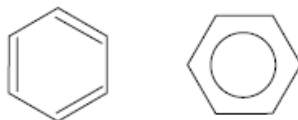


Unit 5 - activity

- 17 Benzene can be represented by either a cyclic triene or with a delocalised ring of electrons.



- *(a) Discuss the evidence, including one example from each of spectroscopy, thermochemistry and the type of reaction normally undergone, that supports the view that the better representation of benzene is with a delocalised ring of electrons.

(6)

Question number	Answer	Additional Guidance
17(a) Cont.	<p>Indicative content:</p> <p>Spectroscopy: (IP 1 and 2) either X-ray diffraction</p> <ul style="list-style-type: none"> all C-C bond lengths in benzene are equal but if it was a cyclic triene then they would alternate in 'short' and 'long' lengths <p>or</p> <p>which is consistent with equivalent C-C bonds with a delocalised ring of electrons</p> <p>or (infrared spectroscopy)</p> <ul style="list-style-type: none"> benzene has peaks at 1600, 1580, 1500, 1450 (cm^{-1}) for an aromatic C=C alkene C=C has a peak at 1669 - 1645 (cm^{-1}). <p>Thermochemistry: (IP 3 and 4)</p> <ul style="list-style-type: none"> enthalpy of hydrogenation is less exothermic than expected for a cyclic triene or enthalpy of combustion data which is consistent with the delocalisation stability of the ring from the ring of electrons <p>Type of reaction: (IP 5 and 6)</p> <ul style="list-style-type: none"> benzene undergoes substitution reactions alkenes undergo addition reactions/decolourise bromine water. 	<p>Ignore references to equal/120° bond angles</p> <p>Allow for one indicative point The infrared spectrum for benzene has a peak for an aromatic C=C at a different wavenumber/absorption/frequency to an alkene C=C</p> <p>Allow benzene is more stable by $\sim 150 \text{ kJ mol}^{-1}$</p> <p>Stated enthalpies (of hydrogenation) ~ 205 to $\sim 210 \text{ kJ mol}^{-1}$ for benzene and $\sim 360 \text{ kJ mol}^{-1}$ for 3 (localised C=C) double bonds</p> <p>Allow di-substitution There are only 3 isomers of di-substituted compounds (not 4) or some di-substituted compounds are the same, e.g. 1,2 and 1,6</p>