PEARSON EDEXCEL IGCSE CHEMISTRY · 4CH1

CHEMISTRY



EXAM QUESTION PACK

SECTION 4: ORGANIC CHEMISTRY (PACK 3)

SCORE	PERCENTAGE
/121	%

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Q1.

Ocimene is an organic compound that gives some plants their particular smell.

The molecular formula of ocimene is $C_{10}H_{16}$

(a) Calculate the relative formula mass (M_r) of ocimene.

(1)

M_r = ...

(b) Using ocimene as an example, explain what is meant by the term **empirical formula**.

(2)

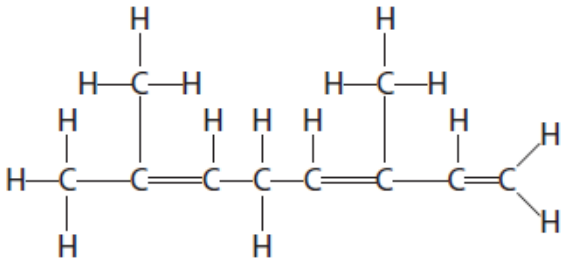
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(c) The displayed formula of ocimene is



Explain why ocimene is described as an unsaturated hydrocarbon.

(3)

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(d) Ocimene is an alkene.

(i) Which of these types of reaction occurs between ocimene and bromine?

(1)

☒ **A** addition

☒ **B** polymerisation

☒ **C** precipitation

☒ **D** substitution

(ii) Many alkenes have the general formula C_nH_{2n}

Suggest why ocimene does not have this general formula.

(1)

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(e) Ocimene can take part in combustion reactions.

Complete the equation for the complete combustion of ocimene.

(2)

$C_{10}H_{16}$ + ... O_2 → ..... + ...

(f) Two different products can form during the incomplete combustion of ocimene. One product is a solid and the other is a poisonous gas.

(i) Identify these two products.

(2)

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(ii) State why the gas produced is poisonous.

(1)

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(Total for question = 13 marks)

Q2.

This question is about nitrogen and some of its compounds.

(a) Nitrogen and oxygen do not react together at room temperature.

At the high temperatures in a car engine, nitrogen and oxygen react to form nitrogen monoxide, NO

(i) Give a chemical equation for this reaction.

(1)

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(ii) Give a reason why this reaction only occurs at high temperatures.

(1)

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.....

(iii) State why it is important that oxides of nitrogen are not released into the atmosphere.

(1)

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(b) Nitrogen monoxide gas can be removed from car exhaust fumes when it reacts with carbon monoxide gas.

(i) The rate of the reaction is increased by passing the gases over a catalyst.

Explain how a catalyst increases the rate of a reaction.

(2)

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(ii) Explain how increasing the pressure of gases increases the rate of reaction.

(3)

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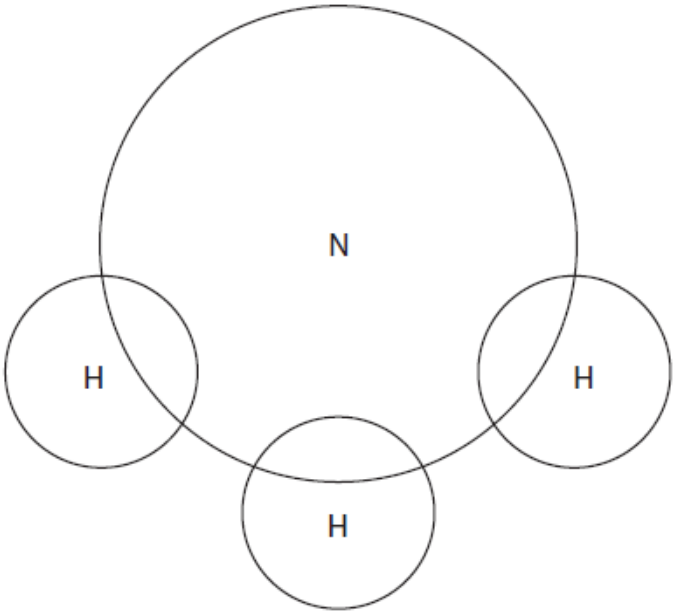
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(c) Ammonia is a simple molecule with the formula NH_3

(i) Complete the diagram to show the outer shell electrons in ammonia.

(2)



(ii) The bonds in ammonia are covalent.

Describe the forces of attraction in a covalent bond.

(2)

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(iii) Explain why ammonia has a low boiling point.

(2)

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(Total for question = 14 marks)

Q3.

Nitrogen dioxide and silicon dioxide are compounds containing covalent bonds.

(a) State what is meant by the term **covalent bond**.

(1)

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(b) In a car engine, nitrogen and oxygen from the air react to form nitrogen dioxide, NO_2

(i) Give a chemical equation for this reaction.

(1)

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(ii) State an environmental problem that occurs when nitrogen dioxide is released into the atmosphere.

(1)

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(c) Nitrogen dioxide and silicon dioxide both contain covalent bonds.

Explain why nitrogen dioxide has a much lower melting point than silicon dioxide.

Refer to structure and bonding in your answer.

(6)

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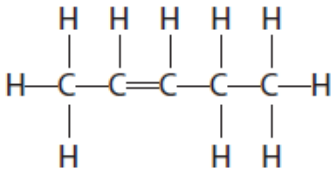
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Q4.

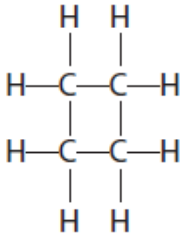
This question is about organic compounds.

(a) The diagram shows the displayed formulae of five compounds, U, V, W, X and Y.

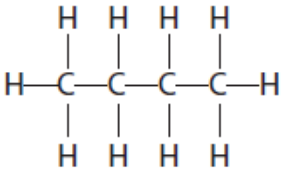
U



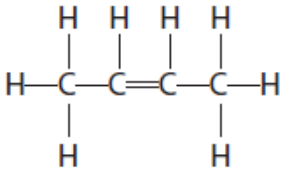
V



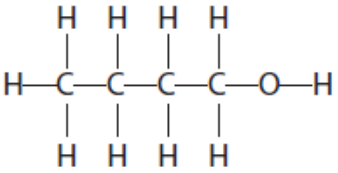
W



X



Y



(i) Give the letter of the compound that is not a hydrocarbon.

(1)

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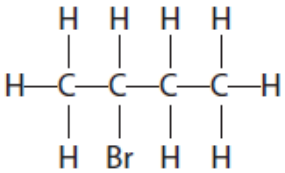
(ii) Give the letter of the compound that is a saturated hydrocarbon with the empirical formula CH_2

(1)

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(iii) Give the letter of the compound that reacts with bromine in the presence of ultraviolet radiation to form this structure.

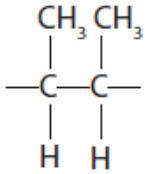
(1)



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(iv) Give the letter of the compound that forms an addition polymer with this repeat unit.

(1)



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(v) Give the displayed formula of an alkene that is an isomer of compound X.

(1)

(vi) Compounds U and X are members of the same homologous series.

Members of the same homologous series have the same functional group.

Give two other characteristics of compounds in the same homologous series.

(2)

1 .....

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2 .....

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(b) Compound Z contains 38.7% carbon, 9.7% hydrogen and 51.6% oxygen by mass.

(i) Show by calculation that the empirical formula of compound Z is CH_3O

(2)

(ii) The relative formula mass (M_r) of compound Z is 62

Deduce the molecular formula of compound Z.

(2)

molecular formula = ...

(Total for question = 11 marks)

Q5.

Propane is a hydrocarbon with the formula C_3H_8

(a) State why propane is a hydrocarbon.

(2)

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(b) (i) Name the poisonous gas that forms when propane is burned in a limited supply of air.

(1)

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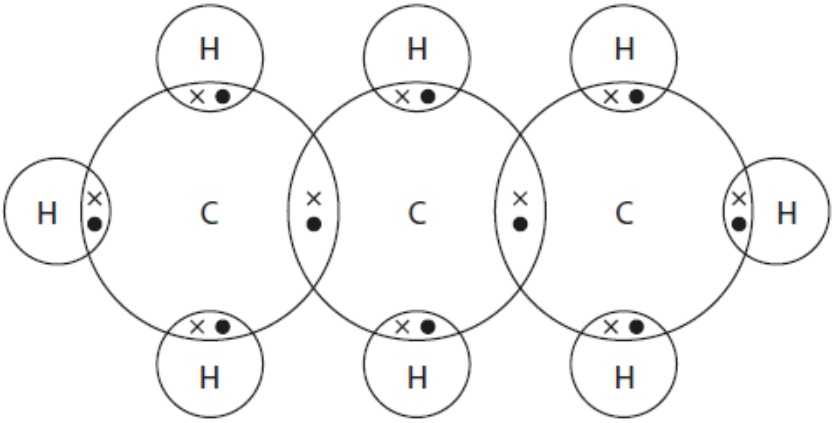
(ii) State why this gas is poisonous to humans.

(1)

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(c) The diagram represents a molecule of propane.



Describe the forces of attraction between the atoms in a molecule of propane.

(2)

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(d) Propane can be produced by cracking.

An equation for cracking is

$$C_{13}H_{28} \rightarrow C_3H_8 + 2C_3H_6 + 2C_2H_4$$

Explain why cracking is an important process in the oil industry.

(3)

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(e) Propane reacts with bromine in the presence of ultraviolet radiation.

(i) Complete the equation for this reaction.

(2)

$C_3H_8 + Br_2 \rightarrow$ ..... + ...

(ii) Give the name of this type of reaction.

(1)

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(Total for question = 12 marks)

Q6.

(a) Propene is an alkene with the molecular formula C_3H_6

(i) Give the general formula for the alkenes.

(1)

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(ii) Explain why propene is described as an unsaturated hydrocarbon.

(3)

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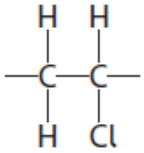
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(b) The polymer poly(chloroethene) has the repeat unit



(i) Draw the displayed formula of the monomer that forms this polymer.

(1)

(ii) Explain why there is a problem in the disposal of polymers such as poly(chloroethene).

(2)

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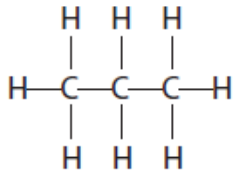
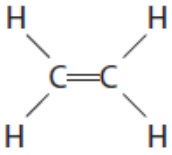
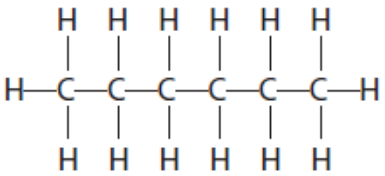
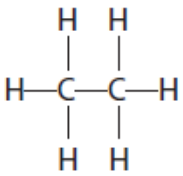
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(Total for question = 7 marks)

Q7.

The table gives the displayed formulae of four hydrocarbons, P, Q, R and S.

P	Q
	
R	**S**
	

(a) (i) Explain why P, Q, R and S are all hydrocarbons.

(2)

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(ii) Give the name of hydrocarbon P.

(1)

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(iii) Give the molecular formula of hydrocarbon S.

(1)

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(iv) Describe a test to show that hydrocarbon Q is unsaturated.

(2)

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(b) Hydrocarbons P, Q, R and S have the same type of structure.

(i) Explain why P, Q, R and S all have low boiling points.

Refer to the type of structure in your answer.

(3)

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(ii) Suggest why the boiling point of hydrocarbon R is higher than the boiling point of hydrocarbon S.

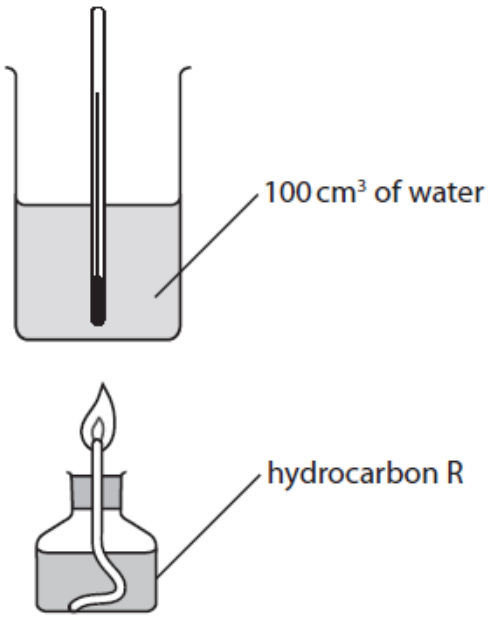
(1)

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(c) A teacher uses this apparatus to investigate the increase in temperature of 100 cm^3 of water when hydrocarbon R is burned.



The temperature of the water before heating is 19.7 °C.

The temperature of the water after heating is 57.2 °C.

The temperature rise is less than the teacher expected.

(i) One reason why the temperature rise is less than expected is that some of hydrocarbon R undergoes incomplete combustion.

Give another reason why the temperature rise is less than expected.

(1)

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(ii) Complete the equation for the incomplete combustion of hydrocarbon R.

(1)

C_6H_{14} + ... O_2 → 3C + ... CO + ... H_2O

(iii) Explain why carbon monoxide (CO) should not be released into the laboratory.

(2)

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(iv) Calculate the heat energy change (*Q*), in joules, in this experiment.

[mass of 1.0 cm^3 of water = 1.0 g]

[for water, c = 4.2 J / g / °C]

(3)

Q = ... J

(Total for question = 17 marks)

Q8.

The box shows the names of some substances.

bromine	carbon dioxide	copper	iodine
methane	nitrogen	sulfur dioxide	water

(a) Complete the table by choosing substances from the box that match the description.

Each substance may be used once, more than once or not at all.

(5)

Description	Substance
a good conductor of electricity	
an element that has a basic oxide	
a substance used as a fuel	
a major cause of acid rain	
a non-metallic element that is a solid at room temperature	

(b) Describe a test for carbon dioxide.

(2)

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(Total for question = 7 marks)

Q9.

Crude oil is a mixture of hydrocarbons, most of which are alkanes.

(a) (i) State what is meant by the term **hydrocarbon**.

(2)

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(ii) Give the general formula for the alkanes.

(1)

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(b) Name the process used to separate crude oil into fractions.

(1)

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(c) One of the fractions obtained from crude oil is fuel oil.

Fuel oil is used to heat homes.

Explain why burning fuel oil in an insufficient supply of oxygen is dangerous.

(2)

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(d) Another fraction obtained from crude oil is gasoline.

Gasoline is used to make petrol for cars.

(i) Explain why it is dangerous to light a match even when standing several

metres away from a petrol spillage.

(2)

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(ii) Suggest why a petrol spillage is more dangerous than a fuel oil spillage.

(1)

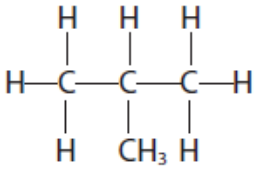
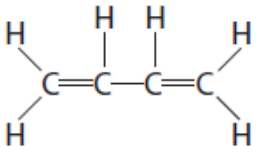
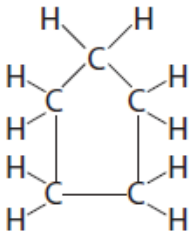
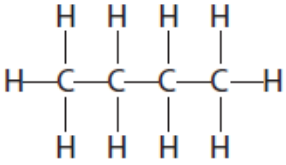
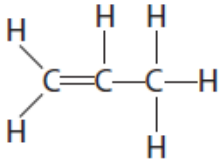
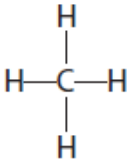
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(Total for question = 9 marks)

Q10.

The table shows the structures of six organic compounds.

A 	B 	C 
D 	E 	F 

(a) (i) Give the letter of a compound **not** shown as a displayed formula.

(1)

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(ii) Give the letter of a saturated compound with the general formula C_nH_{2n}

(1)

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(iii) Name compound E.

(1)

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(iv) Explain why compound A and compound D are isomers.

(2)

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(b) Compound F reacts with bromine in the presence of ultraviolet radiation.

(i) Complete the equation for the reaction.

(1)

$CH_4 + Br_2 \rightarrow$

(ii) Give the name of this type of reaction.

(1)

.....

(c) (i) Another compound, G, has this percentage composition by mass.

C = 37.8 % H = 6.3 % Cl = 55.9 %

Show by calculation that the empirical formula of compound G is C_2H_4Cl

(3)

(ii) The relative formula mass (M_r) of G is 127

Determine the molecular formula of G.

(2)

molecular formula = ...

(d) Compound E is used to make an addition polymer.

(i) Complete the equation to show part of the polymer formed from two molecules of compound E.

(2)



(ii) Give one problem caused by the disposal of addition polymers.

(1)

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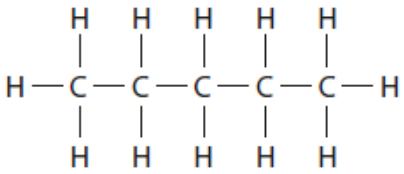
(Total for question = 15 marks)

Q11.

(a) There are three isomers with the molecular formula C_5H_{12}

One of these isomers is pentane.

The displayed formula for pentane is



(i) State what is meant by the term **isomers**.

(2)

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(ii) Draw the displayed formula for another isomer of C_5H_{12}

(2)

(b) Pentane reacts with bromine in the presence of ultraviolet radiation.

(i) Complete the equation for this reaction.

(2)

$$C_5H_{12} + Br_2 \rightarrow \text{.....} + \text{.....}$$

(ii) Give the name of this type of reaction.

(1)

.....

(Total for question = 7 marks)