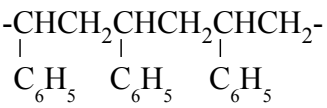
ALKENES: POLYMERISATION

1. a) $CH_2=CHCN$

   (If you have drawn the fully displayed structure, that's fine. In that case, though, you probably ought to show the triple bond between the carbon and nitrogen atoms.)

   b) 

2. a) Branching stops the chains lying so close together and so weakens the effectiveness of van der Waals intermolecular attractions. That means that LDPE will have a melting point that is lower than that of HDPE.

   b) This is again the effect of the branching affecting the intermolecular attractions. LDPE won't be as strong as HDPE because the forces holding the structure together are weaker. LDPE is used for sheet materials like plastic bags because it is more flexible. HDPE is used where greater rigidity is needed, such as plastic milk bottles and washing-up bowls.

   c) Because the molecules can't lie as closely together in LDPE, there will be wasted space within the structure, and so the density will be lower.

3. a) The diagram shows all the CH_3 groups coming out towards you. This tidy arrangement helps the chains to pack better, and so increases the effectiveness of the van der Waals forces. This leads to a fairly strong plastic.

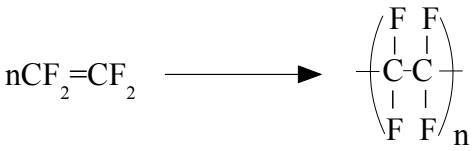
   b) The randomness of the way the CH_3 groups are arranged makes it impossible for the chains to lie so closely together, and so the effect of the intermolecular forces is weakened. Atactic poly(propene) is much softer and has a lower melting point.

4. a) "Amorphous" literally means "without shape". PVC mostly has the polymer molecules jumbled up in a random way. If the molecules were aligned in a regular pattern, lying tidily next door to each other, that would be described as "crystalline".

   b) In a very amorphous structure, van der Waals dispersion forces aren't very effective, and so you might expect the plastic to be soft and flexible. But because of the electronegativity of chlorine, there are dipole-dipole attractions as well as dispersion forces. These extra forces add to the intermolecular attractions, and make the PVC hard and rigid.

   c) Plasticisers work by interfering with, and weakening, the dipole-dipole attractions, and so make the PVC softer and more flexible. The more plasticiser you add, the greater the effect.

5. a)



(When you draw the repeating unit in this way, the extension bonds at either end must pass through the brackets, not stop short inside them.)

b) high melting point – use as a coating on frying pans, for example

resistant to chemical attack – uses in the chemical and food industries as coating on vessels

non-stick – uses as coatings on cooking utensils, and garden tools

low coefficient of friction – uses in low friction bearings