TL 9-11 (Bonding mechanisms)

What bonding mechanism is expected for

a) KCl molecule. From tab 9-3, the equilibrium separation is 0.267nm.

So if it was an ionic bond, then

$$P_{ion} = er_o = (1.6e\text{-}19)(0.267nm) = 4.278e^{-29}\ C\text{-}m$$

The measured dipole moment is

$$P_{meas} = 3.336e\text{-}29\ C\text{-}m$$

So KCl is $\boxed{\frac{P_m}{P_i} = 0.78}$ 78% ionic

b) O_2 molecule

Since this is symmetric, it has no electric dipole moment.

It is purely covalent

c) CH_4 molecule

Methane is in a tetrahedral structure. So one would assume it to have zero electric dipole moment. Nonetheless, a 1971 paper by Irvin Ozier claims to have measured an electric dipole moment of CH_4 in its ground vibronic state to be $(5.38 \pm 0.01) \times 10^{-6}$ Debyes, where 1 Debye = 3.336×10^{-30} Cm. This is ostensibly caused by "centrifugal distortion effects". Ozier, I (1971). PRL 27(20), 1329–1332. doi: 10.1103/physrevlett.27.1329