactam ester condensation product carboxylic acid alcohol ester give suffix oate esterifying
group write substituent number cyclic ester call lactone lactone name number carbon ring
greek letter carbon form bond oxygen α acetolactone β - propiolactone triacylglycerol form fat
storage include ester bond glycerol fatty acid saponification breakdown fat strong base form
soap salt long- chain carboxylic acid anhydride condensation dimer carboxylic acid symmetric
anhydride name parent carboxylic acid follow anhydride asymmetric anhydride name list
parent carboxylic acid alphabetically follow cyclic anhydride synthesize heat dioic acid five-
membered ring generally stable nucleophilic substitution reaction anhydride reactive ester
reactive amide steric hindrance describe reaction proceed significantly slow substituent crowd
reactive site protect group acetal increase steric hindrance decrease reactivity particular
portion molecule induction refer uneven distribution charge σ bond difference
electronegativity electronegative group carbonyl contain compound great reactivity
conjugation refer presence alternate single multiple bond create delocalize π electron cloud
plane molecule electron experience resonance unhybridized p orbital increase stability
conjugated carbonyl- contain compound reactive stabilize transition state increase strain
molecule reactive β lactam prone hydrolysis significant ring strain ring strain torsional strain
eclipse interaction angle strain compress bond angle 109.5° nucleophilic acyl substitution
reaction carboxylic acid derivative undergo nucleophilic substitution reaction rate determine
anhydride cleave addition nucleophile addition ammonia amine result amide addition alcohol
result ester carboxylic acid addition water result carboxylic acid transesterification exchange
esterify group ester attack nucleophile alcohol amide hydrolyze carboxylic acid strongly acidic
basic condition attack nucleophile water answer concept check form ammonia 2 condensation
reaction molecule join loss small molecule example section small molecule lose water 1

anhydride reactive nucleophile follow ester amide acetic anhydride reactive follow ethyl acetate finally acetamide 2 β lactam susceptible hydrolysis high level ring strain

acetamide 2 β lactam susceptible hydrolysis high level ring strain torsional strain eclipse interaction angle strain deviation 109.5° 3 electronic effect like induction effect reactivity carbonyl functional group difference resonance explain increase reactivity anhydride particular steric effect significant depend specific leaving group present 1 ammonia act nucleophile carbonyl carbon anhydride serve electrophile 2 transesterification exchange esterify group ester reaction require alcohol nucleophile case ethyl group ethanol replace isopropyl group isopropyl butanoate result ethyl butanoate 2 propanol 3 strongly acidic condition catalyze amide hydrolysis protonate oxygen carbonyl increase electrophilicity carbon make susceptible nucleophilic attack strongly basic condition greatly increase concentration OH^- act nucleophile amide carbonyl science mastery assessment methyl propanoate ester synthesize react carboxylic acid alcohol presence acid parent chain propanoate esterifying group methyl group b reverse nomenclature form propyl methanoate reaction list form ester question ask product ammonia react acetic anhydride recall chapter amide carboxylic acid form carboxylic acid acid environment ammonia base react form ammonium carboxylate show fischer esterification involve react carboxylic acid alcohol acid catalyst condition carbonyl carbon open attack nucleophilic alcohol rate reaction depend steric hindrance carbonyl carbon room alcohol approach carboxylic acid substrate b c d crowding carbonyl carbon decrease reactivity additional alkyl group choice donate electron density carbonyl carbon make slightly electrophilic question require knowledge nomenclature cyclic molecule δ lactam bond nitrogen fourth carbon away carbonyl carbon ring element nitrogen carbonyl carbon carbon cyclohexane carboxylic acid b cyclohexane six-membered cycloalkane anhydride form pentanedioic acid d carbon parent chain oxygen atom close ring mean element γ -butyrolactone element contain bond ester oxygen carbon away carbonyl carbon element oxygen carbonyl carbon carbon r group steric influence case rely solely electronic

effect take account reactivity nucleophile high anhydride follow ester carboxylic acid amide anhydride particularly cyclic anhydride form spontaneously dicarboxylic acid heat methylamine react readily form

anhydride form spontaneously dicarboxylic acid heat methylamine react readily form amide substitute nucleophile easy nucleophile attack carbonyl carbon form amide fact triethylamine b able form amide hydrogen lose attach carbonyl carbon propanamide amide reactive carboxylic acid derivative discuss chapter strong acid base propanamide able undergo nucleophilic acyl substitution reaction occur β lactam amide form membered ring amide generally reactive type carboxylic acid derivative β lactam experience significant ring strain eclipse interaction torsional strain angle strain susceptible hydrolysis linear form molecule far tell convert ester reaction fact reaction acid catalyze confirm suspicion transesterification reaction reaction hydrolysis amide favor strong acid acid protonate carbonyl oxygen increase electrophilicity carbonyl carbon allow water serve nucleophile attack bond hydrolyze molecule molecule stable positive charge straight- chain alkane conjugation benzene ring permit delocalization charge resonance induction c effect stabilization molecule effectfi significant impact have conjugate system electronegativity nitrogen b primarily affect induction vital component stabilization molecule positive charge oxygen electronegative steric hindrance affect reactivity molecule ability stabilize charge molecule show γ nonalactone cyclic ester call lactone molecule arise intramolecular attack γ - order prepare butyl acetate butanol need perform nucleophilic acyl substitution reaction product ester need start reactant reactive ester reaction proceed anhydride reactive ester amide reactive eliminate c d reaction propanoic anhydride b result butyl propanoate presence water esterification reaction likely revert desire ester carboxylic acid small carboxylic acid like formic acetic acid easily dissolve water eliminate polarity water play little role affect leave group water increase electrophilicity carbonyl carbon protonate carbonyl oxygen eliminate b finally nucleophilic substitution mechanism nucleophilic addition mechanism mention c hydrogen bonding likely augment reaction

consult online resource additional biochemistry chapter 11 lipid amino acid metabolism
organic chemistry chapter 1 organic chemistry chapter 3 organic chemistry chapter 4 analyze
organic reactions organic chemistry chapter 6 aldehyde ketone organic chemistry chapter 8
nitrogen-

chemistry chapter 6 aldehyde ketone organic chemistry chapter 8 nitrogen- phosphorus- pre
med know feeling content know mcat know important high yield badge book help identify
important topic science mastery assessment tool mcat prep arsenal quiz take online resource
guidance help ensure spend appropriate time chapter base personal strength weakness worry
skip mean study later prep complete length test uncover specific piece content need review
come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read
chapter limited note follow review quiz question ensure understand solve answer 8–11
question correctly spend 20–40 minute review quiz question begin question miss read note
correspond subchapter question answer correctly ensure thinking match explanation
understand choice correct incorrect answer 12–15 question correctly spend 20 minute review
question quiz miss include quick read correspond subchapter relevant content subchapter
question review question get correct ensure thinking match explanation review concept
summary end chapter 1 following amino acid I- c. glutamic acid 2 following form methyl
bromide react phthalimide follow hydrolysis 3 following amino acid contain(s sulfur a. b. iii c. ii
iii d. ii iii 4 nylon polyamide produce hexanediamine substance x. substance x probably a(n b.

carboxylic acid 5 intermediate strecker synthesis include following nitrogen contain functional
group a(n 6 biochemist synthesize valine show strecker synthesis following carbonyl contain
compound appropriate start reactant 7 c n bond amide planar i. partial double bond character
ii sp³ hybridize iii sp² character a. b. ii c. ii d. iii 8 primary method amino acid synthesis result
optically active solution a. strecker synthesis b. gabriel synthesis c. strecker gabriel synthesis
d. strecker gabriel synthese 9 gabriel synthesis phthalimide serve c. leaving group 10

following reaction type occur gabriel b. nucleophilic substitution 11 physiological ph form phosphoric acid 12 aqueous solution pyrophosphate likely a. form insoluble complex b. stable inert c. degrade inorganic phosphate d. decrease polarity solvent 13 charge aspartic acid ph 7 d. information answer question 14 bond create nucleotide triphosphate dna synthesis small molecule release reaction b. inorganic phosphate d. organic phosphate 15 hydrogen phosphoric acid pka value a. allow high buffering capacity small ph range b. allow moderate buffering capacity large ph range c. allow low buffering capacity small ph range

d. allow buffering nitrogen- phosphorus- chapter 10.1 amino acid peptide protein 10.2 synthesis α amino acid 10.3 phosphorus contain compound content chapter relevant 4 question organic chemistry mcat chapter cover material following aamc content 1a structure function protein constituent amino 5d structure function reactivity biologically relevant organic chemistry study carbon contain molecule see carbon element play role organic molecule functional group explore point include hydrogen oxygen element 93 composition human body weight atom contribute biomolecule nitrogen comprise 3.2 body weight chapter look biologically important molecule contain nitrogen phosphorus addition amide explore previous chapter amino acid contain nitrogen building block protein discuss depth chapter 1 mcat biochemistry review chapter review structure focus laboratory method synthesize amino acid finally turn attention phosphorus contain molecule transfer energy store genetic information note biological molecule amino acid protein dna call chapter low percentage rating chapter apply non biochemical reaction molecule mastery molecule biological setting important test day success content find chapter 1 2 3 6 7 mcat biochemistry review 10.1 amino acid peptide chapter 10.1 able identify functional group amino acid amphoteric recall mechanism form cleave peptide bond explain c n bond amide planar recall unique property glycine amino acid dipolar molecule come condensation reaction form peptide large fold peptide chain amino acid contain amino group carboxyl group attach single carbon atom α carbon substituent α - carbon hydrogen atom chain refer r group structure show figure 10.1

figure 10.1 amino acid structure α carbon different group chiral stereogenic center glycine simple amino acid exception rule R group hydrogen atom naturally occur amino acid eukaryotes Lth glycine optically active L isomer convention fischer projection amino acid draw amino group left show figure 10.2 L amino acid S configuration cysteine R change priority cause sulfur R group figure 10.2 L- D

amino acids amino acid acidic carboxyl group basic amino group amphoteric molecule act acid basis amino group positive charge protonate carboxyl group negative charge deprotonate amino acid solution charge form dipolar ion zwitterion show figure 10.3 amino acid act depend pH environment basic solution amino acid fully deprotonated acidic solution fully figure 10.3 amino acid exist zwitterion dipolar ion neutral pH amino acid amphoteric molecule like water act acid basis acid base characteristic titration amino acid

discuss thoroughly chapter 1 mcat biochemistry review aside zwitterionic property common amino acid property define R group chain 20 eukaryotic proteogenic amino acid group category nonpolar nonaromatic aromatic polar negatively charged acidic positively charged basic nonpolar nonaromatic amino acid tend chain saturate hydrocarbon like alanine valine leucine isoleucine include glycine proline cyclic secondary amine methionine contain sulfur aromatic amino acid include tryptophan phenylalanine tyrosine nonpolar amino acid nonaromatic aromatic hydrophobic tend sequester interior protein polar amino acid tend terminal group contain oxygen nitrogen sulfur include serine threonine asparagine glutamine cysteine negatively charged acidic amino acid include aspartic acid glutamic acid amino acid terminal carboxylate anion R group finally positively charge basic amino acid include arginine lysine histidine protonate amino group R group polar acidic basic amino acid hydrophilic tend form hydrogen bond water amino acid undergo condensation reaction form peptide bond molecule bond form call polypeptide base unit protein reverse reaction hydrolysis peptide bond catalyze strong acid base reaction show figure 10.4 figure 10.4 peptide bond formation

cleavage like carbonyl contain functional group amide resonance structure show figure 10.5 true structure amide bond hybrid structure partial double bond character nitrogen atom carbonyl carbon double bond character limit rotation $C-N$ bond add rigidity stability backbone protein single bond peptide bond hand permit free figure 10.5 resonance peptide bond rotation limit peptide bond resonance give $C-N$ bond partial double bond character mcat concept check 10.1 assess understanding material 1 make glycine unique amino acid 2 amino acid amphoteric mean functional group amino acid characteristic 3 peptide bond form cleave 4 $C-N$ bond amide planar 10.2 synthesis α amino acid chapter 10.2 able recall require reactant product type strecker gabriel synthesis reaction identify reaction type find strecker gabriel synthesis synthesis amino acid occur astonishing variety mechanism vivo lab simple reaction mechanism

acid occur astonishing variety mechanism vivo lab simple reaction mechanism exploit amino acid neatly efficiently nitrile triple bond nitrogen carbon strecker synthesis start aldehyde ammonium chloride NH_4Cl potassium cyanide KCN show figure 10.6 carbonyl oxygen protonate increase electrophilicity carbonyl carbon see chapter 6 mcat organic chemistry review ammonia attack carbonyl carbon form imine imine carbon susceptible nucleophilic addition reaction CN^- anion KCN attack form nitrile group CN final molecule end step 1 aminonitrile compound contain amino group $-NH_2$ nitrile group figure 10.6 strecker synthesis step 1 aminonitrile generate aldehyde ketone step 2 nitrile nitrogen protonate increase electrophilicity nitrile carbon similar protonate oxygen carbonyl water molecule attack lead creation molecule imine hydroxyl moiety carbon imine attack equivalent water carbonyl form kick ammonia create carboxylic acid functionality step show figure 10.7 perform aqueous acid accelerate use heat figure 10.7

strecker synthesis step 2 amino acid generate aminonitrile start material strecker synthesis planar carbonyl- contain compound product pathway racemic mixture incoming nucleophile

equally able attack carbonyl and α amino acid generate process way synthesize amino acid
gabriel malonic ester synthesis show figure 10.8 figure 10.8 gabriel synthesis amino acid
generate phthalimide diethyl bromomalonate S_N2 reaction hydrolysis decarboxylation method
potassium phthalimide react diethyl bromomalonate phthalimide acidic exist solution
nucleophilic anion diethyl bromomalonate contain secondary carbon bond bromine good
leave group setup sound like S_N2 reaction discuss chapter 4 mcat organic chemistry review
phthalimide nucleophile secondary substrate carbon electrophile bromine leave group
reaction generate phthalimidomalonic ester consider benefit large nucleophile bulkiness
group create steric hindrance prevent substrate carbon undergo multiple instead presence
base carbon α carbon carbonyl easily deprotonate molecule act nucleophile attack substrate
carbon bromoalkane is this example S_N2 reaction nucleophile large deprotonated
phthalimidomalonic ester electrophile substrate carbon leave group bromide anion molecule
hydrolyze strong base heat like convert cyclic anhydride dicarboxylic acid phthalimide moiety remove
phthalic acid carboxylic acid malonic ester hydrolyze dicarboxylic acid amine α carbon strecker
gabriel synthesis method result racemic mixture amino acid finally dicarboxylic acid 1,3
dicarbonyl decarboxylate addition acid heat loss molecule carbon dioxide result formation
complete amino acid like strecker synthesis gabriel synthesis start planar molecule product
racemic mixture l- d amino acid mcat concept check 10.2 assess understanding material 1
reactant strecker synthesis amino acid 2 reaction type strecker synthesis 3 main reactant
gabriel synthesis amino 4 reaction type gabriel synthesis chapter 10.3 able recognize trait
inorganic phosphate useful molecule energy transfer explain phosphoric acid good buffer
recall make molecule organic phosphate phosphoric acid extremely important molecule
biochemically molecule form high energy bond carry energy adenosine biochemical context
phosphoric acid refer phosphate group inorganic phosphate denote P_i physiological pH
inorganic phosphate include molecule hydrogen

phosphate denote P_i physiological pH inorganic phosphate include molecule hydrogen

phosphate dihydrogen phosphate addition energy carry nucleotide phosphate phosphorus find backbone dna phosphodiester bond link sugar moiety nucleotide show figure 10.9 figure 10.9 phosphodiester bond dna new nucleotide join grow strand dna dna polymerase release ester dimer phosphate refer denote ppi show figure 10.10 hydrolytic release molecule provide energy formation new phosphodiester bond pyrophosphate unstable aqueous solution hydrolyze form molecule inorganic phosphate recycle form high energy bond atp figure 10.10 pyrophosphate anion dna replication important process mcat nucleotide triphosphate add grow daughter strand release pyrophosphate ppi process dna synthesis describe chapter 6 mcat biochemistry review phosphoric acid excellent buffer hydrogen pka value span nearly entire ph scale nucleotide atp gtp dna refer organic phosphate presence phosphate group bond carbon- phosphoric acid unique acidic hydrogen pka phosphoric acid properly refer form predominate strongly acidic condition H_3PO_4 mildly acidic condition lose proton dihydrogen phosphate readily lose second

proton hydrogen phosphate weakly basic solution form exist strongly basic solution pka loss hydrogen 2.15 second 7.20 12.32 physiological ph 7.4 mean dihydrogen phosphate hydrogen phosphate predominate inth nearly equal proportion variety pka value make phosphate good buffer pick proton depend ph solution adjacent phosphate group nucleotide triphosphate experience large repulsion negatively charge combine ability phosphate stabilize negative charge resonance mean energy release phosphate pyrophosphate cleave high mcat concept check 10.3 assess understanding material 1 characteristic inorganic phosphate useful energy 2 organic phosphate 3 characteristic phosphoric acid good buffer chapter spend lot time look biologically active molecule notice molecule simply application general principle learn chapter book apply knowledge reaction property different type molecule understand biological process work complex organic chemistry mechanism work like strecker gabriel synthesis process fall category reaction see nucleophilic substitution nucleophilic addition condensation reaction example mcat require memorize table reactant regurgitate hundred name reaction

scratch instead mcat ask look big picture understand trend learn review content test knowledge critical thinking skill complete test like passage set online amino acids peptides proteins α carbon amino acid attach group amino group carboxyl group hydrogen atom R group chiral stereocenter amino acid glycine amino acid eukaryote I amino acid stereochemistry cysteine R amino acid amphoteric mean act acid basis amino acid acidic characteristic carboxylic acid basic characteristic amino group neutral solution amino acid tend exist zwitterion amino acid classify R group nonpolar nonaromatic amino acid include alanine valine leucine isoleucine glycine proline methionine aromatic amino acid include tryptophan phenylalanine tyrosine nonpolar nonaromatic aromatic amino acid tend hydrophobic residue interior protein polar amino acid include serine threonine asparagine glutamine cysteine negatively charged amino acid contain carboxylic acid R group include aspartic acid glutamic acid positively charged amino acid contain amine R group include arginine lysine histidine nonpolar nonaromatic aromatic amino

R group include arginine lysine histidine nonpolar nonaromatic aromatic amino acid tend hydrophobic residue interior protein polar negatively charged acidic positively charged basic amino acid tend hydrophilic residue surface protein make hydrogen bond aqueous environment peptide bond form condensation reaction cleave resonance peptide bond restrict motion C—N bond take partial double bond character strong acid base need cleave peptide bond polypeptide multiple amino acid link peptide bond protein large fold functional polypeptide synthesis α amino acid biologically amino acid synthesize way lab certain standardized mechanism strecker synthesis generate amino acid aldehyde aldehyde mix ammonium chloride NH_4Cl potassium cyanide ammonia attack carbonyl carbon generate imine imine attack cyanide generate aminonitrile aminonitrile hydrolyze equivalent water generate amino acid gabriel synthesis generate amino acid potassium phthalimide diethyl bromomalonate alkyl halide phthalimide attack diethyl bromomalonate generate phthalimidomalonic ester attack alkyl halide add alkyl group ester product hydrolyze create

phthalic acid carboxyl group convert ester carboxylic acid carboxylic acid result 1,3 dicarbonyl
remove phosphorus find inorganic phosphate P_i buffer mixture hydrogen phosphate
dihydrogen phosphate phosphorus find backbone dna use phosphodiester bond form bond
pyrophosphate release pyrophosphate hydrolyze inorganic phosphate phosphate bond high
energy large negative charge adjacent phosphate group resonance stabilization phosphate
organic phosphate carbon contain compound phosphate group notable example nucleotide
triphosphate atp gtp dna phosphoric acid hydrogen unique pK_a wide variety pK_a value allow
phosphoric acid act buffer large range ph value answer concept check 1 amino acid glycine
chiral α carbon r group glycine hydrogen atom chiral optically active 2 amphoteric molecule
act acid basis carboxylic acid amino acid acidic property deprotonate amino group amino acid
basic property protonate 3 peptide bond form condensation reaction water lose cleave
hydrolytically strong acid base 4 $\text{C}=\text{N}$ bond amide planar partial double- bond character
resonance double bond exist planar conformation restrict movement 1 aldehyde ammonium

double bond exist planar conformation restrict movement 1 aldehyde ammonium chloride
 NH_4Cl potassium cyanide KCN aminonitrile water hydrolyze aminonitrile form amino acid 2
strecker synthesis condensation reaction formation imine carbonyl contain compound
ammonia loss water follow nucleophilic addition addition nitrile group follow hydrolysis 3
gabriel synthesis begin potassium phthalimide diethyl bromomalonate follow alkyl halide
water hydrolyze result compound form amino acid acid basis time catalyst 4 gabriel synthesis
proceed $\text{S}_\text{N}2$ reaction hydrolysis 1 inorganic phosphate contain negative charge bond
phosphate group nucleotide triphosphate create repulsion adjacent phosphate group
increase energy bond inorganic phosphate resonance stabilize 2 organic phosphate carbon
contain molecule phosphate group common example nucleotide like dna atp gtp 3 hydrogen
phosphoric acid different pK_a value allow phosphoric acid pick proton wide ph range make
good buffer ph scale science mastery assessment glycine r group hydrogen atom amino acid
achiral central carbon bond different substituent amino acid chiral l- d- reaction similar gabriel

synthesis phthalimide act nucleophile methyl carbon act electrophile bromide act leave group
reaction methyl bromide phthalimide result formation methyl phthalimide subsequent
hydrolysis yield methylamine cysteine known contain sulfur atom able form disulfide bridge
methionine contain sulfur atom r group amide form amine carboxyl group acyl derivative
question amine give compound identify acyl compound acyl compound choice give carboxylic
acid strecker synthesis ammonia attack carbonyl form imine b imine attack cyanide form
amine d nitrile amide bond form amino acid appear strecker synthesis strecker synthesis
create amino acid aldehyde carbonyl carbon ultimately α carbon amino acid remain alkyl chain
r group show start compound 2 methylpropanal isobutyraldehyde resonance structure $\text{C}=\text{N}$
bond amide double bond $\text{C}-\text{N}$ $\text{C}=\text{O}$. $\text{C}=\text{N}$ bond amide sp^2 character sp^2 hybridize atom exhibit
planar geometry strecker gabriel synthesis contain planar intermediate attack nucleophile
result racemic mixture enantiomer solution gabriel synthesis phthalimide attack secondary

result racemic mixture enantiomer solution gabriel synthesis phthalimide attack secondary
carbon diethyl bromomalonate secondary carbon electrophile d bromide leave group c gabriel
synthesis include nucleophilic substitution step follow hydrolysis decarboxylation dehydration
loss water molecule reaction $\text{pK}_a 2$ phosphoric acid close physiological pH pH .

pyrophosphate unstable aqueous solution degrade form equivalent inorganic phosphate
solvent water retain polarity regardless presence solute eliminate d pyrophosphate inorganic
phosphate small charge molecule relatively soluble eliminate amino acid question aspartic
acid acidic amino acid contain extra carboxyl group neutral pH carboxyl group ionize negative
charge molecule charge neutralize positive charge amino group molecule overall negative
charge dna synthesize form phosphodiester bond release pyrophosphate PP_i pyrophosphate
inorganic phosphate contain molecule single phosphate group commonly refer inorganic
phosphate b dna molecule refer organic phosphate d phosphoric acid hydrogen pK_a value
spread pH range allow degree buffering entire standard pH range 0-14 consult online resource

additional biochemistry chapter 1 amino acid peptide proteins biochemistry chapter 6 dna biotechnology biochemistry chapter 9 carbohydrate metabolism general chemistry chapter 10 acid bases organic chemistry chapter 4 analyze organic reaction organic chemistry chapter 8 pre med know feeling content know mcat know important high yield badge book help identify important topic science mastery assessment tool mcat prep arsenal quiz take online resource guidance help ensure spend appropriate time chapter base personal strength weakness worry skip mean study later prep complete length test uncover specific piece content need review come chapter appropriate use assessment answer 0–7 question correctly spend 1 hour read chapter limited note follow review quiz question ensure understand solve answer 8–11 question correctly spend 20–40 minute review quiz question begin question miss read note correspond subchapter question answer correctly ensure thinking match explanation understand choice correct incorrect answer 12–15 question correctly spend 20 minute review question quiz miss include quick read corresponding subchapter relevant content subchapter question review question get correct ensure thinking match explanation review concept summary end chapter 1 ir spectroscopy useful distinguish a. double triple bond b. ch bond c. chirality molecule d.

relative percentage enantiomer mixture 2 oxygen o₂ exhibit ir spectrum a. molecular motion b. possible record ir spectrum gaseous molecule c. molecular vibration result change dipole d. molecular oxygen contain lone pair overall 3 ir spectroscopy employ monitor oxidation benzyl alcohol benzaldehyde follow provide good evidence reaction proceed a. compare fingerprint region spectrum start material product b. note change intensity peak correspond benzene ring c. note appearance broad absorption peak region 3100–3500 cm⁻¹ d. note appearance strong absorption region 4 follow chemical shift correspond aldehydic proton signal ¹hnmr spectrum a. 9.5 ppm b. 7.0 ppm c. 11.0 ppm d. 1.0 ppm 5 isotope ¹²c useful nmr a. abundant nature b. resonance sensitive presence c. magnetic moment d. signal noise ratio spectrum low 6 ¹hnmr splitting spectral line a. coupling carbon atom proton attach b. coupling carbon

atom proton attach adjacent carbon atom c. coupling adjacent carbon atom d. coupling
proton adjacent carbon atom 7 compare ir nmr spectroscopy uv spectroscopy prefer detect a.
aldehyde ketone b. unconjugate alkene c. conjugate alkene d. aliphatic acid amine 8 consider
0 4.5 ppm region ¹hnmr spectrum ethanol isopropanol distinguish a. distinguish ¹hnmr b.
triplet quartet observe ethanol doublet septet observe isopropanol c. triplet quartet observe
isopropanol doublet septet observe ethanol d. alcohol hydrogen ethanol appear region
alcohol hydrogen isopropanol appear downfield region 9 absorb ultraviolet photon electron
find a. homo b. lumo c. homo lumo d. homo lumo 10 ir spectrum extended conjugation
double bond affect absorbance band carbonyl c = o stretch compare normal absorption a.
absorbance band occur low wavenumber b. absorbance band occur high wavenumber c.
absorbance band occur wavenumber d. absorbance band disappear 11 wavenumber directly
proportional c. percent transmittance 12 enantiomer a. identical ir spectrum b.

identical ir spectrum c. different ir spectrum structurally d. different ir spectrum different
specific 13 molecule contain carboxylic acid group expect ¹hnmr spectrum a. deshield
hydrogen peak hydroxyl hydrogen b. deshield hydrogen peak hydroxyl hydrogen c. shield
hydrogen peak hydroxyl hydrogen shift d. shield hydrogen peak hydroxyl hydrogen shift 14
coupling constant j a. value n + 1 determine splitting nmr spectra b. measure part million ppm
c. correct calibration tetramethylsilane d. measure degree splitting cause atom 15 ir spectrum
fully protonate amino acid likely contain follow peak i. sharp peak 1750 cm⁻¹ ii sharp peak
3300 cm⁻¹ iii broad peak 3300 cm⁻¹ a. b. ii c. ii iii d. ii iii chapter 11.1 infrared spectroscopy
intramolecular vibration rotation

11.2 ultraviolet spectroscopy 11.3 nuclear magnetic resonance proton nmr ¹h nmr content
chapter relevant 8 question organic chemistry mcat chapter cover material follow aamc
content 4d light sound interact matter give unknown compound efficient way identify
determine property spectroscopy spectroscopy measure energy difference possible state

molecular system determine frequency electromagnetic radiation absorb molecule possible state quantize energy level associate different type molecular motion molecular rotation vibration bond electron absorption nuclear spin transition different type spectroscopy measure different type molecular property allow identify presence specific functional group detect connectivity backbone molecule medical context spectroscopy important magnetic resonance imaging mri mri scanner actually measure ^1H nmr spectra water molecule different environment body convert signal greyscale allow excellent visualization body especially big advantage laboratory spectroscopy small quantity sample need sample reuse test perform downside spectroscopy difficult special equipment long chemistry lab available good technique identify compound

11.1 infrared spectroscopy

chapter 11.1 able predict ir peak common organic functional group include ketone carboxylic acid alcohol recall condition ir spectroscopy generally measure infrared ir spectroscopy measure molecular vibration see bond stretching bending combination different vibrational mode record ir spectrum infrared light pass sample absorbance measure determine bond exist molecule hope infer functional group molecule wavenumber cm^{-1} analog frequency intramolecular vibration rotation infrared light range run $\lambda = 700 \text{ nm}$ 1 mm useful absorption spectroscopy occur wavelength $2500 - 25,000 \text{ nm}$ ir spectrum use analog frequency call wavenumber standard range correspond $2500 - 25,000 \text{ nm}$ $4000 - 400 \text{ cm}^{-1}$ light wavenumber absorb molecule enter excited vibrational state type vibration occur show figure 11.1 include twisting folding figure 11.1 molecular vibration measure infrared ir spectroscopy bond bending stretching twisting folding occur symmetric stretch ir spectra involve net change dipole movement complex vibration pattern cause motion molecule see $1500 - 400 \text{ cm}^{-1}$ range call fingerprint region specific absorbance pattern characteristic individual molecule

range call fingerprint region specific absorbance pattern characteristic individual molecule spectroscopy expert use region identify substance will need use mcat absorption record vibration result change bond dipole moment mean molecule experience change dipole

moment compose atom electronegativity molecule symmetrical exhibit absorption example
absorption O_2 Br_2 HCl CO symmetric bond triple bond acetylene C_2H_2 silent mcat need
memorize absorption hydroxyl group OH absorb broad wide peak frequency 3300 cm^{-1}
alcohol 3000 cm^{-1} carboxylic acid carbonyl carboxylic acid pull electron density OH bond shift
absorption low wavenumber second carbonyl absorb 1700 cm^{-1} sharp deep peak table 11.1
notice bond atom hydrogen relatively high absorption frequency add bond carbon atom
absorption frequency increase NH bond region OH bond 3300 cm^{-1} sharp peak instead
broad able identify peak ir spectrum need identify peak test day list table peak wavenumber
table 11.1 absorption frequency infrared spectroscopy well identification functional group
important peak know OH broad 3300 cm^{-1} NH

sharp 3300 cm^{-1} $\text{C}=\text{O}$ sharp 1750 cm^{-1} learn great deal information ir spectrum mcat
information come frequency $1400\text{--}4000\text{ cm}^{-1}$ low fingerprint region scope ir spectrum plot
percent transmittance light pass sample reach detector vs. wavenumber ir spectrum percent
transmittance plot vs. frequency equation relate absorbance percent transmittance $t = 2 - \log$
 t mean maximum absorption appear bottom valley spectrum figure 11.2 show ir spectrum
aliphatic alcohol large broad peak 3300 cm^{-1} presence hydroxyl group sharp peak 3000 cm^{-1}
carbon hydrogen bond alkane portion molecule list table 11.1 figure 11.2 ir spectrum aliphatic
alcohol broad peak 3300 cm^{-1} OH mcat concept check 11.1 assess understanding material 1
infrared ir spectroscopy measure ir spectroscopy generally 2 peak expect ir spectrum 11.2
ultraviolet spectroscopy chapter 11.2 able predict give molecule detect uv spectroscopy
describe relationship homo lomo absorption interpret ultraviolet uv spectroscopy datum mcat
fair game discussion basic understanding work suffice uv spectrum obtain pass ultraviolet
light sample usually dissolve inert nonabsorbing solvent record absorbance absorbance plot
wavelength absorbance cause electronic transition orbital big piece information technique
wavelength maximum absorbance tell extent conjugation conjugate system conjugated
compound low energy transition great wavelength maximum absorbance uv spectroscopy

useful study compound contain double bond heteroatom lone pair create conjugate system
mcats need know uv spectroscopy work molecule π electron nonbonding electron excite
ultraviolet light high energy antibonding orbital molecule low energy gap high occupied molecular
orbital hmo low unoccupied molecular orbital lmo easily excite absorb long wavelength low
frequency low energy conjugated molecule molecule unhybridized p orbital excite ultraviolet
light conjugation shift absorption spectrum result high maximum wavelength low frequency
example benzene broad absorbance mark energy level transition find 180 200 255 nm
wavelength large conjugate molecule absorb light visible range lead color technique uv
spectroscopy visible wavelength call uv vis

lead color technique uv spectroscopy visible wavelength call uv vis spectroscopy mcats concept
check 11.2 assess understanding material 1 following molecule detectable uv spectroscopy
propane propene propanone 2 uv spectroscopy hmo lmo relate absorption wavelength
relation absorption wavelength 11.3 nuclear magnetic resonance chapter 11.3 able describe
nmr spectroscopy measure generally recall unit chemical shift standardized nmr identify
deshield spin spin coupling impact nmr spectra recognize key region peak nmr spectrum
match compound give nmr spectrum analysis nuclear magnetic resonance nmr spectroscopy
important spectroscopic technique understand mcats nmr spectroscopy base fact certain
atomic nucleus magnetic moment orient random nucleus place magnetic field magnetic
moment tend align direction apply field nucleus magnetic moment align field say α state low
energy nucleus irradiate radiofrequency pulse match energy gap state excite low energy
nucleus β state high energy absorption radiation lead excitation different frequency depend
atom magnetic environment addition nuclear magnetic moment atom affect nearby atom
possess magnetic resonance imaging mri noninvasive diagnostic tool use proton nmr show
figure 11.3 multiple cross sectional scan patient body take chemical shift absorb proton
translate specific shade grey produce picture show relative density specific type proton
instance dark area t1 weight mri tend correspond water light area indicate fatty tissue

comparison normal mri allow diagnostician detect abnormality scan region mention explain relevance nmr spectroscopy medicine mcat test detail mri work figure 11.3 magnetic resonance imaging mri typical nmr spectrum plot frequency vs. absorption energy different nmr spectrometer operate different magnetic field strength standardized method plot nmr spectrum adopt standardized method see mcat use arbitrary variable call chemical shift δ unit part million ppm spectrometer frequency chemical shift plot x axis increase left refer downfield sure know far downfield compound use tetramethylsilane tms calibration standard mark 0 ppm count peak sure skip tms peak tms provide reference peak

count peak sure skip tms peak tms provide reference peak signal 1h atom assign $\delta = 0$ nucleus odd mass number odd atomic number magnetic moment place magnetic field nucleus magnetic moment ^{12}C example atomic number mass number discuss detail chapter 1 mcat general chemistry review nuclear magnetic resonance commonly study 1h nucleus proton atom possess nuclear spin odd atomic number odd mass number study ^{13}C ^{19}F ^{17}O ^{31}P ^{59}Co mcat test knowledge ^1H nmr determine peak spectrum describe proton differently word dichloromethyl methyl ether show figure 11.4 ha hydrogen carbon chloride hb hydrogen one methyl group possible describe hydrogen distinct rotate freely space figure 11.4 ^1H nmr spectrum dichloromethyl methyl ether peak dichloromethyl proton peak b methyl proton nmr ^1H nmr hydrogen 1h nucleus come resonance 0 10 ppm downfield tms distinct set nucleus give rise separate peak mean multiple proton chemically equivalent have magnetic environment lead peak example figure 11.4 depict ^1H nmr dichloromethyl methyl ether distinct set 1h nucleus single proton attach dichloromethyl group ha different magnetic environment proton methyl group hb class resonate different frequency proton methyl group chemically equivalent resonate frequency group rotate freely average proton see identical magnetic environment thft peak left single dichloromethyl proton tall middle peak methyl proton b height peak proportional number proton contain specifically analyze area peak call integration find ratio b 1:3 correspond exactly ratio proton produce peak know peak let talk

respective position spectrum peak single proton fairly far downfield compare proton attach carbon electronegative chlorine atom oxygen atom atom pull electron density away surround atom deshield proton magnetic field proton electron density pull away shield apply magnetic field result reading downfield reasoning know electron donate group silicon atom tms help shield ^1H nucleus position upfield tetramethylsilane reference calibration peak proton nmr deshield peak group peak multiplet represent single group equivalent proton

deshield peak group peak multiplet represent single group equivalent proton relative area peak reflect ratio proton produce peak position peak upfield downfield shielding deshielding effect reflect chemical environment let little interesting consider compound contain proton bond word compound hydrogen adjacent atom proton close proximity magnetically identical spin spin coupling splitting occur let use molecule figure 11.5 demonstrate concept figure 11.5 1,1 dibromo-2,2 dichloroethane deal ^1H nmr mcat think proton surround shield electron add electronegative atom resonance structure pull electron away proton deshield downfield notice proton H_a H_b 1,1 dibromo-2,2 dichloroethane proximity magnetic environment H_a affect H_b viceversa give time H_a experience different magnetic environment H_b α - β - state different state H_b influence nucleus H_a cause slight upfield downfield shift approximately 50 chance H_b state result absorption doublet peak identical intensity equally space true chemical shift H_a H_b appear doublet couple hydrogen determine number peak present doublet triplet use $n + 1$ rule proton n proton bond away split $n + 1$ peak caveat include proton attach oxygen nitrogen magnitude splitting measure hertz call coupling splitting peak represent number adjacent hydrogen peak split $n + 1$ subpeak n number adjacent hydrogen let try molecule coupled proton 1,1 dibromo-2- chloroethane show figure 11.6 H_a nucleus affect nearby H_b nucleus different state $\alpha\alpha$ $\alpha\beta$ $\beta\alpha$ figure 11.6 1,1 dibromo-2 chloroethan proton nmr good

determine

relative number proton relative chemical show adjacent proton split pattern infer certain functional group technically different state $\alpha\beta$ effect $\beta\alpha$ resonance occur frequency mean unique frequency $\alpha\alpha$ $\alpha\beta$ $\beta\alpha$ $\beta\beta$ ha appear peak triplet center true chemical shift area ratio 1:2:1 let hb hydrogen attach carbon freely rotate magnetically identical hydrogen bond away hydrogen ha mean appear doublet integration doublet represent hb large triplet table 11.2 show ratio seven adjacent hydrogen necessary memorize table mcat remember follow $n + 1$ rule proton interest determine number peak addition peak shift generally refer generically multiplet table 11.2 area ratio peak split adjacent hydrogen total number table 11.3 indicate chemical shift range different type proton unnecessary memorize table fairly low yieldth information value useful memorize outlier like deshielded aldehyde 9 10 ppm deshielded carboxylic acid 10.5 12 ppm popular peak mcat hydrogen aromatic ring lie 6.0 8.5 ppm worthwhile know general range hydrogen sp^3 - hybridize carbon 0.0 3.0 ppm high electron withdraw group present sp^2 hybridize carbon 4.6 6.0 ppm sp hybridize carbon 2.0 3.0 ppm electronegative group present pull electron density away proton electron density pull away proton deshielded downfield proton appear table 11.3 proton chemical shift range type proton approximate chemical shift δ ppm downfield tms type proton approximate chemical shift δ ppm downfield tms test day count number peak unique hydrogen correct answer remember count peak tms need consider shift main one test day alkyl group 0 3 ppm alkyne 2 3 ppm alkene 4.6 6 ppm aromatic 6 8.5 ppm aldehyde 9 10 ppm carboxylic acid 10.5 12 ppm mcat concept check 11.3 assess understanding material 1 nuclear magnetic resonance nmr spectroscopy measure nmr spectroscopy generally 2 unit chemical shift standardized nmr spectrum 3 mean proton deshielded affect peak nmr spectroscopy 4 spin spin coupling chapter number value important

nmr spectroscopy 4 spin spin coupling chapter number value important thing know spectroscopy mcat need know lot number number need know stress heavily chapter know infrared ir spectroscopy good identify presence importantly absence functional group cursory

understanding ultraviolet uv spectroscopy association conjugation suffice nuclear magnetic resonance nmr spectroscopy specifically proton ^1H nmr help figure arrangement functional group know interpret ir nmr spectrum ir spectrum important peak OH $\text{C}=\text{O}$ NH nmr spectrum far complex mcats test chemical shift deshielded proton downfield left spectrum sure interpret peak splitting interference neighbor hydrogen peak integration proportional number magnetically spectroscopy test mcats context experiment- base passage continue study reaction chemistry discuss chapter 4 10 mcats organic chemistry review consider product yield different spectroscopic modality chapter focus method identify compound base structural characteristic interaction electromagnetic energy spectroscopy method characterize organic molecule chapter explore laboratory technique separation purification scheme utilize physical difference molecule allow isolate describe review content test knowledge critical thinking skill complete test like passage set online infrared ir spectroscopy measure absorption infrared light cause molecular vibration stretching bending twisting ir spectrum generally plot percent transmittance vs. normal range spectrum $4000\text{--}400\text{ cm}^{-1}$ fingerprint region $1500\text{--}400\text{ cm}^{-1}$ contain number peak expert identify appear ir spectrum vibration bond change bond dipole moment certain bond characteristic absorption frequency allow infer presence absence particular functional group OH peak broad peak 3300 cm^{-1} molecule OH include alcohol water carboxylic acid carboxylic acid OH peak shift 3000 cm^{-1} NH peak sharp peak 3300 cm^{-1} molecule NH include amine imine amide $\text{C}=\text{O}$ peak sharp peak 1750 cm^{-1} molecule $\text{C}=\text{O}$

include aldehyde ketone carboxylic acid amide ester ultraviolet uv spectroscopy measure absorption ultraviolet light cause movement electron molecular uv spectrum generally plot percent transmittance absorbance vs. wavelength appear uv spectrum molecule small energy difference high occupy molecular orbital HOMO low unoccupied molecular orbital LUMO permit electron orbital small difference HOMO LUMO long wavelength molecule absorb conjugation occur molecule unhybridized p orbital conjugation shift absorption spectrum high maximum

wavelength low frequency nuclear magnetic resonance nuclear magnetic resonance nmr spectroscopy measure alignment nuclear spin apply magnetic field depend magnetic environment nucleus useful determine structure connectivity compound include functional group nucleus low energy α state high energy β - state radiofrequency pulse push nucleus α state β state frequency measure magnetic resonance imaging mri medical application nmr nmr spectrum generally plot frequency vs. absorption energy standardize chemical shift δ measure part million ppm spectrophotometer frequency nmr spectrum calibrate tetramethylsilane tms chemical shift 0 ppm high chemical shift locate left downfield low chemical shift locate right upfield proton ^1H nmr common unique group proton peak integration area curve peak proportional number proton contain peak deshielding proton occur electron withdraw group pull electron density away nucleus allow easily affect magnetic field deshield move peak hydrogen adjacent atom interfere magnetic environment cause spin spin coupling splitting proton group proton peak split $n + 1$ subpeak n number proton bond away proton interest split pattern include doublet triplet multiplet proton sp^3 hybridize carbon usually 0 3 ppm range high electron withdraw group present proton sp^2 hybridize carbon

usually 4.6 6.0 ppm range proton sp hybridize carbon usually 2.0 3.0 ppm range aldehydic hydrogen tend appear 9 10 ppm carboxylic acid hydrogen tend appear 10.5 12 aromatic hydrogen tend appear 6.0 8.5 ppm answer concept check 1 ir spectroscopy measure absorption infrared light specific bond vibrate vibration cause change dipole moment molecule

measure bond molecule determine infer presence number functional group determine identity molecule 2 carboxylic acid broad oh peak 2800–3200 cm^{-1} sharp carbonyl peak 1700–1750 cm^{-1} 1 conjugate system molecule π nonbonding electron absorbance uv spectroscopy plot propane detectable propene propanone 2 homo high occupy molecular

orbital lUMO low unoccupied molecular orbital small difference energy long wavelength
absorb 1 NMR measure alignment spin nucleus apply magnetic field identify different type
magnetic environment proton molecule allow infer connectivity backbone molecule 2 unit
chemical shift standardized NMR spectrum part million ppm 3 deshielding occur molecule
electronegative atom pull electron density away hydrogen measure result downfield leftward
shift proton peak 4 spin spin coupling occur proton close effect magnetic environment result
splitting peak doublet triplet multiplet depend science mastery assessment infrared
spectroscopy useful distinguish different functional group organic compound C-H bond b
fingerprint compound absorption useful little information optical property compound c d
obtain IR molecular oxygen homonuclear compose element diatomic net change dipole
moment vibration rotation word compound absorb measurable way infrared region IR
spectroscopy base principle molecule vibrate rotate change dipole moment incorrect oxygen
molecular motion detectable IR spectroscopy b incorrect possible record IR gaseous molecule
long show change dipole moment vibrate d incorrect lone pair effect ability generate IR
spectrum compound reaction functional group change hydroxyl aldehyde mean sharp peak
appear 1750 cm^{-1} correspond carbonyl functionality c opposite occur reaction characterize
disappearance OH peak 3100–3500 cm^{-1} appearance compare fingerprint region provide
evidence reaction occur useful know reaction occur peak 9.5 ppm correspond aldehydic
proton signal lie downfield carbonyl oxygen electron withdraw deshield proton c correspond
carboxyl proton downfield acidic proton deshielded great degree aldehydic proton b
correspond aromatic proton d characteristic alkyl proton sp^3 hybridized isotope magnetic
moment exhibit resonance apply magnetic field nucleus odd mass number ^1H ^{11}B ^{13}C

apply magnetic field nucleus odd mass number ^1H ^{11}B ^{13}C ^{15}N ^{19}F mass number odd atomic
number ^2H ^{10}B nonzero spin spin coupling splitting influence magnetic environment proton
proton adjacent atom proton bond away split NMR spectra include coupling carbon atom
 ^1H NMR conjugate alkene intense ultraviolet absorption aldehyde ketone acid amine mention

d absorb ultraviolet range form spectroscopy mainly ir nmr useful precise identification isolated alkene b rarely identify uv spectroscopy region question give information type alkyl group present specifically ethanol characteristic triplet methyl group couple ch₂ quartet ch₂ couple methyl group isopropanol septet ch group couple methyl group combine doublet methyl group couple ch case proton alcohol participate coupling alcohol hydrogen likely lie downfield compound bond electronegative homo high occupy molecular orbital absorb ultraviolet light electron excite homo lumo low unoccupied molecular orbital carbonyl group c = o conjugation double bond tend absorb low wavenumber delocalization π electron cause c = o bond lose double bond character shift stretch frequency close co stretch remember higher- order bond tend high absorption frequency loss double bond character decrease absorption frequency directly proportional frequency inversely proportional wavelength proportionality percent transmittance absorbance c d enantiomer identical ir spectra functional group exact absorption frequency enantiomer opposite specific rotation specific rotation actually effect ir spectrum oxygen hydroxyl group deshield hydroxyl hydrogen shift downfield leftward hydrogen carboxylic acid canfi downfield absorbance 10.5 12 ppm coupling constant measure degree splitting introduce atom molecule frequency distance subpeak measure hertz eliminate b coupling constant independent value $n + 1$ change calibration tetramethylsilane eliminate amino acid fully protonate form contain peak memorize test day co nh oh.

statement ii correctly peak c = o bond sharp peak 1750 cm⁻¹ nh bond sharp peak 3300 cm⁻¹ peak oh bond wrong place carboxylic acid c = o bond withdraw electron density oh bond shift absorption frequency 3000 cm⁻¹ statement iii incorrect consult online resource additional general chemistry chapter 1 general chemistry chapter 3 bonding chemical interaction organic chemistry chapter 3 organic chemistry chapter 12 separation purification physics math chapter 8 light optic physics math chapter 9 atomic nuclear phenomena separation purification pre med know feeling content know mcat know important high yield

badge book help identify important topic science mastery assessment tool mcat prep arsenal
quiz take online resource guidance help ensure spend appropriate time chapter base personal
strength weakness worry skip mean study later prep complete length test uncover specific
piece content need review come chapter appropriate use assessment answer 0–7 question
correctly spend 1 hour read chapter limited note follow review quiz question ensure
understand solve answer 8–11 question correctly spend 20–40 minute review quiz question
begin question miss read note correspond subchapter question answer correctly ensure
thinking match explanation understand choice correct incorrect answer 12–15 question
correctly spend 20 minute review question quiz miss include quick read correspond
subchapter relevant content subchapter question review question get correct ensure thinking
match explanation review concept summary end chapter 1 fractional distillation atmospheric
pressure likely separate following compound a. methylene chloride boiling point 40°C water
boiling point 10°C b. ethyl acetate boiling point 77°C ethanol boiling point c. aniline boiling
point 184°C benzyl alcohol boiling point 205°C d. aniline boiling point

184°C water boiling point 2 following compound effective extract benzoic acid diethyl ether
solution b. aqueous hydrochloric acid c. aqueous sodium hydroxide 3 follow good procedure
extract acetaldehyde aqueous solution a. single extraction 100 ml ether b. successive
extraction 50 ml portion ether c. successive extraction 33.3 ml portion ether d. successive
extraction 25 ml portion ether question 4 5 refer following table retardation factor ether 4
effect rf value thin layer chromatography tlc run hexane ether a. effect b. increase tenfold 5
compound separate column chromatography ether silica gel elute a. benzyl alcohol b. benzyl
acetate 6 compound ii iii iv separate chromatographic technique compound iii polar ii polar iv
intermediate polarity solvent system 85:15 ethanol methylene chloride spot card likely belong
compound iii 7 suppose extraction methylene chloride perform desire compound initially
brine separatory funnel layer organic layer a. layer b. layer c. layer observe methylene chloride
brine d. information need answer question 8 silica gel thin layer chromatography property

silica gel probably possess make useful c. specifically size pore d. aqueous solubility 9 mixture sand benzoic acid naphthalene ether good a. filtration follow acidic extraction follow b. filtration follow basic extraction follow c. extraction follow distillation follow gas d. filtration follow size exclusion column chromatography follow extraction 10 simple distillation separate a. toluene boiling point 111°C water boiling point b. naphthalene boiling point 218°C butyric acid boiling point 163°C c. propionaldehyde boiling point 50°C acetic acid boiling point 119°C d. benzene boiling point 80°C isopropyl alcohol boiling point 83°C 11 order

separate biological effector solution chromatographic technique effective a. thin layer chromatography b. ion exchange chromatography c. affinity chromatography d. size exclusion chromatography 12 give solution insulin molecular weight = 5.8 kd titin molecular weight = 3816 kd chromatographic technique effective separate usable molecule a. thin layer chromatography b. ion exchange chromatography c. affinity chromatography d. size exclusion chromatography 13 gas eluent gas chromatography liquid eluent paper chromatography example component a. stationary phase b. mobile phase 14

gravity filtration student forget heat solution run filter capture filtrate student analyze sample infrared ir spectroscopy find desire product filtrate likely occur student product a. product degrade prolong filtration time b. product evaporate collection filtrate c. product precipitate present residue d. product dissolve solvent 15 lactoferrin milk protein valuable antimicrobial agent extract pasteurize defatted milk utilize column contain charge resin example following chromatographic technique a. thin layer chromatography b. ion exchange chromatography c. affinity chromatography d. size exclusion chromatography answer key follow page separation purification chapter 12.1 solubility base method thin layer paper chromatography high performance liquid chromatography content chapter relevant 17 question organic chemistry mcat chapter cover material following aamc content 5c separation purification method spend lot time discuss theoretically product range reagent sure learn organic chemistry lab

chemistry straightforward real world paper time spend lab dedicate isolation purification
desire product reaction occur chapter discuss technique good news lab practical mcat course
need understand technique purification separation technique procedure exploit different
physical property mcat test knowledge basic principle technique 12.1 solubility base method
chapter 12.1 able recall condition require solvent explain repetition important extraction
procedure predict give solute likely dissolve aqueous organic layer separatory funnel like
dissolve like fundamental concept mcat remember polar substance associate polar substance
nonpolar nonpolar simple way separate desire product extraction transfer dissolve compound
desire product start solvent solvent product soluble extraction base fundamental concept like
dissolve like principle tell polar substance dissolve well polar solvent nonpolar substance
dissolve well nonpolar solvent characteristic take advantage order extract desire product leave
impurity solvent think organic aqueous layer like oil water salad dressing shake mixture
increase interaction ultimately separate perform extraction important sure solvent immiscible
mean form layer mix like water oil layer temporarily mix shake solute pass solvent example
solution isobutyric acid diethyl ether show figure

pass solvent example solution isobutyric acid diethyl ether show figure 12.1 extract isobutyric
acid water isobutyric acid polar carboxyl group soluble polar solvent like water nonpolar
solvent like ether solvent mix isobutyric acid transfer water layer call aqueous phase layer
nonpolar ether layer call organic phase layer figure 12.1 isobutyric acid diethyl ether isobutyric
acid polar diethyl ether exhibit hydrogen bonding congregate aqueous layer diethyl ether
remain organic layer layer mix desire product water aqueous ether organic phase separate
give time order isolate phase use piece equipment call separatory funnel show figure 12.2
gravitational force cause dense layer sink funnel remove turn stopcock common organic layer
opposite occur remember position layer determine relative density figure 12.2 separatory
funnel separate solvent base relative density dense solvent drain extraction depend rule
solubility like dissolve like remember intermolecular force affect solubility 1 hydrogen bonding

compound alcohol acid easily aqueous layer 2 dipole dipole interaction compound likely aqueous layer 3 van der waals london force interaction compound likely aqueous layer use property acid basis advantage $HA + base \rightleftharpoons A^- + H^+$ acid dissociate anion form soluble aqueous layer original protonate acid charge add base help extract acid example assume aqueous layer dense settle separatory funnel drain aqueous layer separatory funnel repeat extraction time additional water add separatory funnel shake allow settle aqueous layer drain order extract isobutyric acid ether layer possible completely transfer extraction multiple extraction fresh water effective obtain product single extraction large volume water imagine analogous laundry dirty clothes time laundry water clean volume water dirt likely leave clothes afterward desire product isolate solvent obtain product evaporate solvent usually rotary way advantage solubility property perform reverse extraction describe order remove unwanted impurity case small solvent extract remove impurity compound interest process call wash addition extraction filtration recrystallization use solubility characteristic separate

call wash addition extraction filtration recrystallization use solubility characteristic separate compound mixture filtration isolate solid liquid chemistry lab pour liquid solid mixture paper filter allow solvent pass like coffee filter end filtration leave solid call residue flask liquid pass filter know filtrate filtration modify depend substance interest solid dissolve filtrate gravity filtration solvent weight pull filter commonly product interest filtrate hot solvent generally product dissolve liquid vacuum filtration solvent force filter vacuum connect flask solid desire product recrystallization method purify crystal solution process dissolve product minimum hot solvent let recrystallize cool solvent choose process shouldnt product soluble high temperature solution cool desire product recrystallize solution exclude impurity mcat concept check 12.1 assess understanding material 1 true solvent extraction work 10 ml solvent extraction 30 ml 3 acid dissolve well aqueous acid aqueous base chapter 12.2 able differentiate separatory capability simple vacuum recall condition distillation helpful separatory select good distillation technique give solute mixture extraction require solvent

immiscible order separate product happen product liquid soluble solvent distillation come handy distillation take advantage difference boiling point separate liquid evaporation condensation liquid low boiling point vaporize vapor rise distillation column condense water cool condenser condensate drip vessel end product call distillate heating temperature keep low liquid high boiling point able boil remain liquid initial container process liquor distillery ethanol boil low temperature water use distillation beverage high simple distillation indicate complex version distillation proceed precisely describe technique separate liquid boil 150°C 25°C difference boiling point restriction prevent temperature high compound degrade provide large difference boiling point second compound will accidentally boil distillate apparatus technique consist distil flask contain combine liquid solution distillation column consist thermometer condenser receiving flask collect distillate setup show figure 12.3 sans vacuum adapter additional piece equipment boiling chip ebulliator magnetic stirrer introduce break surface tension

equipment boiling chip ebulliator magnetic stirrer introduce break surface tension prevent superheating superheating occur liquid heat temperature boiling point vaporization superheate situation occur gas bubble liquid unable overcome combination atmospheric pressure surface tension figure 12.3 vacuum distillation initial solution place heat distilling flask component solution low boiling point vaporize vapor condense water cool condenser distillate drip receive flask use vacuum distillation want distill liquid boiling point 150°C vacuum lower ambient pressure decrease temperature liquid reach order sufficient vapor pressure boil allow distill compound high boiling point low temperature worry degrade product apparatus vacuum distillation show figure 12.3 remember chapter 7 mcat general chemistry review liquid boil vapor pressure equal ambient pressure vacuum distillation lower ambient pressure liquid boil low temperature separate liquid similar boiling point 25°C apart use fractional distillation technique fractionation column connect distillation flask condenser show figure 12.4 fractionation column column surface area increase inclusion inert object like

glass bead steel wool vapor rise column condense surface reflux rise heat cause evaporate
condense higher column time condensate evaporate vapor consist high proportion compound
low boiling point time column reach desire product drip figure 12.4 fractional distillation
increase surface area distillation column distillate place condense way column allow refined
separation liquid fairly close boiling point mcat concept check 12.2 assess understanding
material 1 distillation separate compound base property 2 give solution ether boiling point
308 k methylene chloride boiling point 313 k type distillation separate 3 give solution
bromobenzene boiling point 156 ° c camphor boiling point 204 ° c type distillation separate
chapter 12.3 able identify property separate compound chromatography differentiate thin
layer paper column gas high performance liquid chromatography describe main specialized
type column column chromatography method predict good chromatography method give
chromatography tool use physical chemical property separate identify compound complex
mixture

tool use physical chemical property separate identify compound complex mixture form
chromatography discuss concept identical similar compound surrounding polarity charge
characteristic stick slowly chromatography separate compound base strongly adhere solid
stationary phase word easily come mobile phase process begin place sample solid medium
call stationary phase adsorbent run mobile phase usually liquid gas gas chromatography
stationary phase displace elute sample carry stationary phase depend characteristic substance
sample polarity mobile phase adhere stationary phase differ strength cause different
substance migrate different speed call partitioning represent equilibrium phase different
compound different partitioning coefficient elute different rate result separation stationary
phase allow isolate substance individually different medium stationary phase exploit different
property allow separate desire compound mcat property commonly polarity instance thin
layer chromatography tlc shortly discuss use silica gel highly polar substance stationary phase
cellulose polar substance mean polar compound adhere gel elute slowly column

chromatography size charge role quickly compound move stationary phase chromatography use strong interaction antibody ligand mention early chromatography base speed compound medium practice measure far substance travel give time tlc long take elute column gas chromatography type chromatography discuss include thin layer paper chromatography column chromatography gas chromatography call gas liquid chromatography high performance liquid chromatography hplc thin layer paper chromatography thin layer chromatography paper chromatography extremely similar technique vary medium stationary phase thin layer chromatography thin layer silica gel alumina adherent inert carrier sheet paper chromatography suggest medium paper compose cellulose technique sample want separate place directly adsorbent call spotting apply small define spot sample directly silica paper plate plate develop involve place adsorbent upright develop chamber usually beaker lid wide mouthed jar jar shallow pool solvent call eluent spot sample level solvent dissolve pool solvent run plate set correctly solvent creep plate capillary action carry compound sample vary rate solvent near plate plate remove chamber

compound sample vary rate solvent near plate plate remove chamber allow dry. mention tlc silica gel polar hydrophilic mobile phase hand usually organic solvent weak moderate polarity bind gel nonpolar compound dissolve organic solvent quickly solvent move plate polar molecule stick gel nonpolar sample plate show figure 12.5 figure 12.5 thin layer chromatography sample place x mark nonpolar solvent move plate capillary action sample nonpolar plate solvent sample polar far reverse phase chromatography exact opposite technique stationary phase nonpolar polar molecule plate quickly nonpolar molecule stick tightly stationary phase spot individual compound usually white make difficult impossible white paper tlc plate problem develop plate place ultraviolet light compound ultraviolet sensitive alternatively iodine phosphomolybdic acid vanillin stain spot destroy compound tlc perform compound generally identify retardation factor r_f relatively constant particular compound give solvent r_f calculate equation value relatively constant r_f value identify

technique frequently perform small scale identify unknown compound large scale means purification technique call preparative tlc large plate develop large spot sample split band individual compound scrape wash yield pure principle column chromatography thin- layer chromatography difference column chromatography use entire column fill silica aluminum bead adsorbent allow great separation setup show figure 12.6 addition thin layer chromatography use capillary action solvent plate column chromatography use gravity solvent compound column speed process force solvent column using fl gas pressure technique call flash column chromatography column chromatography solvent polarity change help elute figure 12.6 column chromatography sample add column solvent pour similar sample mobile phase fast elute similar stationary phase slowly elute all).ff eventually solvent drip end column different fraction leave column collect time fraction contain different compound collection solvent evaporate leave compound interest column chromatography particularly useful biochemistry separate collect macromolecule protein nucleic acid technique isolate specific material describe follow paragraph chapter 3 mcat biochemistry review ion exchange chromatography

follow paragraph chapter 3 mcat biochemistry review ion exchange chromatography bead column coat charge substance attract bind compound opposite charge instance positively charged compound attract hold negatively charged backbone dna protein pass column increase retention time retain completely compound move column salt gradient elute charge molecule stick size exclusion chromatography bead column contain tiny pore vary size tiny pore allow small compound enter bead slow large compound fit pore travel column fast important remember type chromatography small compound slow retain long counterintuitive size pore varied molecule different molecular weight fractionate common approach protein purification use ion exchange column follow size- affinity chromatography protein interest bind create column high affinity protein accomplish coat bead receptor bind protein specific antibody protein case protein retain column common stationary phase molecule include nickel

separation genetically engineer protein histidine tag antibody antigen enzyme substrate analogue mimic natural substrate enzyme interest protein retain column elute wash column free receptor target antibody compete bead bind receptor ultimately free protein column eluent create vary ph salinity level disrupt bond ligand protein interest drawback elution step recover substance bind eluent example eluent inhibitor enzyme difficult remove gas chromatography gc method qualitative separation gc know vapor phase chromatography vpc similar type chromatography show figure 12.7 main conceptual difference eluent gas usually helium nitrogen instead liquid adsorbent crush metal polymer inside 30 foot column column coil keep inside oven control temperature mixture inject column vaporize gaseous compound travel column different rate adhere adsorbent column different degree separate space time reach end column inject compound volatile low melting point sublimable solid vaporizable liquid compound register detector record peak chart figure 12.7 gas chromatography sample inject column move gaseous mobile phase stationary liquid solid phase computer identify sample component common separate molecule gc inject pure molecule mass spectrometer molecular weight determination mass spectrometry

inject pure molecule mass spectrometer molecular weight determination mass spectrometry involve ionization fragmentation compound fragment run magnetic field separate mass charge ratio total molecular weight determine relative concentration different fragment calculate compare reference value identify high performance liquid chromatography high performance liquid chromatography hplc previously call high pressure liquid chromatography suggest eluent liquid travel column define composition variety stationary phase choose depend target molecule quantity material need purify fairly similar column chromatography compound solution react differently adsorbent material past high pressure recent advance allow low pressure change hplc small sample inject column separation occur flow compound pass detector collect solvent flow end apparatus interface similar gc entire process computerize use liquid pressure instead gas process computer control sophisticated solvent

gradient temperature apply column help resolve compound sample high performance hplc regular column chromatography mcat concept check 12.3 assess understanding material 1 property molecule thin layer chromatography paper chromatography standard column chromatography advantage separate compound 2 specialized type column chromatography use order separate sample type column method separate sample 3 way gas chromatography distinct technique discuss 4 major historical distinction hplc column chromatography major distinction forget mcat will ask lab coat extract product reaction long understand principle govern technique apply great shape remember separation purification technique exploit physical property compound polarity solubility size shape charge obtain purified product property trace intermolecular force property molecule have variety tool method separate collect purified product essential practical organic chemistry choose proper technique require knowledge consideration desire product look big picture method easy conceptualize actually apply lab despite subject compelling relevance everyday life college organic chemistry terrify alienate student mcat hand ask memorize table reactant regurgitate hundred name reaction scratch instead mcat ask look big picture know trend participate logic chemistry hope study mcat give chance rediscover organic chemistry focus instead organic chemistry like mcat

chance rediscover organic chemistry focus instead organic chemistry like mcat see obstacle opportunity work hard fun way think head feel white coat review content test knowledge critical thinking skill complete test like passage set online extraction combine immiscible liquid easily dissolve compound interest polar water layer call aqueous phase dissolve compound hydrogen bonding polarity nonpolar layer call organic phase dissolve extraction carry separatory funnel phase collect solvent evaporate acid base property increase solubility wash reverse extraction small solvent dissolve impurity run compound interest filtration isolate solid residue liquid filtrate gravity filtration product interest filtrate hot solvent maintain solubility vacuum filtration product interest solid vacuum connect flask pull solvent recrystallization product dissolve minimum hot solvent impurity soluble crystal reform flask

cool exclude impurity distillation separate liquid accord difference boiling point liquid low boiling point vaporize collect distillate simple distillation boiling point 150°C 25°C apart vacuum distillation boiling point 150°C prevent degradation product fractional distillation boiling point 25°C apart allow refined separation liquid boiling point form chromatography use phase separate compound base physical chemical property stationary phase adsorbent usually polar solid mobile phase run stationary phase usually liquid gas elute sample stationary compound high affinity stationary phase small retardation factor long pass compound high affinity mobile phase elute quickly compound separate call partitioning thin layer paper chromatography identify sample stationary phase polar material silica alumina mobile phase nonpolar solvent climb card capillary action card spot develop rf value calculate compare reference value reverse phase chromatography use nonpolar card polar column chromatography utilize polarity size affinity separate compound base physical chemical property stationary phase column contain silica alumina mobile phase nonpolar solvent travel column gravity ion exchange chromatography bead coat charge substance bind compound opposite charge size exclusion chromatography bead small pore trap small compound

charge size exclusion chromatography bead small pore trap small compound allow large compound travel fast affinity chromatography column high affinity compound coat bead receptor antibody compound gas chromatography separate vaporizable compound accord adhere adsorbent column stationary phase coil crush metal polymer mobile phase nonreactive gas gas chromatography combine sequence mass spectrometry ionize fragment molecule pass fragment magnetic field determine molecular weight structure high performance liquid chromatography hplc similar column chromatography use sophisticated computer mediate solvent temperature gradient sample size small force capillary action affect result call high pressure liquid chromatography answer concept check 1 solvent immiscible different polarity acid base property allow compound interest dissolve easily 2 well wash 10 ml 30 ml compound interest extract multiple sequential extraction large 3 acid dissolve well

aqueous base dissociate form conjugate base highly charge soluble note like dissolve like
apply polarity acid basis dissolve easily solution opposite acid base 1 distillation take
advantage difference boiling point order separate solution miscible liquid 2 solution ether
methylene chloride close boiling point separate fractional distillation 3 vacuum distillation
good technique separate chemical high boiling point decreased ambient pressure allow boil
low temperature 1 method separate compound charge type column method separate sample
column give charge attract molecule opposite charge small pore small molecule trap large
molecule pass specific receptor antibody trap target column target wash solution 3 suggest
gas chromatography simply technique mobile stationary phase perform gaseous eluent
instead liquid stationary phase usually crush metal polymer 4 historically hplc perform high
pressure column chromatography use gravity pull solution column hplc perform sophisticated
variable solvent temperature gradient allow specific separation compound column
chromatography high pressure science mastery assessment fractional distillation effective
procedure separate liquid boil degree ethyl acetate ethanol boil 25 ° c good candidate
fractional distillation fractional distillation liquid c require low pressure high boiling

distillation fractional distillation liquid c require low pressure high boiling point extract sodium
hydroxide benzoic acid convert sodium salt sodium benzoate sodium benzoate unlike
conjugate acid dissolve aqueous solution aqueous layer simply acidify afterward retrieve
benzoic acid incorrect diethyl ether tetrahydrofuran nonpolar miscible hydrochloric acid
transform benzoic acid soluble salt b incorrect finally d incorrect protonate benzoic acid
limited solubility water effective perform successive extraction small amount ether perform
extraction large hexane polar ether likely displace polar compound adsorb silica gel decrease
distance polar compound travel decrease rf value column chromatography tlc polar
compound travel rapidly mean 1 naphthalenemethanol high rf value travel rapidly elute
example reverse phase chromatography solvent system polar mean polar compound travel
furth card result large rf give compound iii large rf correspond spot a.

methylen chloride dense brine salt water organic layer settle funnel methylen chloride
soluble water eliminate c silica gel polar polarity selectively attract specific solute nonpolar
solvent phase silica gel property important tlc question substance separate combination
technique step obvious remove sand filtration remain compound benzoic acid naphthalene
dissolve ether solution extract aqueous base benzoate anion form dissolve aqueous layer
naphthalene nonpolar compound remain ether finally evaporation ether yield purified
naphthalene option effectively separate simple distillation b require vacuum distillation boiling
point 150°C d boiling point 25°C require fractional distillation order separate affinity
chromatography target biological effector specific antibody work well case specifically bind
protein interest column solution compose large molecule small molecule size exclusion
chromatography effectively remove small insulin molecule fraction retain column allow titin
elute affinity chromatography c come risk render titin unusable eluent run affinity
chromatography column bind target molecule mobile phase system solute dissolve stationary
phase gas chromatography usually crush metal polymer stationary phase paper
chromatography paper warm hot solvent generally gravity filtration desire product soluble
allow product remain filtrate collect case student likely solvent cold product crystallize product
present residue lactoferrin protein likely charge resin describe question example ion
exchange chromatography charge protein molecule stick column remainder milk wash later
wash column collect consult online resource additional equation remember 12.1 retardation
factor biochemistry chapter 3 nonenzymatic protein function protein analysis general
chemistry chapter 7 general chemistry chapter 8 gas phase general chemistry chapter 9
general chemistry chapter 10 acid basis organic chemistry chapter 11 carbon adjacent
carbonyl amino acid chiral stereocenter amino acid hydrogen atom connect α carbon adjacent
carbonyl magnetic state see nmr spectroscopy nucleus magnetic moment align incident
magnetic field have low exact spatial arrangement atom group chiral molecule single chiral
atom designate r s functional group contain carbon atom

chiral atom designate r s functional group contain carbon atom bond or group alkyl chain
hydrogen acid dissociation constant K_a molecule contain chiral center contain chiral center
plane symmetry superimposable mirror image measurement strength acid solution high K_a
low pK_a strong acid special type column chromatography column customize bind substance
interest functional group contain carbonyl hydrogen $RCOH$ find end chain reaction aldehyde
ketone act electrophile nucleophile result formation carbon carbon bond new molecule call
aldol simple hydrocarbon molecule formula functional group contain carbonyl amino group
 $RCONR_2$ dipolar compound contain amine carboxylic acid attach single carbon α - carbon
building block peptide azimuthal quantum number l describe molecule act acid basis increase
energy result bond angle deviate ideal value functional group contain carbonyl separate
oxygen atom $RCOOR$ condensation dimer carboxylic acid type stagger conformation large
group antiperiplanar energetically high energy stable orbital result overlap wave function
conformation substituent plane opposite side bond describe group cyclic molecule
perpendicular plane molecule point straight describe subshell electron find possible value
range $0 \leq l \leq n-1$

represent s subshell $l = 0$ represent p $l = 1$ represent d $l = 2$ represent f.

carboxylic acid derivative chemical shift δ membered cyclic amide reactive hydrolysis linear
amide large cyclic amide backbone antibiotic magnetic state see nmr spectroscopy nucleus
irradiate radio- frequency pulse bring high energy state low energy stable orbital result
overlap wave function double bond carbon functional group contain carbonyl hydroxyl group
carbon compound create carboxylic acid nucleophilic acyl substitution include anhydride ester
amide characteristic compound change chemical composition reaction determine molecule
react molecule arbitrary variable plot nmr spectrum measure part reaction preference
location molecule molecule carbon atom bond different group plane symmetry

superimposable mirror image atom chiral molecule tool separate compound base strongly adhere stationary phase travel mobile phase molecule substituent immovable bond diastereomer different arrangement substituent type chromatography use column fill silica alumina bead adsorbent allow separation use gravity solvent compound column reaction combine molecule loss small molecule spatial arrangement atom group molecule coordinate covalent bond coupling constant J isomer interconvert break bond include enantiomer diastereomer cis trans isomer isomer molecule different point natural rotation σ bond alternate single multiple bond create system parallel unhybridized p orbital electron share orbital form electron cloud plane molecule stabilize molecule molecule molecular formula different connectivity call covalent bond electron bond come start nmr spectroscopy phenomenon occur proton close proximity magnetic moment affect appearance nmr spectrum subdivide peak subpeak call splitting magnitude splitting nmr spectroscopy measure type chemical bond electron share atom functional group contain nitrile CN hydroxyl group atomic orbital compose symmetrical lobe contain node complete loss carboxyl group carbon dioxide reversion protect group original functional group removal hydrogen cation H^+ molecule phenomenon atom pull electron density away surround atom nmr spectroscopy pull group downfield beaker lid wide-mouthed jar thin layer chromatography alcohol hydroxyl group commonly protect group aldehyde ketone carbonyl call diol isomer differ chiral carbon different chemical physical property liquid evaporate

isomer differ chiral carbon different chemical physical property liquid evaporate condense collect distillation separation purification technique take advantage difference boiling point separate liquid vaporization condensation peak identical intensity nmr spectrum equally space true chemical shift group proton result split movement left nmr describe group push additional electron density atom stabilize positive charge destabilize negative charge decrease describe group pull electron density away atom stabilize negative charge destabilize positive charge electron love atom positive charge positive polarization accept electron pair form new

bond nucleophile solvent chromatography pass stationary phase displace solvent thin layer nonsuperimposable mirror image chiral molecule physical chemical property rotation plane polarized light reaction chiral environment resonance form carbonyl carbon carbon double bond ene alcohol ol describe group cyclic molecule plane molecule functional group contain carbonyl alkoxy group rcoor transfer dissolve compound start solvent solvent product ir spectrum region 1500 400 cm^{-1} complex vibration pattern cause motion molecule see characteristic individual molecule formation ester carboxylic acid alcohol acidic condition system represent three- dimensional molecule horizontal line indicate bond project plane page wedge flash column chromatography gabriel malonic ester synthesis gas chromatography gc vertical line indicate bond go plane page dash point intersection represent carbon technique speed column chromatography force solvent column increase pressure nonreactive gas modify form distillation separate liquid similar boiling point 25°C apart use fractionation column contain inert material liquid condense reflux reaction vial allow refined separation volume eluted fluid column chromatography fraction contain different compound collect leave column method synthesize amino acid use potassium phthalimide diethyl bromomalonate follow alkyl halide substitution reaction follow hydrolysis type chromatography separate vaporizable compound stationary phase crush metal polymer mobile phase nonreactive gas high performance liquid chromatography hplc highest occupy molecular orbital homo type stagger conformation large group 60° apart functional group hydroxyl group carbon call hydrate functional

$^{\circ}$ apart functional group hydroxyl group carbon call hydrate functional group contain carbon atom bond or group oh group alkyl chain hydrogen atom functional group contain carbon atom bond or group oh group cleavage bond electron give atom form chromatography small sample column manipulate sophisticated solvent gradient allow refined separation characterization call high pressure liquid high energy molecular orbital contain electron uv spectroscopy electron excite homo reduce reagent contain hydride infrared ir spectroscopy

inorganic phosphate pi intermolecular force result extreme polarity bond hydrogen atom attach highly electronegative atom n o breaking molecule water oh group see alcohol hemiacetal hemiketal carboxylic acid water compound contain quinone conjugate ring carbonyl hydroxyl group double bond carbon nitrogen describe solvent mix dissolve pull electron density sigma technique measure molecular vibration different frequency specific bond determine functional group infer base information derive phosphoric acid molecule form high- energy bond energy transfer nucleotide triphosphate like atp enzyme regulation special type column chromatography bead column coat charge substance attract bind compound opposite type chemical bond electron transfer atom molecule molecular formula different chemical structure oxidation reaction primary alcohol oxidize carboxylic acid secondary alcohol oxidize ketone require CrO_3 dissolve dilute sulfuric acid acetone functional group contain carbon atom bond or group alkyl chain functional group contain carbonyl alkyl group rcor find chain cyclic amide name accord greek letter carbon close ring cyclic ester name accord greek letter carbon close ring straight- chain form compound molecular fragment retain electron heterolysis stable solution low unoccupied molecular orbital lomo magnetic quantum number ml electron acceptor formation covalent bond electron donor formation low energy molecular orbital contain electron uv spectroscopy electron excite homo lomo describe orbital electron find possible value range $l + 1$. molecule chiral center optically active internal plane symmetry compound contain functional group SO_3CH_3 derive methanesulfonic acid reaction carbanion

compound contain functional group SO_3CH_3 derive methanesulfonic acid reaction carbanion attack α β unsaturated carbonyl liquid gas gas chromatography run stationary phase result electron structure atomic orbital combine peak shift nmr nuclear magnetic resonance nmr spectroscopy nucleophilic acyl substitution method visualize compound line sight carbon carbon bond axis orbital structure area probability find electron zero increase energy result nonadjacent atom group compete space call steric strain technique measure alignment

magnetic moment certain molecular nucleus external magnetic field determine connectivity functional group molecule nucleus lone pair π bond form new bond substitution nucleophile leave group carboxylic acid carboxylic acid derivative type configurational isomer different spatial arrangement substituent affect rotation plane polarized light nucleotide variable number phosphate loss electron cause increase oxidation state increase bond oxygen heteroatom molecule indication hypothetical charge atom bond completely element compound accept electron species reduce atomic orbital compose lobe locate symmetrically nucleus contain node type chromatography use paper stationary phase component sample adhere differentially mobile stationary phase chromatographic setup cause different substance migrate different speed stationary phase amide bond form amino acid condensation nucleophilic acyl alcohol aromatic ring slightly acidic hydroxyl hydrogen π bond preparative thin layer chromatography principal quantum number n type bond link sugar moiety adjacent nucleotide dna characteristic compound change chemical composition melting point boiling point solubility odor color density bond molecular orbital form parallel p orbital share electron exist electron cloud sigma σ bond nucleus uneven distribution charge cause atom molecule have different molecule form multiple amino acid connect peptide bond thin layer chromatography tlc means purification large plate develop large spot sample split band individual compound scrape wash yield pure describe shell electron find value range 1 .th retardation factor r_f addition hydrogen cation H^+ ester dimer phosphate release new nucleotide join grow strand dna dna polymerase compound produce

new nucleotide join grow strand dna dna polymerase compound produce oxidation phenol contain conjugate ring ketone general alkyl chain amino acid chemistry variable chain α carbon mixture + enantiomer present equal concentration gain electron cause decrease oxidation state decrease bond oxygen heteroatom molecule spatial arrangement group chiral molecule compare chiral delocalization π electron increase stability molecule possible arrangement π electron molecule actual electronic structure molecule weight average

resonance structure base stability ratio thin layer chromatography identify compound
calculate far compound traveled relative far solvent travel reverse aldol condensation reaction
carbon carbon bond cleave heat base yield aldehyde ketone

opposite

traditional thin layer chromatography stationary phase nonpolar mobile phase polar energy
create cyclic molecule angle strain torsional strain nonbonded strain determine ring stable
stay intact atomic orbital spherical symmetrical center nucleus process fat hydrolyze basic
condition produce soap piece laboratory equipment extraction immiscible solvent separate
gravity cause dense layer sink remove turn stopcock phenomenon atom push electron density
surround atom nmr spectroscopy pull group upfield spectrum th sigma σ bond specific
rotation α bond molecular orbital form head head tail tail overlap atomic orbital single bond
sigma bond distillation special feature separate liquid boil 150°C 25°C difference boiling
special type column chromatography bead column contain tiny pore vary size slow small
compound enter bead hybrid orbital 50 s character 50 p- hybrid orbital 33 s character 67 p-
hybrid orbital 25 s character 75 p- standardized measure compound ability rotate plane-
laboratory technique rely measurement energy difference possible state molecular system
determine spin quantum number m frequency electromagnetic radiation light absorb
molecule response magnetic field describe intrinsic spin electron orbital arbitrarily assign
electron spin + spin thin layer chromatography place sample directly adsorbent small define
molecule overlap substituent line sight carbon newman projection solid medium sample place
chromatography call adsorbent describe chiral center molecule isomer chemical formula
atomic connectivity differ atom arrange space isomer structural isomer stereoisomer reaction
form unequal distribution isomer product determine stability product reaction preferentially
yield specific conformation product $\text{S}_{\text{N}}2$ reaction thin layer chromatography tlc prevention
reaction particular location molecule substituent group reactive site prevention formation

alternative product protect group method synthesize amino acid use condensation aldehyde hydrogen cyanide follow hydrolysis molecule molecular formula different connectivity call functional group isomer differ placement proton double bond calibration standard mark 0 ppm plot nmr spectrum type chromatography use silica gel alumina card medium stationary phase

type chromatography use silica gel alumina card medium stationary phase increase energy result molecule assume eclipse gauche staggered totally eclipse conformation ultraviolet uv spectroscopy compound contain functional group so3c6h4ch3 derive toluenesulfonic acid type conformation large group 0° apart energetically unfavorable conformation molecule substituent opposite side immovable bond process transform ester alcohol act nucleophile displace alkoxy group ester ester long chain carboxylic acid fatty acid glycerol 1,2,3 propanetriol storage form energy peak area ratio 1:2:1 nmr spectrum center true chemical shift group proton result split biologically active quinone vital electron carrier electron transport chain call technique measure absorbance ultraviolet light wavelength pass sample movement right nmr spectrum.fi modify form distillation separate liquid boiling point 150°C lower pressure decrease temperature liquid boil dialcohol hydroxyl group reverse extraction small solvent pour compound interest dissolve remove impurity analog frequency infrared spectra instead wavelength compound contain charge absolute conformation 54 r s form 51 55–58 acetal protect group 113 141–142 formation 167 172 summary 147 167 241 acetic acid 27 achiral 48 50 acid anhydride anhydrides acid dissociation constant K_a 99–101 120 acid dissociation constant 99–101 amphoteric molecule 99 263 brønsted lowry acid basis 98 99 carbonyl group α hydrogen 101 112 185 186 electrophile lewis acid 104 extraction 313 leaving group 105 lewis acid basis 98–99 nucleophile vs. basis 102 pK_a 99–101 138fi reaction step 114 acyl derivative 213 adenosine triphosphate atp 269 270 adsorbent chromatography 318 319 321–323 327 affinity chromatography 322 327

acid behavior 101 120 136 138 boiling point 137 common name 16 136 consuming alcohol 135 definition 14 136 electrophile 104 infrared spectroscopy 287 288 jones oxidation 140 nomenclature 14 16 24 136–137 nucleophile electrophile reaction 102 120 140 166–167 oxidation level 108 oxidation reaction 108–109 139–140 164 phenol 136 138 143–145 physical property 137–138 147 pka 100 138 protect group 141–142 167 241 reactive site 111–112 reduction product 110 122 170 summary 26 147 acid behavior 101 120 aldol condensation 191–192 α hydrogen acidic 101 112 185 186 boiling point 163 common name 19 162 definition 18 162 electrophile 104 120 163 enolate chemistry 187–188 infrared spectroscopy 287 nmr chemical shift 294 295 nomenclature 18–20 24 162–163 nucleophilic addition reaction 165–168 186 oxidation level 108 oxidation 109 164 169–170 oxidation product 109 139–140 physical property 163 protect group 113 141–142 147 167 241 reactive site 112 reduction 110 122 170 summary 27 172 aldol 192 195 aldol condensation 191–192 retro aldol reaction 192 alkane 14 15 infrared spectroscopy 287 288 leave group 105 nmr chemical shift 294 295 nomenclature 14 24 26 oxidation level 108 oxidation 109 sp^3 hybrid orbital 80–81 e z form 61 infrared spectroscopy 287 nmr chemical shift 294 295 nomenclature 14 24 26 oxidation 109 sp^2 hybrid orbital 81–82 alkoxy group 21 27 alcohol physical property 138 nmr chemical shift 294 295 nomenclature 12 14 27 oxidation level 108 sn_2 reaction 106 infrared spectroscopy 287 nmr chemical shift 294 295 nomenclature 14 24 26 oxidation 109 sp hybrid orbital 82 α amino acid 273 amino acid 262 carbonyl 120 186 194 acidic β dicarboxylic acid 210–211 220 carbonyl group 101 112 120 185 186

keto enol tautomerization 187–188 kinetic thermodynamic enolate 189 194 base behavior 101 120 boiling point 236 definition 22 236 electrophilicity 104 formation 213–214 235 236 hydrogen bonding 236 induction 241 242 infrared spectroscopy 287 lactam 214 236 242 nitrogen contain 22 213 236 nomenclature 22 24 213 236 nucleophilic acyl substitution 220 245–246 249 oxidation level 109 reactivity 240 244 reduction 110 122 steric hindrance 241 summary 27 248 base behavior 101 120 infrared spectroscopy 287 oxidation level 108 reactive

site 112 reduction product 110 122 carboxylic acid 207 263 category 263–264 fischer projection 262 263 infrared spectroscopy 287 nitrogen contain 261 synthesis 265–268 amino group 22 amphoteric molecule 99 120 263 272 angle strain 47 60 boiling point 239 definition 23 238 electrophilicity 104 formation 215 235 238–239 induction 241 242 nomenclature 23 24 nucleophilic acyl substitution 220 244–245 oxidation level 108 reactivity 240 244 steric hindrance 241 summary 28 248 anion stability 186 anti conformation 45–46 60 antibonding molecular orbital 77 85 uv spectroscopy 289 aprotic solvent nucleophilicity 103–104 aqueous phase solvent 312 326 aromatic amino acid 272 infrared spectroscopy 287 nmr chemical shift 294 295 phenol 136 138 147 asymmetric conformation 28 atomic orbital 85 axial hydrogen 48 60

azimuthal quantum number l 76 85 acid base reaction brønsted lowry basis 98 99 lewis basis 98–99 nucleophile vs. 102 120 β dicarboxylic acid 210–211 220 β lactam 242 248–240 bimolecular nucleophilic substitution reaction s_n2 reaction boat cyclic conformation 47 alcohol 137 147 hydrogen bonding 163 207 vacuum distillation 316 alkane alkene alkyne 14 bond numbering 14 carbon chain numbering 11 cis trans designation 48 52–53 conformational isomer 44 e z form 53 55 high order functional group 10 hydrogen bonding bond length 78–79 carbon tetravalency 75 81 conjugation 83 115 241–242 289 covalent bond 75 98–99 induction 241 242 ionic bond 75 molecular orbital 77–79 85 π bond 78–79 quantum number 76 sigma σ bond 78–79 brønsted lowry acid basis 98 99 120 butane 15 26 cahn ingold prelog priority rule 55 61 carbanion 101 186 enolate carbanion 112 188 michael addition 188 electrophilicity 104 s_n2 reaction 105–106 112 stability 138 magnetic moment 292 organic chemistry basis 75 261 sp^3 hybrid orbital 80–81 tetravalency 75 81 oxidation level 108 aldehyde ketone α hydrogen acidic 101 112 120 185 186 definition 18 161 geminal diol dehydration 16 infrared spectroscopy 287 nucleophile electrophile reaction 102 161 163 nucleophilic addition reaction 165–168 nucleophilic substitution reaction 240 oxidation reduction reaction 169–170 physical property 163–164 polarity 163–165 209 protect group 113 141–142 167 241 reactive site 112

summary 27 172 acid behavior 101 120 207 210–211 common name 21 208–209 definition 21 207 208 derivative amide anhydrides esters electrophile 104 120 hydrogen bonding 207 209 infrared spectroscopy 287 jones oxidation 140 nmr chemical shift 294 295 nomenclature 21–24 208–209 nucleophilic acyl substitution 212–215 oxidation level 108 oxidation product 109 140 164 170 212

physical property 209–211 pka 100 207 210 reactive site 112 reduction 110 122 215 summary 27–28 220–221 synthesis 212 chain terminate group 18 chair cyclic conformation 47–48 chair flip 47 chemical property 43 chemically equivalent nmr 292 protect group 113 141–142 167 241 reactive site 112 chiral center 49 61 amino acid α carbon 262 diastereomer 50 52–53 r s form 55 57 absolute conformation 54 optical activity 51–53 r s form 55–58 relative configuration 54 column chromatography 321–322 gas chromatography 323 high performance liquid chromatography 323–324 paper chromatography 319–320 process 318–319 thin layer chromatography 319–320 cis trans isomer 42 48 52–53 61 cleavage anhydride 243–245 249 coenzyme q 145 148 column chromatography 321–322 327 alcohol 16 136 aldehyde 19 162 carboxylic acid 21 208–209 concerted reaction 106 condensate distillation 315 aldol condensation 191–192 195 amino acid peptide bond 264 anhydride formation 215 238–239 carboxylic acid derivative 235 imine formation 167 168 condenser distillation 315 316 configurational isomer 42 48–53 diastereomer 42 50 52–53 enantiomer 42 50–51 optical activity 51 optical isomer 48 conformational isomer 42 44–48 anti gauche 45–46 cyclic conformation 47–48 newman projection 45 conformer conformational isomer conjugation 83 241–242 carboxylic acid derivative 241–242 248 ultraviolet spectroscopy 289 297 constitutional isomer 42 43 coordinate covalent bond 98–99 heterolytic reaction vs. 105 coupling constant j 293 covalent bond 75 98–99 cyanohydrin 168 172 cyclic conformation 28 47–48 cycloalkane conformation 47–48 cyclohexane molecule 60 cysteine r configuration 262 272 decarboxylation 216 220 dehydration reaction 191–192 195 deprotection 141 147 deshielding proton 293 298 develop chromatography plate 319 327 diastereomer 42 50 52–53 60–61

dicarboxylic acid 209 210 220 carboxylic acid 209 220 acetal 112 geminal 16 26 139 166 172
oxidation 109 oxidation product 109 dipole dipole interaction solubility 313 distillate 315 326
distillation 315–317 326

distillation column 315 316 distilling flask 315 316 bond length 78–79 pi π sigma σ 78–79 sp³
hybrid orbital 80–81 doublet nmr 293 298 downfield nmr 291 293 298 e z nomenclature 53 55
eclipsed conformation 45–46 torsional strain 47 anion stability 186 leave group 105 lewis acid
basis 98 104 molecular orbital 77–79 node orbital 76 nucleophile electrophile reaction 102–106
organic chemistry basis 103 oxidize agent 108 quantum number 76 acid vs. 104 carbonyl
group 163 leave group 104 eluent chromatography 319 322 323 elution chromatography 318
319 322 327 enamine 168 172 189 194 enantiomer 42 50–51 60 acidic α hydrogen 101 112 185
186 keto enol tautomerization 187–188 194 kinetic thermodynamic enolate 189 envelope
cyclic conformation 47 epoxide oxidation product 109 equatorial hydrogen 48 60 boiling point
237 common name 215 definition 21 237 electrophilicity 104 fischer esterification 237
formation 235 237 hydrogen bonding 237 induction 241 242 lactone 215 237 242
nomenclature 21–22 24 215 237 nucleophilic acyl substitution 220 245 oxidation level 108
oxidation product 109 reactivity 240 244 reduction 110 122 steric hindrance 241 summary 27
248 transesterification 245 249 ethane 15 26 ethanoic acid 27 ether infrared spectroscopy 287
ethyl alcohol 26 acid base reaction 313 filtrate 314 326 filtration 314 326 fingerprint region 286
297fi fischer esterification 237 248 fischer projection 57–58 61 amino acid 262 263 flagpole
interaction 47 formic acid 27 fractional distillation 316–317 326 carbonyl group 161 carbonyl
group carboxylic acid high priority 21 24 chemical property 43 infrared spectroscopy 287
nomenclature 10 11 oxidation level 108 oxidization state priority 11 24 oxidization state
reactivity 111 pka 100–101 summary 24 28 gabriel synthesis 267–268 stereospecificity 106 115
steric hindrance 112 241 gas chromatography gc 323 327 gauche conformation 45–46 60
geminal diol 16 26 139 166 172

geometric isomer cis trans isomer glycine achiral 262 272 gravity filtration 314 326 half chair conformation 47 hemiacetal formation 166–167 172 hemiketal formation 166 172 heterolytic reaction 105 high performance liquid chromatography hplc 323–324 327 high occupy molecular orbital homo 289 297 high priority functional group bond 10 carboxylic acid 21 24 numbering carbon chain 11 suffix compound 11 s p character 80–82 sp hybrid orbital 82 sp² hybrid orbital 81–82 sp³ hybrid orbital 80–81 hydrate geminal diol hydration form geminal diol 166 172 hydride reagent 170 173 hydrocarbon nomenclature 14–15 26 hydrogen bonding 137 alcohol physical property 137–138 147 163 boiling point 163 207 carboxylic acid 207 209 melting point 137 protic vs. aprotic solvent 103 solubility 137–138 313 hydrogen cyanide hcn nucleophile 168 leave group 105 hydroxyl group 136 infrared spectroscopy 287 288 leave group 140 phenol 136 147 hydroxyquinone 143–144 148 enamine 168 189 formation 167 168 172 265 oxidation level 108 immiscible solvent 312 induction 241 242 248 infrared ir spectroscopy 286–288 297 inorganic phosphate pi 269 273 integration nmr spectra 292 298 international union pure applied chemistry iupac nomenclature ion exchange chromatography 322 327 ionic bond 75 cis trans 42 48 52–53 61 configurational 42 48–53 60 conformational 42 44–48 definition 41 42 e z form 55 fischer projection 57–58 newman projection 45 optical activity 51–53 optical isomer 48 r s form 55–58 stereoisomer 42 44–53 structural 42 43 60 tautomer 168 187–190 216 jones oxidation 140 ketal protect group 113 141–142 summary 147 167 241 acid behavior 101 120 aldol condensation 191–192 α hydrogen acidic 101 112 185 186 boiling point 163 common name 163 definition 18 162 electrophile 104 120 163 enol enolate form 112 enolate chemistry 187–188 infrared spectroscopy 287 nomenclature 18–20 24 163

nucleophilic addition reaction 165–168 194 oxidation level 108 oxidation 109 oxidation product 109 140 oxidation reduction reaction 169–170 physical property 163–164 protect group 113 141–142 147 167 241 reactive site 112 reduction 110 122 170 steric hindrance 186 summary 27 172 kinetic enolate 189 194 kinetic property 102 104 lactam 214 220 236 242 248

lactone 215 220 237 242 248 leave group 105 carbonyl nucleophilic attack 165 213 electrophilicity 104 steric protection 112 weak basis 213 lewis acid basis 98–99 electrophile lewis acid 104 like dissolve like 311–313 lithium aluminum hydride LiAlH_4 122 220 low unoccupied molecular orbital lUMO 289 297 magnetic moment 290–292 magnetic quantum number ml 76 85 magnetic resonance imaging mri 285 291 298 malonic ester synthesis 267–268 mass spectrometry 323 327 melting point alcohol 137 147 meso compound 53 60 mesylate 140–141 147 methane 14 15 26 sp^3 hybrid orbital 80–81 methanoic acid 27 micelle 217 221 michael addition 188 194 mobile phase chromatography 318 319 323 327 molecular orbital 77–79 highest occupy 289 297 lowest unoccupied 289 297 multiplet nmr 294 298 negatively charge amino acid 272 newman projection 45 60 nitrile group 265–266 nitrogen contain group amide amine amino acid nmr

nuclear magnetic resonance spectroscopy node orbital 76 common name prefix suffix alcohol 14 16 24 136–137 aldehyde 18–20 24 162–163 alkane alkene alkyne 14 24 alkyl group 12 14 amide 22 24 213 236 anhydride 23 24 carbonyl group 20 carboxylic acid 21–24 208–209 cis trans designation 48 52–53 e z form 53 55 ester 21–22 24 215 237 greek letter prefix 20 greek number prefix 14 iupac step 10–13 26 ketone 18–20 24 163 r s form 51 55–58 substituent 11–14 16 20 22 136 nonbonded strain 47 60 nonpolar nonaromatic amino acid 272 like dissolve like 311–313 nucleophile electrophile reaction 104 nuclear magnetic resonance spectroscopy nmr 290–295 α state β state 291 293 chemical shift 291 294–295 deshielding 293 298 doublet 293 298 downfield 291 293 298 integration 292 298 magnetic resonance imaging 285 291 multiplet 294 298 $n + 1$ rule peak 293 294 spin spin coupling 293 298 tetramethylsilane calibration 291 293 294 triplet 294 298 nucleophile electrophile reaction 102–106 alcohol hydroxyl group 102 140 166–167 aldehyde vs. ketone 186 carbonyl group 102 161 163 165–168 240 electrophile vs. acid 104 functional group oxidation 111 induction 241 nucleophile 102–104 168 nucleophile vs. basis 102 nucleophile vs. leave group 105 nucleophilic acyl substitution 212–215 220 241 244–246 249 nucleophilic addition reaction

165–168 191–192 216 nucleophilic substitution reaction 105–106 167 168 240 reaction step
114 sn1 reaction 105–106 112 167 241 sn2 reaction 106 112 115 241 267 solvent effect
103–104 summary 120–121 172

nucleotide organic phosphate 270 optical activity 51 53 amino acid 262 meso compound 53
racemic mixture 51 specific rotation 51 optical isomer 48 electrophilicity 104 carbon basis 75
261 electron basis 103 reaction problem solving 114–118 reaction type 102 reaction organic
phase solvent 312 326 organic phosphate 270 273 oxidation reduction reaction 107–110
alcohol 109 139–140 164 aldehyde 109 110 164 170 biological molecule 145 functional group
oxidation 111 ketone 109 110 169–170 oxidizing agent 108–109 reaction step 114 reduce
agent 109–110 215–216 summary 121–122 173 paper chromatography 319–320 327

parent chain nomenclature 10–13 26 partitioning chromatography 318 327 partitioning
coefficient 318 peptide bond 264 272 acidity 100 bond strength 100 carbon near center 75
nucleophile reactivity 103 nucleophilicity solvent 103 transition metal 109 amino acid behavior
263 inorganic phosphate 269 phosphoric acid 270 phosphate group 269 273 phosphodiester
bond 269 273 phosphoric acid 269–270 buffer 270 physical property 43 carbonyl group
163–164 carboxylic acid 209–211 diastereomer 51 52 pi π bond 78–79 85 pka 99–101 138
alcohol 100 138 carboxylic acid 100 207 210 hydrogen cyanide 168 phosphoric acid 270 water
100 138 polar amino acid 272 assume solvent polar 103 like dissolve like 311–313
nucleophilicity 103–104 carbonyl group 163–165 209 carboxylic acid 209 polypeptide 264 272
positively charge amino acid 272 prefix nomenclature alkyl 14 24 alphabetization 13 carboxy
21 24 cis 42 48 52–53 d + 51 double bond 14 e 53 55 greek letter 20 greek number 14 hydroxy
16 24 26 136 144 147 keto 20 24 27 172 l 51 meta m 136 147 multiple substituent 12 13 n 12 13
n 22 213 236 248 ortho o 136 147 oxo 20 24 27 172 para p 136 147 r 51 55–58 s 51 55–58 tert t
13 trans 42 48 52–53 triple bond 14 z 53 55 preparative thin layer chromatography 320
principal quantum number n 76 85 propane 15 26 propanoic acid 27 propionic acid 27 protect

group 113 141–142 167 241 248 protein 264 272 alcohol 136 nucleophilicity 103–104 proton
nmr 1h nmr 292–295 proton brønsted lowry acid basis 98 99 puckered cyclic conformation 47
preparative thin layer chromatography 320 327 recrystallization 314 326 washing 313 326
pyridinium chlorochromate pcc 139–140 147 164 170 172 pyrophosphate ppi 270 273

quantum number 76 85 r s nomenclature 51 55–58 racemic mixture 51 amino acid synthesis
267 268 meso compound equivalence 53 sn1 reaction 105 example reaction 115–119
nucleophile electrophile reaction 102–106 oxidation reduction reaction 107–110 problem
solving step 114–118 receive flask distillate 315 316 recrystallization purifying 314 326 reduce
oxidize agent 108 121–122 reduce agent 109–110 122 215–216 relative configuration 54 61
residue filtration 314 326 carbonyl α hydrogen 101 112 186 carboxylic acid 209 conjugation
241–242 248 leaving group 105 peptide bond 264 phenol 135 138 retardation factor rf 320 327
retro aldol reaction 192 195 reverse phase chromatography 320 327 ring strain 47 249 lactam
lactone 242 rotary evaporator rotovap 313 s r nomenclature 51 55–58 saponification 217–218
221 238 248 like dissolve like 311–313 separatory funnel 312–313 sigma σ bond 78–79 double
triple vs. 78–79 sp² hybrid orbital 81–82 simple distillation 315 326 single bond 78 85 sigma σ
bond size exclusion chromatography 322 327 skew boat cyclic conformation 47 sn1 reaction
unimolecular nucleophilic substitution 105–106 acetal ketal formation 167 reactive site 112
steric hindrance 241 sn2 reaction bimolecular nucleophilic substitution 106 121 soap 217–218
221 238 solubility base separation 312–313 intermolecular force affect 313 aqueous phase 312
assume solvent polar 103 like dissolve like 311–313 organic phase 312 sp hybrid orbital 82 85
sp² hybrid orbital 81–82 85 sp³ hybrid orbital 80–81 85 specific rotation 51 infrared 286–288
297

magnetic resonance imaging 285 291 nuclear magnetic resonance 290–295 298 ultraviolet 289
297 spin quantum number ms 76 85 spin spin coupling nmr 293 298 coupling constant j 293
splitting nmr 293 spotting chromatography 319 327 stagger conformation 45–46 60 stationary

phase chromatography 318 319 323–324 327 stereoisomer 42 44 absolute conformation 54
configurational 42 48–53 conformational 42 44–48 e z form 55 fischer projection 57–58
newman projection 45 r s form 55–58 61 relative configuration 54 sn2 reaction 106 115 steric
hindrance 112 carboxylic acid derivative 241 protect group 113 141–142 167 241 248 strain
molecule 47 lactam lactone 242 strecker synthesis 265–267 273 structural isomer 42 43 60
cahn ingold prelog priority rule 55 61 cis trans isomer 48 52–53 e z form 55 fischer projection
57–58 nomenclature 11–14 16 20 22 26 136 r s form 55–58 suffix nomenclature al 18 24 27 162
172 amide 22 24 27 213 220 236 248 ane 12 14 24 26 anhydride 23 24 28 215 220 238 248
carbaldehyde 162–163 172 dioic acid 208 220 ene 14 24 26 oate 22 24 27 220 237 248 oic acid
21 24 27 208 220 ol 16 24 26 136 147 19 24 27 163 172 yl 12 14 yne 14 24 26 symmetric
conformation 28 enamine 168 189 keto enol tautomerization 187–188 194 216
tetramethylsilane tms calibration 291 293 294 298 thermodynamic enolate 189 194
thermodynamic property 102 104 thin layer chromatography tlc 319–320 327 retardation
factor 320 327 torsional strain 47 60 tosylate 140–141 147 totally

eclipse conformation 45–46 60fi transesterification 245 249 transition metal 109 transmittance
infrared spectra 287–288 297 triacylglycerol 238 248 bond length 78–79 sp hybrid orbital 82 pi
 π sigma σ 78–79 triplet nmr 294 298 twist boat cyclic conformation 47 ubiquinol 145 148
ubiquinone 145 148 ultraviolet uv spectroscopy 289 297 unimolecular nucleophilic substitution
reaction sn1 reaction vacuum distillation 316 326 vacuum filtration 314 326 van der waals
force 47 solubility 313 vapor phase chromatography vpc 323–324 vicinal diol 16 26 vitamin k1
quinone 143–144 148 volatility gas chromatography 323 amphoteric 99 aqueous phase 312
dehydration reaction 192 235 238–239 hydration reaction 166fi hydro prefix 23 magnetic
resonance imaging 285 291 pka 100 138 protic solvent 103 wavenumber 286 297 z e
nomenclature 53 55 zwitterion 263 272 chapter 2 cover image credit vladyslav starozhylov
chapter 3 cover image credit fikmik shutterstock chapter 4 cover image credit andrea danti
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