

ORGANIC REVISION

June 10 ✓

ANSWERS

04

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1.

Crude oil is a mixture of many different compounds.

(a) During industrial refining, crude oil is first separated into fractions.

(i) What is the name of the process used to obtain fractions from crude oil?

Fractional Distillation

(1)

(ii) Describe how the fractions are obtained.

- Crude oil heated
- (vapour) passed into column/tower
(* must make it clear oil was not heated in column for mark 2)
- Fractions collected at different heights.

ONE of these } • Small molecules collect at top, large at bottom
 } • low bpt fraction at top
 } • Cooler at top; hotter at bottom

(4)

(b) Four of the fractions obtained from crude oil are:

- bitumen
- diesel
- gasoline
- kerosene

(i) Which of these four fractions is the most viscous?

bitumen

(1)

(ii) Which of these four fractions is the most volatile?

gasoline

(1)

(iii) Which of these four fractions is used in making roads?

bitumen

(1)

(iv) Name two other fractions obtained from crude oil.

1 refinery gases

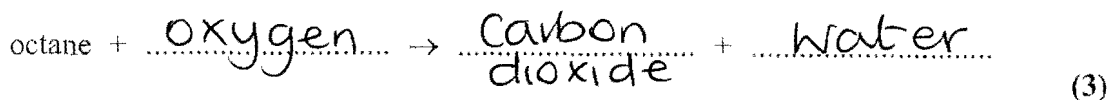
2 fuel oil

(2)



(c) Octane is a hydrocarbon in the gasoline fraction.

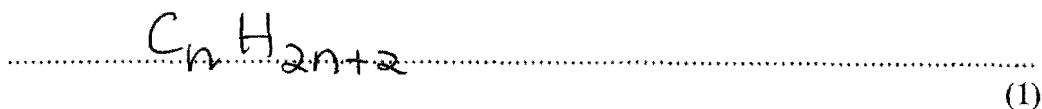
Write the names of the substances in the word equation for the complete combustion of octane.



(d) Octane belongs to a homologous series called the alkanes.

One characteristic of a homologous series is that each member of the series has the same general formula.

(i) What is the general formula of the alkanes?



(ii) State two other characteristics of a homologous series.

1 Same chemical properties / same functional group.

2 graduation in physical properties / bpt changes gradually.

3. Neighbouring members differ by CH_2 (2)

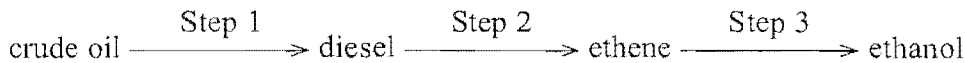
Q4

(Total 16 marks)

TOTAL FOR SECTION A: 45 MARKS



2. The sequence shows the steps that can be used to obtain ethanol from crude oil.



(a) Step 1 is fractional distillation, which takes place in a fractionating column. Crude oil vapour is pumped in just above the bottom of the column.

Some info given

(i) Describe how the fractions are separated in the fractionating column.

- vapour / hydrocarbons / molecules / fractions / compounds / substances rise (or collect at diff heights)
- condense / turn back to liquid (at different heights / temperatures)

(2)

(ii) Explain why the hydrocarbons in the fuel oil fraction are obtained from the column below the hydrocarbons in the diesel fraction.

- heavier / bigger / greater M_r
- (fuel oil molecules) boil / condense at higher temperature

(2)

(iii) One of the hydrocarbons in the diesel fraction has the formula $C_{16}H_{34}$. Suggest the formula of a hydrocarbon found in the gasoline fraction.

any example C_xH_y where $x = 5-12$ and y is $2x$ or $2x+2$

(1)

(iv) Name the fraction that is more viscous than fuel oil.

bitumen

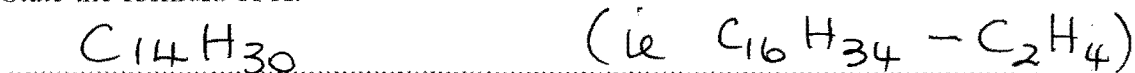
(1)



(b) Step 2 is cracking, which is carried out by heating the diesel fraction with a catalyst.

(i) During cracking, one molecule of $C_{16}H_{34}$ is converted into one molecule of ethene and one molecule of hydrocarbon X.

State the formula of X.



(1)

(ii) Describe, in terms of the bonds broken and formed, what happens during cracking.

- $C-C / C-H$ bonds break
- $C=C$ bonds form

(award 1 max for single bonds break & double bonds form)

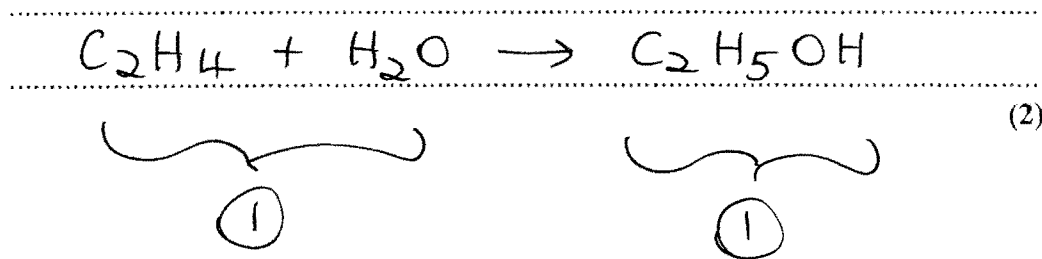
(c) Step 3 is hydration, which is carried out by heating ethene and steam at a temperature of about $300\text{ }^\circ\text{C}$ and a pressure of about 65 atm.

(i) Identify one other condition used in Step 3.

phosphoric acid / H_3PO_4 catalyst

(1)

(ii) Write a chemical equation for the reaction occurring in Step 3.



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02

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3

Propanone and water are both covalently bonded compounds. The table shows their boiling points.

Compound	Boiling point (°C)
propanone	56
water	100

(a) Some anhydrous copper(II) sulphate was added to a mixture of propanone and water. What colour change would be seen?

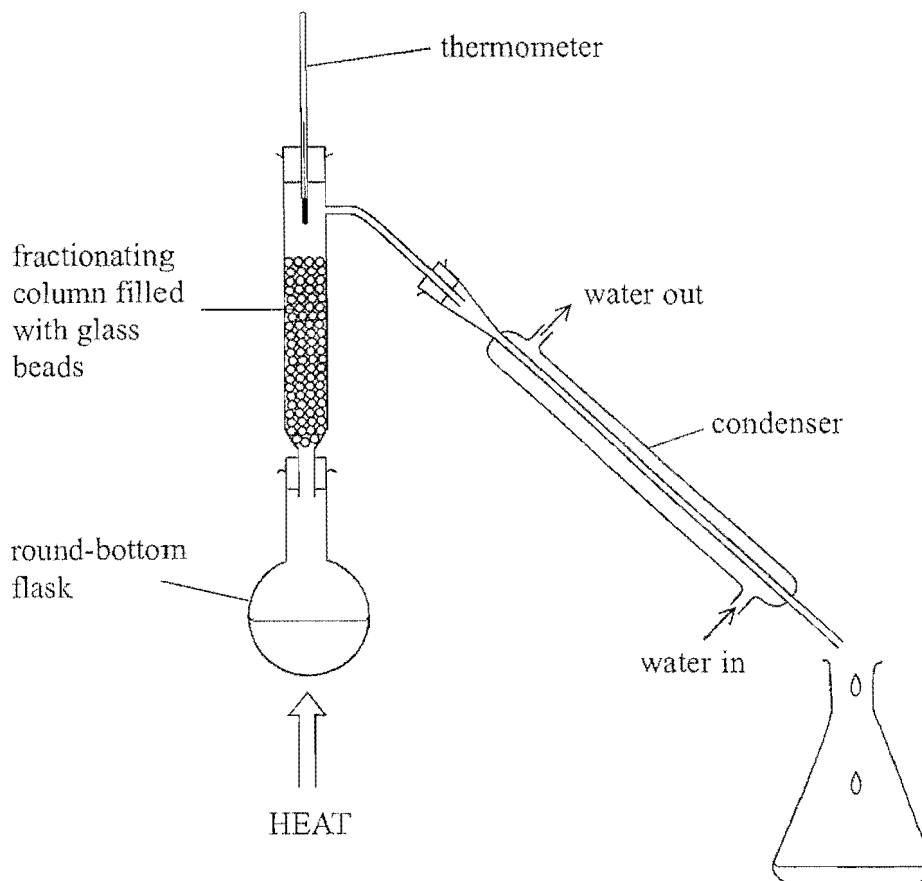
Analysis

Colour at start *white*

Colour at end *blue*

(2)

(b) Propanone can be obtained from a mixture of propanone and water using the apparatus shown.



(i) Name the method of separation carried out using this apparatus.

..... *fractional distillation*

(1)

(1)

(2)



(ii) Why can propanone and water be separated by this method?

• different boiling points / boiling point of propanone lower than water (1)

(iii) Outline how a sample of pure propanone can be obtained from the mixture.

- Heat / boil
- propanone boils / collects (first)
- stop collecting liquid above 56 °C

(3)

(c) Propanone and water both have simple molecular structures. They have low boiling points. Place a cross (☒) in **one** box from **each** column of statements to explain why they have low boiling points.

(Structure = Extraction)

the covalent bonds between their atoms are strong

the covalent bonds between their atoms are weak

the attractive forces between their molecules are strong

the attractive forces between their molecules are weak

AND

these require a lot of energy to be overcome

these require little energy to be overcome

these get weaker as the temperature increases

(2)

Q2

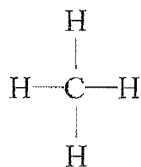
(Total 10 marks)



4

Methane, CH_4 , is an organic compound. It is the first member of an homologous series of **saturated hydrocarbons**.

The displayed formula of methane is



(a) What is meant by the term **hydrocarbon**?

- carbon and hydrogen (atoms)
- ONLY

(2)

(b) What is meant by the term **saturated**?

- Only single bonds (C-C bonds) / no
~~#~~ double bonds (between carbon atoms)

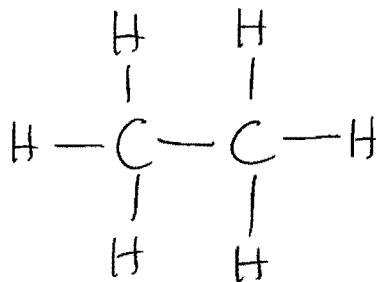
(1)

(c) (Name) the homologous series of which methane is the first member.

alkane(s)

(1)

(d) Draw the displayed formula of the second member of this homologous series.



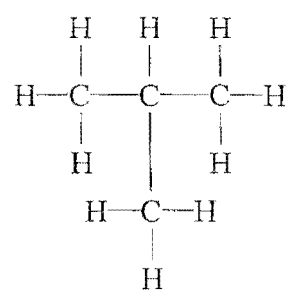
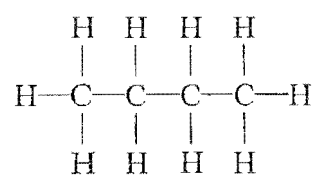
M1: two carbon
atoms joined
by single bond

M2: rest.

(2)



(e) The displayed formulae of two other organic compounds are



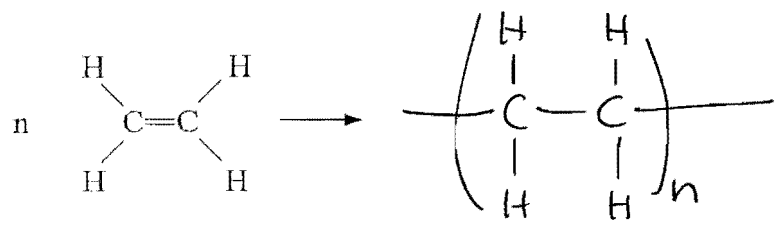
(i) What is the molecular formula of these two compounds?

..... C₄H₁₀ (1)

(ii) What name is given to compounds that have the same molecular formula but different displayed formulae?

..... isomers (1)

(f) Some other organic compounds are used to make polymers. Poly(ethene) is an addition polymer made from many identical monomer molecules. Complete the following equation to show the formation of poly(ethene).



M1 = repeat unit
M2 = extension bonds and n
(2)

(g) Nylon is another example of a polymer.

(i) What type of polymer is nylon?

..... condensation (1)

(ii) Put a cross (⊗) in the two boxes to show the types of monomers used in the manufacture of nylon.

- alcohol
- alkene
- diamine
- dicarboxylic acid

(2) Q3

(Total 13 marks)



- 5 (a) The table shows the displayed formulae of some organic compounds.

Compound	Displayed formula
A	<pre> H H H-C-C-H H H </pre>
B	<pre> H H H-C-C-O H H H </pre>
C	<pre> H H \ / C=C / \ H H </pre>
D	<pre> H H H H-C-C-C-H H H H </pre>
E	<pre> H H \ / C / \ H C=C H \ / \ / H H </pre>

- (i) Give one reason why compound **B** is not a hydrocarbon.

• contains oxygen / contains an element other than C & H. (1)

- (ii) State the empirical formula of compound **A**.

CH₃ / H₃C (1)

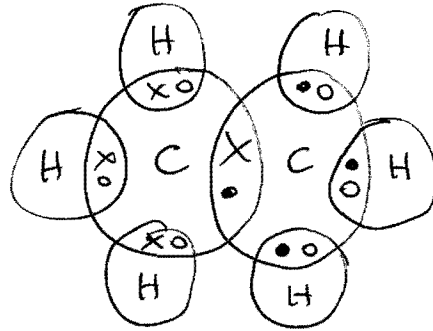
- (iii) Both **A** and **D** are members of the same homologous series. What is a homologous series?

Any two.

- same general formula
 - members differ by CH₂
 - same chemical reactions / same functional group
 - gradation in physical properties
- (2)



(iv) Draw a dot and cross diagram to show the bonding in compound A.



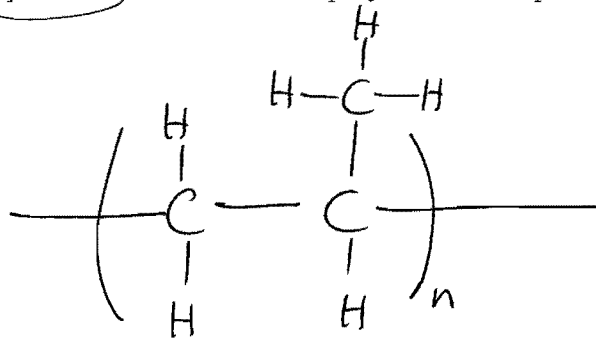
(2)

(v) What is the name of the addition polymer formed by compound E?

poly(propene) / polypropene / polypropylene

(1)

(vi) Draw the repeat unit of the addition polymer of compound E.



M1 = correct structure

M2 = continuation bonds.

(dependent on M1)

(2)

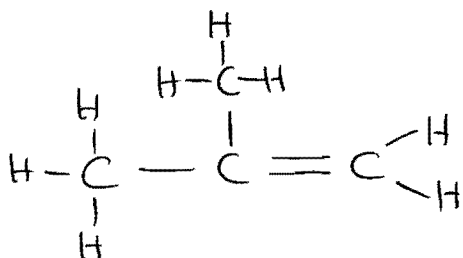
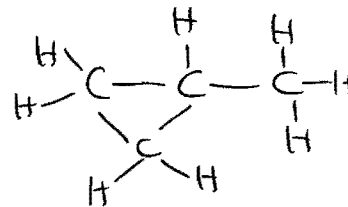
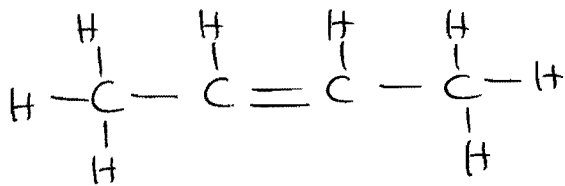
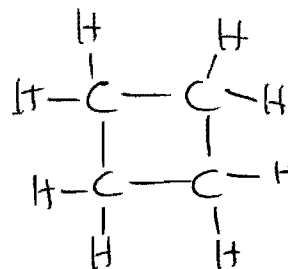
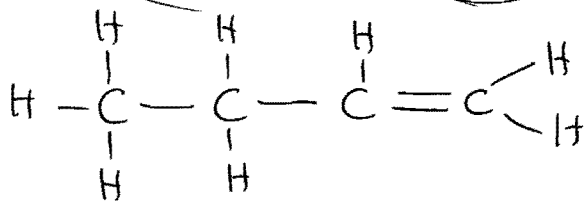
(vii) Compound E reacts rapidly with bromine water but the addition polymer of compound E does not. Explain this difference in behaviour.

- E has double bond / unsaturated
- polymer has no double bond / saturated

(2)



(b) Draw the displayed formulae of three isomers with molecular formula C_4H_8 .



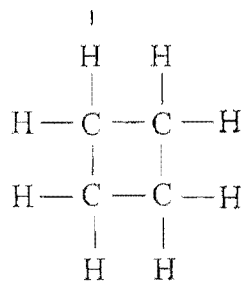
(any 3)

(3)

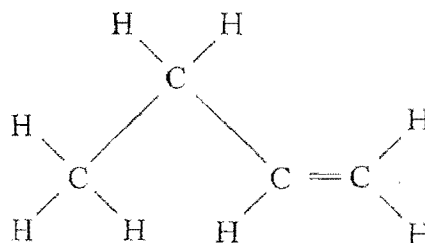
Q8

organic

(6) A and B are two hydrocarbons with the molecular formula C_4H_8 . Their structures are:



A



B

(a) Describe a chemical test to distinguish between hydrocarbons A and B. Give the result you would expect for each hydrocarbon.

Test Bromine (water)

Result with A (stays) yellow/orange/brown/no change

Result with B (becomes) colourless / decolourised

(3)

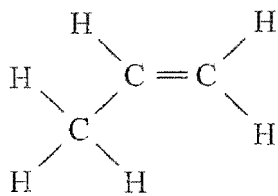
(b) To which homologous series does B belong?

alkene(s)

(1)

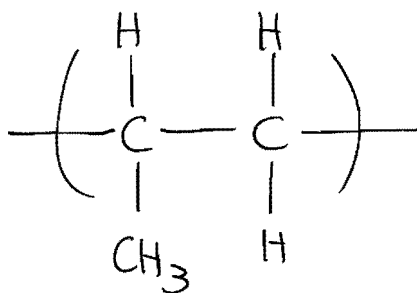


(c) Hydrocarbon **C** belongs to the same homologous series as **B**. It has the structure:



C

C forms an addition polymer. Draw the repeat unit of this polymer.



(2)

(d) Give the name of the addition polymer formed by **C**.

poly(propene) / polypropene / polypropylene

(1)

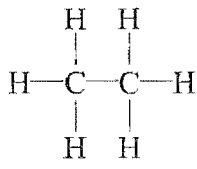
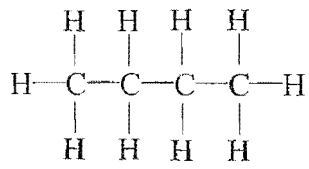
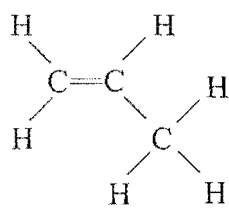
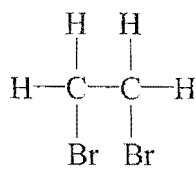
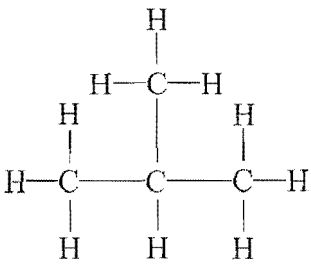
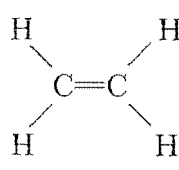
Q7

(Total 7 marks)



7

The table shows the structures of some organic compounds.

 <p>A</p>	 <p>B</p>
 <p>C</p>	 <p>D</p>
 <p>E</p>	 <p>F</p>

(a) Explain why compound C is not a saturated hydrocarbon.

• Double bond / C=C / not all bonds are single (1)

(b) Explain why compound D is not a hydrocarbon.

• Contains bromine / another element (or atom) and does not contain only C & H (1)

(c) Give the letters of two compounds that are isomers of each other.

B & E (1)



(d) Give the letters of two compounds that are members of the same homologous series but have different molecular formulae.

A and B / A and E / C and F (1)

(e) Name and give the general formula of the homologous series to which compound E belongs.

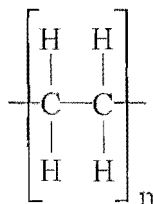
Name of homologous series alkane(s)

General formula C_nH_{2n+2} (2)

(f) What colour change is seen when bromine water is added to compound F?

• yellow / orange / brown
• to colourless / decolourised (NOT 'clear') (2)

(g) A polymer has the structure:



(i) Give the letter of the monomer which is used to make this polymer.

F (1)

(ii) Give the name of the polymer.

poly(ethene) / polyethene / polythene (1)

(iii) What type of polymer is this?

addition (1)

Q5

(Total 11 marks)

TOTAL FOR SECTION A: 45 MARKS



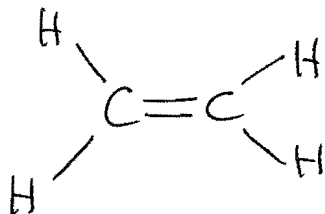
SECTION B

8 Alkenes are unsaturated hydrocarbons.

(a) State the general formula of all alkenes.

..... C_nH_{2n} (1)

(b) Draw the displayed formula of ethene.

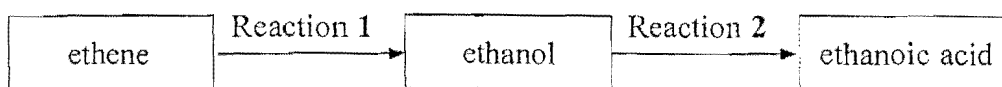


(1)

(c) Alkenes can be shown to be unsaturated using bromine water. Describe the colour change that occurs when an alkene reacts with bromine water.

- yellow / orange
 - to colourless / decolourised
- (2)

(d) Ethene is the starting material in the following sequence of reactions.



(i) State the other reagent, the catalyst, and one other condition used in Reaction 1.

Reagent water / steam / H_2O

Catalyst phosphoric acid

Condition ~~200-400 °C~~ ~~100~~ 200 - 400 °C / 60 - 70 atm

(3)

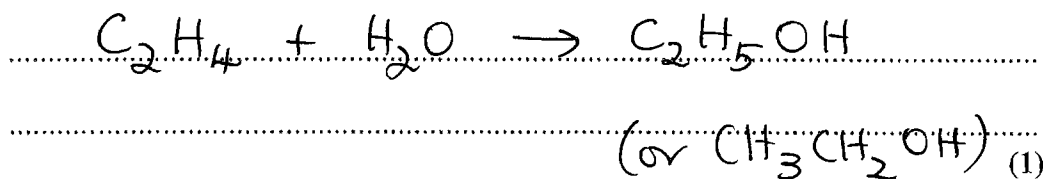


9. Ethene can be converted to ~~ethyl ethanoate~~ ^{ethanol} as follows:



(a) In industry, ethene is converted to ethanol by reacting it with steam in the presence of a catalyst.

(i) Write the chemical equation for this reaction.



(ii) Name the catalyst used.

(concentrated) phosphoric acid (1)

(b) Ethanol can also be made by fermentation. Describe how this is done.

Description to include: -

- sugar / sucrose / glucose
- yeast

and two from: -

- dissolved in water
- absence of air
- temp in range 20-40°C

(additional wrong reagent loses the sugar mark)

(4)

