1) If it is going to be a radical chain reaction, need to be certain that we provide a good chain reaction. Using ultraviolet light, here is a possibility:

Initiation:

\[ \text{Cl} - \text{O}_2\text{Cl} \xrightarrow{hv} \text{Cl} - \text{SO}_2\text{Cl} + \text{Cl}^\bullet \xrightarrow{} \text{SO}_2 + \text{Cl}^\bullet \]  
(need this step to account for role of chemical initiator.)

Propagation:

i)  
\[ \text{H} \quad \text{Cl}^\bullet \quad \text{Cl} \xrightarrow{} \text{X} + \text{HCl} \]

ii)  
\[ \text{Cl} - \text{SO}_2\text{Cl} \xrightarrow{} \text{X} + \text{SO}_2\text{Cl} \]  
(this intermediate again fragments like the second initiation step above.)

2) We are asked to find all possible products for the following reaction: (amazing how a chemical equation can still help clarify a problem!)

\[ \text{HBr} \xrightarrow{\text{peroxides}} \]

From the presence of peroxides, we know we are dealing with ‘anti-Markovnikov’ addition; therefore, we should expect the following products (radical intermediates, as requested, are also shown)
Of these, the 3° allylic radical shown is the most stable, and leads to the preferred product.
3) Well, this question was really poor. One of the ratios got inverted, so that made the problem more difficult. It should have said the DCl/HCl ratio is the same as the (CH₃)₃CCl/(CH₃)₃CDCH₂Cl ratio. With that correction, here is the logic. Every H atom abstraction yields an intermediate radical with a deuterium atom, and a primary radical site; this primary radical site leads to the deuteroisobutylchloride product. Similarly, every D atom abstraction yields the tertiary radical with no deuterium, which leads to the tert-butylchloride product. There is no way I can see to rationalize (and utilize) the data given. Sorry.

4a) NBS/CCl₄
2) NaCN/DMF

b) Br₂
hν
Br
(CH₃)₃CO-K⁺
(CH₃)₃COH
1) O₃
2) H₂O₂/H₂O⁺
6) Simply to give answers may not be as instructive as to redraw things more suggestively; thus, I will do this latter piece.
7) The answer becomes relatively easy to see if you can rotate the product molecule in 3-space (in your mind) and see where some of the groups might arise. To do ‘retro-synthetic analysis’ verbally: the two aldehyde groups almost certainly arise from ozonolysis under reductive conditions which requires a bicycle[2.2.1]heptane system; systems like these can easily arise from cyclopentadienes via Diels-Alder chemistry with an appropriate dienophile. Here we are in a scheme: