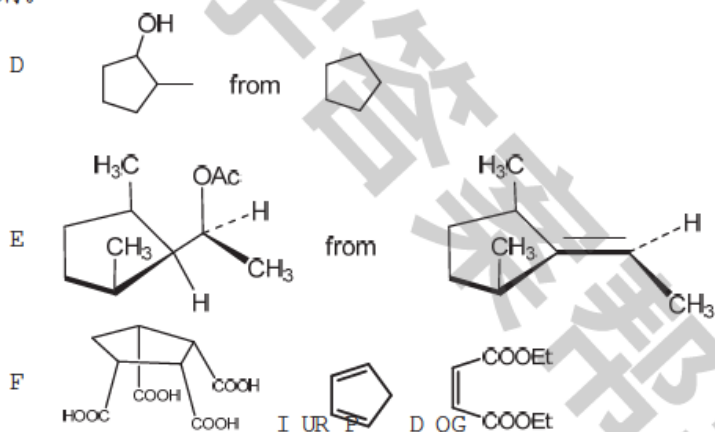


The 200-MHz ^1H NMR spectrum of isomer **G** of $\text{C}_3\text{H}_5\text{Br}$.

- b) 异构体 **H** 的 ^{13}C NMR spectrum: δ 32.6 ppm (CH_2); 118.8 ppm (CH_2); and 134.2 ppm (CH).
- c) 异构体 **I** 的 ^{13}C NMR spectrum: δ 12.0 ppm (CH_2) and 16.8 ppm (CH). The peak at lower field is only half as intense as the one at higher field.

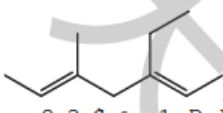
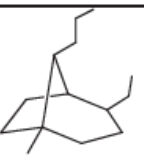
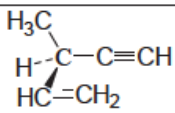
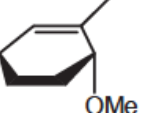
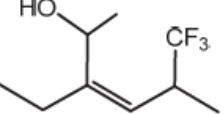

(15) 完成下面化合物的合成。除指定原料外，可用无机试剂和不多四碳的有机试剂。



课程代码	C	H	M	2	3	4	0	0	T
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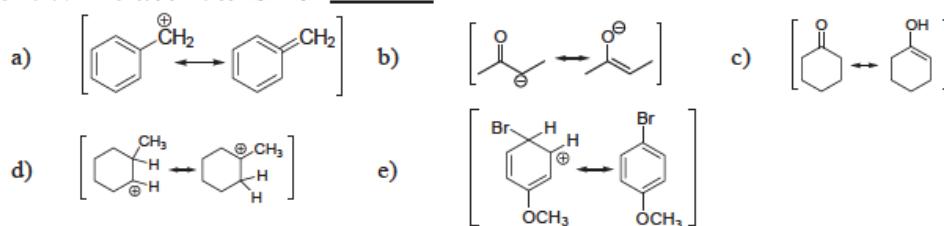
N 1,				fl	h	A		?	1	
k										

1. (12 pts) ; IUPAC \ [2~4# Q E'' Q E '' E (= ~ 0 ' X _ ° ~ V • (M A'' ~A, Q E ° R/S ☉Z/E X _ ~

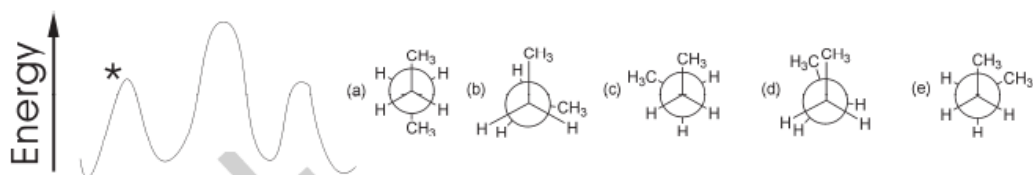
N 1,	☉ (=	N 1,	☉ (=
1)	 , 8 3 \$ & 1 D P H [2~4# E~	2)	 , J Q R U H 6 W H U R F K H P L V W U , 8 3 \$ & 1 D P H [2~4# E~
3)	 , 8 3 \$ & 1 D P H [2~4# E~	4)	 , 8 3 \$ & 1 D P H [2~4# E~
5)	 , 8 3 \$ & 1 D P H [2~4# E~	6)	 , 8 3 \$ & 1 D P H [2~4# E~

2. (20 pts) 选择题: 针对下面每一个问题, 选择最佳答案。

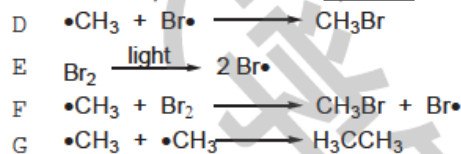
1) 以下哪一对结构互为共振式? _____



2) _____

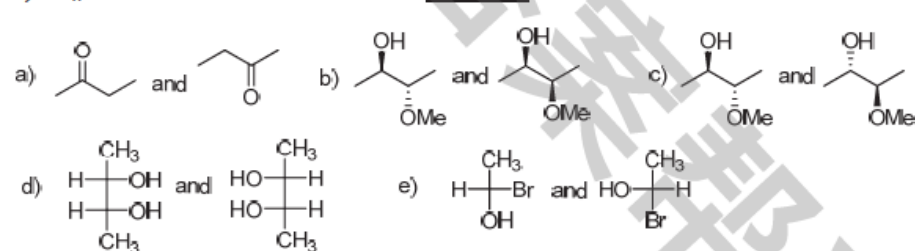


3) _____

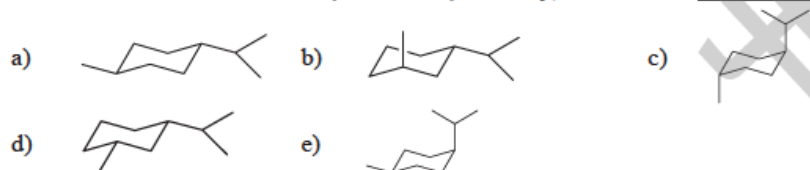


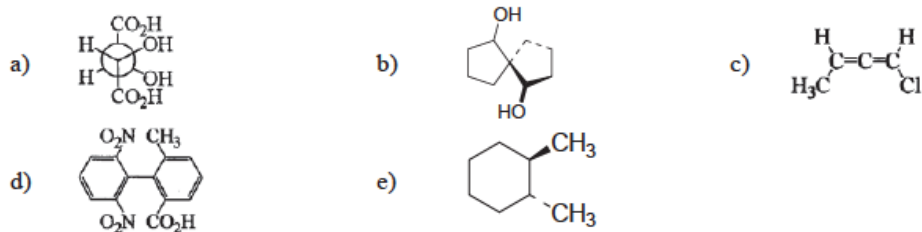
H _____

4) _____



5) _____





- 7) $\text{C}_6\text{H}_5\text{COOH}$ (aq) \rightleftharpoons $\text{C}_6\text{H}_5\text{COO}^-$ (aq) + H^+ (aq) $K_a = 1.06 \times 10^{-4}$. A 0.50 g sample of $\text{C}_6\text{H}_5\text{COOH}$ is dissolved in 100 mL of water. The pH of the solution is _____.
- a) (+) 1.06 b) (+) 10.6 c) (+) 100.6 d) (+) 0.106 e) (+) 0.53

- 8) $\text{C}_6\text{H}_5\text{COOH}$ (aq) \rightleftharpoons $\text{C}_6\text{H}_5\text{COO}^-$ (aq) + H^+ (aq) $K_a = 1.06 \times 10^{-4}$. A 0.50 g sample of $\text{C}_6\text{H}_5\text{COOH}$ is dissolved in 100 mL of water. The pH of the solution is _____.
- a) 92 % (+) and 8 % (-) b) 92 % (-) and 8 % (+)
c) 84 % (+) and 16 % (-) d) 96 % (+) and 4 % (-)
e) 88 % (+) and 12 % (-)

- 9) $\text{CH}_3\text{Cl} + \text{OH}^- \rightarrow \text{CH}_3\text{OH} + \text{Cl}^-$, $k = 3.5 \times 10^{-3} \text{ mol}^{-1} \text{ L s}^{-1}$. $[\text{CH}_3\text{Cl}] = 0.50 \text{ mol L}^{-1}$, $[\text{OH}^-] = 0.015 \text{ mol L}^{-1}$. The rate of reaction is _____.
- a) $2.6 \times 10^{-5} \text{ mol L}^{-1} \text{ s}^{-1}$ b) $2.6 \times 10^{-6} \text{ mol L}^{-1} \text{ s}^{-1}$
c) $2.6 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$ d) $1.76 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$
e) $1.76 \times 10^{-5} \text{ mol L}^{-1} \text{ s}^{-1}$

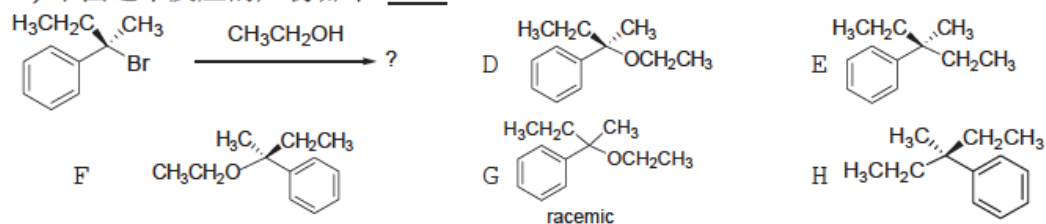
- 10) $\text{C}_6\text{H}_5\text{COOH}$ (aq) \rightleftharpoons $\text{C}_6\text{H}_5\text{COO}^-$ (aq) + H^+ (aq) $K_a = 1.06 \times 10^{-4}$. A 0.50 g sample of $\text{C}_6\text{H}_5\text{COOH}$ is dissolved in 100 mL of water. The pH of the solution is _____.
- (a) F^- (b) Cl^- (c) Br^- (d) I^-

- 11) $(S)-(+)-2\text{-iodobutane}$ reacts with NaI in acetone. The product is _____.
- (a)
- (b)
- (c)
- (d)
- (e)

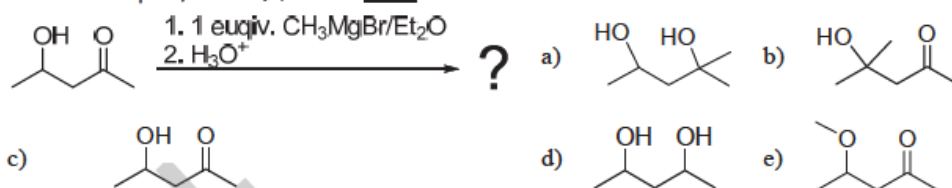
- 12) $(\text{CH}_3)_3\text{CCl} \xrightarrow{\text{CH}_3\text{O}^-} \text{H}_3\text{C}-\text{C}(\text{CH}_3)=\text{CH}_2$

a) E1 b) E2 c) S_N1 d) S_N2

13) 下面这个反应的产物哪个?_____

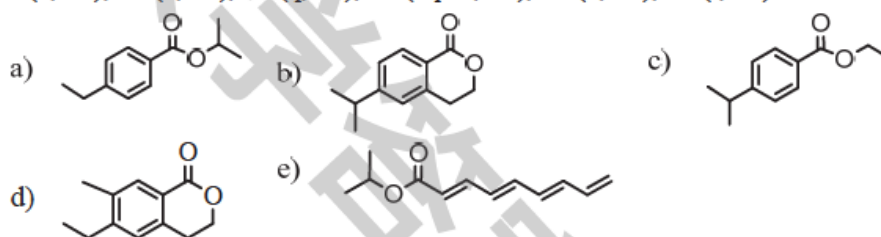


14) M6E > ; h, X { (= ? _____



15) " E (= K V1H, NMR?

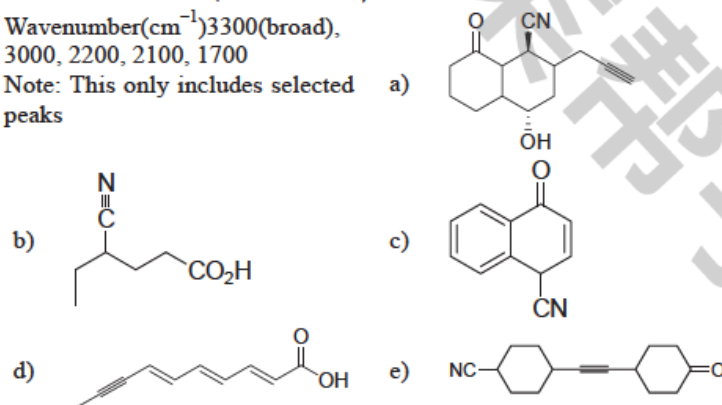
δ 7.9 (d, 2H), 7.2 (d, 2H), 4.1 (q, 2H), 2.7 (septet, 1H), 1.6 (d, 6H), 1.2 (t, 3H)



16) M6Fw € (= K V , X4v ?€ B

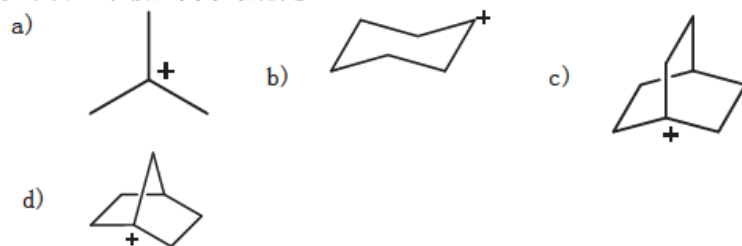
Wavenumber(cm^{-1}) 3300(broad), 3000, 2200, 2100, 1700

Note: This only includes selected peaks



17) ? (= 1 E O E ' 2640 cm⁻¹ E " B " u 9 ~ WX 4 SX
^6 " ?

25) 以下哪一个碳正离子最稳定



26) DMF 是以下哪一个溶剂的缩写

- a) $\text{HC}(=\text{O})\text{NMe}_2$ b) $\text{CH}_3(\text{=O})\text{CH}_3$ c) CHCl_3 d) $\text{CH}_3\text{S}(=\text{O})\text{CH}_3$

27) 下面这个三级碳自由基的单电子处于哪一种分子轨道中? _____



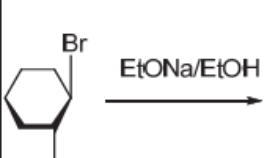
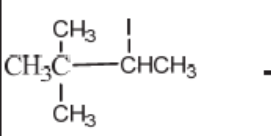
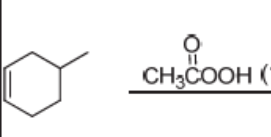
Tertiary carbon radical

D V SE VS VSG VSH

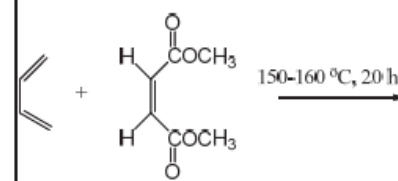
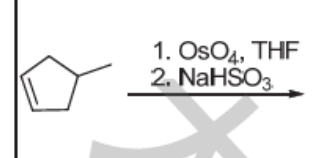
28) " -6. " " \$K", f 0* ?U ____/ i "

- a) hydrogen bond b) London force c) dipole-dipole interaction

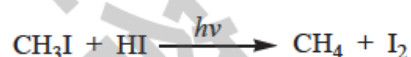
S W V m M6 i h, X { (= " E4 > ,E ,X i h 5 °

1		<div style="border: 1px solid black; width: 300px; height: 60px; margin: 0 auto;"></div>
2		<div style="border: 1px solid black; width: 300px; height: 60px; margin: 0 auto;"></div>
3		<div style="border: 1px solid black; width: 300px; height: 60px; margin: 0 auto;"></div>

4)	$ \begin{array}{c} \text{Cyclohexane} \xrightarrow[\text{mono-chlorination}]{\text{Cl}_2, h\nu} \left[\quad \quad \quad \right] \xrightarrow{\text{Mg, Et}_2\text{O}} \left[\quad \quad \quad \right] \xrightarrow[2. \text{H}_3^+\text{O}]{1. [\text{HCHO}]_n} \left[\quad \quad \quad \right] \\ \\ \left[\quad \quad \quad \right] \xrightarrow{\text{SOCl}_2} \text{Cyclohexyl-CH}_2\text{Cl} \xrightarrow{\text{EtONa/EtOH}} \left[\quad \quad \quad \right] \\ \\ \xrightarrow{\text{HBr, } t\text{BuOO}t\text{Bu}} \left[\quad \quad \quad \right] \xrightarrow[3. \text{H}_3^+\text{O}]{\begin{array}{l} 1. \text{Mg, Et}_2\text{O} \\ 2. \text{Epoxide} \end{array}} \left[\quad \quad \quad \right] \end{array} $
5 ~ ~	$ \left[\quad \quad \quad \right] \xrightarrow{\text{Br}_2} \text{meso-4R,5S-dibromopentane} $
6 ~ ~	$ \text{Cycloocta-1,3-diene} \xrightarrow[2. \text{H}_2\text{O}_2/\text{H}_2\text{O}]{1. \text{B}_2\text{H}_6/\text{THF}} \left[\quad \quad \quad \right] $
7 ~ ~	$ \begin{array}{c} \text{Me} \quad \text{H} \\ \diagdown \quad / \\ \text{C} = \text{C} \\ / \quad \diagdown \\ \text{Et} \quad \text{Me} \end{array} \xrightarrow{\text{Br}_2} \left[\begin{array}{c} \text{Me} \quad \text{Me} \\ \quad \\ \text{---} \\ \quad \\ \text{Me} \quad \text{Me} \end{array} + \begin{array}{c} \text{Me} \quad \text{Me} \\ \quad \\ \text{---} \\ \quad \\ \text{Me} \quad \text{Me} \end{array} \right] $ <p style="text-align: center;">Fischer Projection Fischer Projection</p> <p>Note: Backbones of Fischer projections of products were drawn as time savers.</p>
8 ~ ~	$ \text{CH}_3\text{CH}=\text{CH}_2 \xrightarrow[2. \text{NaOH}]{1. \text{Cl}_2/\text{H}_2\text{O}} \left[\quad \quad \quad \right] \xrightarrow{\text{CH}_3\text{OH, H}^+} \left[\quad \quad \quad \right] $
9 ~ ~	$ \text{H}_3\text{C}-\text{C}\equiv\text{CH} \xrightarrow{2\text{HBr, Br}^-} \left[\quad \quad \quad \right] $

10)		
11)	$\text{CH}_2=\text{CHCH}_2\text{CH}_3 \xrightarrow{\text{NBS}}$	<div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 150px; height: 100px; margin: 0 10px;"></div> <div style="margin: 0 10px;">+</div> <div style="border: 1px solid black; width: 150px; height: 100px; margin: 0 10px;"></div> </div>
12)		

4. (7 pts) 碘甲烷与碘化氢在光照的条件下发生自由基链反应，生成甲烷和碘分子。
总反应方程式如下：

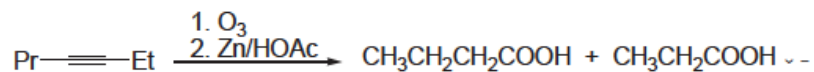


, $\Delta H^\circ(\text{CH}_3-\text{H}) = 105 \text{ kcal mol}^{-1}$, $\Delta H^\circ(\text{CH}_3-\text{I}) = 57 \text{ kcal mol}^{-1}$, $\Delta H^\circ(\text{H}-\text{I}) = 71 \text{ kcal mol}^{-1}$, and $\Delta H^\circ(\text{I}-\text{I}) = 36 \text{ kcal mol}^{-1}$ ~

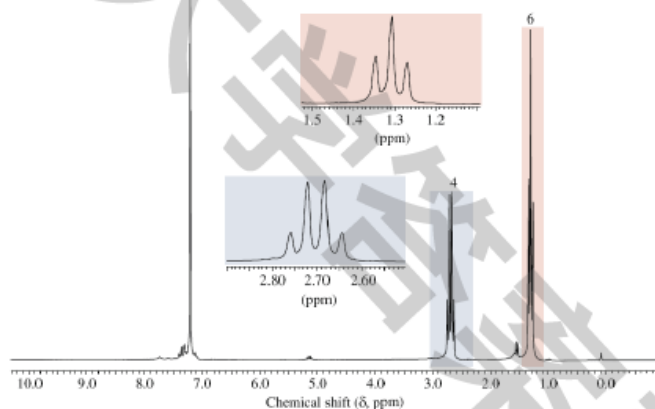
- a) ΔH° for the propagation step $\text{CH}_3\text{I} + \text{HI} \rightarrow \text{CH}_4 + \text{I}_2$ is $\Delta H^\circ = 105 - 57 - 71 + 36 = 13 \text{ kcal mol}^{-1}$ ~
b) ΔH° for the initiation step $\text{CH}_3\text{I} \rightarrow \text{CH}_3^\bullet + \text{I}^\bullet$ is $\Delta H^\circ = 105 - 57 = 48 \text{ kcal mol}^{-1}$ ~
c) ΔH° for the termination step $\text{CH}_3^\bullet + \text{I}^\bullet \rightarrow \text{CH}_3\text{I}$ is $\Delta H^\circ = -48 \text{ kcal mol}^{-1}$ ~

5. (8 pts) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 \xrightarrow{\text{NBS}}$ $\text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{CH}_3$ ~
a) ΔH° for the propagation step $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 + \text{NBS} \rightarrow \text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{CH}_3 + \text{HBr}$ is $\Delta H^\circ = 105 - 57 - 71 + 36 = 13 \text{ kcal mol}^{-1}$ ~
b) ΔH° for the initiation step $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2^\bullet$ is $\Delta H^\circ = 105 - 57 = 48 \text{ kcal mol}^{-1}$ ~
c) ΔH° for the termination step $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2^\bullet + \text{NBS} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NBS}$ is $\Delta H^\circ = -48 \text{ kcal mol}^{-1}$ ~

6. (10 pts) 化合物 A \cdot $C_{14}H_{25}Br$ dA \ " I_{11} (NaC \equiv CH) 0
 1,12-dibromododecane (Br(CH $_2$) $_{12}$ Br) - o d 0NaNH $_2$ - o **B** ^
 (C $_{14}$ H $_{24}$) d \$ **B** ^ y ~ HO $_2$ C(CH $_2$) $_{12}$ CO $_2$ H d } Lindlar ' \$ ' \$
 i / . **PB** \$ **E** ^ (C $_{14}$ H $_{26}$) dC **E** y ~ [
 O=CH(CH $_2$) $_{12}$ CH=O d T l » h < r . n **A-E** ^ r d
 7. (: - y ~ I n z ~ N 6 d H " !



8. (4 pts) \$ **F** h34 Q ^1H NMR V " " d n c r d



^1H NMR spectrum of compound F.

- (6 pts) T l » V α' o n \$ C $_3$ H $_5$ Br 8 Q r:
 a) r **G** ^1H NMR V " " .!