Write-on

Chemistry A
Unit H432

Practice Paper 2A

Name	

Time allowed
2 hours 15 minutes

Information
- The total marks available for this paper is 100. The number of marks available for each question is shown in brackets.
- Answer all questions and show all working

You will need:
An OCR A Chemistry data sheet

You may use:
- A scientific or graphical calculator
- A pencil for graphs and drawings
- A ruler

Question	Mark
MCQs	
16	
17	
18	
19	
20	
21	
Total	

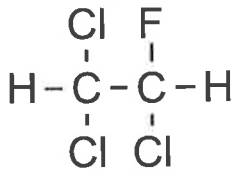
 © ZigZag Education, 2017

Paper 2A

SECTION A

You should aim to finish this section within 20 minutes.

1 The following molecule underwent homolytic fission in the presence of UV light.



Which of the these is not a likely product?

A $CHCl_2CHF\bullet$

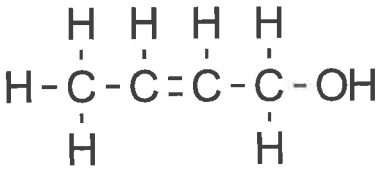
B $CHCl_2CClF\bullet$

C $\bullet CHClCHClF$

D $CHCl_2CHCl\bullet$

Your answer ☐

2 Which of these bond angles is found in the molecule shown?



A 180°

B 90°

C 85°

D 104.5°

Your answer ☐

3 How many hydrogen atoms are in 0.500 moles of 1,2-dibromopropene?

A 1.20×10^{24}

B 1.81×10^{24}

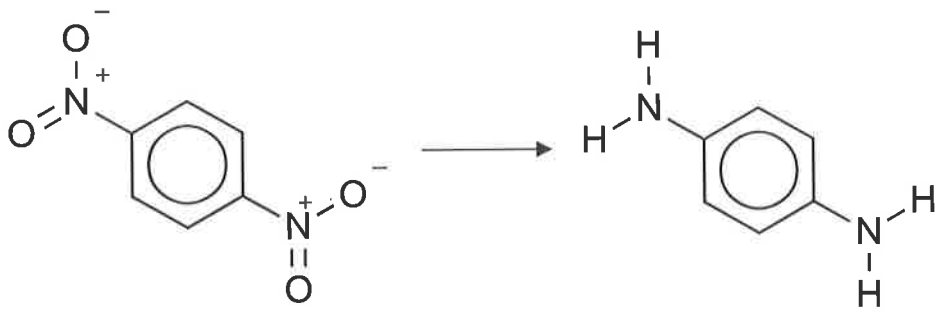
C 2.41×10^{24}

D 3.61×10^{24}

Your answer ☐

 © ZigZag Education, 2017

4



For the transformation above, identify the number that precedes [H] in the following equation. (NB The molecule shown above is not the only product.)

$$C_6H_4N_2O_4 + \_\_\_ [H] \rightarrow \text{Products}$$

A 4

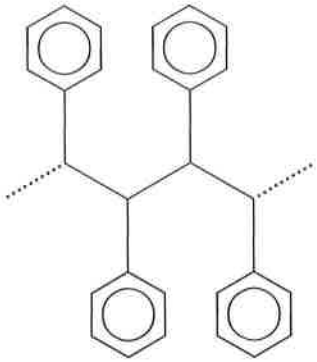
B 6

C 8

D 12

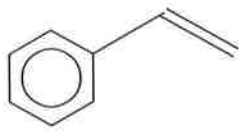
Your answer ☐

5 A section of a polymer is shown.

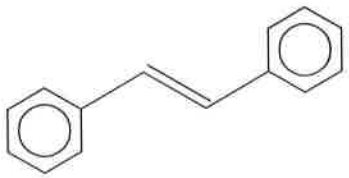


Which of the following shows the simplest monomer that could be used to form the polymer shown?

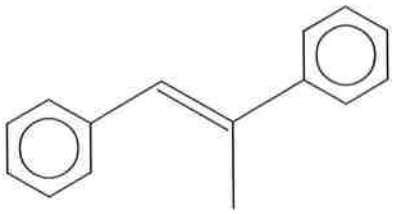
A



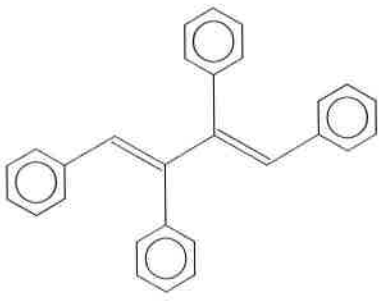
B



C



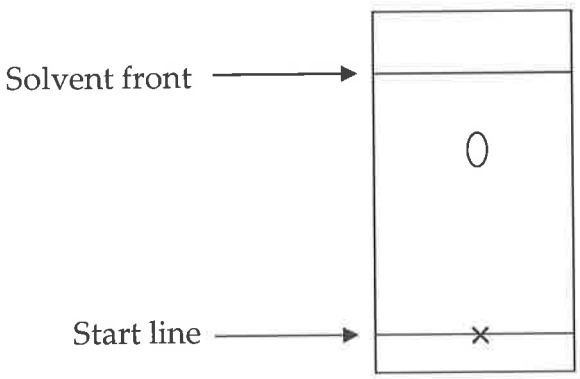
D



Your answer ☐

 © ZigZag Education, 2017

6 Calculate the R_f of the compound shown on this paper chromatogram.



A 0.25

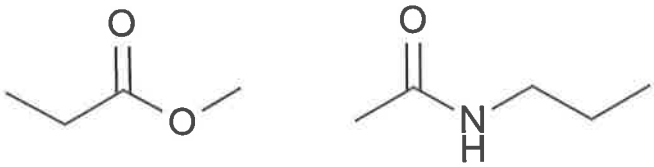
B 0.63

C 0.68

D 0.78

Your answer ☐

7 Name the compounds below.



A Methyl propanoate and N–propylethanamide

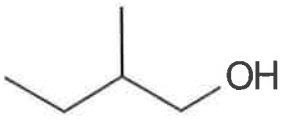
B Propyl methanoate and N–ethylpropanamide

C Methyl ethanoate and N–propylmethanamide

D Propyl ethanoate and N–methylpropanamide

Your answer ☐

8 Which of the following fragments would not be seen in the mass spectrum of this alcohol due to single fragmentation of the molecular ion?



A 28

B 29

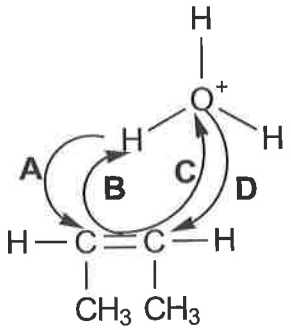
C 31

D 59

Your answer ☐

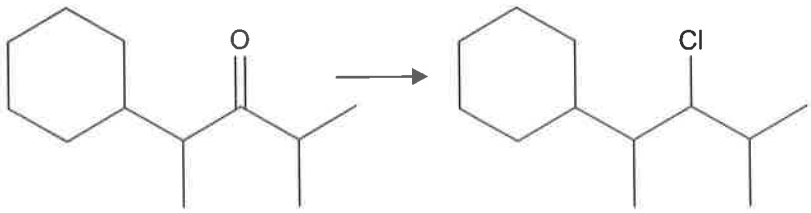
 © ZigZag Education, 2017

9 Which of these is the correct arrow in the hydration of the alkene below?



Your answer ☐

10 Which set of reagents would allow the following conversion?



A Heat and $SOCl_2$ only

B i) Ni/H_2 then ii) Cl_2, UV light

C ii) Sn and HCl then ii) $SOCl_2$

D iii) $NaBH_4$ then ii) NaCl in H_2SO_4

Your answer ☐

11 Which volume of H_2 gas at room temperature and pressure would react with one mole of $CH_2CHCH_2CH(CH_3)C(CH_3)CHCHBrCHBrCH_3$ in the presence of a Ni catalyst?

A 12,000 cm^3

B 24,000 cm^3

C 48,000 cm^3

D 72,000 cm^3

Your answer ☐

12 Which of the following correctly explains the trend in rate of hydrolysis of the haloalkanes (R–X) that contain halogens from further down group 7?

A Rate of substitution of X increases as group 7 is descended because the electronegativity difference between C and X increases.

B Rate of substitution of X decreases as group 7 is descended because the electronegativity difference between C and X decreases.

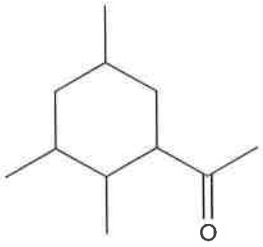
C Rate of substitution of X increases as group 7 is descended because the bond strength decreases.

D Rate of substitution of X decreases as group 7 is descended because the bond strength increases.

Your answer ☐

 © ZigZag Education, 2017

13 Which of the statements below is true of this structure?

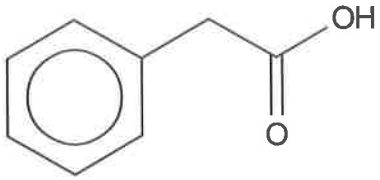


1. Reacts with Tollens' reagent
2. Has a peak in the region of 160–180 ppm in its ^{13}C NMR
3. Is alicyclic and not aliphatic

A 1 only
B 2 only
C 3 only
D None of the above

Your answer ☐

14 Which of the following would react with this molecule?



1. Sodium carbonate solution
2. Magnesium
3. HNO_3

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Your answer ☐

15 Which of these is true for a reflux reaction?

1. Should be sealed to stop reactants escaping
2. Should be stirred, if possible
3. Prevents an equilibrium being reached

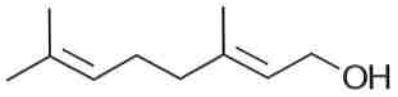
A 1 and 2 only
B 1 and 3 only
C 2 only
D 3 only

Your answer ☐

 © ZigZag Education, 2017

SECTION B

16 Geraniol, $C_{10}H_{18}O$, is the main component in rose oil, and is useful as a natural mosquito repellent. Its structure contains both alkene and alcohol functional groups.



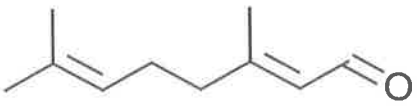
a) What is meant by the term 'functional group'?

.....

.....

(1)

b) Geraniol can be converted to the aldehyde below using acidified potassium dichromate, $K_2Cr_2O_7$.



i) State the role of the acidified potassium dichromate in this reaction.

.....

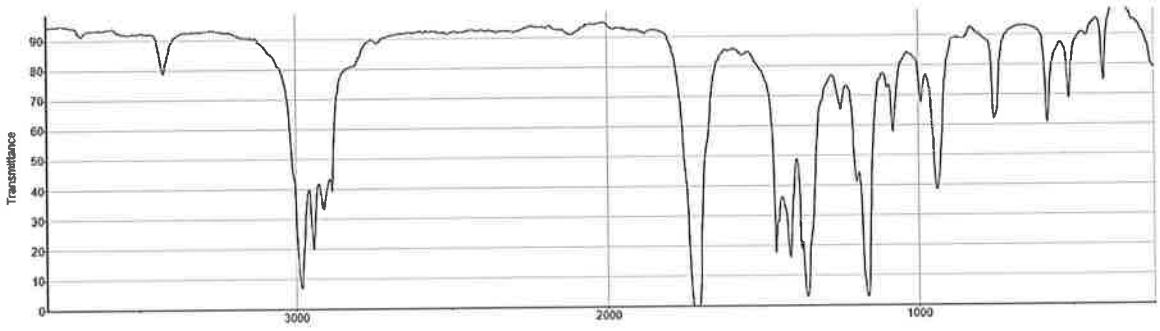
(1)

ii) Write an equation for the reaction of geraniol with acidified potassium dichromate to form an aldehyde.

.....

(2)

iii) How does the following infrared spectrum indicate that geraniol has been successfully converted to an aldehyde, but not to a carboxylic acid?



.....

.....

.....

.....

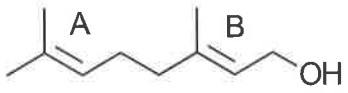
.....

.....

(3)

 © ZigZag Education, 2017

c) Geraniol can exist as a pair of stereoisomers due to E/Z isomerism at one of the double bonds.



Explain what causes E/Z isomerism, and explain why it only occurs at one of the two labelled double bonds (A and B).

.....

.....

.....

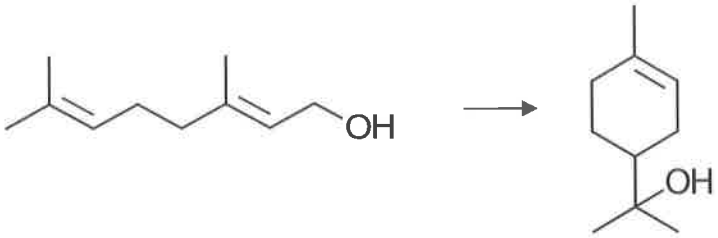
.....

.....

.....

(3)

d) Under mild conditions, geraniol is converted to alpha-terpineol.



Explain why geraniol is a structural isomer of alpha-terpineol.

.....

.....

.....

.....

(2)

e) Upon heating with a concentrated H_2SO_4 catalyst, alpha-terpineol can form a pair of products via a dehydration reaction.

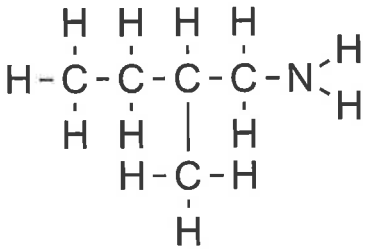
Draw the structure of the products.

(2)

QUESTION TOTAL: 14 MARKS

 © ZigZag Education, 2017

17 A simple amine is shown below. This amine is useful in synthesis.



a) Give the IUPAC name of the amine above.

.....

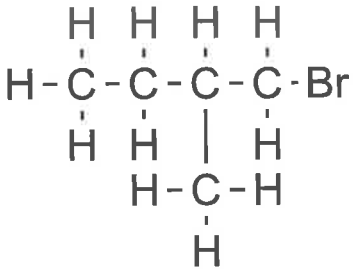
(1)

b) Write the structural formula for the amine above.

.....

(1)

c) Explain how the amine above can be made from the haloalkane shown.



.....

.....

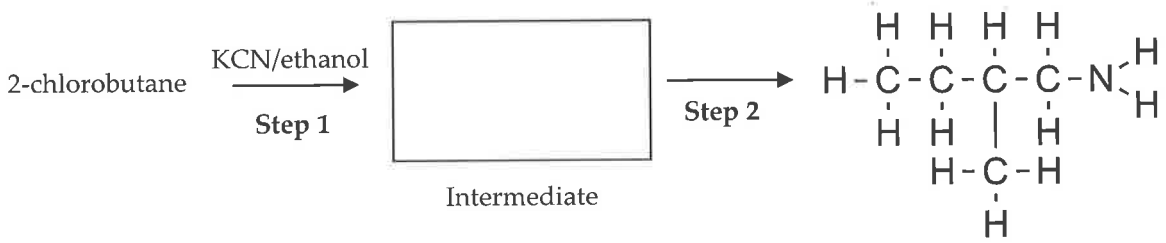
.....

.....

(2)

 © ZigZag Education, 2017

d) The amine above can also be made from 2-chlorobutane in a two-step reaction as follows:



i) Draw the mechanism for Step 1 to form the intermediate, and name the type of mechanism occurring.

.....

.....

(4)

ii) Identify the reagents required to carry out Step 2.

.....

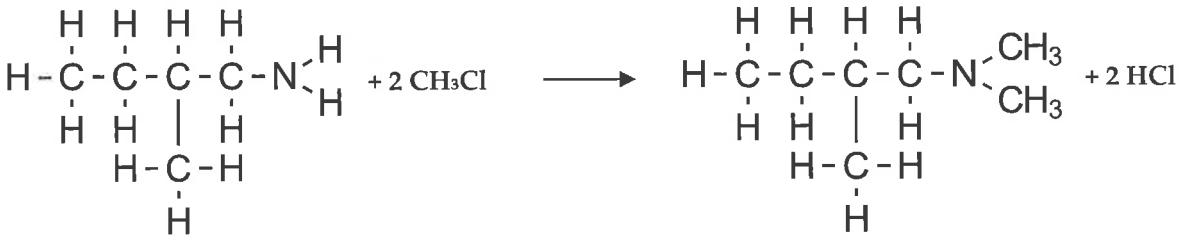
(1)

e) The simple amine can exist as a pair of optical isomers. Draw a 3D diagram to show this, labelling the chiral carbon with a *.

(2)

 © ZigZag Education, 2017

f) The amine itself can react further. The overall equation, after purification, is:



i) 3.00 g of chloromethane, CH_3Cl, gave 3.00 g of the amine product. Calculate the percentage yield.

(2)

ii) The product cannot be easily identified using normal thin layer chromatography, which uses slightly acidic SiO_2 as a stationary phase. Suggest why not.

.....

.....

(1)

iii) The reaction above occurs less readily if tetrachloromethane, CCl_4, is used. This is partly because the amine does not dissolve well in tetrachloromethane, which is non–polar. Explain why tetrachloromethane is non–polar.

.....

.....

.....

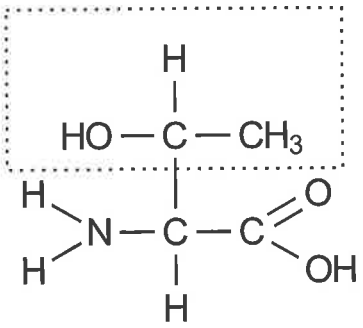
.....

(2)

QUESTION TOTAL: 16 MARKS

 © ZigZag Education, 2017

18 The structure of the amino acid threonine is shown below, with a box around the side chain. The side chains give each amino acid a distinctive ^1H NMR.



Threonine

a) Draw the structure of threonine at pH 14.

(1)

b) Explain how D_2O can be used to identify the hydrogens on the amine group and the carboxylic acid group in a ^1H NMR.

.....

.....

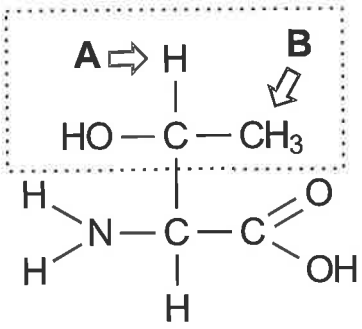
.....

.....

(2)

 © ZigZag Education, 2017

c) The structure of threonine is shown again with two protons' environments labelled A and B, which would each give rise to a peak in the ^{1}H NMR.

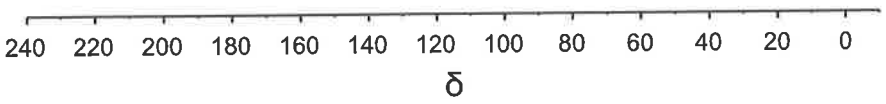


Fill in the integration, approximate shift and splitting for these peaks in the table below.

Environment	Integration	Approximate shift	Splitting
A			
B			

(3)

d) Sketch an approximate ^{13}C NMR for threonine on the scale below, indicating which peak corresponds to which carbon.

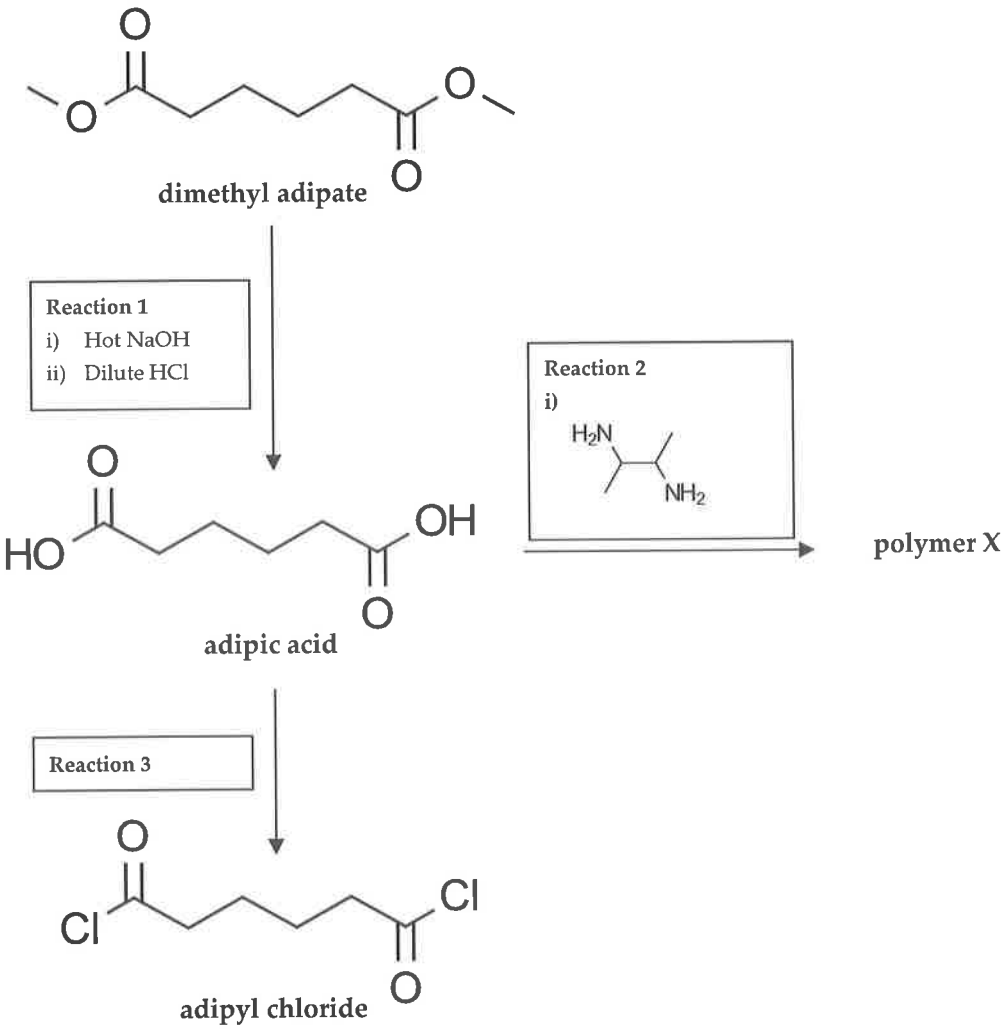


(3)

QUESTION TOTAL: 9 MARKS

 © ZigZag Education, 2017

19 Dimethyl adipate is a plasticiser that can be readily converted to other chemicals.



a) Give the molecular formula of dimethyl adipate.

.....

(1)

b) i) Write an equation for stage i) of Reaction 1, and name the type of reaction.

.....

.....

(3)

 © ZigZag Education, 2017

ii)* The dicarboxylic acid formed is a solid. Explain how this can be purified and its identity confirmed without the use of spectroscopic techniques.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)

c) Reaction 2 can be used to generate a polymer if large quantities of the reactants are used.

i) Name the type of polymerisation occurring.

.....

(1)

ii) Draw the repeat unit of the monomer formed.

(2)

iii) The combination of Reactions 1 and 2 is an example of feedstock recycling. Explain three advantages of feedstock recycling over other methods of polymer disposal.

.....

.....

.....

.....

.....

.....

(3)

 © ZigZag Education, 2017

d) i) Give the reagent necessary for Reaction 3 (to form adipyl chloride).

.....

(1)

ii) Give one reason why this compound might be used, rather than the dicarboxylic acid, adipic acid, to form polyesters.

.....

.....

(1)

QUESTION TOTAL: 18 MARKS

20 Benzene rings contain an aromatic ring of delocalised electrons. The acceptance of this idea was dependent on the following experimental evidence:

- Bond lengths
- Reactivity with compounds such as bromine
- An enthalpy of hydrogenation of -207 kJ mol^{-1}, in light of the enthalpy of hydrogenation of cyclohexene, which is -120 kJ mol^{-1}

a)* Describe how this experimental evidence led to acceptance of the delocalised nature of benzene.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

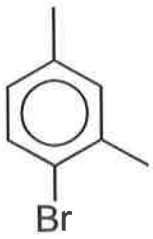
.....

.....

(6)

 © ZigZag Education, 2017

b) Benzene rings can be made to react by use of halogen carrier catalysts such as $FeBr_3$. Outline a mechanism to show how compound A, below, can be made from 1,3-dimethylbenzene.



Compound A

You should include in your answer how the $FeBr_3$ generates the electrophile for this reaction, and how the $FeBr_3$ is regenerated.

.....

.....

.....

(5)

c) A student attempted to perform a similar reaction to form compound B from 3,5-dimethylphenol.

Compound B

Explain why this is likely to be a very minor product and suggest the identity of the major product.

.....

.....

.....

.....

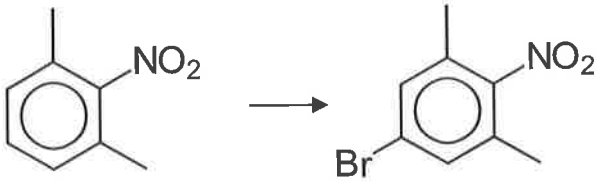
.....

.....

(3)

 © ZigZag Education, 2017

d) A student then tried to carry out the following reaction in the presence of bromine and a halogen carrier. Explain why this reaction will yield a different major product.



.....

.....

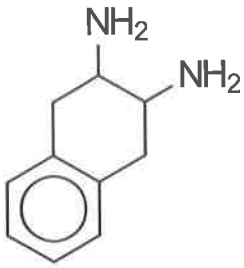
(1)

QUESTION TOTAL: 15 MARKS

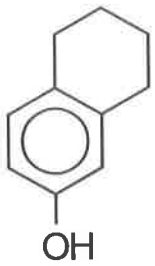
21 A chemical researcher is cleaning out a frozen chemical store that he believes contains the following five aromatic compounds. The researcher needs to confirm their identities.

A

B

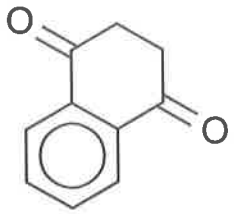


C



D

E



a) Describe a chemical test that could confirm that A is an alkene, and draw a mechanism for the reaction occurring.

.....

.....

.....

.....

(5)

 © ZigZag Education, 2017

b) B could be identified using elemental analysis. Give the percentage by mass of each element in B to the nearest whole number, showing your working.

.....

.....

.....

(3)

c) Describe how C could be distinguished from aliphatic alcohols and carboxylic acids using simple chemical tests.

.....

.....

.....

.....

(2)

d) Describe a chemical test that would give a positive result with E but not with the other four compounds.

.....

.....

.....

.....

(2)

e) Only one of the compounds above can be identified by looking at the number of environments in ^{13}C NMR. Identify which one, and state the number of peaks that would be observed.

.....

.....

(1)

QUESTION TOTAL: 13 MARKS

 © ZigZag Education, 2017