請依照題號次序作答

I. (50%) Simple choice. There is only one correct answer in each question.

1. Which compound is the major component in natural gas? (**A**) methane (**B**) nitrogen (**C**) acetylene (**D**) ethene
2. Which functional group is **not** contained in cysteine $HSCH_2CH(NH_2)COOH$? (**A**) amino (**B**) carboxylic acid (**C**) hydroxyl (**D**) thiol
3. Which compound reacts rapidly with Br_2 and discharge the brown color? (**A**) hexane (**B**) 3-hexene (**C**) 3-hexanone (**D**) 3-hexanol
4. How many chiral carbon(s) in a molecule of 2,3-dimethylbutane? (**A**) 0 (**B**) 1 (**C**) 2 (**D**) 3
5. The triple bond of an alkyne RC≡CR is composed of (**A**) three σ bonds (**B**) three π bonds (**C**) one σ bond and two π bonds (**D**) two σ bonds and one π bond
6. Which compound is the strongest acid? (**A**) HCN (**B**) H_2CO_3 (**C**) CH_3CO_2H (**D**) CF_3CO_2H
7. Which reagent can convert 2-methyl-1-propene $(CH_3)_2C=CH_2$ to 1,1-dimethylethanol $(CH_3)_3COH$? (**A**) O_3 (**B**) H_2O_2 (**C**) 6 M NaOH/H_2O (**D**) 6 M H_2SO_4/H_2O
8. Which compound reacts with Tollens reagent $Ag(NH_3)_2^+$ to give a positive silver mirror test? (**A**) pentanal (**B**) penatanol (**C**) 2-pentene (**D**) 2-pentanone
9. Which reaction is good to prepare *tert*-butyl methyl ether $(CH_3)_3COCH_3$? (**A**) $(CH_3)_3CO^-K^+ + CH_3I$ (**B**) $(CH_3)_3C^-K^+ + CH_3OH$ (**C**) $(CH_3)_3CI + CH_3O^-Na^+$ (**D**) $(CH_3)_3COH + CH_3O^-Na^+$
10. Which compound reacts most rapidly with Br_2 in the presence of $NaHCO_3$? (**A**) chlorobenzene ClC_6H_5 (**B**) toluene $C_6H_5CH_3$ (**C**) aniline $C_6H_5NH_2$ (**D**) nitrobenzene $C_6H_5NO_2$
11. Which compound has the highest boiling point? (**A**) pentane (**B**) diethyl ether (**C**) 2-butanone (**D**) 2-butanol
12. Which compound is a tertiary amine? (**A**) butylamine (**B**) diethylamine (**C**) 2,2-dimethylethylamine (**D**) *N*,*N*-dimethylethylamine
13. Which compound is insoluble in water but dissolves in aqueous $NaHCO_3$ solution with a release of CO_2 gas? (**A**) aldehyde (**B**) ester (**C**) carboxylic acid (**D**) ketone
14. The relationship between acetone and 2-hydroxy-1-propene is (**A**) tautomers (**B**) enantiomers (**C**) diastereomers (**D**) conformational isomers
15. For D-glyceraldehyde HOH_2C-CH(OH)-CHO (**A**) it is achiral (**B**) it is a planar molecule (**C**) it has (*R*)-configuration (**D**) 1,3-dihydroxyacetone is its configurational isomer
16. Peptide bonds are (**A**) ester bonds (**B**) amide bonds (**C**) hydrogen bonds (**D**) acetal bonds
17. Compound $CH_3(CH_2)_{16}CO_2H$ is (**A**) a bile acid (**B**) a fatty acid (**C**) a nucleic acid (**D**) an amino acid
18. Nature rubber $[CH_2CH=C(Me)CH_2]_n$ is formed by polymerization from monomers of (**A**) 2-methyl-2-butene (**B**) 3-methyl-2-butene (**C**) 2-methyl-1,3-butadiene (**D**) 3-methyl-1,3-butadiene
19. Which IR absorption corresponds to the carbonyl group of acetone $(CH_3)_2C=O$? (**A**) 1200 cm^{-1} (**B**) 1710 cm^{-1} (**C**) 2100 cm^{-1} (**D**) 3300 cm^{-1}
20. The reaction of (*E*)-2-butene with *m*-chloroperoxybenzoic acid will give (**A**) *meso*-2,3-butanediol (**B**) racemic 2,3-butanediol (**C**) *cis*-1,2-dimethyloxirane (**D**) *trans*-1,2-dimethyloxirane
21. The reaction of 1,2-epoxycyclohexane with phenylmagnesium bromide C_6H_5MgBr, after aqueous workup, will give (**A**) 1-phenylcyclohexanol (**B**) *trans*-2-phenylcyclohexanol (**C**) *cis*-2-phenylcyclohexanol (**D**) cyclohexyl phenyl ether

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22. Which compound is the most stable? (**A**) 1,4-pentadiene (**B**) *trans*-1,3-pentadiene (**C**) *trans*-1,4-hexadiene (**D**) *cis*-1,4-hexadiene

23. Which reagent is used to convert methyl benzoate $C_6H_5COOCH_3$ to benzyl alcohol and methanol? (**A**) $NaBH_4$ (**B**) NaOH (**C**) $LiAlH_4$ (**D**) CrO_3

24. Which reagent is used to convert benzene to bromobenzene? (**A**) HBr (**B**) PBr_3 (**C**) Br_2/NaOH (**D**) $Br_2/FeBr_3$

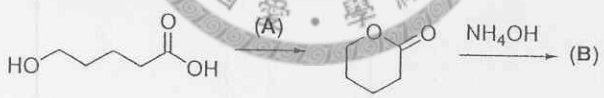
25. Which product is obtained from the Claisen condensation of ethyl acetate $CH_3CO_2C_2H_5$? (**A**) ethyl acetoacetate $CH_3COCH_2CO_2C_2H_5$ (**B**) ethyl butanoate $CH_3CH_2CH_2CO_2C_2H_5$ (**C**) ethyl 3-hydroxybutanoate $CH_3CH(OH)CH_2CO_2C_2H_5$ (**D**) ethyl 2-butenoate $CH_3CH{=}CHCO_2C_2H_5$

II. (10%) Draw Newman projections for two staggered and two eclipsed conformations of 1,2-dichloroethane. Indicate which conformation is the most stable, and which conformation is the least stable.

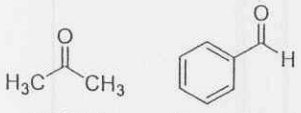
III. (10%) Propose a mechanism for the addition of HI to 1-methyl-1-cyclopentene to give 1-iodo-1-methylcyclopentane. Why this reaction disfavors the formation of 2-iodo-1-methylcyclopentane?

IV. (10%) Arrange the following compounds in order of increasing acidity: phenol C_6H_5OH, benzyl alcohol $C_6H_5CH_2OH$ and 4-nitrophenol $O_2NC_6H_4OH$. Explain this trend of acidity.

V. (10%) Treatment of a carboxylic acid with an alcohol in the presence of an acid catalyst to give an ester is known as Fischer esterification. Give reagent (**A**) and product (**B**) to complete the following reactions.



VI. (10%) Aldol reactions are the condensation reactions between two aldehydes or ketones. The base-catalyzed aldol reactions between acetone and benzaldehyde may give two products (**C**) and (**D**). Dehydration of compounds (**C**) and (**D**) gives compounds (**E**) and (**F**), respectively. Show the structures of compounds (**C**), (**D**), (**E**) and (**F**).



acetone benzaldehyde

(C): $C_6H_{12}O_2$ (D): $C_{10}H_{12}O_2$

本次考試共有以上六大題

試題隨卷繳回