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一、選擇題(均為單選，每題 2 分，答錯倒扣 0.5 分)

1. Diazomethane reacts with carboxylic acids to yield
  - A. amines.
  - B. imines.
  - C. esters.
  - D. alcohols.
  - E. aldehydes.
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. The Cannizzaro reaction is used to produce an alcohol from a(n)
  - A. alkane.
  - B. acid.
  - C. ketone.
  - D. aldehyde.
  - E. amide.
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. Naphthalene is most soluble in which of the following solvents?
  - A. water
  - B. alcohol
  - C. oil
  - D. acetic acid
  - E. benzene
6. Of the following, the compound possessing optical isomerism is
  - A.  $\text{CH}_3\text{CH}_2\text{OH}$ .
  - B.  $\text{CH}_2\text{OHCHOHCH}_2\text{OH}$ .
  - C.  $\text{CCl}_2\text{F}_2$ .
  - D.  $\text{CCl}_2\text{BrF}$ .
  - E.  $\text{CH}_3\text{CHOHC}_2\text{H}_5$ .
7. Select the most reactive toward  $\text{Br}_2$  in the presence of  $\text{FeBr}_3$ :
  - A. methoxybenzene
  - B. benzene
  - C. bromobenzene
  - D. nitrobenzene
  - E. chlorobenzene
8. The strongest acid among the following is
  - A. p-nitrophenol.
  - B. m-nitrophenol.
  - C. o-nitrophenol.
  - D. p-chlorophenol.
  - E. m-chlorophenol.

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9. Ethyl acetoacetate is prepared from ethyl acetate by the
- A. Benzoin condensation.
  - B. Acyloin condensation.
  - C. Claisen condensation.
  - D. Aldol condensation.
  - E. Dieckmann condensation.
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. The Williamson synthesis is an important means of preparing
- A. alkyl halides
  - B. ketones
  - C. higher alkynes
  - D. mixed ethers
  - E. aldehydes
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.  $\alpha$ -dione.
  - E. acetal.

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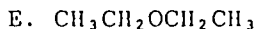
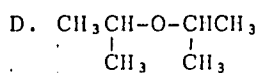
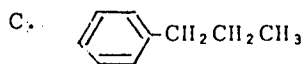
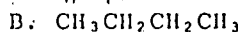
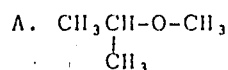
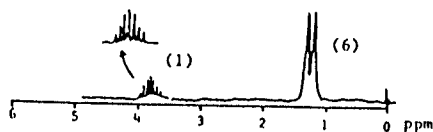
17. The Hofmann rearrangement has an intermediate that is electronically similar to that in the
- Pinnacol rearrangement.
  - Claisen rearrangement.
  - Cope rearrangement.
  - Beckmann rearrangement.
  - Homoallylic rearrangement.
18. Ozonolysis of fatty acids is a technique used for determining
- number of OH groups.
  - average molecular weights.
  - number of COOH groups.
  - ability to form soaps.
  - position of double bonds.
19. Gabriel synthesis is used for the preparation of
- primary amine.
  - aldehydes.
  - tertiary amines.
  - phthalimides.
  - secondary amines.
20. The compound n-butyl magnesium iodide when reacted with water will produce
- magnesium iodide.
  - n-butyl alcohol.
  - n-butyl ether.
  - n-butane.
  - n-butene.
21. Which is the compound called benzyl chloride?
- $C_6H_5Cl$
  - $C_6H_5CH_2Cl$
  - $C_6H_5CHCl_2$
  - $C_6H_5CCl_3$
  - $ClC_6H_4CH_3$
22. The Lucas test is used to determine the types of
- alcohol.
  - amines.
  - acids.
  - amino acids.
  - phenols.
23. In esterification of acids, the nucleophilic reagent is the
- acid.
  - alcohol.
  - water.
  - hydroxyl ion.
  - hydride ion.
24. Allylic bromination of olefins is usually carried out with
- phenylmagnesium bromide.
  - pyridium perbromide.
  - $\alpha, \alpha$ -dibromosuccinic acid.
  - N-bromosuccinimide.
  - $\alpha$ -bromotoluene.

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25. 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.

26. Which of the following substances would give the nmr spectrum below?



27. Examine the following statements pertaining to an  $S_N2$  reaction.

- a. The rate of reaction is independent of the concentration of the nucleophile.
- b. The nucleophile attacks carbon on the side of the molecule opposite the group being displaced.
- c. The reaction proceeds with simultaneous bond formation and bond rupture.

Which of the above are true?

- A. a, b
- B. a, c
- C. none
- D. b, c
- E. all

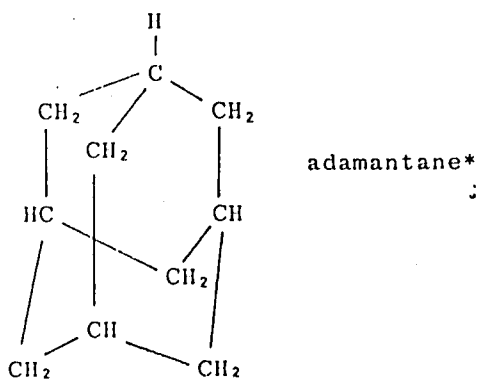
28. Which of the following compounds has the largest dipole moment?

- A.  $CH_3Cl$
- B.  $CF_4$
- C.  $CH_4$
- D.  $CO_2$
- E.  $CCl_4$

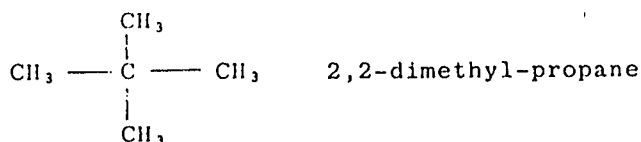
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29. Which of the following compounds would have highest melting point?

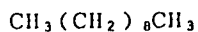
A.



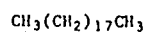
B.



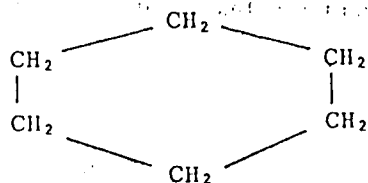
C. n-decane



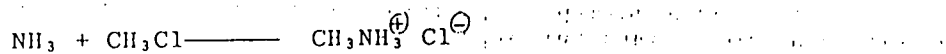
D. n-nonadecane



E. cyclohexane



30. The rate of the following reaction is accelerated by an increase in the polarity of the solvent.



In which of the following solvents would the reaction proceed at the greatest rate?

A.  $\text{CF}_4$

B.  $\text{CH}_3\text{OCH}_2\text{CH}_3$

C.  $\text{CH}_3\text{OCH}_3$

D.  $\text{CH}_3\text{SCH}_3$

E.  $\text{CH}_3\text{CHCH}_2\text{CH}_3$

31. Which of the following compounds would be the least basic? (On which nitrogen atom is the electron pair least available for bond formation with  $\text{H}^+$ ?)

A.  $\text{NH}_3$

B.  $\text{CH}_3\text{NH}_2$

C.  $\text{HONH}_2$

D.  $\text{FNH}_2$

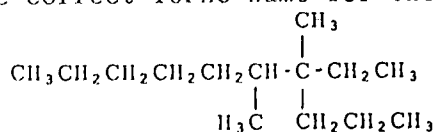
E.  $\text{C}\equiv\text{NH}_2$

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32. Which of the following compounds would be the most basic? (On which nitrogen atom is the electron pair most available for bond formation with  $H^+$ ?)

- A.  $NH_3$
- B.  $CH_3NH_2$
- C.  $HONH_2$
- D.  $FNH_2$
- E.  $C\equiv NH_2$

33. What is the correct IUPAC name for the following compound?



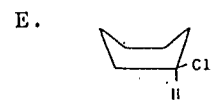
- A. 3,4-dimethyl-3-n-propylnonane
- B. 4,5-dimethyl-4-ethyldecane
- C. 6,7-dimethyl-7-n-propylnonane
- D. 6,7-dimethyl-7-ethyldecane
- E. 3,4-dimethyl-3-ethylnonane

34. Radical-induced oxidation of cells by molecular oxygen has been implicated in the process of aging. Which of the following simple molecules would be expected to most readily undergo a radical oxidation reaction?

- A.  $CH_3CH_2CH_3$
- B.  $CH_4$
- C.  $(CH_3)_3CH$
- D.  $CH_3CH_2CH_2CH_3$
- E.



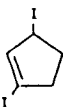




35. Which of the following pictures best represents the most stable conformation of chlorocyclohexane at room temperature?

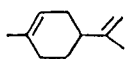


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36. Which is the correct structural formula for 1,4-diiodocyclopentene?

- A. 
- B. 
- C. 
- D. 
- E. 

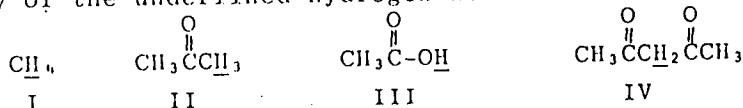
37. Limonene (shown below) is the main volatile component of orange and lemon oil,



What is the IUPAC name for limonene?

- A. 1-methyl-2-(4-propenyl) cyclohexene  
 B. 1-methyl-4-(isopropenyl) cyclohexene  
 C. 1-(isopropenyl)-4-methyl cyclohexene  
 D. 1-methyl-4-(1-propenyl) cyclohexene  
 E. 1-(isopropenyl)4-methyl-3-cyclohexene
38. Which of the following sequences would be best for the preparation of 2-bromobutane?
- A.  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3 \xrightarrow{\text{HBr}}$   
 B.  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2 \xrightarrow{\text{HBr}}$   
 C.  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2 \xrightarrow[\text{peroxide}]{\text{HBr}}$   
 D.  $\text{CH}_3\text{C}\equiv\text{CCH}_3 \xrightarrow{\text{HBr}}$   
 E.  $\text{CH}_3\text{CH}=\text{CHCH}_3 \xrightarrow{\text{Br}_2}$

39. Which of the following arrangements is correct with respect to decreasing acidity of the underlined hydrogen atom?



- A. I>II>III>IV  
 B. III>II>IV>I  
 C. III>IV>II>I  
 D. IV>II>III>I  
 E. II>III>IV>I

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40. 1,2,3-Trimethylcyclopropane is allowed to react with bromine in the absence of light. Which statement best describes the products?
- Only 3-methylpentane is obtained.
  - A mixture of 2,2-dibromo-3-methylpentane and 3,3-dibromo-3-methylpentane is obtained.
  - Only 2,4-dibromo-3-methylpentane is obtained.
  - No reaction occurs.
  - A mixture of 1,4-dibromopentane and 2,2-dibromo-3-methylpentane is obtained.

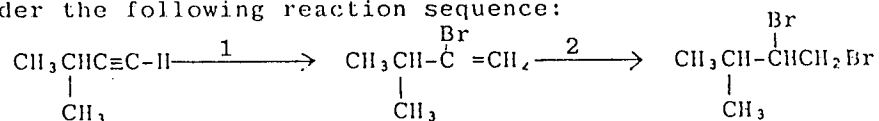
41. For dimethylcyclohexanes:

- cis-1,2 is more stable than trans-1,2
- cis-1,3 is more stable than trans-1,3
- cis-1,4 is more stable than trans-1,4

Which of the above statements are correct?

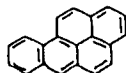
- a
  - a, b
  - c
  - b
  - all
42. In the reaction of cyclohexene with Br<sub>2</sub> in the presence of sodium iodide, what products would be found in the reaction mixture?
- 1,2-dibromocyclohexane only
  - 1,2-dibromocyclohexane and 1,3-dibromocyclohexane
  - 1-bromo-2-iodocyclohexane, 1,2-dibromocyclohexane and 1,3-diiodocyclohexane
  - 1-bromo-2-iodocyclohexane and 1,2-dibromocyclohexane
  - iodocyclohexane and 1,2-dibromocyclohexane

43. Consider the following reaction sequence:



What reagents would be required for steps 1 and 2 respectively?

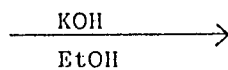
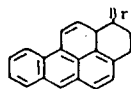
- HBr, then Br<sub>2</sub>
  - HBr + peroxide, then HBr
  - Br<sub>2</sub>, then HBr
  - 2Br<sub>2</sub>, Zn
  - HBr, then HBr + peroxide
44. The compound 3,4-benzpyrene is found in the ambient air and in charcoal-broiled steaks, and has been implicated as a carcinogen (cancer-causing agent).



3,4-benzpyrene

Consider the following reactions.

(a)





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(b)



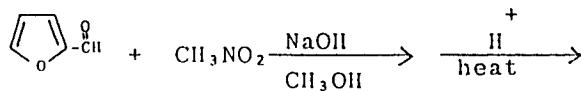
(c)



Which of the above syntheses would produce 3,4-benzopyrene?

- A. a
- B. b
- C. b, c
- D. none
- E. all

45. Which of the compounds listed below would be the product of the following reactions?



- A.
- B.
- C.
- D.
- E.

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46. For cis-1,4-dimethylcyclohexane, which of the following statements is correct?

- A. It can be optically active.
- B. It is dissymmetric.
- C. The boat form is the most stable conformer.
- D. It interconverts to an identical conformer.
- E. It interconverts to a non-identical conformer.

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47. If an equimolar mixture of pyridine and pyrrole is treated with a deficiency of nitronium acetate in acetic anhydride, the major product is

- A. 2-nitropyrrole.
- B. 3-nitropyrrole.
- C. 2-nitropyridine.
- D. 3-nitropyridine.
- E. 4-nitropyridine.

二寫出下列各反應產物之化學式

48. (6%) Write structures for the products A - F of the following reaction sequence.

