I. Select the best answer (2% each)

1. Cis-trans isomers generally

(a) contain an asymmetric carbon atom
(b) rotate the plane of polarized light
(c) are enantiomorphs
(d) contain a triple-bond
(e) contain double-boned carbon atoms

2. Which of the following reagents is not used in making derivatives of aldehydes and ketones

(a) hydroxylamine hydrochloride
(b) phenylhydrazine
(c) 2,4-dinitrophenylhydrazine
(d) 2,4-dinitrofluorobenzene
(e) semicarbazide hydrochloride

3. Select the most reactive compound toward Br_2 in the presence of $FeBr_3$:

(a) anisole
(b) benzene
(c) bromobenzene
(d) nitrobenzene
(e) chlorobenzene

4. The basic unit of the porphyrin system, which occurs in chlorophyll and in hemoglobin, is

(a) pyrrole
(b) furan
(c) thiophene
(d) oxazole
(e) thiazole

5. The Markovnikoff rule is used in connection with

(a) stereochemistry of elimination reactions
(b) stability of free radicals
(c) activity of enzymes
(d) addition of acids to double bonds
(e) electrophilic aromatic subtitution

6. Of the following, the compound possessing optical isomerism is

(a) CH_3CH_2OH
(b) $CH_2OHCHOHCH_2OH$
(c) CCl_2F_2
(d) CCl_2BrF
(e) $CH_3CHOHC_2H_5$

7. Of the following, the formula which represents an unsaturated organic compound is

(a) C_6H_{14}
(b) C_4H_8
(c) C_3H_7OH
(d) $C_2H_4Cl_2$
(e) CH_3OH

8. The strongest acid among the following is

2·S

(a) p-nitrophenol
(b) m-nitrophenol
(c) o-nitrophenol
(d) p-chlorophenol
(e) m-chlorophenol

9. In practical organic chemistry, tetramethylsilane is used mainly for

(a) making volatile derivatives of alcohol
(b) a spectroscopic standard
(c) a substitute for neopentane
(d) a solvent for infrared spectra
(e) an "anti-knock" in gasolines

10. Ketones react with primary amines to give

(a) ureas
(b) guanidines
(c) amides
(d) Schiff bases
(e) oximes

11. Natural rubber is a polymer of

(a) ethylene
(b) propene
(c) isobutene
(d) chloroprene
(e) isoprene

12. Which of the following would react fastest with N-bromosuccinimide

(a) benzene
(b) methane
(c) cyclopropane
(d) pyridine
(e) toluene

13. Which of the following is a monosaccharide?

(a) sucrose
(b) galactose
(c) maltose
(d) lactose
(e) cellobiose

14. The compound furan is a five member ring containing, in addition to carbon atoms, an atom of

(a) nitrogen
(b) phosphorus
(c) sulfur
(d) selenium
(e) oxygen

15. Methyl ketones are usually characterized through

(a) the Tollens' reagent
(b) the Benedict's solution
(c) the Schiff test
(d) the bromine test
(e) the iodoform test

16. The presence of dry HCl, ethylene glycol reacts with acetaldehyde to yield a(n)

(a) ester
(b) acid
(c) ketal
(d) α-dione
(e) acetal

17. The Hofmann rearrangement has an intermediate that is electronically similar to that in the

(a) Pinnacol rearrangement
(b) Claisen rearrangement
(c) Cope rearrangement
(d) Beckmann rearrangement
(e) Homoallylic rearrangement

18. Ozonolysis of fatty acids is a technique used for determining

(a) number of OH groups
(b) average molecular weights
(c) number of COOH groups
(d) ability to form soaps
(e) position of double bonds

19. Gabriel synthesis is used for the preparation of

(a) primary amine
(b) aldehydes
(c) tertiary amines
(d) phthalimides
(e) secondary amines

20. The compound n-butyl magnesium iodide when reacted with water will produce

(a) magnesium iodide
(b) n-butyl alcohol
(c) n-butyl ether
(d) n-butane
(e) n-butene

21. Which is the compound called benzyl chloride?

(a) C_6H_5Cl
(b) $C_6H_5CH_2Cl$
(c) $C_6H_5CHCl_2$
(d) $C_6H_5CCl_3$
(e) $ClC_6H_4CH_3$

22. The Lucas test is used to determine the types of

(a) alcohol
(b) amines
(c) acids
(d) amino acids
(e) phenols

23. In esterification of acids, the nucleophilic reagent is the

(a) acid
(b) alcohol
(c) water
(d) hydroxyl ion
(e) hydride ion

24. Allylic bromination of olefins is usually carried out with

(a) phenylmagnesium bromide
(b) pyridium perbromide
(c) α,α-dibromosuccinic acid
(d) N-bromosuccinimide
(e) α-bromotoluene

25. Oxidation may be defined as

(a) the gain of hydrogen
(b) the loss of electrons
(c) a loss of mesons from the nucleus
(d) an increase in negative charge
(e) the gain of electrons

26. Fehling's solution and Benedict's solution are reduced by glucose to form

(a) CuO
(b) Cu_2O
(c) $Cu(OH)_2$
(d) $Cu(CO)_4$
(e) $Zn(OH)_2$

27. The definition of the epimers is a pair of diastereomeric aldoses that differ only in configuration at the position

(a) C-1
(b) C-2
(c) C-3
(d) C-4
(e) C-5

28. A mixture of benzene, 2,4-hexadiene, hexane, 1-hexanol, and butyl acetate is eluted through a columh of silica gel. The first eluent would be rich in

(a) benzene
(b) 2,4-hexadiene
(c) hexane
(d) 1-hexanol
(e) butyl acetate

29. The most basic species among the following is

(a) F^-
(b) OH^-
(c) NH_2
(d) CH_3
(e) H_2O

30. The following solvents are commonly used in reversed-phase HPLC. Select the most nonpolar one from them.

(a) methanol
(b) acetonitrile
(c) water
(d) tetrahydrofuran
(e) ethanol

31. An acid that is classified as a hydroxy acid is

(a) oxalic acid
(b) lactic acid
(c) succinic acid
(d) acetic acid
(e) propionic acid

32. Examine the following statements pertaining to an S_N2 reaction.

I. The rate of reaction is independent of the concentration of the nucleophile.
II. The nucleophile attacks carbon on the side of molecule opposite the group being displaced.
III. The reaction proceeds with simultaneous bond formation and bond rupture

Which of the above are true?

(a) I, II
(b) I, III
(c) none
(d) II, III
(e) all

33. Diazomethane reacts with carboxylic acids to yield

(a) amines
(b) imines
(c) esters
(d) alcohols
(e) aldehydes

34. The Cannizzaro reaction is used to produce an alcohol from a(n)

(a) alkane
(b) acid
(c) ketone
(d) aldehyde
(e) amide

35. Compound X has the formula C_8H_{10}. Nitration produces one mononitration product and three dinitration products. X could be

(a) ethylbenzene
(b) o-xylene
(c) p-xylene
(d) m-xylene
(e) octene

II. Give a scheme of synthesis of benzaldehyde to 5,5-diphenylhydantoin. (10%)

III. Describe a synthesis scheme from nitrobenzene to p-nitrotolene. (10%)

IV. Describe a synthesis scheme from glycine and alanine to gly-ala-gly tripeptide. (10%)