

國立中山大學 102 學年度轉學考招生考試試題

科目名稱：普通化學【化學系三年級】

題號：722001

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單一選擇題：共 20 題，每題 5 分

- Red light has a _____ frequency and a _____ wavelength than blue light.
(a) higher, longer (b) lower, longer (c) higher, shorter (d) lower, shorter
- The energy needed to remove an electron from the $n = 1$ state of a hydrogen atom to $n = \infty$ (electron is free) state is 13.6 eV. Hence the energy needed to free an electron from $n = 2$ state of a hydrogen atom is (a) 13.6 eV (b) 6.8 eV (c) 3.4 eV (d) 1.5 eV (e) 9.6 eV
- From the solutions of the Schrödinger equation for particle-in-a-box, the most probable place to find the particle is at
(a) the boundary of the box (b) the 1/4 length of the box (c) the middle of the box (d) It depends on which the quantum state is.
- Which one of the following sets of quantum numbers (n, l, m) represents as impossible arrangement?
(a) (3, 2, -2) (b) (4, 0, 0) (c) (3, 2, -3) (d) (5, 3, 0)
- If the angular momentum quantum number is 2, then there are _____ possible values for the magnetic quantum number.
(a) 2 (b) 4 (c) 5 (d) 8 (e) none of these
- Two p electrons of a particular nitrogen atom have the quantum number (2,1,0,1/2) and (2,1,0,-1/2). This atom must be excited because _____ has not been obeyed.
(a) the Aufbau Principle (b) Bohr model (c) Hund's rule (d) the Pauli Exclusion Principle
- Atom A and B are brought together along the z -axis. Which of the following pairs of atomic orbitals will yield non-zero overlap?
(a) $p_z(A), p_x(B)$ (b) $p_y(A), s(B)$, (c) $p_x(A), p_y(B)$, (d) $s(A), p_z(B)$
- In the valence bond model of $\text{HC}\equiv\text{N}$, where are the four electron pairs around N placed if N is hybridized? Assume that the z -axis is the internuclear axis.
(a) $2s, 2p_z, 2p_y, 2p_x$ (b) $2s, 2p_x, 2p_y, sp$ (c) $2p_x, 2p_y, sp, sp$ (d) $sp^3, sp^3, sp^3, 2p_z$
- What is the "visible" shape of ozone molecule O_3 ?
(a) bent (b) linear (c) trigonal planar (d) tetrahedral
- OF_2 and SiO_2 both contain polar bonds. What is the correct polarity of these molecules?
(a) OF_2 is nonpolar. SiO_2 is polar. (b) OF_2 is polar. SiO_2 is polar. (c) OF_2 is nonpolar. SiO_2 is nonpolar. (d) OF_2 is polar. SiO_2 is nonpolar.
- Strong acids have energetically low-lying _____, whereas strong bases have energetically high lying _____.
(a) lone pair electrons, bonding electrons (b) HOMO, LUMO (c) LUMO, HOMO (d) H^+, OH^-

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12. How many π MO's are there in benzene?

- (a) 4 (b) 5 (c) 6 (d) 8

13. Antibonding MO's result from

- (a) constructive interference of atomic orbitals (b) different hybridization on the bonding atoms
(c) destructive interference of atomic orbitals. (d) in-phase overlap of atomic orbitals.

14. An **isochoric** process is one for which _____ equals zero.

- (a) w (b) q (c) ΔH (d) ΔE

15. If you are using Hess's Law and must multiply a reaction by two to get things to "add up right", you must multiply ΔH° for the reaction by 2, as well. This is because ΔH° is

- (a) an extensive variable. (b) an intensive variable. (c) a state function. (d) equal to q_p .

16. Arrange the following substances in order of increasing molar entropy: $C_2H_6(g)$, $Pb(s)$, $Mg(s)$, $CH_4(g)$.

- (a) $CH_4 < C_2H_6 < Mg < Pb$ (b) $Mg < Pb < CH_4 < C_2H_6$ (c) $C_2H_6 < CH_4 < Pb < Mg$ (d) $Pb < Mg < CH_4 < C_2H_6$
(e) $Pb < Mg < C_2H_6 < CH_4$

17. What is ΔG° at $T = 303$ K for the reaction $N_{2(g)} + 3 H_{2(g)} \rightarrow 2 NH_{3(g)}$? Note that $\Delta H^\circ_{f,298} = -11.0$ kcal/mole for $NH_{3(g)}$ as well as the following:

compound	S°_{298} (cal/K mole)
$H_{2(g)}$	31.2
$N_{2(g)}$	45.8
$NH_{3(g)}$	46.0

- (a) -3.34 kcal/mole (b) -7.64 kcal/mole (c) -20.4 kcal/mole (d) -6.30 kcal/mole

18. If the equilibrium constant for the reaction $H_2 + 1/2 O_2 \leftrightarrow H_2O$ is K , the equilibrium constant for the reaction $2 H_2O \leftrightarrow 2 H_2 + O_2$ at the same temperature is?

- (a) $1/K$ (b) $1/(2K)$ (c) $2K$ (d) K^2 (e) $1/K^2$

19. Without any knowledge of standard reduction potentials which of the following reaction cannot occur at the cathode?

- (a) $2H_2O(l) + 2e^- \rightarrow H_{2(g)} + 2OH^-(aq)$ (b) $Ca^{2+}(aq) + e^- \rightarrow Ca^+(aq)$
(c) $H_{2(g)} + 2OH^-(aq) \rightarrow 2H_2O(l) + 2e^-$ (d) $F_{2(g)} + 2e^- \rightarrow 2F^-(aq)$

20. Many d^8 metal ions form _____ complexes, leaving the _____ orbital unoccupied.

- (a) tetrahedral, dz^2 (b) octahedral, dz^2 (c) tetrahedral, dx^2-y^2 (d) square planar, dx^2-y^2

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科目名稱：有機化學【化學系三年級】

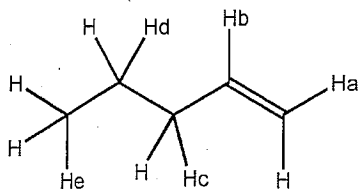
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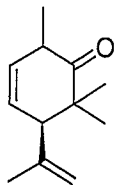
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1. (a) List the following radicals in order of increasing stability (i.e., from least stable to most stable).
 $(\text{CH}_3)_3\text{C}\cdot$, $\text{CH}_2=\text{CHCH}_2\cdot$, $\text{CH}_3\text{CH}_2\cdot$, $\text{CH}_3\cdot$, $(\text{CH}_3)_2\text{CH}\cdot$ (5 points)

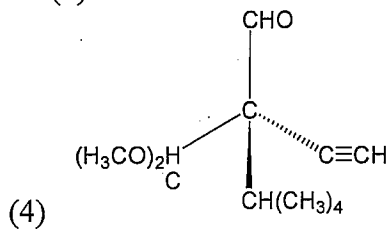
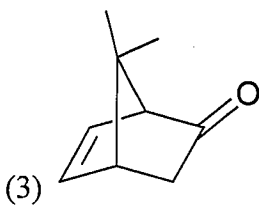
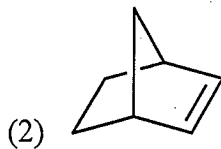
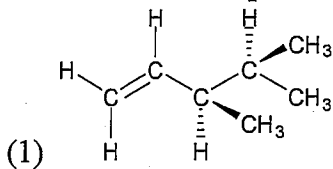
(b) Which H atom in the molecule shown will be most readily abstracted by a bromine radical? Ha, Hb, Hc, Hd, or He? And explain why. (5 points)



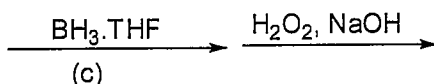
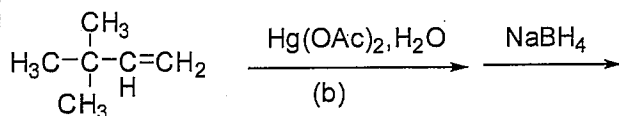
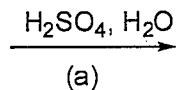
2. (a) The structure of one of the enantiomers of carvone is shown here. Find the asymmetric carbon atom and determine whether it has the (R) or the (S) configuration and please explain why? (5 points)



(b) Please label the asymmetric carbon atom of compounds (1)-(4) with the asterisk (*), then please determine and explain whether it has the (R) or (S) form. (10 points)

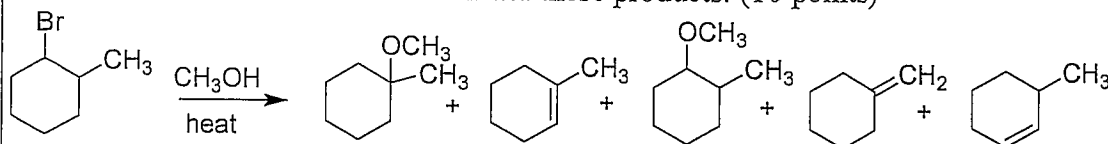


3. Please propose the reasonable mechanisms and predict the products in the reactions (a), (b) and (c). (15 points)

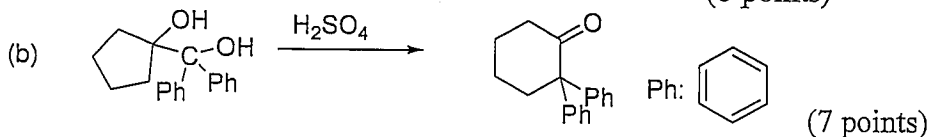
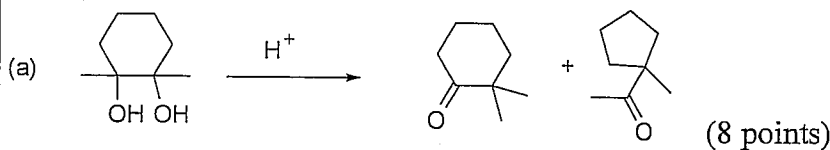


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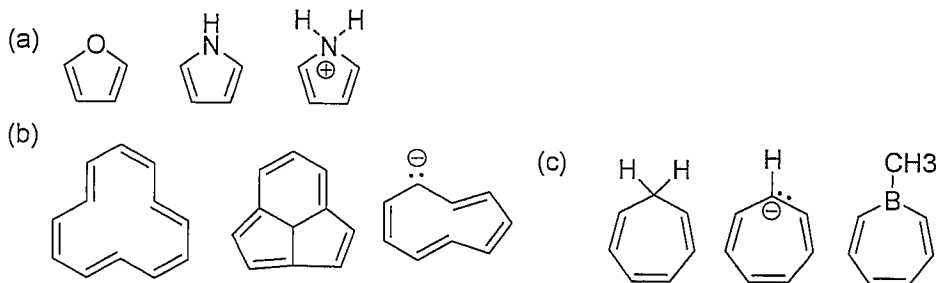
4. When 1-bromo-2-methylcyclohexane undergoes solvolysis in methanol, five major products are formed. Give mechanisms to account for these products. (10 points)



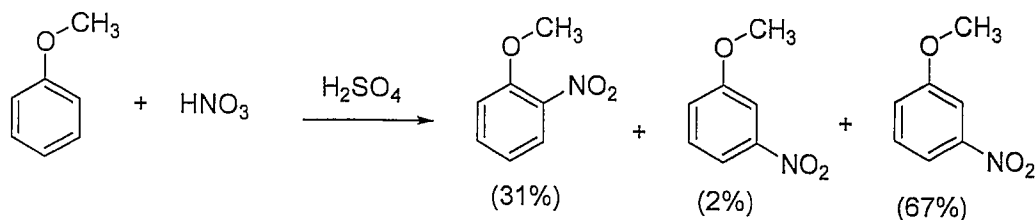
5. Propose the reasonable mechanism for each reaction.



6. The following molecules and ions are grouped by similar structures. Classify each as aromatic, antiaromatic, or nonaromatic. For the aromatic and antiaromatic species, give the number of pi electrons in ring. (15 points)



7. Please explain why the para and ortho substitution are the major products in the nitration reaction of methoxybenzene by resonance forms of sigma complexes (10 points)



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8. Show how the following diketone might be synthesized using a Michael addition.
(10 points)

