

1. a) 1

b) This reaction will be slower than the other reactions that only involve reactants in the gas phase, but not slower than those that involve reactants in the liquid or solid phase.

c) 3, 1, 4, 2.

3. Reaction c), because the reactants are aqueous ions. In this case, the reactions occur almost instantaneously.

4. a), d), c), b).

Reaction a) will be the fastest reaction, since it involves aqueous ions, while reaction b) will be slower, since it is a heterogeneous reaction in which the reactants are in two different phases. Reactions c) and d) will have rates intermediate to those of reactions a) and b). Reactions c) and d) both occur in the gas phase, but reaction c) has more bonds to break, therefore it will be slower than reaction d).

5. a) Reaction 1):

$$\Delta H_{\text{reactants}} = E_{\text{H-H}} + E_{\text{Cl-Cl}} = 436 \text{ kJ/mol} + 243 \text{ kJ/mol} = 679 \text{ kJ/mol}$$

Reaction 2):

$$\begin{aligned} \Delta H_{\text{reactants}} &= E_{\text{H-H}} + \left(\frac{1}{2} \cdot E_{\text{O-O}}\right) \\ &= 436 \text{ kJ/mol} + \left(\frac{1}{2} \cdot 498 \text{ kJ/mol}\right) \\ &= 685 \text{ kJ/mol} \end{aligned}$$

b) Reaction 2, since the energy of the bonds to be broken is slightly greater.

7. Given that the oil is in liquid form, the reaction with the oxygen (O<sub>2</sub>) in the air occurs more rapidly because the velocity of the particles is greater in liquid form than in solid form.