2-32
(a) \[ \text{cis} \]
(b) The coplanar atoms in the structures to the left and below are marked with asterisks.

(c) trans
There are still six coplanar atoms.

2-33 Collinear atoms are marked with asterisks.

2-34
(a) no cis-trans isomerism
(b) \[ \text{H}_2\text{C} = \text{C} - \text{CH}_3 \] and \[ \text{H}_2\text{C} = \text{C} - \text{H} \]
(c) no cis-trans isomerism
(d) Theoretically, cyclopentene could show cis-trans isomerism. In reality, the trans form is too unstable to exist because of the necessity of stretched bonds and deformed bond angles. trans-Cyclopentene has never been detected.

\[ \text{cis} \]
\[ \text{trans} - \text{not possible because of ring strain} \]

(e) \[ \text{H} \text{CH}_3 \text{CH}_2 \text{CH}_3 \text{C} = \text{C} - \text{CH}_2 \text{CH}_3 \text{CH}_3 \]
and \[ \text{H} \text{CH}_3 \text{CH}_2 \text{CH}_3 \text{C} = \text{C} - \text{CH}_2 \text{CH}_3 \text{CH}_3 \]
these are cis-trans isomers, but the designation of cis and trans to specific structures is not defined because of four different groups on the double bond
2-35
(a) constitutional isomers— the carbon skeletons are different
(b) constitutional isomers— the position of the chlorine atom has changed
(c) cis-trans isomers— the first is cis, the second is trans
(d) constitutional isomers— the carbon skeletons are different
(e) cis-trans isomers— the first is trans, the second is cis
(f) same compound— rotation of the first structure gives the second
(g) cis-trans isomers— the first is cis, the second is trans
(h) constitutional isomers— the position of the double bond relative to the ketone has changed (while it is true that the first double bond is cis and the second is trans, in order to have cis-trans isomers, the rest of the structure must be identical)

2-36 CO₂ is linear; its bond dipoles cancel, so it has no net dipole. SO₂ is bent, so its bond dipoles do not cancel.

\[
\text{net dipole moment} = 0
\]

2-37 Some magnitudes of dipole moments are difficult to predict; however, the direction of the dipole should be straightforward in most cases. Actual values of molecular dipole moments are given in parentheses. (The C—H bond is usually considered non-polar.)

(a) [Diagrams showing different dipole moments]

(b) [Diagram showing a large dipole moment (3.96)]

(c) [Diagram showing net dipole moment = 0; electron pairs on bromines are not shown]

(d) [Diagram showing a large dipole moment (2.89)]

(e) [Diagram showing a net dipole moment = 0]

(f) [Diagram showing a moderate dipole moment]

(g) [Diagram showing electron pairs on chlorine are not shown]