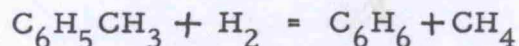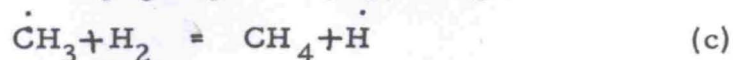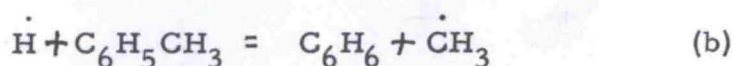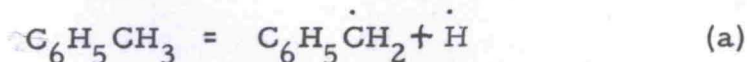For instance, benzene is obtained from toluene at a 90% yield. Previously
it was thought that this is a bimolecular process:

$$C_6H_5CH_3 + H_2 = C_6H_6 + CH_4$$

However, studies at the Organic Chemistry Institute of the USSR Academy
of Sciences have shown that for a wide range of pressures (up to 1350 atm)
this is actually a complex radical-chain mechanism including the following
steps:

$$C_6H_5CH_3 = C_6H_5\overset{\cdot}{C}H_2 + \overset{\cdot}{H} \qquad \text{(a)}$$

$$\overset{\cdot}{H} + C_6H_5CH_3 = C_6H_6 + \overset{\cdot}{C}H_3 \qquad \text{(b)}$$

$$\overset{\cdot}{C}H_3 + H_2 = CH_4 + \overset{\cdot}{H} \qquad \text{(c)}$$

Reaction (a) -the rupture of the weakest bond in toluene- is the
source of atomic hydrogen which interacts with a second toluene molecule
in reaction (b) forming a new radical which sustains the chain mechanism
in reaction (c). Most intersting is reaction (b) in which a hydrogen atom
extracts the CH_3 radical from toluene.

A mechanism including an analogous step was proposed for the ho-
mogeneous destructive hydrogenation of other alkylbenzenes. In accordance
with this mechanism one may expect that increased hydrogen pressure will
bring to an accelerated cleaving of the alkyl group from the benzene nucleus.
This was confirmed in isopropylbenzene: increasing the pressure from 200
to 600 atm (at 475°), the propane content of the hydrocarbon products inc-
reased from 21 to 59%.

As the pressure increases the rate of the gas phase reaction gradu-
ally deviates from calculated rates obtained from kinetic expressions der-
ived for normal pressures. The classical theory of activated collisions ex-
plains this deviation on the basis of the decreasing free mean path between
colliding molecules with increasing pressure until it becomes proportional