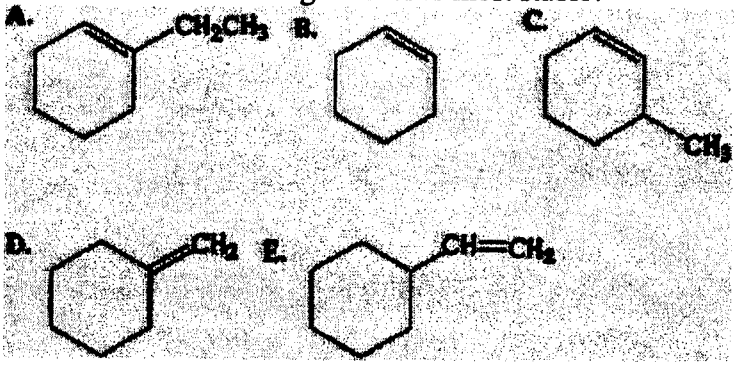
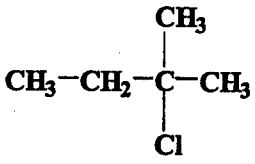
1-45 (2 points for each; wrong answer will deduct 1 point)

1. Which of the following alkenes is most stable?



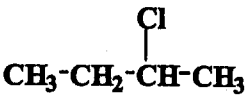
2. What is the order of reactivity toward S_N2 displacement in the following series?

A.



B.

C.



A. A>B>C
B. A>C>B
C. B>A>C
D. B>C>A
E. C>A>B

3. Which reagent would convert cyclohexene into a *cis*-glycol?

A. sodium tert-butoxide in chloroform
B. hydrogen peroxide and aqueous acetic acetic acid
C. ozone and moist zinc dust
D. periodic acid
E. cold dilute potassium permanganate

4. Which statement is correct for an S_N1 reaction at a chiral carbon atom?

A. the product will be optically active, but have the opposite configuration
B. the reaction will involve racemation
C. a carbanion is formed as an intermediate
D. the rate of the reaction is a function of the concentration of the nucleophile
E. the attacking group will be a strong electrophile

5. The reagent which would distinguish between 1-hexyne and 1-hexene is

A. $Ag(NH_3)_2^+$
B. $KMnO_4$
C. Br_2 in CCl_4
D. H_2SO_4
E. NaOH

(背面仍有題目,請繼續作答)

6. In methyl alcohol solution, bromine reacts with ethylene (ethene) to yield $BrCH_2CH_2OCH_3$ in addition to 1,2-dibromoethane because

A. the methyl alcohol solvates the bromine.
B. the ion formed initially may react with Br^{1-} or CH_3OH.
C. this is a free radical reaction.
D. the reaction follows Markovnikov's rule.
E. of none of these reasons.

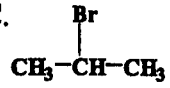
7. The important <u>minor</u> product from the reaction of sodium cyanide with 2-iodopentane in anhydrous acetone is

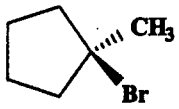
A. 1-pentene B. 2-pentene
C. pentane D. 2-pentanol
E. 4,5-dimethyloctane

8. When a solid organic compound is recrystallized, the cold filtrate from the cooled mixture is

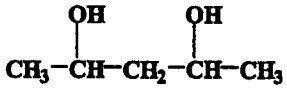
A. saturated with the compound. B. an unsaturated solution of the compound.
C. entirely free of the compound. D. pure solvent.
E. supersaturated with the compound.

9. Sodium iodide in anhydrous acetone reacts most rapidly with

A. $CH_3CH_2CH_2Br$ B. $(CH_3)_3CBr$ C. 

D. $CH_2=CHBr$ E. 

10. What is the possible number of stereoisomers having the structure below?



A. two optically active and one meso
B. None optically active
C. four optically active
D. two optically active and two meso
E. one optically active and one meso

11. The addition of Br_2 to trans-2-butene giving meso-2,3-dibromobutane can be explained by a mechanism involving

A. a free radical. B. a carbocation.
C. a cyclic bromonium ion. D. a carbanion.
E. simultaneous attack by to bromine atoms.

12. Which dimethylcyclobutane has two optically forms?

A. *trans*-1,2- B. *cis*-1,2- C. 1,1-
D. *cis*-1,3- E. *trans*-1,3-

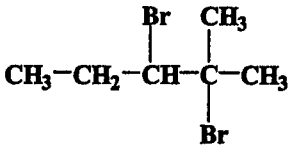
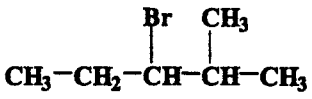
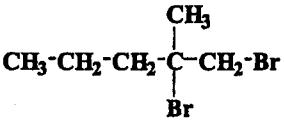
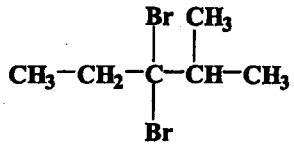
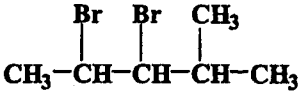
13. Which is NOT characteristic of a free radical chain reaction?

A. It produces a mole of product for a mole of free radical initiated.
B. It gives the product derived from the most stable free radical.
C. It may be initiated by peroxides.
D. It may be initiated by high heat.
E. It may be initiated by ultraviolet light.

14. A reaction at a chiral carbon of an optically pure isomer which takes place exclusively by an S_N2 reaction, and in which priorities do not change, proceeds with

A. inversion and no racemization.
B. inversion and some racemization.
C. inversion and complete racemization.
D. retention of configuration and some racemization.
E. retention of configuration and no racemization.

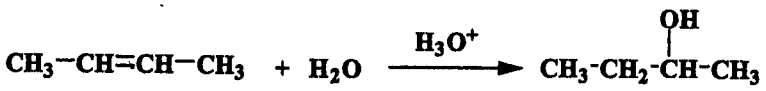
15. Which would yield 2-methyl-2-pentene when refluxed with zinc dust in alcohol?

A. 
B. 
C. 
D. 
E. 

16. If *tert*-butyl bromide and sodium amide ($NaNH_2$) react, the product formed is

A. *tert*-butylamine. (amines are R-NH_2)
B. *tert*-butylammonium bromide.
C. a mixture of butylamines.
D. isobutylene. (2-methylpropene)
E. none of these.

17. In the reaction below, the product would be



A. a mixture of diastereomers.
B. opticaly active.
C. unresolvable.
D. a racemate.
E. a meso compound.

18. The rate of an S_N2 reaction run in a polar aprotic solvent relative to the same reaction in a polar protic solvent would be

A. the same.
B. slower.
C. faster.
D. unpredictable.
E. unimolecular.

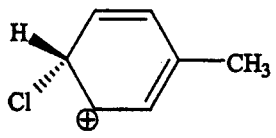
19. Which could NOT be prepared directly from 4-bromobenzene-diazonium ion?

A. Phe-Br
B. 4-Br-Phe-Br
C. 4-Br-Phe-F
D. 4-Br-Phe-CN
E. 4-Br-Phe-$COCH_3$

20. A good starting material for the preparation of 4-chlorobenzenesulfonic acid would be

A. benzenesulfonic acid
B. 1,4-dinitrobenzene
C. chlorobenzene
D. 4-chlorobenzioc acid
E. 1,4-dichlorobenzene

21. Which represents an intermediate formed in the reaction of toluene and chlorine at elevated temperature in sunlight?

A.


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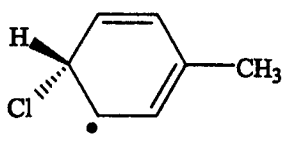
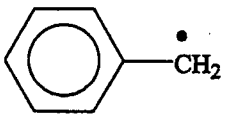
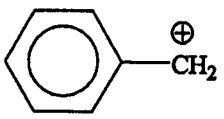
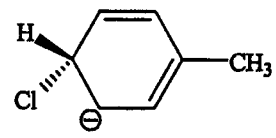


C.


D.


E.


22. Which is the best way to prepare *meta*-bromoaniline?

A. Phe-NH_2 $\xrightarrow{H_2SO_4}$ $\xrightarrow{Br_2}$ $\xrightarrow{H_3O+}$

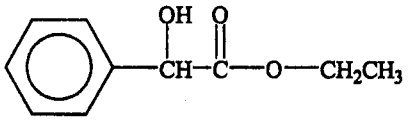
B. Phe-H $\xrightarrow{Br_2}$ $\xrightarrow{HNO_3}$ $\xrightarrow[HCl]{Sn}$

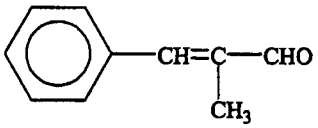
C. Phe-NO_2 $\xrightarrow{(CH_3CO)_2O}$ $\xrightarrow{Br_2}$ $\xrightarrow{H_3O+}$

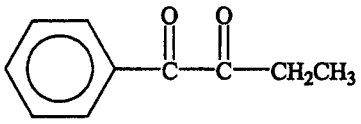
D. Phe-NO_2 $\xrightarrow[H_2SO_4]{HNO_3}$ $\xrightarrow{(NH_4)_2S}$ $\xrightarrow[HBr]{NaNO_2}$ $\xrightarrow{CuBr}$ $\xrightarrow{Sn\ /\ HCl}$

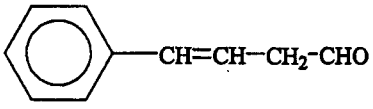
E Phe-NO_2 $\xrightarrow{H_2SO_4}$ $\xrightarrow{NaOH}$ $\xrightarrow[fuse]{NaBr}$ $\xrightarrow[HCl]{Sn}$

23. Which is the principal product when benzaldehyde is allowed to react with propionaldehyde in the presence of dilute aqueous sodium hydroxide at room temperature?

A. 

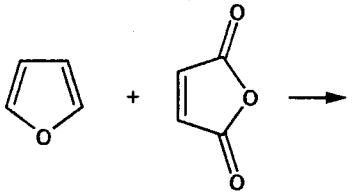
B. 

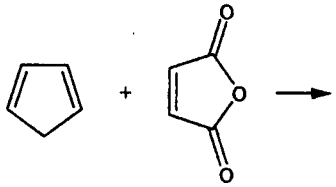
C. 

D. 

E. None of them

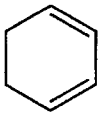
24. Which does NOT represent a Diels-Alder type of reaction?

A. 

B. 

C. CH_2=CHCH=CH_2 + CH_2=CHCOOH

D. CH_3COCH_3 + CH_3CH=CHCHO

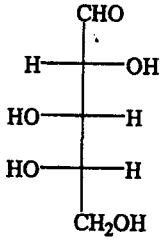
E.  + H_2C=CH–CHO

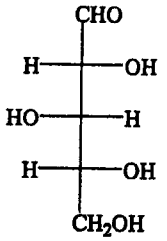
25. Which statement about the aldol condensation is correct?

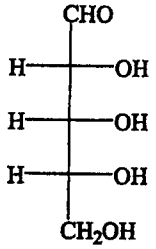
A. A Lewis acid is commonly used as a catalyst.
B. The initial step is probably the formation of a carbanion.
C. A Lewis base is employed to induce carbocation formation.
D. The carbon chain is lengthened through the elimination of 1 mole of water.
E. None of them

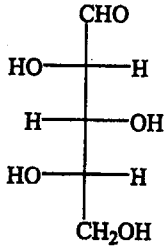
（背面仍有題目,請繼續作答）

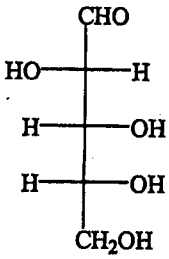
26. Which is an L-sugar that on oxidation gives an optically inactive dibasic acid (2 COOH groups)?

A. 

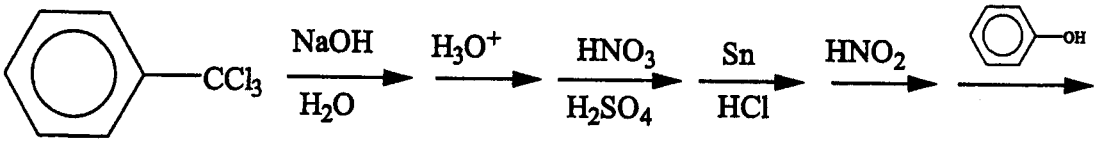
B. 

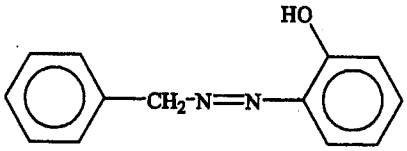
C. 

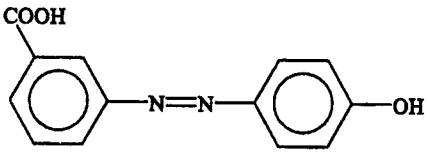
D. 

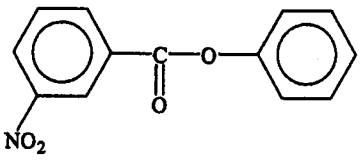
E. 

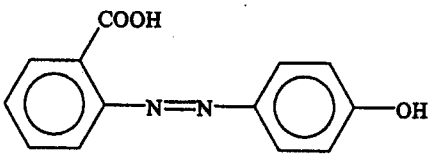
27. Select the final product from this sequence of reactions.

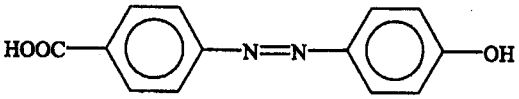


A. 

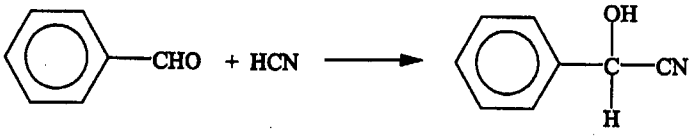
B. 

C. 

D. 

E. 

28. In the reaction below, the product would be

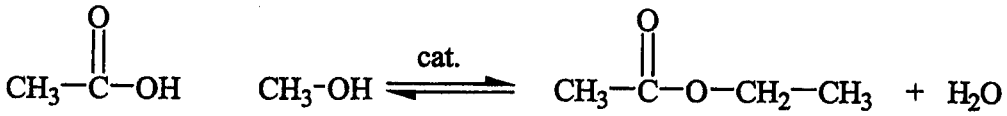


A. a racemate.
B. optically active.
C. a meso compound.
D. a mixture of diastereomers.
E. unresolvable.

29. A group which deactivates the benzene ring towards EAS but which directs the incoming group principally to the ortho and para positions is

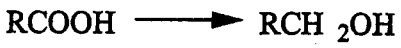
A. $-NH_2$
B. $-Cl$
C. $-NO_2$
D. $-C_2H_5$
E. $-NHCOCH_3$

30. What is true for the equilibrium reaction



A. The use of equimolar quantities of CH_3OH and CH_3COOH will give the greatest yield of the ester at equilibrium.
B. Removal of water will increase the amount of ester at equilibrium.
C. Addition of CH_3COOCH_3 will cause the formation of equal an equal number of moles of water.
D. Application of pressure increases the amount of ester at equilibrium.
E. Changing the catalyst will affect the position of the equilibrium.

31. Which reagent would bring about this transformation?



A. Sn and HCl
B. Zn and HCl
C. H_2 and Pt
D. $LiAlH_4$ and ether
E. Na and alcohol

32. The reaction between carbon dioxide and a Grignard reagent will yield

A. an alkane.
B. an alkylmagnesium halide.
C. an alcohol.
D. magnesium carbonate.
E. a carboxylic acid.

33. Which is a practical method for the preparation of iodobenzene?

A. iodine + benzene + iron
B. iodine + benzene + UV light
C. potassium iodide + chlorobenzene
D. sodium hypoiodite + benzamide
E. potassium iodide + benzenediazonium ion

34. Which reaction sequence would be best to prepare 3-chloroaniline from benzene?

A. chlorination, nitration, reduction
B. nitration, chlorination, reduction
C. nitration, reduction, chlorination
D. nitration, chlorination
E. nitration, reduction, acetylation, chlorination, hydrolysis

（背面仍有題目,請繼續作答）

35. The catalyst used in the halogenation of benzene is

A. a proton donor.
B. an electron donor.
C. a Lewis base
D. a Lewis acid
E. a proton acceptor

36. The reaction of $Br_2/FeBr_3$ with benzene to form bromobenzene is know as

A. free radical substitution
B. nucleophilic substitution
C. electrophilic substitution
D. ionic addition
E. elimination

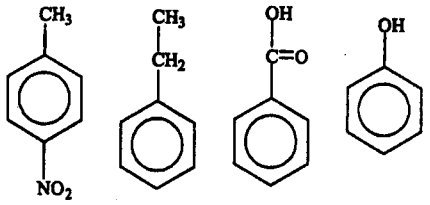
37. Which reagent will lengthen the carbon chain by two carbons in one step when reacted with an organolithium reagent?

A. acetic acid
B. formaldehyde
C. iodomethane
D. ethylene oxide
E. ethanol

38. An explanation of the addition of sodium bisulfite to heptanal and 2-heptanone but not to 3-heptanone is

A. steric inhibition of resonance.
B. steric hinderance.
C. steric inhibition of solvation.
D. differences in resonance effects.
E. the lower dipole moment of 3-heptanone.

39. Which will undergo a Friedel-Crafts alkylation reaction?



A B C D

A. a, b, c
B. a and c
C. b and d
D. a and b
E. c and d

40. The reaction of diethylmalonate with sodium ethoxide produces ethanol and a

A. free radical
B. carbocation
C. molecular species
D. carbanion
E. carboxylate ion

41. The principal product of the reaction between methyl butanoate and 2 moles of CH_3MgBr after hydrolysis is

A. $C_3H_7COCH_3$
B. $C_3H_7C(OH)(CH_3)_2$
C. $C_3H_7CHOHCH_3$
D. $C_3H_7COCH(CH_3)_2$
E. $C_3H_7CH_2OH$

42. Which reaction sequence would be best to prepare 1,4-diaminobenzene from benzene

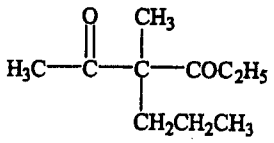
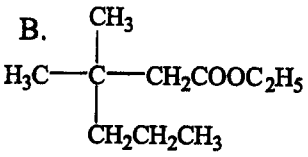
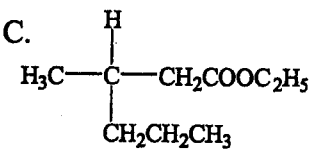
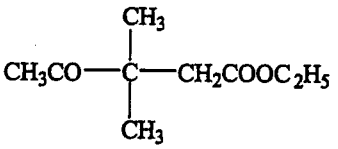
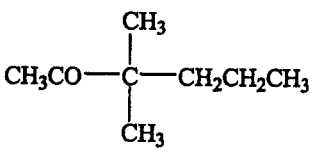
A. nitration, sulfonation, nitration, hydrolysis, reduction
B. nitration, reduction, nitration, reduction
C. nitration, reduction, acetylation, nitration, reduction
D. nitration, reduction, acetylation, nitration, hydrolysis, reduction
E. nitration, reduction

43. Which of the following would react most rapidly with sodium ethoxide to produce an ether?

A. chlorobenzene
B. *p*-nitrotoluene
C. *p*-nitrochlorobenzene
D. *m*-(chloromethyl)-toluene
E. *m*-chlorotoluene

44. Select the final product from this sequence of reactions.

acetoacetic ester $\xrightarrow{NaOEt}$ $\xrightarrow{CH_3I}$ $\xrightarrow{NaOEt}$ $\xrightarrow{CH_3CH_2CH_2Br}$

A. 
B. 
C. 
D. 
E. 

45. A possible reaction of CH_3CH_3 with a chlorine radical is:

Bond dissociation energies are:

Bond A-B	ΔH kcal
Cl-Cl	58
CH_3-H	104
CH_3CH_2-H	98
CH_3-CH_3	88
CH_3-Cl	84
H-Cl	103

Calculate ΔH for this reaction.

A. - 4 kcal
B. +4 kcal
C. +5 kcal
D. +7 kcal
E. none of these

（背面仍有題目,請繼續作答）

46. Identify the unknown compound that has all the following characteristics. (10 points)

a) The molecular formula is $C_{11}H_{16}O_2$. Calculate the index of hydrogen deficiency.

b) The IR spectrum shows no absorptions in the range 3100-3500 or 1700-1800 cm^{-1}. What can you conclude from these data?

c) The proton NMR shows the following four absorptions. Correlate the hydrogens in your final structure with each peak.

A 7.5 ppm, 5H, multiplet
B 3.8 ppm, 6H, singlet
C 1.8 ppm, 2H, quartet
D 1.1 ppm, 3H, triplet

d) The mass spectrum shows a strong peak at m/z = 149 , as well as the parent molecular ion at m/z = 180. Explain what structure the 149 peak corresponds to.

e) How many different C-13 peaks would be expected for this compound.