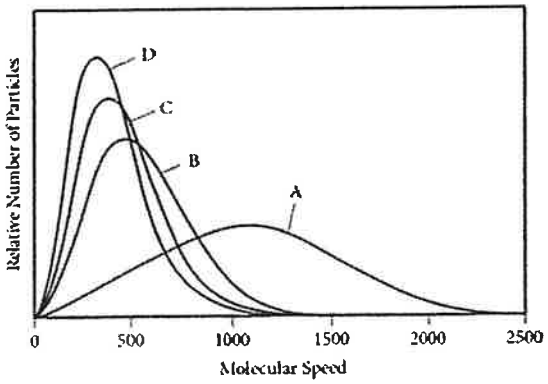
1. Which of the following statements is FALSE?
A) Halogens are very reactive elements. B) The alkali metals are fairly unreactive. C) Sulfur is a main group element. D) Noble gases do not usually form ions. E) Zn is a transition metal.

2. Write the name for $Sn(SO_4)_2$. Remember that Sn forms several ions.
A) tin (I) sulfite B) tin (IV) sulfate C) tin sulfide D) tin (II) sulfite E) tin (I) sulfate

3. What is the chemical formula for magnesium hydride?
A) MgH_2 B) MgOH C) MgH D) $MgOH_2$ E) $Mg(OH)_2$

4. Which of the following compounds is soluble in water?
A) CaS B) $MgCO_3$ C) $PbCl_2$ D) $BaSO_4$ E) None of these compounds is soluble in water.

5. Which of the gases in the graph below has the largest molar mass?



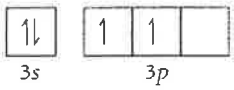
A) A B) B C) C D) D E) There is not enough information to determine.

6. Which of the following statement is TRUE?
A) State functions do not depend on the path taken to arrive at a particular state.
B) DErxn can be determined using constant volume calorimetry.
C) Energy is neither created nor destroyed, excluding nuclear reactions.
D) ΔHrxn can be determined using constant pressure calorimetry.
E) All of the above are true.

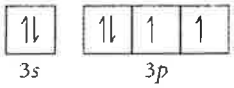
7. Which of the following statement is TRUE?
A) We can sometimes know the exact location and speed of an electron at the same time.
B) All orbitals in a given atom are roughly the same size.
C) Since electrons have mass, we must always consider them to have particle properties and never wavelike properties.
D) Atoms are roughly spherical because when all of the different shaped orbitals are overlapped, they take on a spherical shape.
E) All of the above are true.

8. Choose the valence orbital diagram that represents the Si.

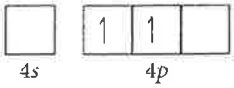
A)



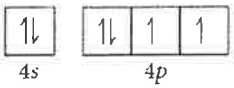
B)



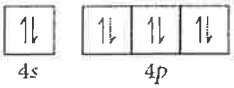
C)



D)



E)



9. Predict the charge for the most stable ion of nitrogen

A) -3 B) -2 C) 1 D) 0 E) +3

10. Choose the compound below that should have the highest melting point according to the ionic bonding model.

A) SrI_2 B) MgF_2 C) $CaCl_2$ D) SrF_2 E) $SrBr_2$

11. Draw the Lewis structure for NO_2^- including any valid resonance structures. Which of the following statements is TRUE?

A) The nitrite ion contains one N-O single bond and one N=O double bond.
B) The nitrite ion contains two N-O bonds that are equivalent to 1.5 bonds.
C) The nitrite ion contains two N=O double bonds.
D) The nitrite ion contains two N-O single bonds.
E) None of the above are true.

12. Place the following in order of **decreasing** X-A-X bond angle, where A represents the central atom and X represents the outer atoms in each molecule.

N_2O NCl_3 NO_2^-

A) $NCl_3 > NO_2^- > N_2O$
B) $NO_2^- > N_2O > NCl_3$
C) $N_2O > NO_2^- > NCl_3$
D) $NCl_3 > N_2O > NO_2^-$
E) $N_2O > NCl_3 > NO_2^-$

13. Draw the Lewis structure for BrF_4^-. What is the hybridization on the Br atom?
A) sp^3d^2 B) sp^3d C) sp^3 D) sp^2 E) sp

14. Using the VSEPR model, the molecular geometry of the central atom in SO_2 is _____.
A) linear B) trigonal planar C) tetrahedral D) bent E) trigonal pyramidal

15. Place the following substances in order of **increasing** vapor pressure at a given temperature.

NF_3 NH_3 BCl_3

A) $NH_3 < NF_3 < BCl_3$
B) $NF_3 < NH_3 < BCl_3$
C) $BCl_3 < NF_3 < NH_3$
D) $NH_3 < BCl_3 < NF_3$
E) $BCl_3 < NH_3 < NF_3$

16. Which of the following compounds exhibits only dispersion and dipole-dipole intermolecular interactions?

A) H_2 B) HI C) CO_2 D) CH_3NH_2 E) CH_3OH

17. Which of the following statements is TRUE?
A) The solubility of a solid is not dependent on either temperature or pressure.
B) The solubility of a solid is highly dependent on pressure.
C) The solubility of a solid is highly dependent on both pressure and temperature.
D) The solubility of a solid is highly dependent on temperature.
E) None of the above.

18. Consider the following reaction at equilibrium. What will happen if we add more SO_3 in the system?

$$SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$$

A) The reaction will shift in the direction of products.
B) The reaction will shift to decrease the pressure.
C) No change will occur since SO_3 is not included in the equilibrium expression.
D) The reaction will shift in the direction of reactants.
E) The equilibrium constant will decrease.

19. Which BrØnsted-Lowry acid is not considered to be a strong acid in water?
A) HI B) HBr C) H_2SO_3 D) HNO_3 E) HCl

20. Which of the following is a Lewis acid?
A) BCl_3
B) CH_4
C) NH_3
D) $CHCl_3$
E) None of the above are Lewis acids.

21. When titrating a weak monoprotic acid with NaOH at 25°C, the
A) pH will be less than 7 at the equivalence point.
B) pH will be equal to 7 at the equivalence point.
C) pH will be greater than 7 at the equivalence point.
D) titration will require more moles of base than acid to reach the equivalence point.
E) titration will require more moles of acid than base to reach the equivalence point.

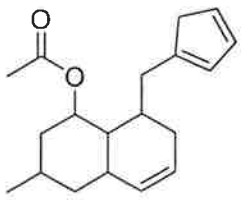
22. Which of the following statements is TRUE?
A) Entropy is not a state function.
B) Endothermic processes decrease the entropy of the surroundings, at constant T and P.
C) Endothermic processes are never spontaneous.
D) Exothermic processes are always spontaneous.
E) None of the above are true.

23. What statement is NOT true about standard electrode potentials?
A) E°cell is positive for spontaneous reactions.
B) Electrons will flow from more negative electrode to more positive electrode.
C) The electrode potential of the standard hydrogen electrode is exactly zero.
D) E°cell is the difference in voltage between the anode and the cathode.
E) The electrode in any half-cell with a greater tendency to undergo reduction is positively charged relative to the standard hydrogen electrode and therefore has a positive E°.

24. What will happen during gamma ray emission.
A) The mass number and atomic number decrease.
B) The mass number and atomic number increase.
C) The mass number is unchanged and the atomic number decreases.
D) The mass number is unchanged and the atomic number increases.
E) The mass number and atomic number do not change.

25. Identify the element that is not used as a radioactive tracer.
A) iron-59
B) phosphorus-32
C) thallium-201
D) iodine-131
E) carbon-13

26. How many chiral centers are there in the following molecule?

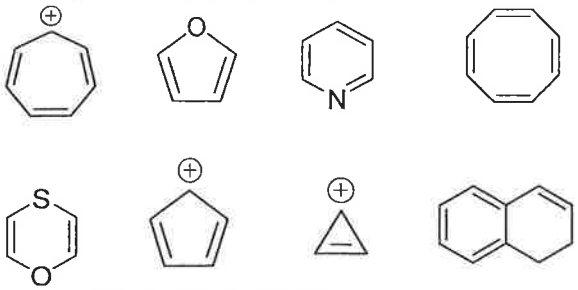


(A) 4 (B) 5 (C) 6 (D) 7

27. Which of compounds can be reduced by sodium borohydride ?

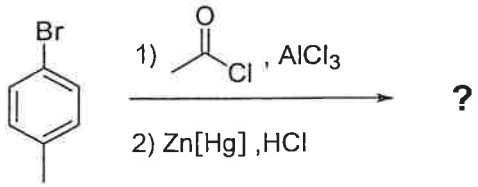
(A) 2-butanol
(B) butyric acid
(C) 2-butene
(D) 3-pentanone

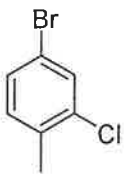
28. Among the following compounds, how many are aromatic?

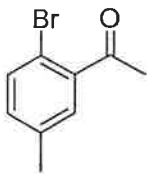


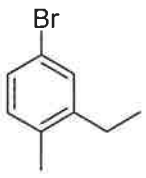
(A) 4 (B) 5 (C) 6 (D) 7

29. Predict the major product of the following reaction:



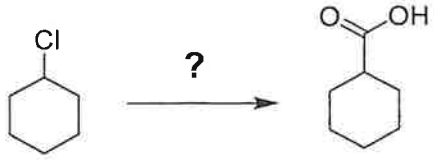
(A) 

(B) 

(C) 

(D) 

30. Which reagent(s) are necessary to carry out the following reaction ?



(A)

1) Mg, Et_2O
2) CO_2
3) H_3O^+

(B)

1) PCC
2) CO_2

(C)

1) H_2, Pt
2) CO_2

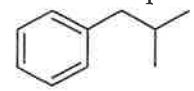
(D)

1) BH_3, THF
2) H_2O_2, OH^-

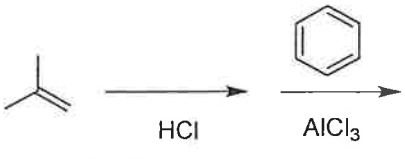
31. Which of the following reagents would convert 2-butanol into 2-bromobutane ?

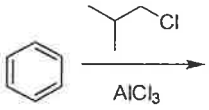
(A) Br_2/CCl_4
(B) Br_2/light; heat
(C) PBr_3/pyridine
(D) $CuBr_2$/MeOH

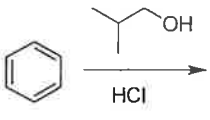
32. Choose the possible process to produce Isobutylbenzene.

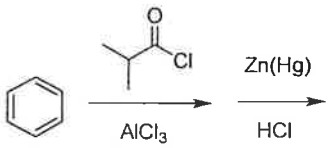


Isobutylbenzene

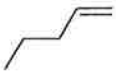
(A) 

(B) 

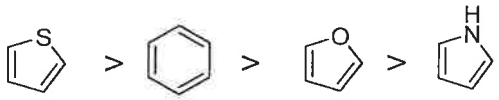
(C) 

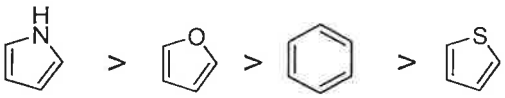
(D) 

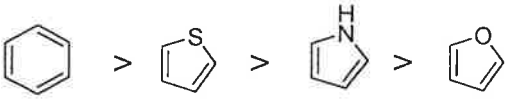
33. Which is major product of following reaction?

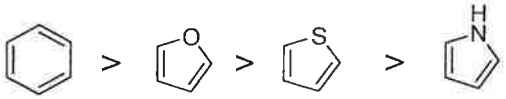
(A)  (B)  (C)  (D) all of above is incorrect

34. Please order following compounds with aromaticity.

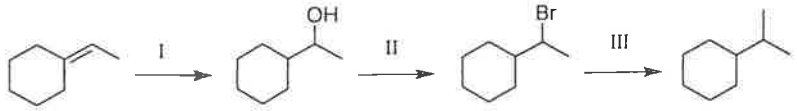
(A) 

(B) 

(C) 

(D) 

35. Which process of following reaction is incorrect ?



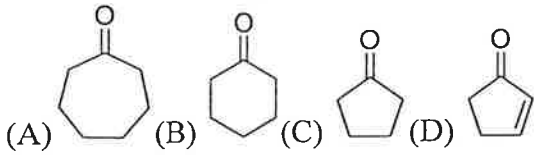
(A) I should be $\xrightarrow[2.CsOH]{1.LAH}$

(B) II should be $\xrightarrow{PBr_3}$

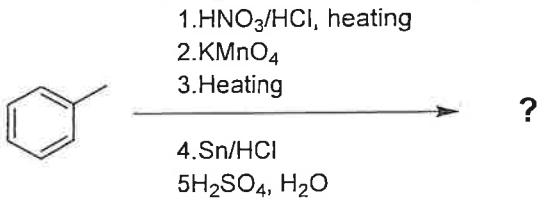
(C) III should be $\xrightarrow{(CH_3)_2CuLi}$

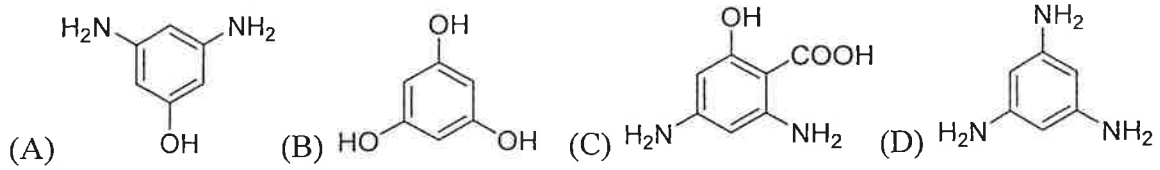
(D) all of above is correct

36. There is a IR absorption at 1747 cm^{-1}, what structure would you expect?

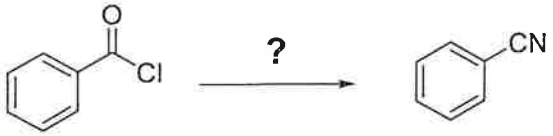


37. Which is major product of following reaction ?



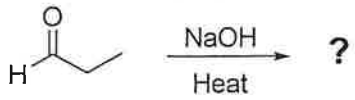


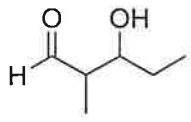
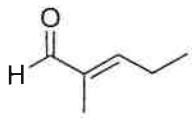
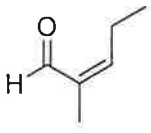
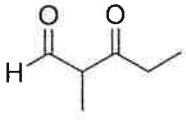
38. Identify the reagents of the following transformation:



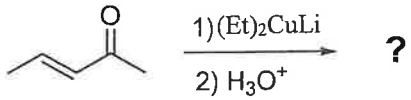
(A) 1) Excess NH_3 2) LAH 3) H_2O (B) 1) Excess NH_3 2) NaOH, heat 3) H_3O^+
(C) 1) Excess NH_3 2) $SOCl_2$ (D) 1) NaCN 2) LAH 3) H_2O

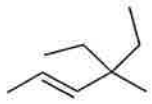
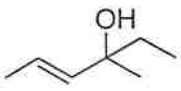
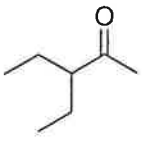
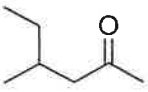
39. Predict the major product of the following reaction:



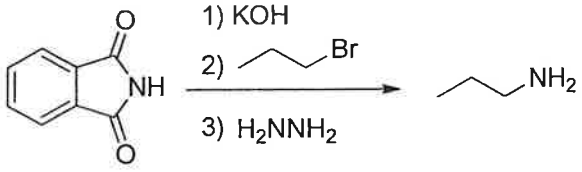
(A) 
(B) 
(C) 
(D) 

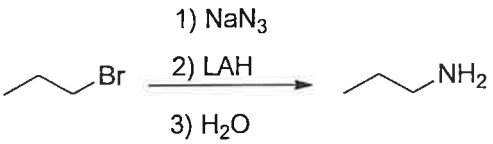
40. Predict the major product of the following reaction:

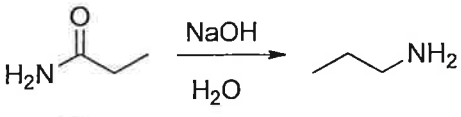


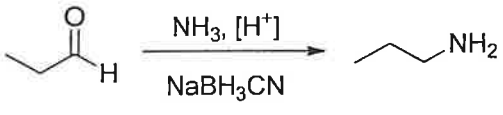
(A) 
(B) 
(C) 
(D) 

41. Which of the following reactions is not correct ?

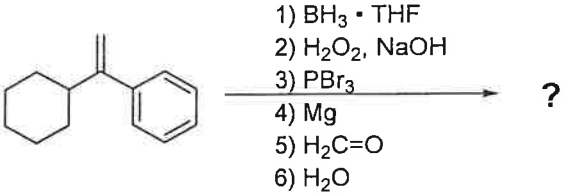
(A) 

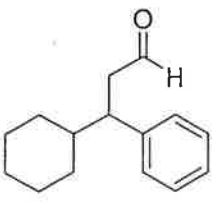
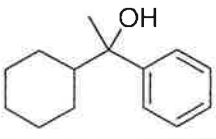
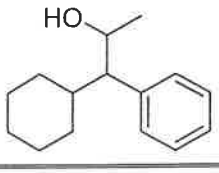
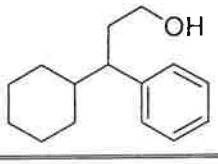
(B) 

(C) 

(D) 

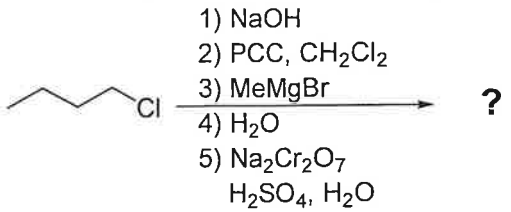
42. Predict the product of the following reaction:

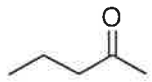
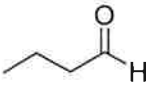
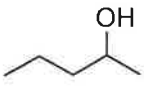
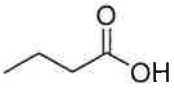


(A) 
(B) 
(C) 
(D) 

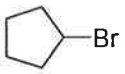
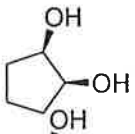
　背面有題，請繼續作答。

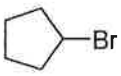
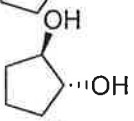
43. Predict the product of the following reaction:

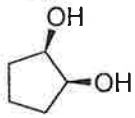


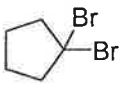
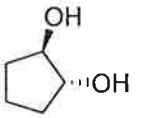
(A)  (B)  (C)  (D) 

44. Identify the reagents and products of the following transformation:

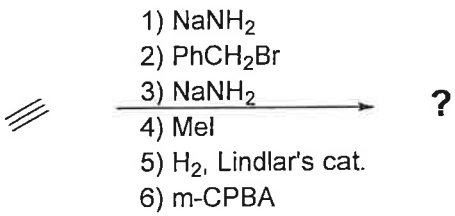
(A) **A** =  **B** = H_2SO_4 **C** = 1) OsO_4 2) $NaHSO_3$, H_2O **D** = 

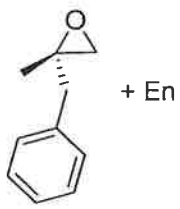
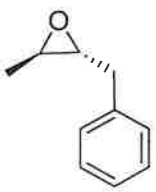
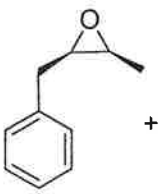
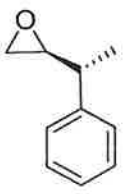
(B) **A** =  **B** = NaOEt **C** = m-CPBA **D** =  + En

(C) **A** =  **B** = NaOEt **C** = m-CPBA **D** = 

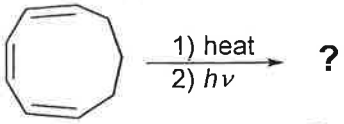
(D) **A** =  **B** = H_2SO_4 **C** = 1) OsO_4 2) $NaHSO_3$, H_2O **D** =  + En

45. Predict the products of the following reaction:



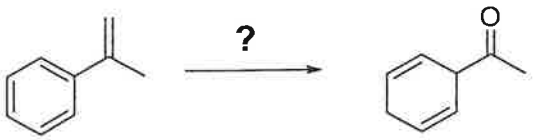
(A)  + En (B)  + En (C)  + En (D)  + En

46. Predict the product of the following reaction:



(A) 
(B) 
(C) 
(D) 

47. Identify the reagents of the following transformation:



(A)
1) O_3
2) DMS
3) Na, NH_3
MeOH

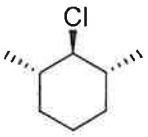
(B)
1) OsO_4
2) $NaHSO_3$, H_2O
3) O_3
4) DMS

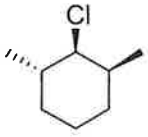
(C)
1) HBr
2) H_2SO_4
3) O_3
4) DMS

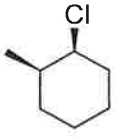
(D)
1) 9-BBN
2) H_2O_2, NaOH
3) Na, NH_3
MeOH

48. Which compound can not undergo an E2 reaction ?

(A) 

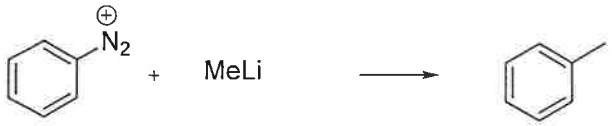
(B) 

(C) 

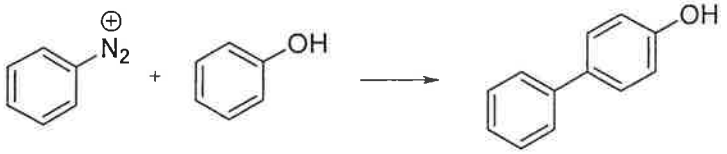
(D) 

49. Which of the following reactions is correct ?

1

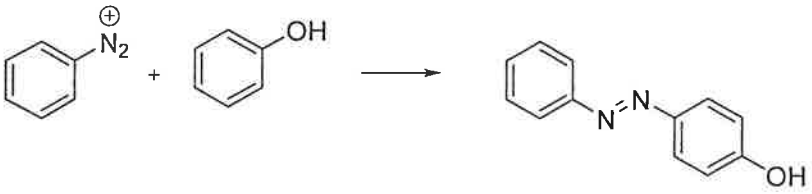


2



3

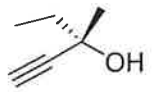
4



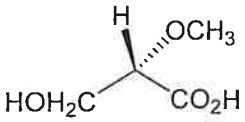
(A) **1**、**2** (B) **1**、**4** (C) **3**、**4** (D) **2**、**3**

50. Assign R or S configuration in the following molecules.

A =



B =



(A) **A** = R ; **B** = S
(B) **A** = S ; **B** = S
(C) **A** = S ; **B** = R
(D) **A** = R ; **B** = R