1. Which of the following structures represents 1R-bromo-5S-isopropyl-2R-methylcyclohexane? \boldsymbol{D}

2. The ketose, D-xylulose has two chiral carbons. One of its chiral carbons has an R configuration the other chiral carbon has an S configuration. Which Fisher projection below represents D-xylulose? \boldsymbol{D}

- 3. The reaction below is best described as: E
 - a) an addition
 - b) an elimination
 - c) a rearrangement
 - d) a substitution
 - e) a combination of a, c and b

4. Which of the following statements is true related to the five steroids given below? C

- a) Lanosterol and testosterone will react with both silver nitrate in ethanol and with sulfuric acid.
- b) 5α -Dihydrotestosterone and 5-androstene-3,17-dione will both react with sulfuric acid but neither will react with silver nitrate in ethanol.
- c) Progesterone and testosterone will both react with sulfuric acid.
- d) All five steroids will react with bromine.
- e) a & c
- 5. Penicillin G has three chiral carbons, labeled as 1,2 and 3 in the structure below. The absolute configurations of these three chiral carbons are: *C*

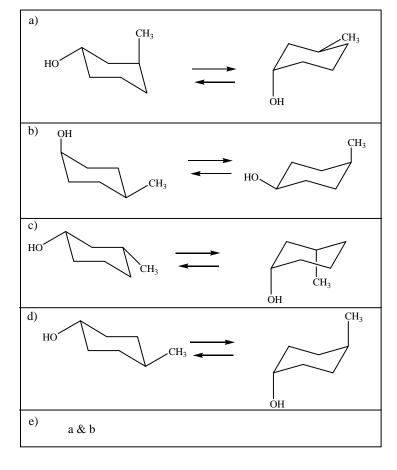
$$\begin{array}{c|c}
 & H & H \\
 & 1 & 2 \\
 & S \\
 & O & OH
\end{array}$$

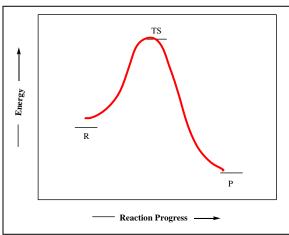
$$\begin{array}{c|c}
 & Penicillin G & O & OH
\end{array}$$

a) 1R, 2R, 3R
b) 1R, 2S, 3R
c) 1R, 2R, 3S
d) 1S, 2S, 3R
e) 1R, 2S, 3S

6. Which of the following compounds has a stereoisomer that is meso? \boldsymbol{E}

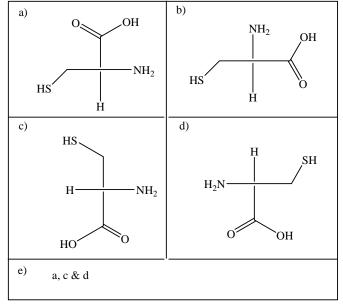
7. Which of the following transformations is represented by the reaction energy diagram at the right? ${\pmb B}$



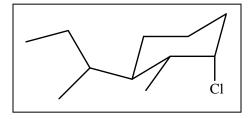


8. Which of the following Fisher projections represents the S-stereoisomer of the amino acid cysteine, given below? \boldsymbol{B}

$$\begin{array}{c} O \\ \\ NH_2 \\ \\ \textit{cysteine} \end{array}$$



- 9. The correct name of the molecule represented in the chair conformation below is: $\bf{\it B}$
 - a) 1R-sec-butyl-3R-chloro-2R-methylcyclohexane
 - b) 3R-sec-butyl-1S-chloro-2R-methylcyclohexane
 - c) 3S-sec-butyl-1R-chloro-2R-methylcyclohexane
 - d) 3R-sec-butyl-1S-chloro-2S-methylcyclohexane
 - e) 2S-methyl-3S-chloro-6S-sec-butylcyclohexane

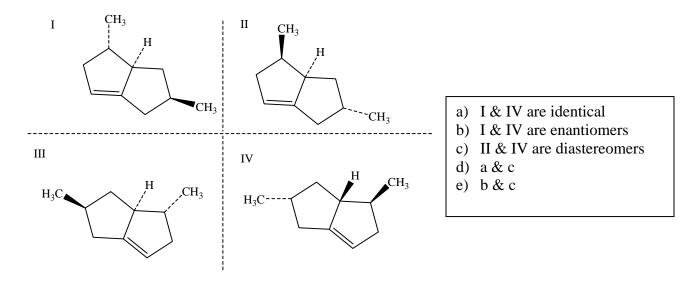


10. How many chiral carbons are in the structure of lovastatin, a cholesterol lowering drug? D

- a) 5
- b) 6 c) 7
- d) 8
- e) none

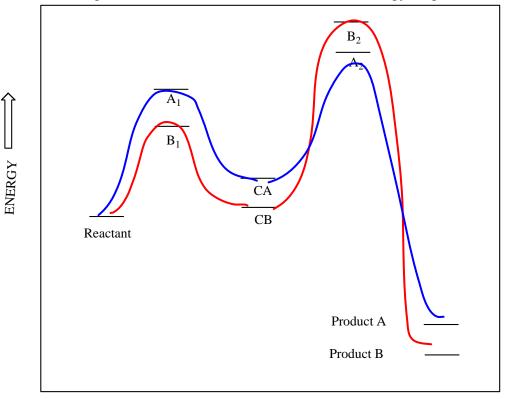
11. Methylphenidate (RITALIN) is a chiral drug sold as a racemic mixture to treat ADHD (attention deficit and hyperactivity disorder). Recently, Focalin, the *d*-isomer (R,R) of methylphenidate was approved by the FDA for treating ADHD. It has a longer duration of action and is more effective in reducing the symptoms of ADHD. Which of the following represents the racemic mixture marketed as RITALIN? **D**

12. Which best describes the stereochemical relationships among/between the compounds below? **D**



- 13. The product that forms the *fastest* in the reaction of 1-pentene with HCl is: \mathbf{B}
 - a) 1-chloropentane
 - b) 2-chloropentane
 - c) 3-chloropentane
 - d) 1,2-dichloropentane
 - e) all of these products form at the same rate

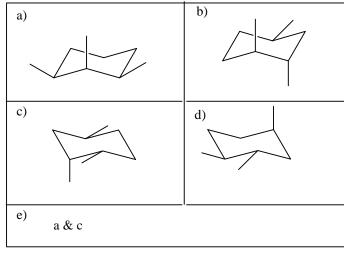
14. Which of the following statements is true related to the reaction energy diagram below? A

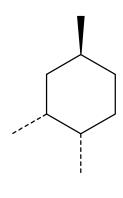


REACTION PROGRESS

- a) Step 2 is the rate-determining step of the reaction.
- b) The reaction has a positive ΔG°
- c) The equilibrium constant is less than 1.
- d) Products A and B will form equally.
- e) a & d

15. The most stable conformation of the compound given below is : ${m C}$





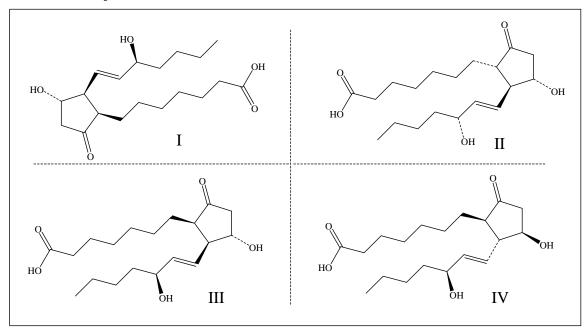
16. Reaction of the R-isomer of the 5-isopropyl-2-methylcyclohex-2-en-1-one (below) with Br_2 will provide: C

- a) a meso compound
- b) a racemic mixture
- c) a mixture of diastereomers
- d) a single stereoisomer
- e) a molecule with no chiral centers

17. A diastereomer of PGE₂, a naturally occurring prostaglandin is: A

PGE₂

- a) I & III
- b) IV & II
- c) II & III
- d) I, II, & III
- e) none of these are diastereomers



18. The percent ratio of the two conformers of *cis*-1-isopropyl-4-methylcyclohexane at 30°C is:

a) 6.36% : 93.64%

b) 23.8%: 76.2%

c) 87.1% : 12.9%

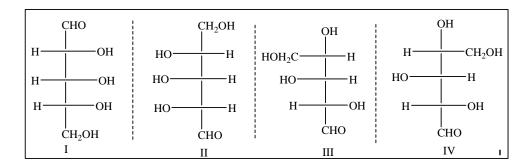
d) 11.8%: 88.2%

e) 96.8% : 3.21%

Credit given for all

e)

19. Which sugar(s) given below has (have) an L-configuration? \boldsymbol{D}



- a) I
- b) II
- c) I & II
- d) III
- e) III & IV

20. Which compound(s) will have a boiling point identical to temocapril? \boldsymbol{D}

Temocapril (antihypertensive)

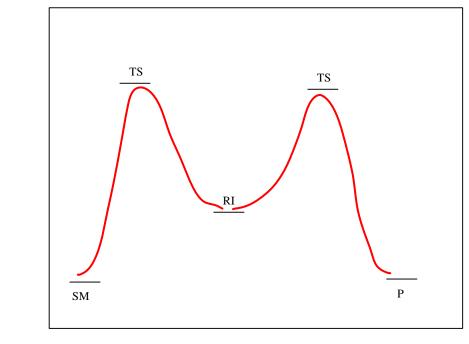
All of these will have the same boiling point as temocapril

21. Oxaceprol, an anti-inflammatory agent (given below) has an optical rotation of -116.5° . Which of the following compounds will have an optical rotation of $+116.5^{\circ}$? A

22. Lobelanine, lobelanidine and lobeline are three compounds that are used as respiratory stimulants. All of these molecules have chiral carbons. Lobelanine has three stereoisomers (one meso compound), lobelanidine has 14 stereoisomers (2 meso compounds), and lobeline has 8 stereoisomers (no meso compounds). Which of the structures below correspond to lobelanine, lobelanidine and lobeline? \boldsymbol{E}

- a) I = lobelanine II = lobelanidine III = lobeline
- b) I = lobelanidine II = lobelanine III = lobeline
- c) I = lobeline II = lobelanidine III = lobelanine
- d) I = lobelanine II = lobelanidine III = lobeline
- e) I = lobelanine II = lobeline III = lobelanidine

- 23. Assume that in a two step reaction, the rate determining step is step 2 and the reaction has a positive ΔG° . Which of the following statements is true? E
 - a) Step 2 occurs faster that step 1
 - b) The product is more stable than the reactant
 - c) There are *at least* three reaction intermediates
 - d) The reaction favors formation of the product.
 - e) The activation energy of step one is smaller than the activation energy of step 2
- 24. Four atoms are labeled A,B, C and D in the structure below. Which of these atoms would be the *most reactive with a nucleophile?* **D**
 - a) A
 - b) B
 - c) C
 - d) D
 - e) All of these atoms will react equally with a nucleophile.
- 25. Which reaction below corresponds to the reaction energy diagram given? A



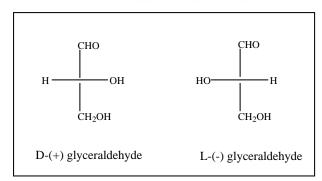
— Reaction Progress →

- a) 2-butene + HCl \rightarrow
- b) 1-butene + HCl \rightarrow
- c) 2-methylpropene + HCl →
- d) b&c
- e) none of these

USEFUL INFORMATION

Representative Representative																		
r(main group)												(main group)						
	elements									elements								
	IA																	VIIIA
	1																	2
1	н																	He
1	1.0079	IIA											IIIA	IVA	VA	VIA	VIIA	4.003
	3	4		D 1 11 T11 (d F)									5	6	7	8	9	10
2	Li	Be	Periodic Table of the Elements										В	C	N	О	F	Ne
	6.941	9.012		Transition metals									10.811	12.011	14.007	15.999	18.998	20.180
	11	12		- transition metals									13	14	15	16	17	18
3	Na	Mg	шв	IVB	VB	VIB	VIIB		VIIIB		IB	IIB	Al	Si	P	s	CI	Ar
	22.990	24.305	21	22	23	24	25	26	27	28	29	30	26.982	28.086	30.974	32.066	35.453 35	39.948 36
	K	Ca	Sc	Ti	v	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
4	39.098	40.078	44.956	47.88	50.942	51.996	54.938	55.845	58.933	58.69	63.546	65.39	69.723	72.61	74.922	78.96	79.904	83.8
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
-	85.468	87.62	88.906	91.224	92.906	95.94	98	101.07	102.906	106.42	107.868	112.411	114.82	118.71	121.76	127.60	126.905	131.29
	55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
6	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	T1	Pb	Bi	Po	At	Rn
	132.905	137.327	138.906	178.49	180.948	183.84	186.207	190.23	192.22	195.08	196.967	200.59	204.383	207.2	208.980	209	210	222
_	87	88	89	104	105	106	107	108	109	110	111	112		114		116	-	118
7	Fr 223	Ra 226.025	Ac 227.028	Rf 261	Db 262	Sg 263	Bh 262	Hs 265	Mt	Uun 269	Uuu	Uub 277						
	22.5	225,025	227.028	261	262	20.3	262	266	266	269	272	2//			1 1			
						Rare earth elements												
					58	59	60	61	62	63	64	65	66	67	68	69	70	71
		La	anthan	ides	Ce	Pr	Nd	Pm	Sm	Eu	Gd	ТЪ	Dy	Ho	Er	Tm	Yb	Lu
					140.115	140.908	144.24	145	150.36	151.964	157.25	158.925	162.5	164.93	167.26	168.934	173.04	174.967
					90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Actin				Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
					232.038	231.036	238.029	237.048	244	243	247	247	251	252	257	258	259	262

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1,3-Diaxial Interactions						
H-Methyl	0.9 kcal					
H-Ethyl	1.2 kcal					
H-isopropyl	1.6 kcal					
H-sec-butyl	1.8 kcal					
Н-ОН	1.1 kcal					
H-Cl	1.0 kcal					
Methyl-Methyl	2.8 kcal					
Methyl-Ethyl	3.1 kcal					
Methyl-isopropyl	3.5 kcal					
Methyl-sec-butyl	3.7 kcal					
Me-OH	3.0 kcal					

$$\Delta G^{\circ} = Ep - Er$$

$$\Delta G^{\circ} = -RTlnKeq$$

$$R = 0.00198 \text{ kcal/}^{\circ}Kmol$$

$${}^{\circ}K = {}^{\circ}C + 273$$