

## CHEMISTRY VCE UNITS 1&2 DIAGNOSTIC TOPIC TESTS 2007

### TEST 4: HYDROCARBONS AND POLYMERS

#### SUGGESTED SOLUTIONS AND MARKING SCHEME

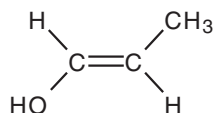
#### SECTION A: MULTIPLE-CHOICE QUESTIONS

##### Question 1      A

Neither structure shows a C–C double bond, so the answer is not **D**. The molecular formula of both compounds is  $C_7H_{16}$ , so the answer must be **A** or **B**. Isomers have different structures, but the diagrams shown are both representations of the same molecule (2,4-dimethylpentane) so the answer is not **B**.

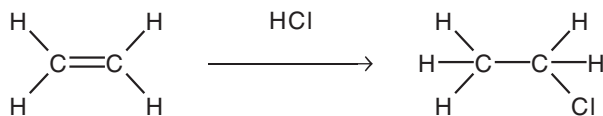
##### Question 2      C

This is an addition polymer, so look for the repeating unit. The monomer is therefore as shown below. Note that monomers may be reversed during the polymerisation process. Alternative **A** shows two monomers joined together.



##### Question 3      B

The relevant equation is:



The HCl adds across the double bond, removing it.

##### Question 4      B

The molecule shown is a branched isomer of hexane. Branching lowers the boiling point, so the physical properties of this hydrocarbon and hexane will not be the same. Therefore **B** is an incorrect statement and so it is the required response. The statements **A**, **C**, and **D** are correct.

**Question 5 D**

Alkenes are more reactive due to the presence of the double bond, so **A** is not correct. The bond angle in ethane ( $109^\circ$ ) is less than the bond angle in ethene ( $120^\circ$ ), so **B** is not correct. The extensive branching in LDPE leads to a lower melting point, as polymer chains do not align well, so **C** is not correct. LDPE is highly branched and HDPE is not, so **D** is correct.

**Question 6 A**

A small amount of cross linking leads to some elasticity in the polymer. Tyre tubing has this property, while bowling balls, glass-substitute perspex and coffee cups do not.

**Question 7 D**

$C_nH_{2n+2}$  is the formula for alkanes, so IV ( $C_5H_{12}$ ) is correct. I is  $C_3H_4$ , II is  $C_2H_4$  and III is  $C_3H_6$ .

**Question 8 C**

The correctly balanced equation is:  $2C_3H_6(g) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(g)$ .

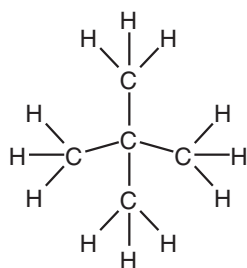
**Question 9 A**

I ( $C_3H_4$ ) contains a C–C triple bond, giving a bond angle of  $180^\circ$ . The relevant angles in II and III are  $120^\circ$ , and in IV,  $109^\circ$ .

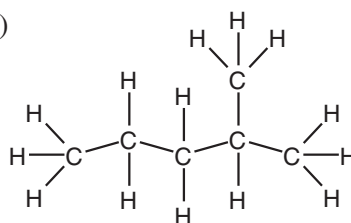
**Question 10 C**

For **A** and **D**, simply count the atoms to show that both have the molecular formula  $C_5H_{12}$  (i.e. they are isomers of  $C_5H_{12}$ ). For **B** and **C**, draw the structures.

**B** ( $C_5H_{12}$ )



**C** ( $C_6H_{14}$ )

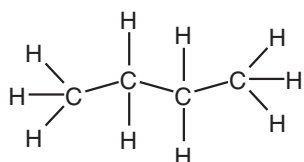


2-methylpentane has the molecular formula  $C_6H_{14}$ , and so it is the required response (i.e. it is not  $C_5H_{12}$ ).

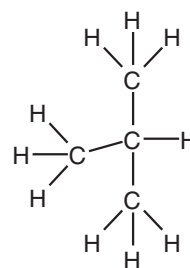
## SECTION B: SHORT-ANSWER QUESTIONS

### Question 1

- a. Any two of:  
forms four bonds with other atoms;  
forms single, double and triple bonds;  
forms strong C–C bonds, leading to large molecules, chains and rings;  
bonds with a range of elements including hydrogen, oxygen, nitrogen, halogens and sulfur. 2 marks
- b. i. 32 1 mark  
*The general alkane formula is  $C_nH_{2n+2}$ , so with 15 carbon atoms we have  $C_{15}H_{32}$ .*
- ii. 6 1 mark  
*The prefix 'hex' denotes six.*
- iii. 3-methylpentane 1 mark  
*The longest chain is 5 C.*
- iv.



or



1 mark

*For 10 hydrogen atoms, the formula  $C_nH_{2n+2}$  gives  $C_4H_{10}$ .*

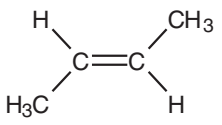

Total 6 marks

### Question 2

- a. i. IV 1 mark  
*Polymer IV has covalent bonds between chains.*
- ii. II 1 mark  
*Polymer II has branching that leads to low density.*
- b. IV 1 mark  
Strong covalent bonds between the chains must be broken for melting to occur (the substance chars rather than melts). The other polymers have weaker bonding between chains (dispersion forces and hydrogen bonding). 1 mark
- c. Lengthening the polymer chain would make a stronger polymer. 1 mark  
The longer the polymer, the stronger the dispersion forces between the polymer chains. 1 mark

Total 6 marks

### Question 3

- a. i.  1 mark
- ii. but-2-ene or 2-butene 1 mark
- iii.  2 marks
- iv. Thermosoftening (thermoplastic) 1 mark  
Bonding between chains is by weak dispersion forces only. Melting occurs at relatively low temperatures. 1 mark
- b. Only thermosoftening polymers are recyclable. 1 mark  
Thermosetting polymers do not melt to enable recycling. 1 mark
- Total 8 marks

### Question 4

- a.  $C_5H_{10}$  or  $C_6H_{12}$  1 mark  
*Cyclic alkanes have the formula  $C_nH_{2n}$ , as two hydrogens are 'lost' when the ring structure forms.*
- b.  $C_5H_8$  1 mark  
*Alkynes have the formula  $C_nH_{2n-2}$  as they contain a C–C triple bond.*
- c.  $C_4H_{11}$  1 mark  
*This formula is incorrect as it contains too many hydrogen atoms for the number of carbon atoms.*
- d.  $C_6H_{12}$  1 mark  
*The first member of the homologous series of alkenes is  $C_2H_4$ .*
- e.  $CH_2CHCH_3$  1 mark  
*This is a molecule with a double C–C bond.*

Total 5 marks