Compare and contrast gas phase and surface/catalytic reactions

	Gas phase	catalytic reactions
Kinetics	1. Usually simple overall rate law (first order, second order, half order) 2. Often first order 3. Usually follows Arrhenius's law or Perin's equation	4. Usually complex kinetics 5. often zero order 6. sometimes negative order 7. curved arrhenius plots 8. Individual steps follow arrhenius' law 9. Overall does not follow arrhenius's law
Mechanisms	10. Initiation propagation mechanism 11. Reactive species are radicals 12. Reaction occur throughout the phase 13. Usually only single radicals 14. Initiation step - bond in reactants break 15. Propagation steps where radicals products form 16. Require a catalytic cycle 17. Require low barriers 18. Ea < 0.15T for initiation 19. Ea < 0.07 T for propagation 20. Usually Termination	21. Initiation propagation mechanism 22. Reactive species are radicals bound to surfaces 23. Reactions occur only near the catalyst 24. Can be di or tri-radicals 25. Initiation step - create an active site 26. Propagation steps where radicals products form 27. Require a catalytic cycle 28. Require low barriers 29. Ea < 0.15T for initiation 30. Ea < 0.07 T for propagation 31. No Termination needed
Relative rates	32. Low rates except at high temperatures 33. Low selectivity	34. Much higher rates (10^10 to 10^40 higher) 35. Much higher selectivity's 36. Possible to form different products (because of di radicals)
Activation barriers	37. High 38. Often determined by initiation step 39. Can estimate with Polayni equation of Blowers-Masel 40. Eao=1 for initiation 41. Eao=12 for atom transfer 42. Eao=45 for ligand transfer to hydrogen 43. Eao=50 for ligand transfer to hydrogen	44. Low 45. Usually determined by propagation steps 46. Can estimate with Blowers-Masel 47. Polayni usually does not work 48. Eao=1 for initiation 49. Eao=12 for atom transfer 50. Eao=45 for ligand transfer to hydrogen 51. Eao=50 for ligand transfer to hydrogen 52. Extra 15 kcal/mole for proximity effect.