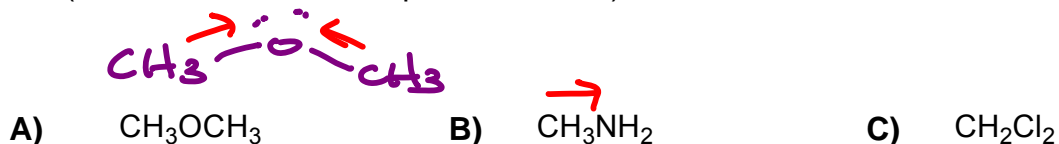


Ave = 67.3 SD = 14.1 skew = -0.39

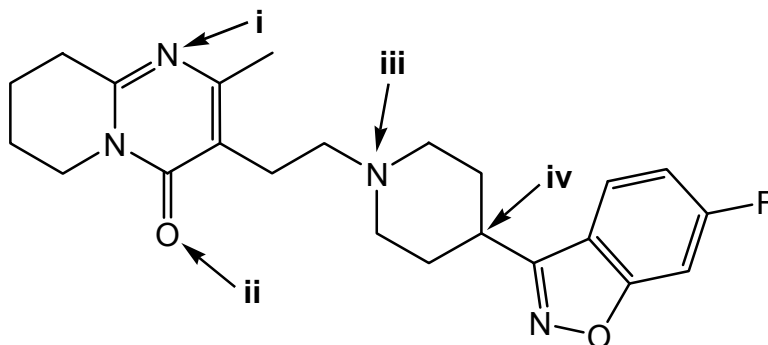
★★ Before you start, please enter code 111 on your Scantron sheet ★★

median = 68.6

1. Which one of the following has a net dipole moment equal to zero (i.e. which one is a non-polar molecule)?



2. *Risperdal*, shown below, is a medication for the treatment of bipolar mania. What are the hybridizations and approximate bond angles of the atoms indicated?



	i	ii	iii	iv
A)	sp^2	sp^2	120°	sp^2
B)	sp^3	sp^2	120°	sp^2
C)	sp^3	sp^3	109°	sp^3
D)	sp^2	sp^3	109°	sp^3
E)	sp^2	sp^2	109°	sp^3

% got wrong

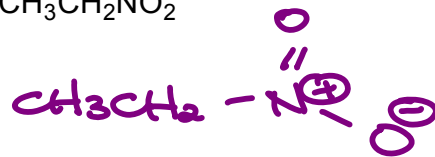
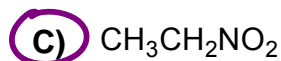
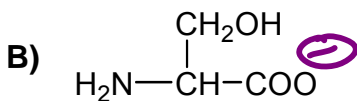
30

done in class

7

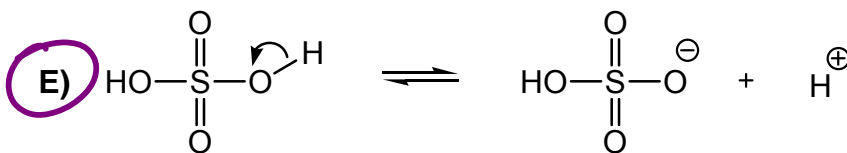
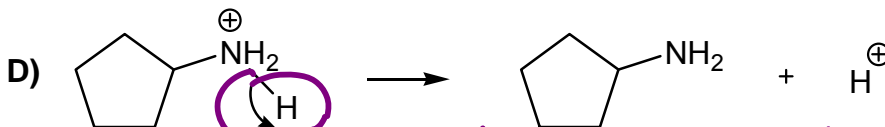
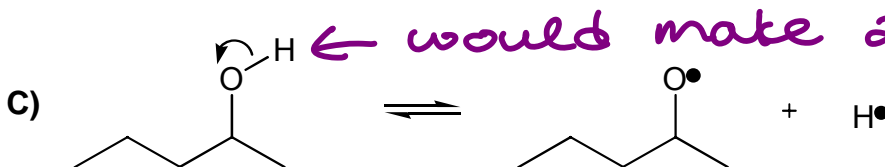
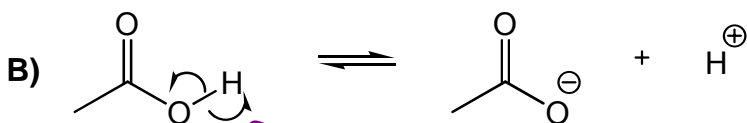
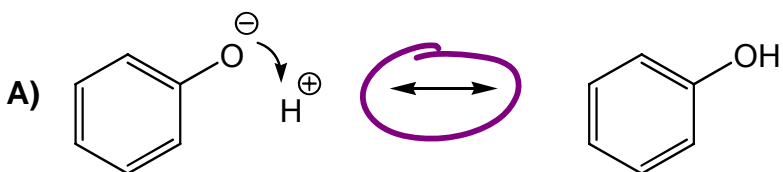
3. Which one of the following has no net charge? Assume all atoms have a full valence shell.

26



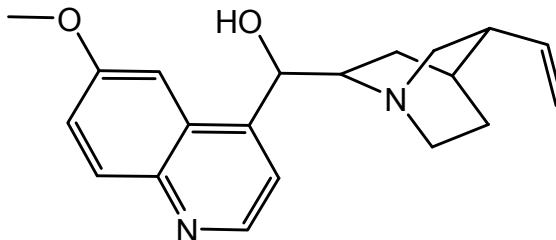
4. Taking the starting materials and products into consideration, which one of A – E shows the proper use of organic-chemistry arrow conventions?

23

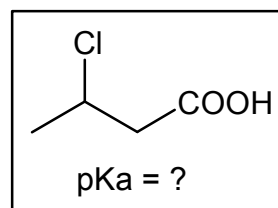
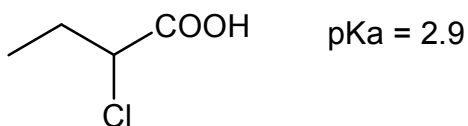
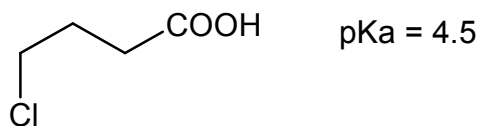
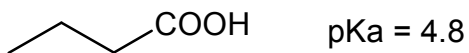


5. Which functional group is NOT present in the anti-malarial drug quinine?

- 26
- A) Amide
 - B) Alcohol
 - C) Ether
 - D) Alkene
 - E) Amine



6. The measured pKa values for three acids are shown below. Which one pKa value listed in A – E is possible for the boxed molecule?

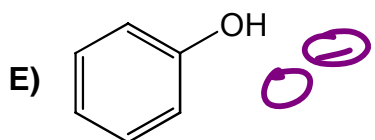
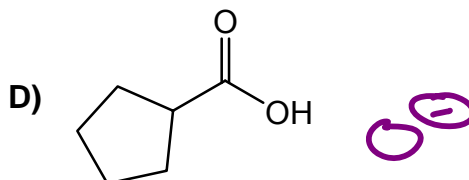
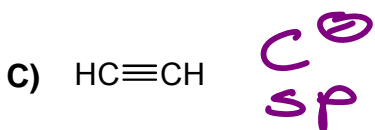
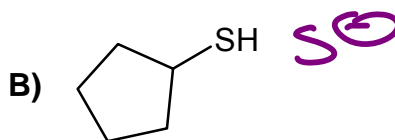
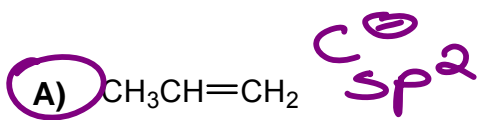


in between
2.9 - 4.5

- 4
- A) 4.7
 - B) 2.5
 - C) 4.0
 - D) 5.1
 - E) 1.9

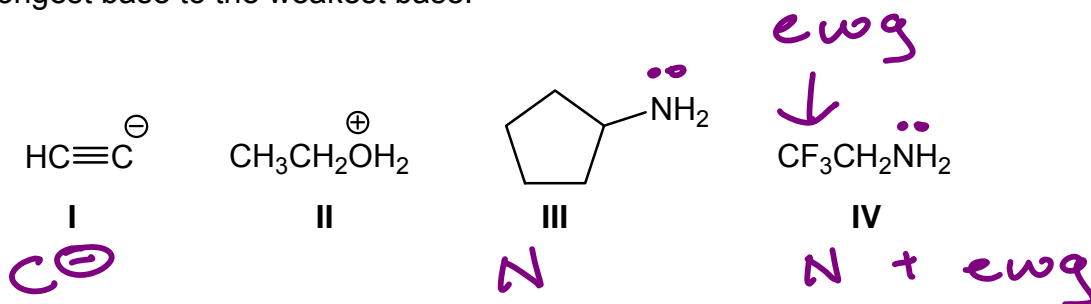
7. Which one of the following is the weakest acid? *least-stable conj base*

38



8. Arrange the following compounds in the order of base strength, from the strongest base to the weakest base.

35



	strongest base	→	weakest base
A)	III		I
B)	II		I
C)	IV		II
D)	I		II
E)	I		II

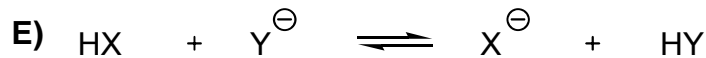
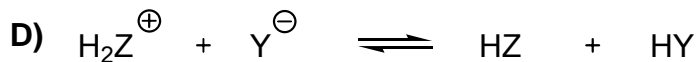
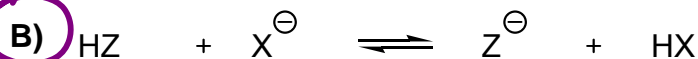
II = not a base (cannot accept another proton), analogous to H₃O⁺

9. Given the pKa values for the four acids listed below, which one of equilibria A – E lies furthest to the LEFT?

26

HX	pKa = -2
H ₂ Z ⁺	pKa = +3
HY	pKa = +10
HZ	pKa = +13

HX stronger than H₂. so X⁻ stabler than Z⁻, so eqm would lie to side of X⁻



10. How many constitutional (structural) isomers of C₄H₉Cl are possible?

17

A) 2

B) 8

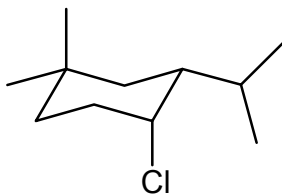
C) 10

D) 6

E) **4**

11. What is a correct IUPAC name for the following compound?

60



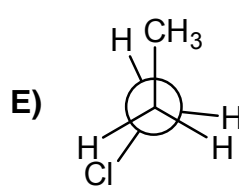
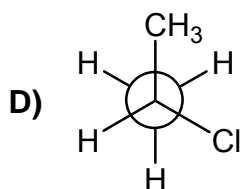
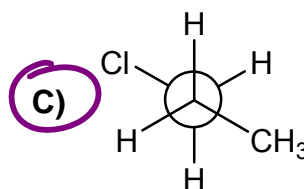
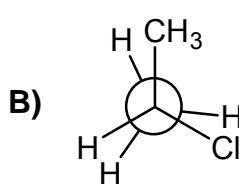
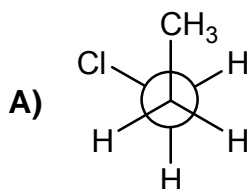
note: Cl can only be compared to the isopropyl group when assigning cis/trans

- A) *trans*-4-chloro-3-isopropyl-1,1-dimethylcyclohexane
 B) *trans*-4-chloro-3-propyl-1,1-dimethylcyclohexane
 C) *trans*-1-chloro-2-isopropyl-4,4-dimethylcyclohexane
 D) *cis*-1-chloro-2-isopropyl-4,4-dimethylcyclohexane
 E) *cis*-4-chloro-3-isopropyl-1,1-dimethylcyclohexane

(can't compare to the two me on the same C)

12. Which Newman projection shows the most stable conformation of 1-chloropropane?

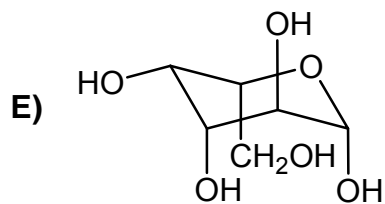
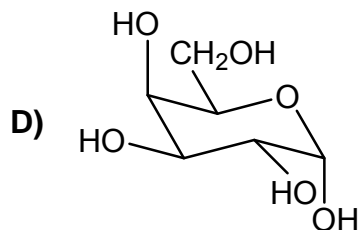
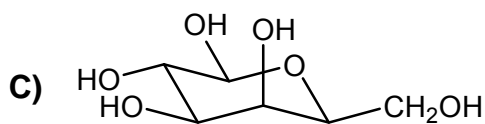
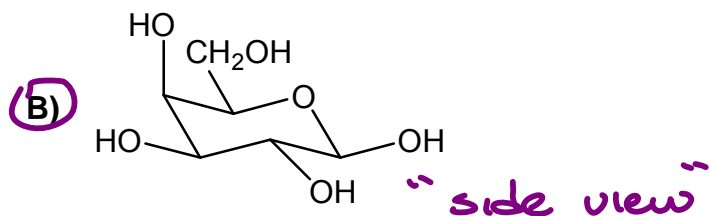
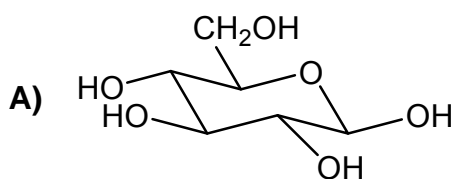
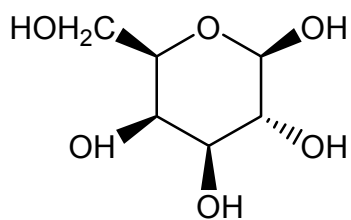
3



model kit helps!

13. The structure of the sugar α -galactose, shown below, corresponds to which one of the chair conformations in A - E?

10



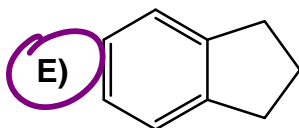
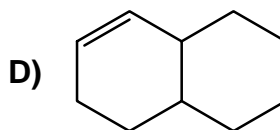
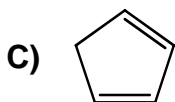
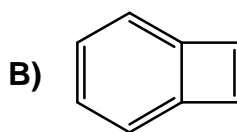
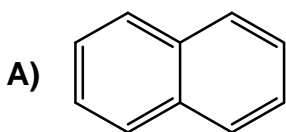
14. The molecular formulas of five compounds are listed along with two physical properties. Which two compounds are a possible pair of constitutional isomers?

	formula	density (g/mL)	boiling point (°C)
I	C ₄₀ H ₈₂	160	375
II	C ₄₀ H ₈₀	160	375
III	C ₃₆ H ₇₂	160	375
IV	C ₄₀ H ₈₂	132	340
V	C ₃₆ H ₇₀	132	340

- A) IV and V
 B) III and IV
 C) I and IV
 D) I and III
 E) II and V

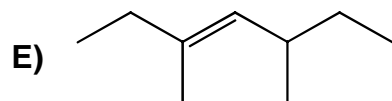
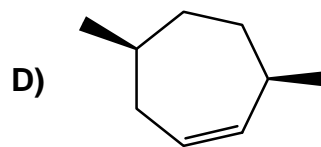
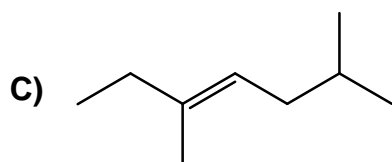
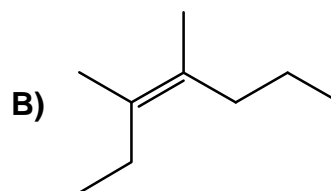
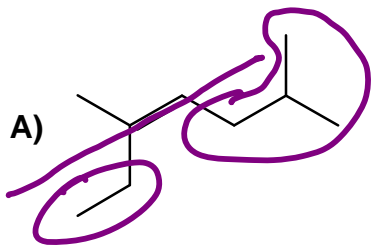
same formula, diff sequence, so diff properties

15. Which one of the following has five units of unsaturation?

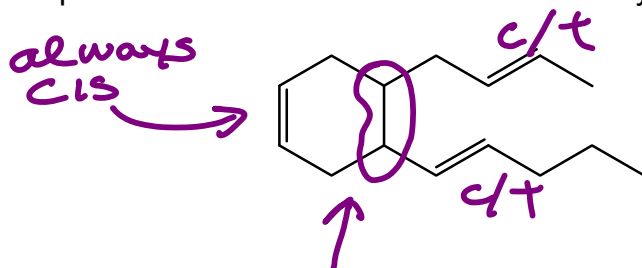


3 π + 2 rings

16. Which one of the following is (Z)-3,6-dimethylhept-3-ene?



17. The compound below exists in a total of how many *cis/trans* isomers?



A) 4

B) 8

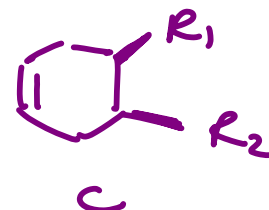
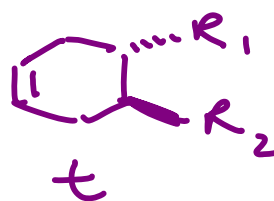
C) 2

D) 16

E) 6

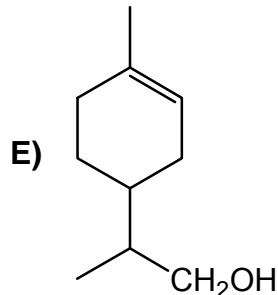
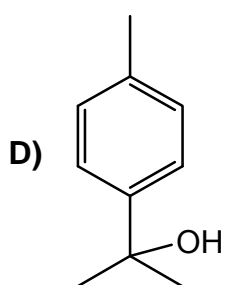
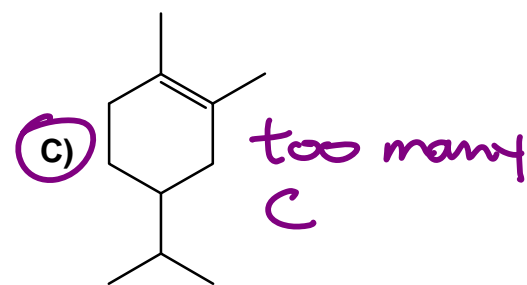
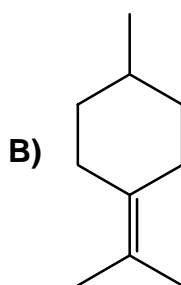
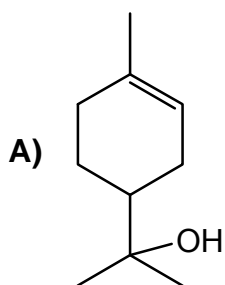
could be c or t relative to each other

e.g.



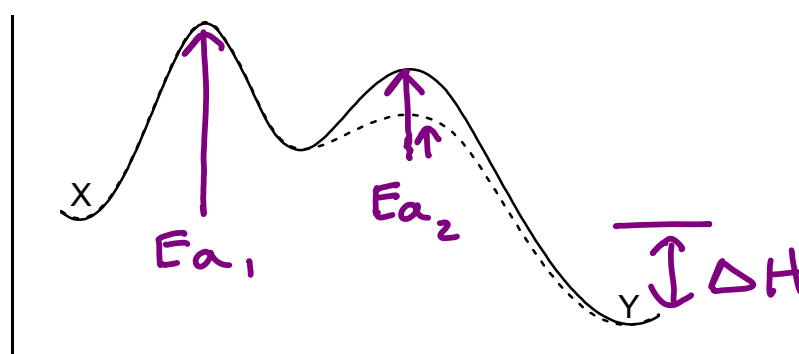
$$2^3 = 8$$

18. Which one of the following is NOT a terpene?



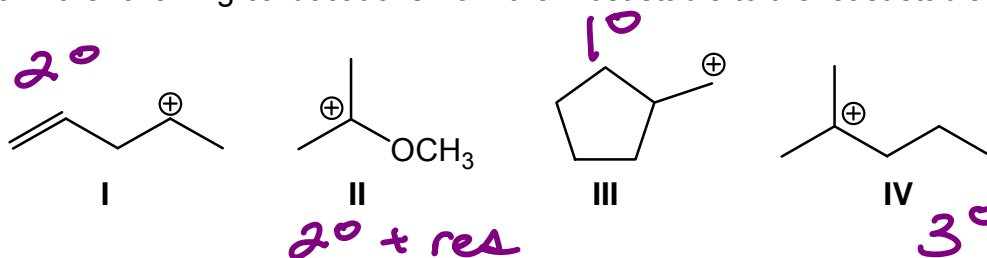
recall
 $n \times C_5$

19. Consider the conversion of X to Y, which follows the reaction coordinate of the solid line. If the reaction is made to proceed along the dotted line instead, which one of the following statements would be correct for the altered reaction?



- A) The energy of the intermediate becomes lower
 B) The energy of the first transition state increases
 C) The ΔH of reaction becomes more negative
 D) The rate of the reaction increases
 E) The energy of the second transition state decreases

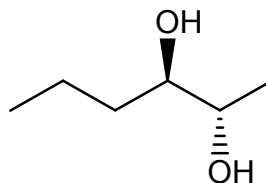
20. Rank the following carbocations from the most stable to the least stable?



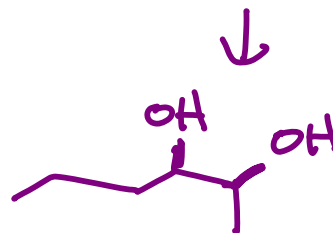
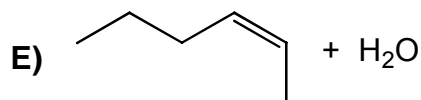
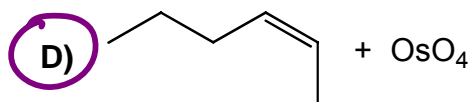
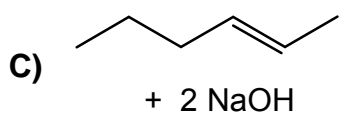
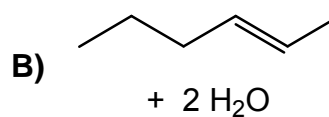
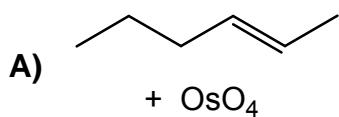
	most stable	→	least stable
A)	IV	II	I
B)	II	I	III
C)	IV	I	II
D)	I	II	IV
E)	II	IV	I

recall class notes:
ability of O to donate by resonance exceeds inductive alky donation

21. The best yield of the molecule shown can be achieved using which two reagents?



assigned text problem 5.39c

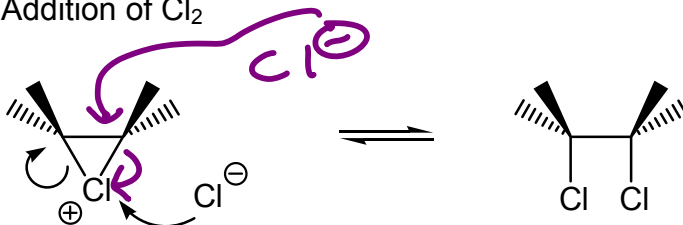


22. Which one of A – E does NOT show a correct mechanistic step for the indicated reaction?

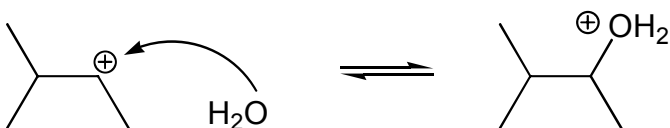
34

_____ *should attack C*

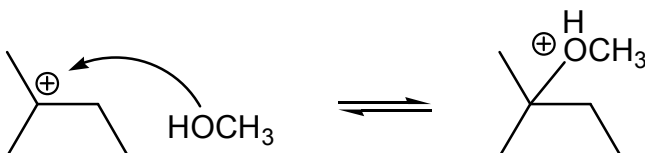
- A) Addition of Cl_2



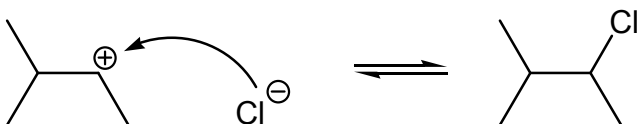
- B) Acid-catalyzed addition of H_2O



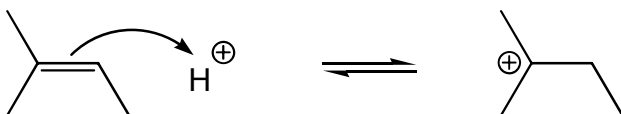
- C) Acid-catalyzed addition of CH_3OH



- D) Addition of HCl

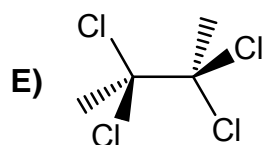
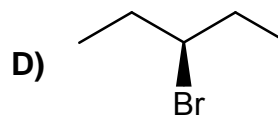
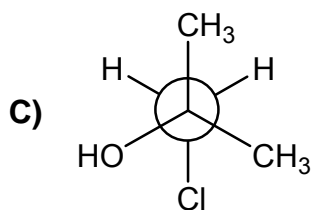
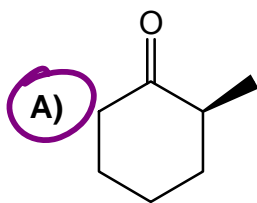


- E) Addition of HBr

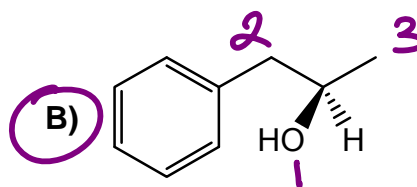


23. Which one of the following molecules is chiral?

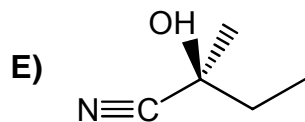
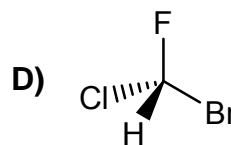
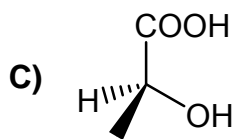
18



24. Which one of the following is in the *R* configuration?

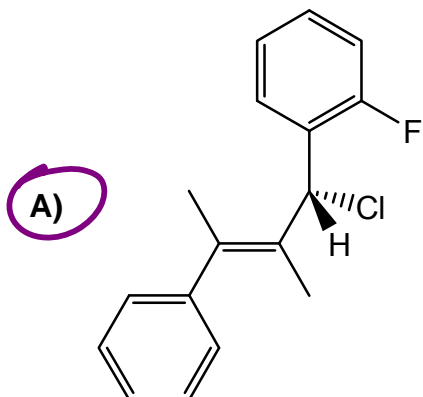


13

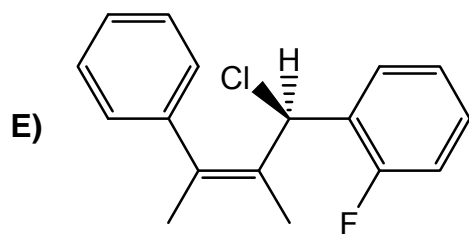
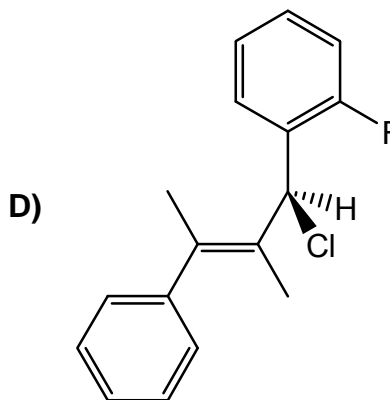
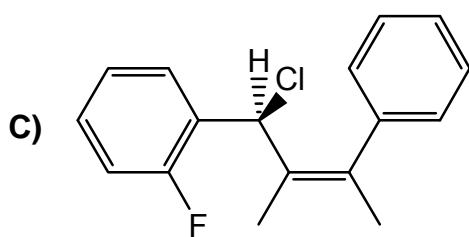
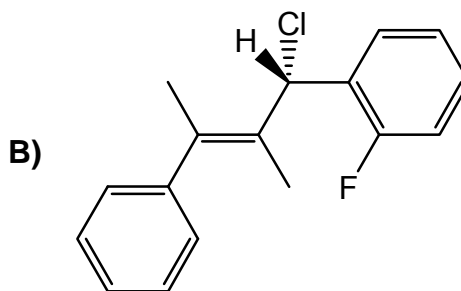


25. Which one of the following is an *E,R* stereoisomer?

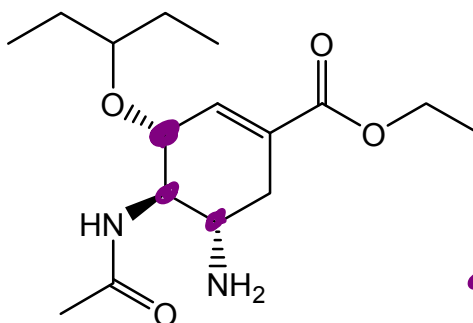
18



from notes



26. *Tamiflu* is an antiviral drug that is currently being stockpiled by governments in the event of an influenza or bird flu pandemic. What is the total number of ALL possible stereoisomers in this compound?

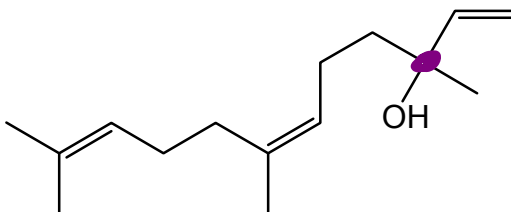


28

23

- A) 8
B) 2
C) 32
D) 4
E) 16

27. Nerolidol is a terpene excreted by plants to attract insects. Which statement about nerolidol is NOT correct?

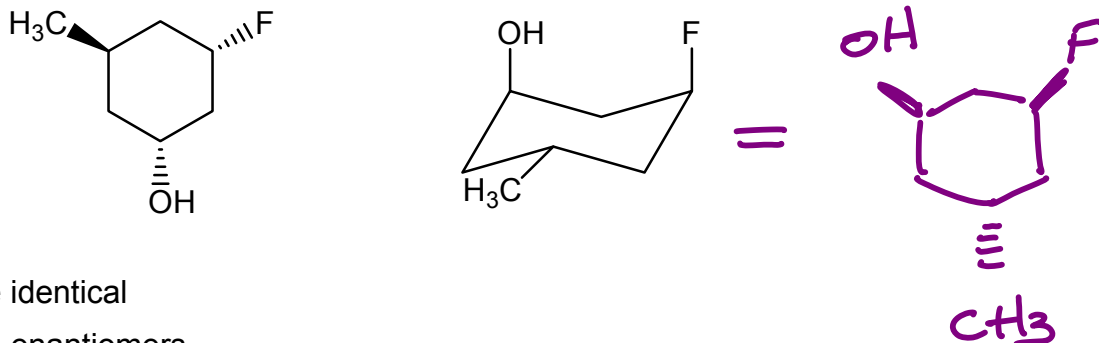


35

- A) It has one chiral centre ✓
B) It contains three isoprene units ✓
C) It is a tertiary alcohol ✓
D) It has four *cis/trans* isomers only 1 C=C can be c/t
E) All isoprene units are joined head-to-tail

28. What is the relationship between these two compounds?

36



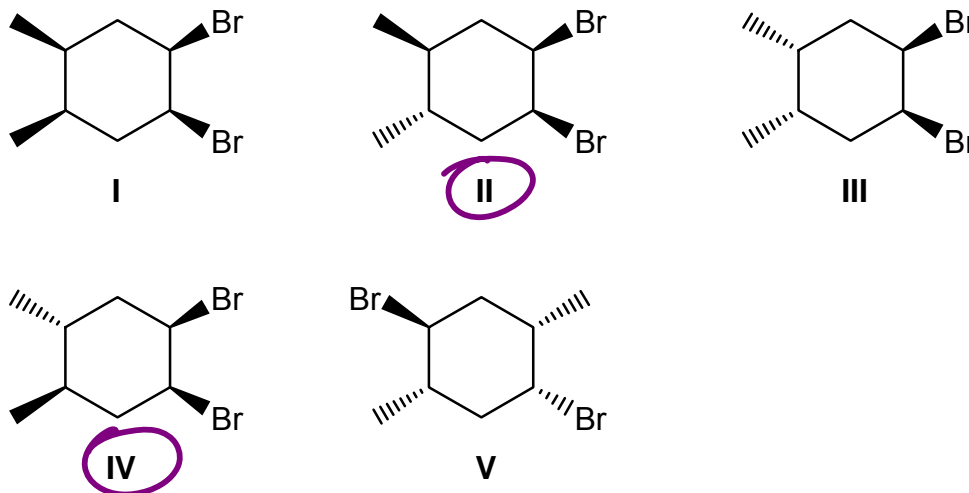
- A) They are identical
- B) They are enantiomers
- C) They are *meso* compounds
- D) They are diastereomers
- E) They are constitutional isomers

(turn over to get 1st molecule)

29. Which two of the following compounds have equal but opposite specific rotations (i.e. same magnitude but opposite sign)?

i.e. enantiomers

24

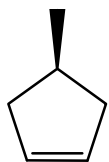


- A) I and II
- B) I and III
- C) II and IV
- D) II and III
- E) II and V

note: I and II are meso, so don't rotate
PPL

30. How many stereoisomers are formed in the following reaction?

54



2 carbocations of equal stability are formed, each of which can be attacked from either side by Cl^-

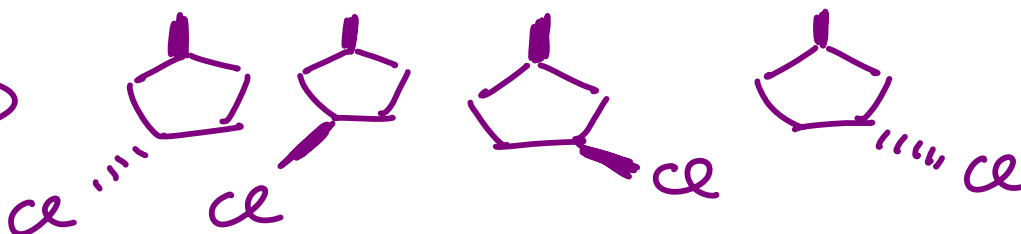
A) 6

B) 2

C) 5

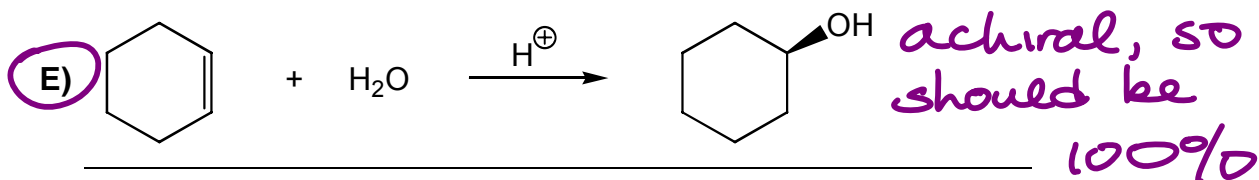
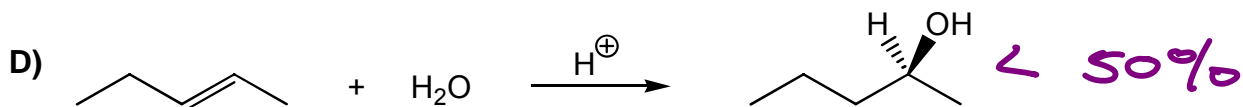
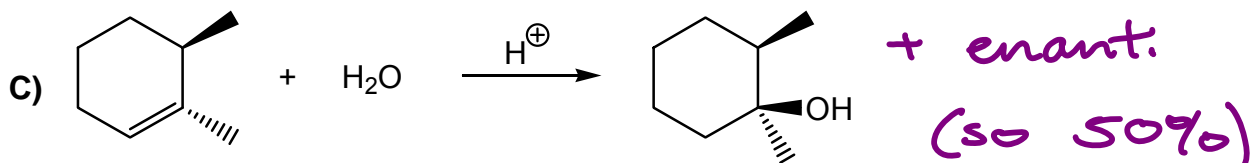
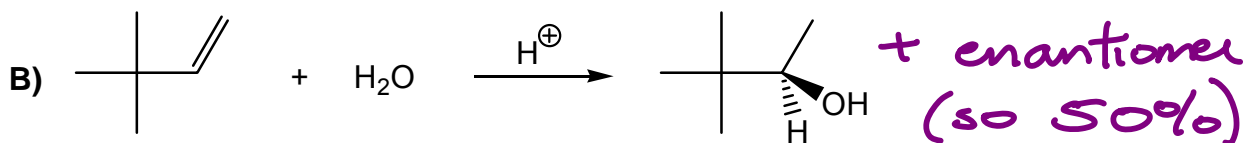
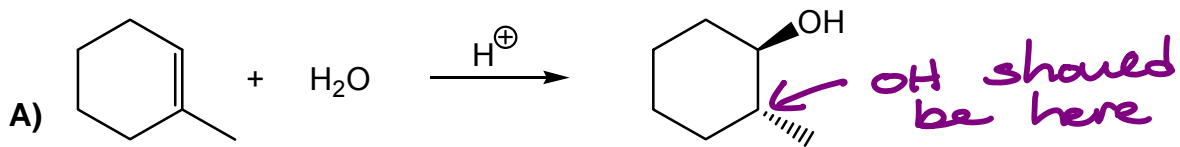
D) 4

E) 3



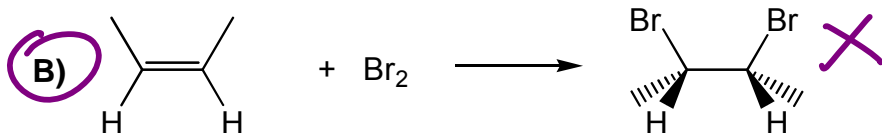
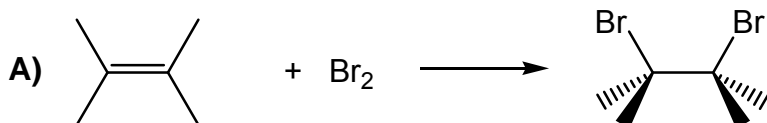
31. Which one of the following reactions gives the best yield of the product shown?

81

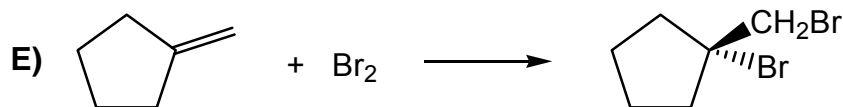
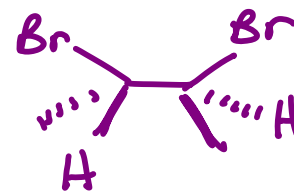
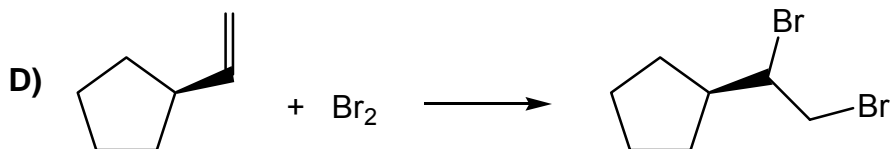
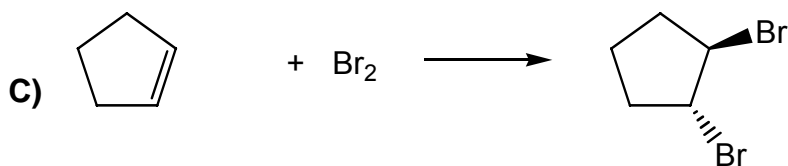
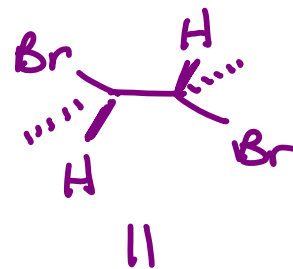


32. Which one of the following reactions gives the poorest yield of the product shown?

59



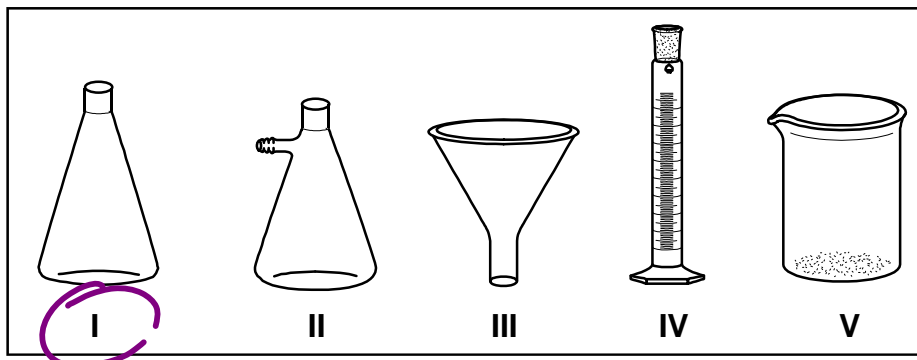
reaction would give



33. In a hot gravity filtration, such as the one performed in Experiment #1, which one of the laboratory items shown is used to collect the filtrate?

stuff that went through the filter

- A) II
B) V
C) III
D) I
E) IV



90

34. Which one of the following is NOT a necessary property of a good recrystallization solvent?

- A) It must not react with the substance.
B) It must have good solubility for the impurities in the impure substance at low temperatures, or not dissolve the impurities at all.
C) It must dissolve a moderate quantity of the impure substance at an elevated temperature but only a small quantity at a low temperature.
D) It must be immiscible with water. *does not need to be*
E) It must be readily removable from the purified product.

65

35. A mixture of 3-nitroaniline, benzoic acid, and biphenyl is dissolved in ether. The solution is shaken with aqueous 3 M hydrochloric acid and the layers are allowed to separate. The major compound(s) remaining in the ether layer is/are:

- A) Benzoic acid and biphenyl
B) Benzoic acid only
C) Benzoic acid and 3-nitroaniline
D) Biphenyl only
E) 3-Nitroaniline only

HCl extracts 3-nitroaniline, leaving rest in ether

18

END OF EXAM