

1. Advantages:

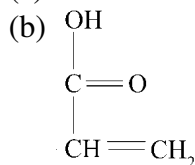
- usually have a long life
- cheaper and less dense (lighter) than glass so is a useful alternative
- cheaper and less dense than metal and do not corrode
- useful as a replacement for cotton and wool in textiles and carpets

Disadvantages:

- susceptible to degradation by UV light
- mostly only useful at very low temperatures
- litter problems due to low biodegradability
- hard to separate filler from polymer therefore hard to recycle
- burning can lead to toxic products on decomposition

2.

(a) Addition



3.

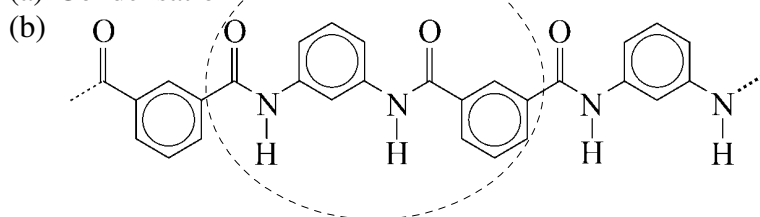
(a) C=C bond (alkene group)

(b)

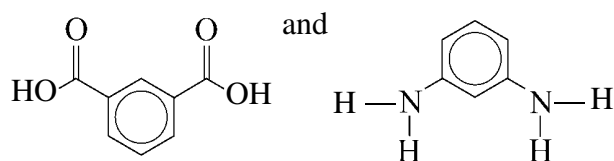
- (i) rigidity / elasticity / hardness / durability / brittleness
 (ii) The strong covalent bonds between polymer chains mean they (can no longer slide past each other / require more energy to separate)

4.

(a) Condensation



(c)



(d) Polyamide, as it contains amide links (double bonded O and an N-H bond)

(e) A filler improves the properties of a polymer such as flexibility (or reduces cost of production).
 A filler can make the polymer more difficult to recycle.

5.

- (i) Dispersion forces exist between non-polar side groups and main chain links. Polymers containing only dispersion forces between chains will be soft, flexible and non-elastic.
 (ii) Hydrogen bonding exists between chains that have O-H, N-H and/or C=O bonding. Polymers with more hydrogen bonding will be stronger, more rigid and more elastic.
 (iii) Covalent bonding between polymer chains are cross-links, and extensive cross-links will lead to a three dimensional network structure. The more cross-links, the more hardness, rigidity, brittleness and durability.

6. Thermoplastics (have only dispersion forces and hydrogen bonds between chains, so they) will soften when heated and return to their original condition when cooled. They are suited to recycling. Thermosets (have highly cross-linked network structures and) will not soften when heated. For this reason they are very difficult to recycle.