# Chemical comparisons

## Target level
This resource is a set of probes for use across the 11–19 age range.

## Topic
These materials are designed to be open-ended. Although individual probes may be selected to match teaching topics, the materials may also be used to as a way of exploring the extent of students' ideas at various stages of a course.

## Rationale
The materials ask students to suggest similarities and differences between various pairs of chemical systems presented as simple diagrams. This is one way of exploring a student's repertoire of chemical ideas - and although the focus is on what students can suggest, the exercise can provide evidence of glaring omissions as well as of alternative conceptions. The activity provides an opportunity for students to undertake a task with no single 'right' answer (although teachers will identify certain responses, they would expect students to make at different ages), and thus provides scope for students to demonstrate creativity and lateral thinking. Students are also given the opportunity to indicate which responses they feel are important to chemistry to allow them to distinguish significant from trivial comparisons. These ideas are discussed in Chapter 2 of the Teachers' notes.
Teachers may find their students providing only one or two responses. This is discussed in Chapter 7 of the Teachers' notes. During piloting it was found that the probes revealed deeply held alternative conceptions, and revealed areas where students were confused. Students tended to find the activity challenging (perhaps indicating that students are more familiar with closed questions in science), but it provided a basis for valuable discussion. The activity was considered useful.

## Instructions
The teacher should select one or more probes suitable for the age and knowledge base of the group. The probes may be set as individual work, or as the focus for group discussion. Probes 1–20 may be more suitable for pre-16 work.

## Resources
_ Student worksheets
– Chemical comparisons
The worksheets invite comparison between:
**1.** Iron and sulfur
**2.** Water and sugar solution
**3.** Sea water and mercury
**4.** Particle models of gas and liquid
**5.** Particle model of liquid and particle model of solid
**6.** Salt crystal and sulfur crystal
**7.** Ionic models of silver chloride and sodium chloride
**8.** Particle models of solid sodium chloride and sodium chloride solution
**9.** Bonding in carbon (diamond) and sulfur
**10.** Structural formulae of ethanoic acid and carbon dioxide
**11.** Formulae of sulfur and copper(II) sulfate
**12.** Electron shell model of fluorine and formula of hydrogen fluoride
**13.** Particle models of water and helium

**14.** Particle models of iron and sodium chloride
**15.** Models of bonding in carbon (diamond) and silver nitrate
**16.** Electron shell models of a sodium atom and a fluorine atom
**17.** Electron shell models of a hydrogen molecule and a hydrogen atom
**18.** Particle models of solid iodine and nitrogen gas
**19.** Particle models of iron and copper
**20.** Particle models of iodine and magnesium oxide
**21.** Electron cloud and electron shell models
**22.** Structural formula and electron cloud models
**23.** Different structural formulae (inorganic)
**24.** Different structural formulae (organic)
**25.** Electron cloud and structural formulae
**26.** Electron pair and free-radical mechanisms
**27.** Two electron cloud models
**28.** Reaction profiles for endothermic and exothermic reactions
**29.** Structural formulae of ketone and alkenal
**30.** Stereochemistry of $PF_5$ and $CuCl_4^{2-}$
**31.** Bonding of $CF_4$ and sterochemistry of $CH_4$
**32.** Structural formulae of halogenoalkanes
**33.** Electron shell diagrams for $CF_4$ and $F_2$
**34.** Displayed formulae for benzene and cyclohexene
**35.** Electron cloud diagrams for $NH_3$ and $BCl_3$
**36.** Structural formulae of ethanoic acid and ethanoic acid dimer

## Feedback for students

It may be useful to make OHP transparency copies of the probes used as a basis for discussing the comparisons with the class. Discussion should be based around sharing ideas rather than simply judging responses are correct or incorrect. It is suggested that all valid comparisons should be encouraged, but that those relating to key curriculum ideas should be emphasised.

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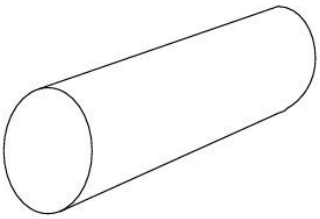
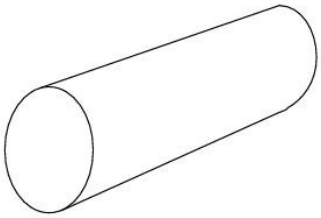


Iron



Sulfur

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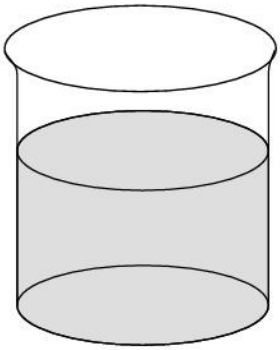
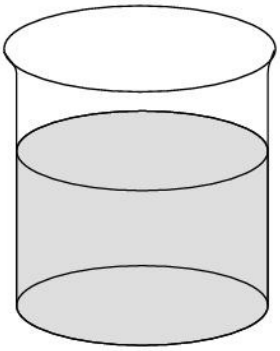


Water



Sugar solution

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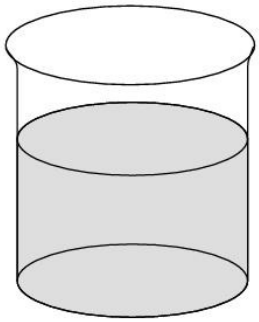
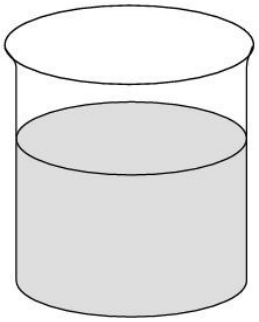


Sea water



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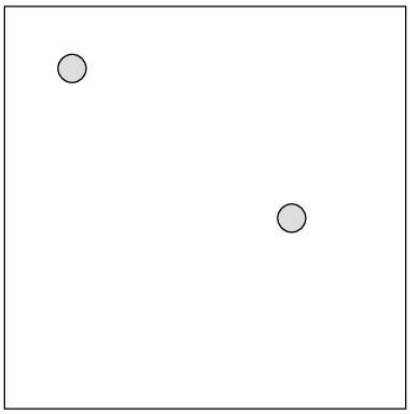

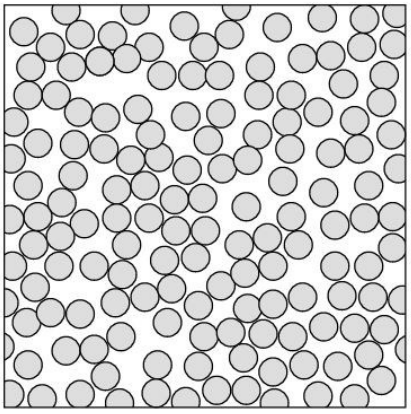

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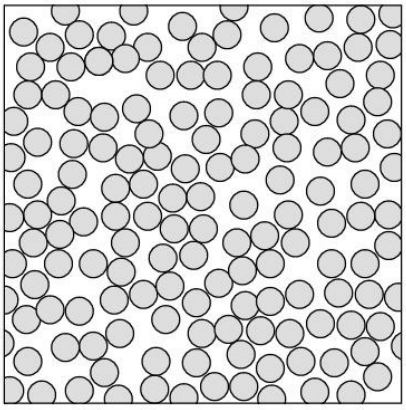

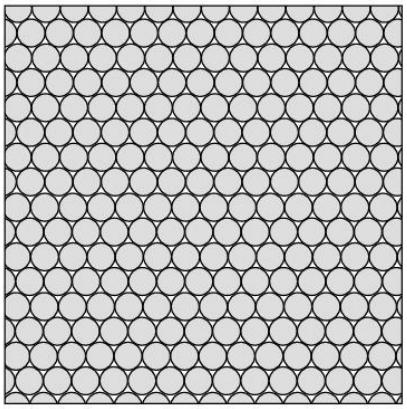

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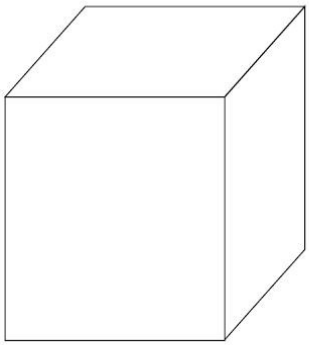
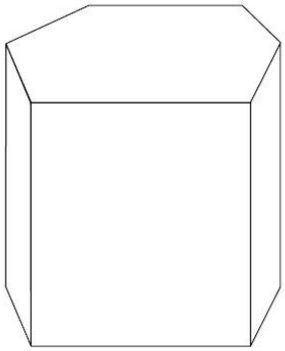


Salt crystal



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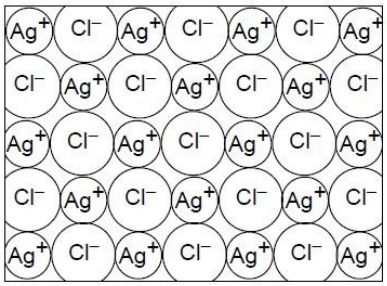


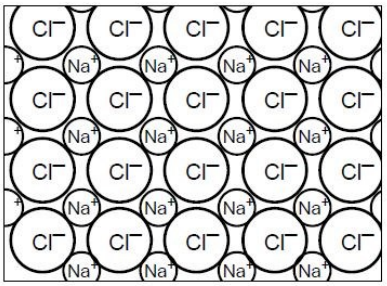


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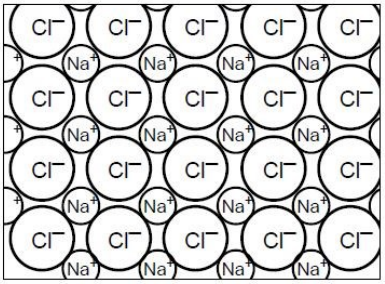


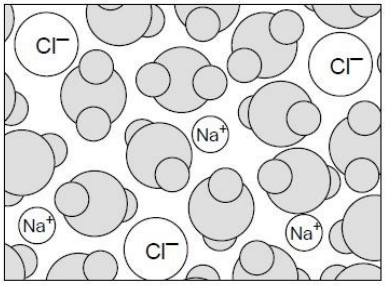


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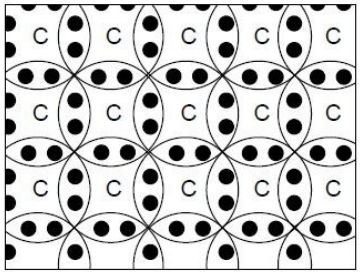


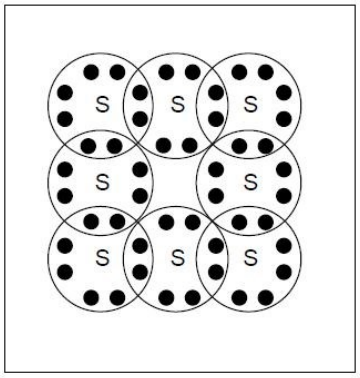


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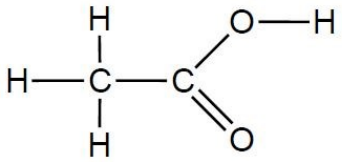



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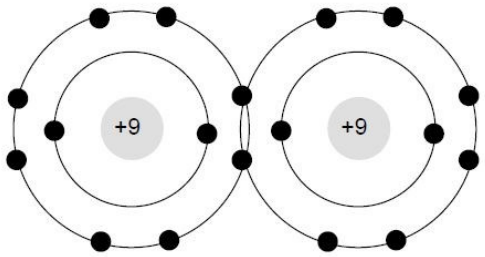


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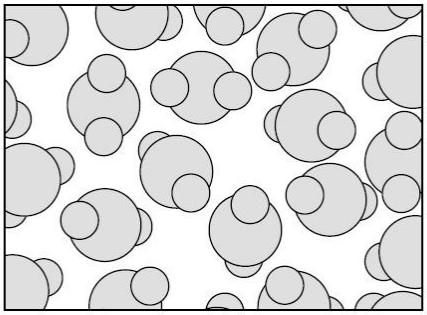

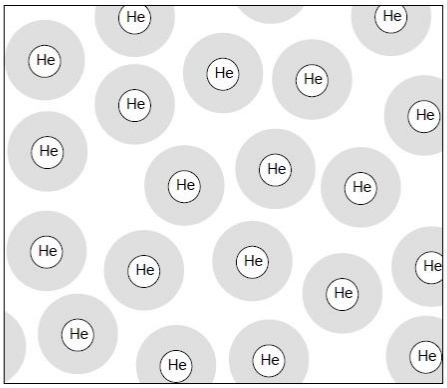


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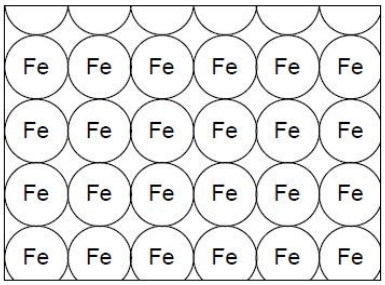


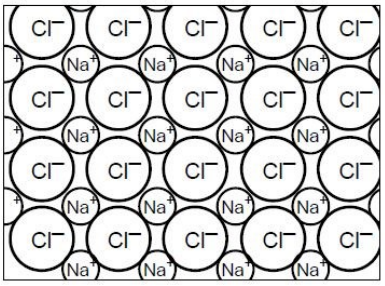


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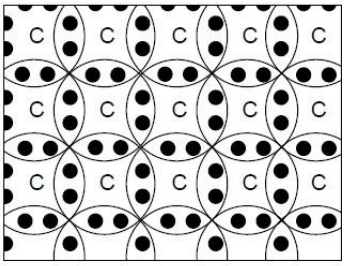


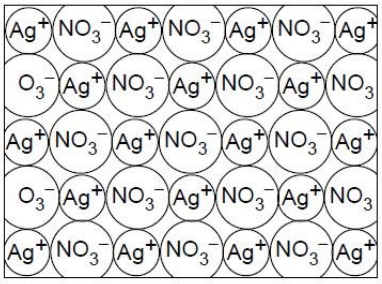


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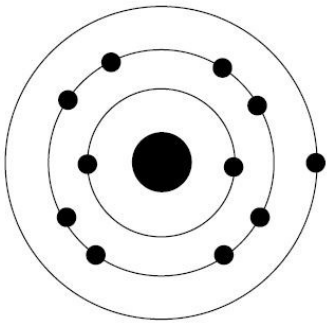
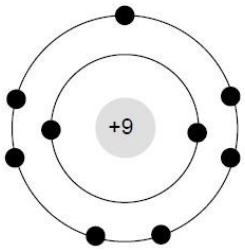


Sodium atom

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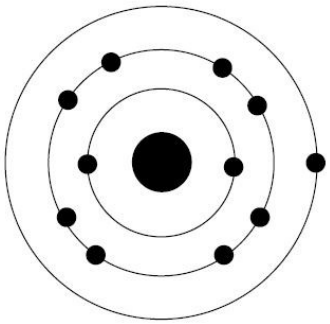

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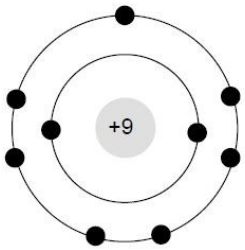


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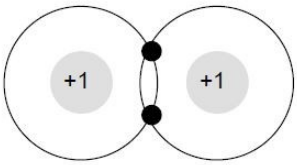
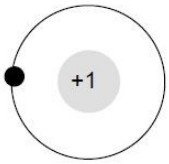



Hydrogen molecule

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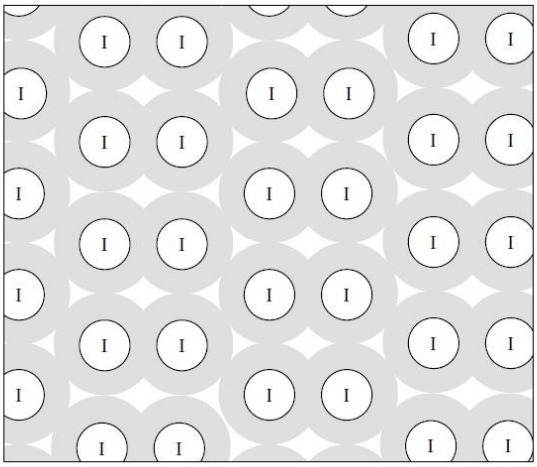


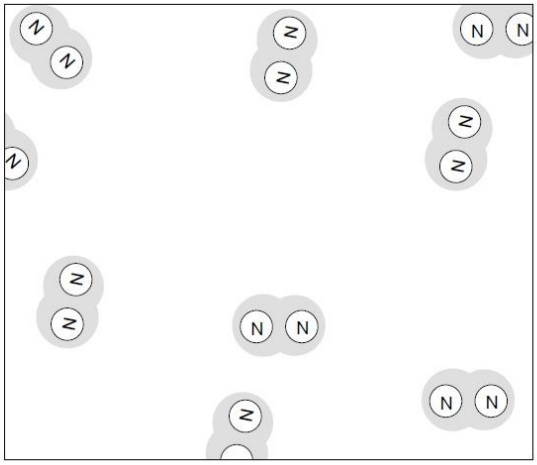


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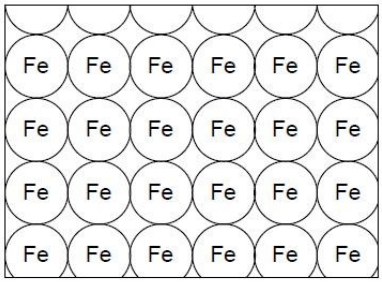


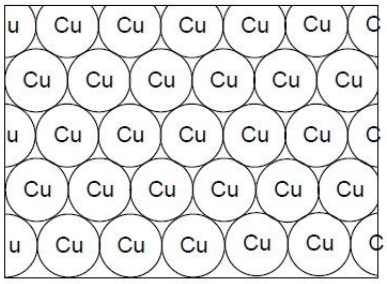


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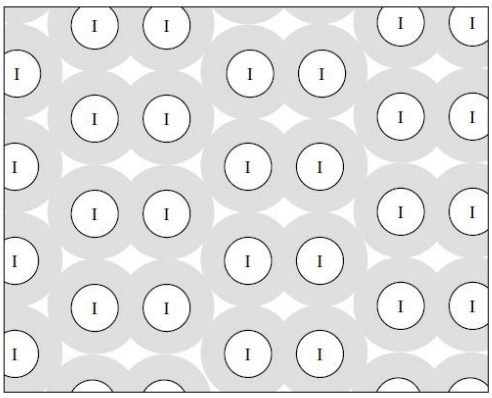


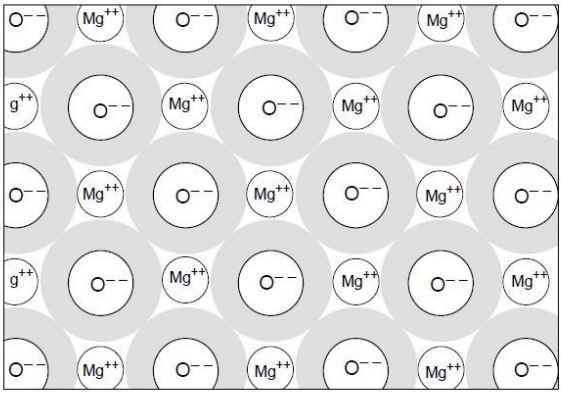


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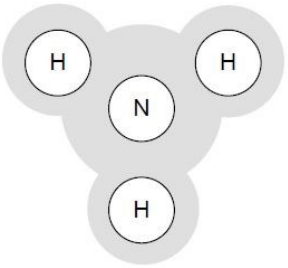
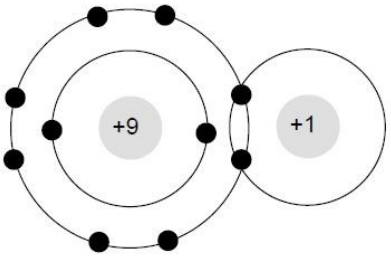



Ammonia molecule




Hydrogen fluoride molecule

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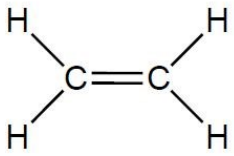


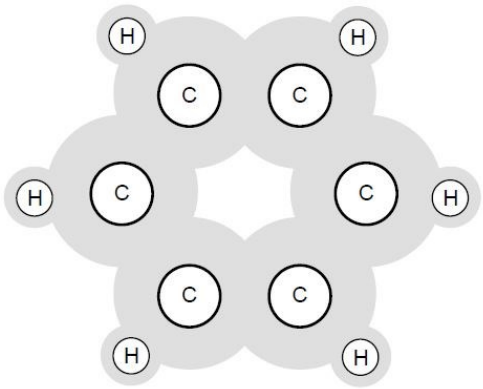


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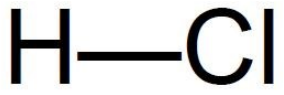


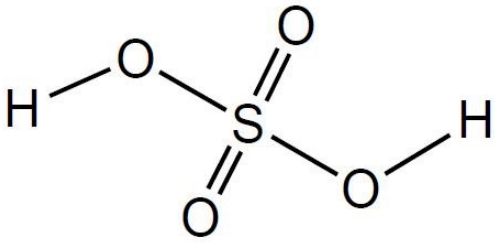


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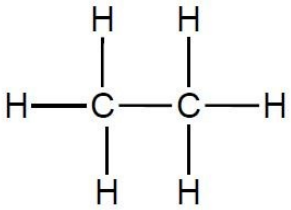


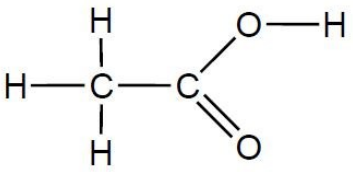


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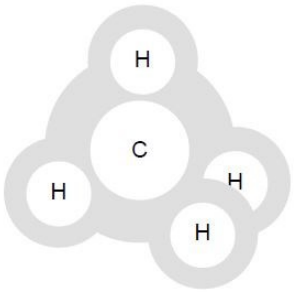


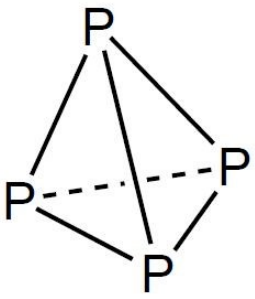


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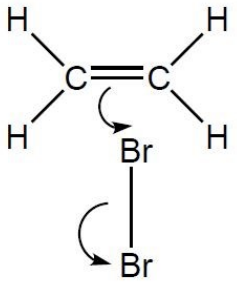


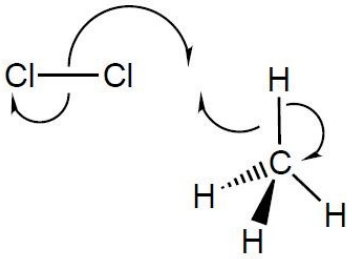


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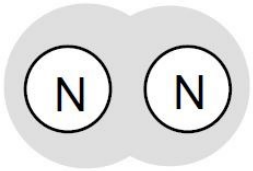


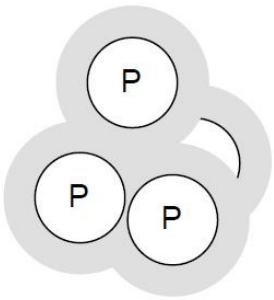


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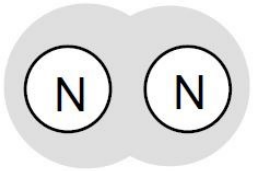


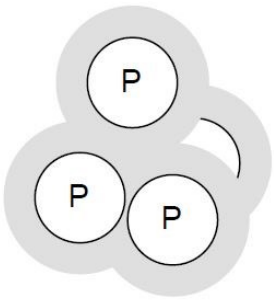


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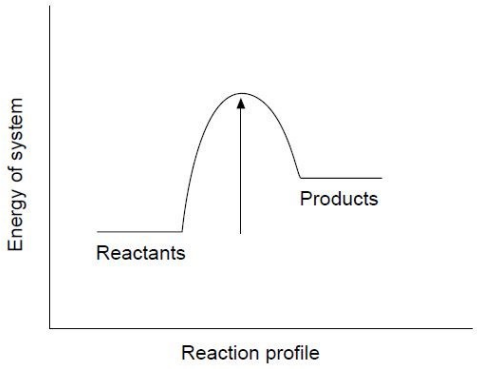


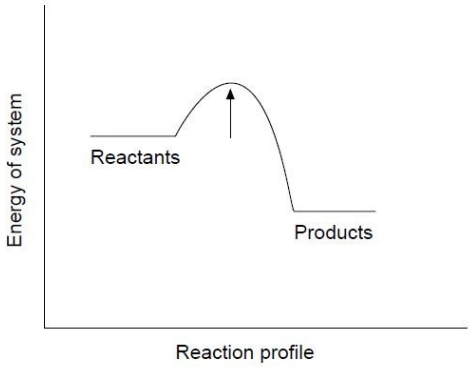


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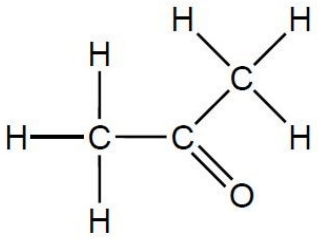


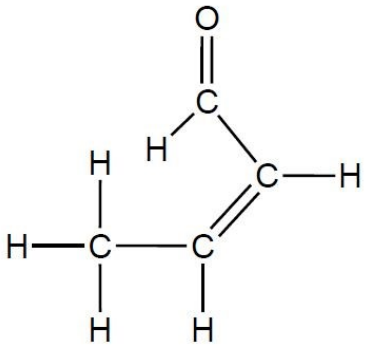


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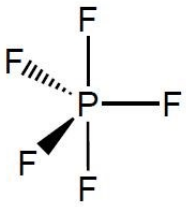


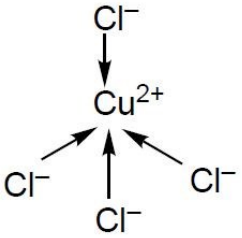


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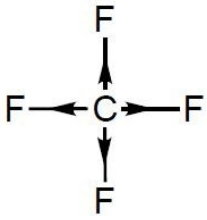


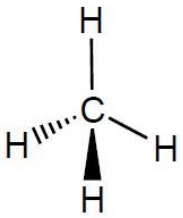


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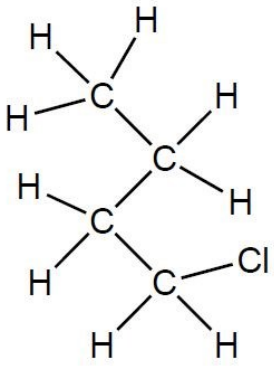


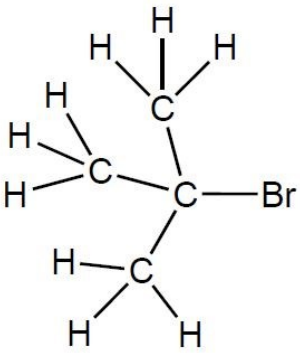


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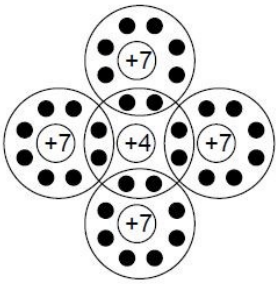


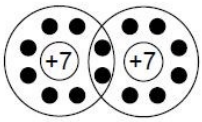


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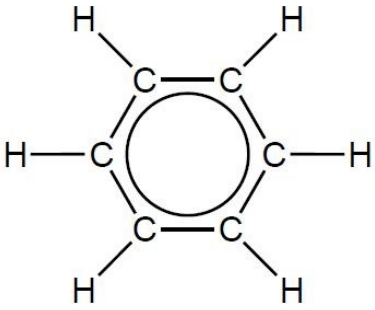


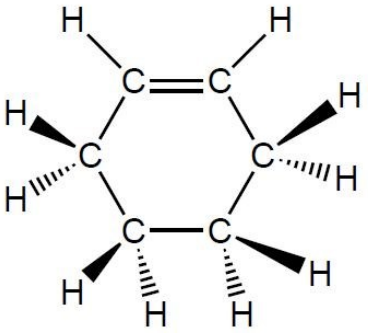


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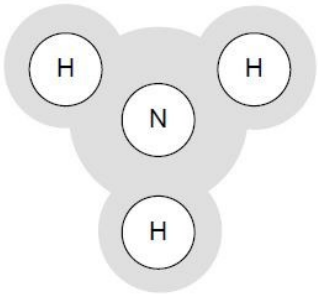


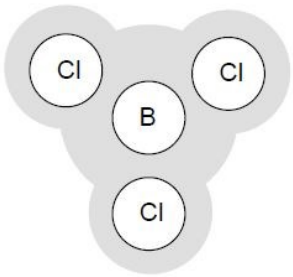


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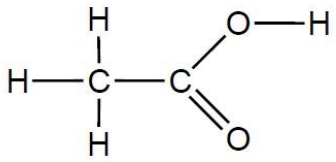

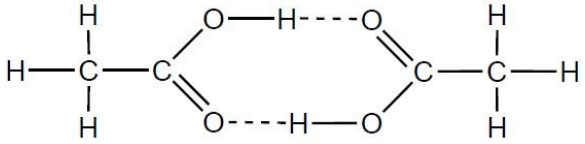

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