(a) \[
\begin{align*}
\text{HO} & \quad \text{CH}_3 \\
\text{BrH}_2C \quad \text{CH}_3 & \quad \text{OH} \quad \text{H}
\end{align*}
\]

(b) \[
\begin{align*}
\text{HO} & \quad \text{HOH} \\
\text{CH}_3CH_2 & \quad \text{Br}
\end{align*}
\]

(c) \[
\begin{align*}
\text{H}_3C & \quad \text{OH} \\
\text{H} & \quad \text{H} \quad \text{CH}_2Br \\
\text{H} & \quad \text{CH}_3 \\
\text{H} & 
\end{align*}
\]

(d) \[
\begin{align*}
\text{OH} & \\
\text{BrH}_2C \quad \text{CH}_3 & \\
\text{H} & \quad \text{CH}_3 \\
\text{H} & \quad \text{OH} \\
\text{H} & 
\end{align*}
\]

(e) \[
\begin{align*}
\text{Br} & \quad \text{OH} \\
\text{CH}_3CH_2 & \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{H} & 
\end{align*}
\]

(f) \[
\begin{align*}
\text{H} & \quad \text{H} \quad \text{OH} \\
\text{CH}_3CH_2Br & 
\end{align*}
\]
note the distinction between the concept of “an identical molecule” meaning the connectivity and stereoisomerism (i.e., the same name), versus the concept of a single molecule that is in an identical or a different conformation

(a) (2S,3S)-1-bromo-2-methylbutane-2,3-diol

(b) (S)-1-bromobutan-2-ol

(c) (R)-1-bromobutan-2-ol

(d) (2R,3R)-1-bromo-2-methylbutane-2,3-diol

(e) (2S,3S)-3-bromo-3-methylpentan-2-ol

(f) (S)-1-bromobutan-2-ol

same molecule and an identical conformation as letter (b):
Br/CH₂CH₃ are eclipsed
OH/H are eclipsed
H/H are eclipsed
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(a) rotate the back atom clockwise by 120°

(b) rotate the back atom clockwise by 180°

(c) rotate the front atom counterclockwise by 120°

(d) rotate the back atom counterclockwise by 60°

(e) rotate the back atom clockwise by 180°

(f) rotate the front atom clockwise by 120°
(a) none

(b) A: steric  
B: steric  
C: charge repulsion  
hydrogen bonding
C: steric

(c) A: steric

(d) A: steric  
B: charge repulsion

(e) A: steric  
B: steric

(f) A: steric  
B: steric  
C: charge repulsion  
(low if any, as the “CH₂OH” can rotate away)  
hydrogen bonding
this conformation:  
most stable  
least stable  
intermediate  
stability

this conformation:  
most stable  
least stable  
intermediate  
stability

this conformation:  
most stable  
least stable  
intermediate  
stability
(a) (S)-2-Bromo-3-methylbutane

conformation A

conformation B

conformation C

answers will vary depending on starting point and which atom is turned and its direction of turning (this show front atom clockwise)

+ 1.3 kcal/mol
+ 2.0 kcal/mol
+ 1.1 kcal/mol

gauche interaction:
CH$_3$/CH$_3$ = 0.9 kcal/mol
CH$_3$/Br = 0.2 kcal/mol

eclipsed interaction:
CH$_3$/H = 1.7 kcal/mol
CH$_3$/CH$_3$ = 2.5 kcal/mol
CH$_3$/Br = 1.8 kcal/mol
H/Br = 0.8 kcal/mol

(b)

The other activation energy (C to A) would be:
CH$_3$/Br
& H/CH$_3$
& H/CH$_3$
+ 5.2 kcal/mol
3D drawing for C1-C2 bond of 1-bromobutane that has a gauche interaction

3D drawing for C1-C2 bond of 1-bromobutane (eclipsed form during the interconversion of the two gauche forms)

3D drawing for C1-C2 bond of 1-bromobutane that has a gauche interaction, continuing from the first drawing through the eclipsed form
In compound P, the conformation shown has one gauche interaction, and the OH group can be a hydrogen bond donor with respect to the OCH$_3$ group, stabilizing that conformation.

In compounds Q, which is stated as having a different relationship between the oxygen atoms, there is also one gauche interaction, but the two oxygen atoms are now anti because deprotonation of the OH removes the option of creating the stabilizing hydrogen bond.
(a) 

Conformation L1 

\[
\text{gauche} = 1.1 \text{ kcal/mol}
\]

less stable form 

Conformation L2 

\[
\text{gauche} = 0.5 \text{ kcal/mol}
\]

more stable form 

(b) 

more stable on the right 

\[ K_{\text{EQ}} \text{ predicted to be } > 1 \]

\[ \Delta G^\circ < 0 \]

\[ \Delta G^\circ = 0.5 - 1.1 = -0.6 \text{ kcal/mol} \]