The Friary Sixth Form

Chemistry Summer Project Pack 2023

Summer Tasks

In Year 13 we will be making aspirin as part of our organic Chemistry.

Your task for September is to:

You will also need to prepare a sample of aspirin.

You should:

1. Research how to make aspirin from salicylic acid and purify it in order to write a method and apparatus list.
2. Identify any safety considerations
3. You should also research how to test if your aspirin sample is pure. You should find tests to do this and evaluate their reliability.

Make sure you include any references you have used for this work and have included the dates you accessed any websites.

You should also complete the attached exam questions to consolidate your learning from Year 12 and prepare you for the topics coming up in Year 13.

Organic Chemistry

Q1.

The number of structural isomers of molecular formula C_4H_9Br is

A 5

B 4

C 3

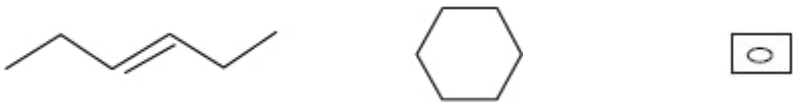
D 2

(Total 1 mark)

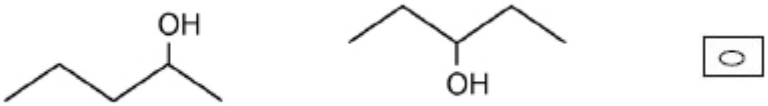
Q2.

Which is a pair of functional group isomers?

A



B



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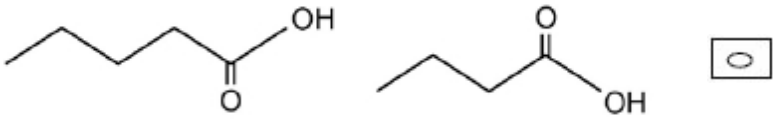

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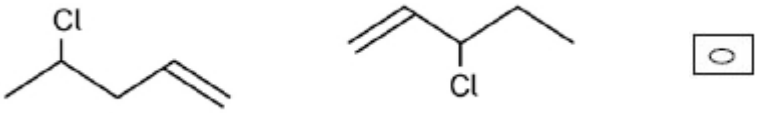


(Total 1 mark)

Q3.

How many isomers have the molecular formula C_5H_{12}?

A 2

B 3

C 4

D 5

(Total 1 mark)

Q4.

What is the total number of structural isomers with the molecular formula $C_2HBrClF_3$?

A 2 ⬭

B 3 ⬭

C 4 ⬭

D 5 ⬭

(Total 1 mark)

Q5.

How many structural isomers, which are esters, have the molecular formula $C_4H_8O_2$?

A 2

B 3

C 4

D 5

(Total 1 mark)

Q6.

The number of structural isomers of $C_3H_2Cl_6$ is

A 2

B 3

C 4

D 5

(Total 1 mark)

Q7.

Which one of the following is a pair of functional group isomers?

A $CH_3COOCH_2CH_3$ and $CH_3CH_2COOCH_3$

B $(CH_3)_2CHCH(CH_3)_2$ and $(CH_3)_3CCH_2CH_3$

C $CH_3CH_2OCH_3$ and $(CH_3)_2CHOH$

D $ClCH_2CH_2CH{=}CH_2$ and $CH_3CH{=}CHCH_2Cl$

(Total 1 mark)

Q8.

How many structural isomers, which are aldehydes, have the molecular formula $C_5H_{10}O$?

A 2

B 3

C 4

D 5

(Total 1 mark)

Q9.

Which one of the following can exhibit both geometrical and optical isomerism?

A $(CH_3)_2C=CHCH(CH_3)CH_2CH_3$

B $CH_3CH_2CH=CHCH(CH_3)CH_2CH_3$

C $(CH_3)_2C=C(CH_2CH_3)_2$

D $CH_3CH_2CH(CH_3)CH(CH_3)C=CH_2$

(Total 1 mark)

Q10.

Summarised directions for recording responses to multiple completion questions			
A (i), (ii) and (iii) only	**B** (i) and (iii) only	**C** (ii) and (iv) only	**D** (iv) alone

Isomers of the ester $HCOOCH_2CH_2CH_3$, include

(i) ethyl ethanoate

(ii) methyl propanoate

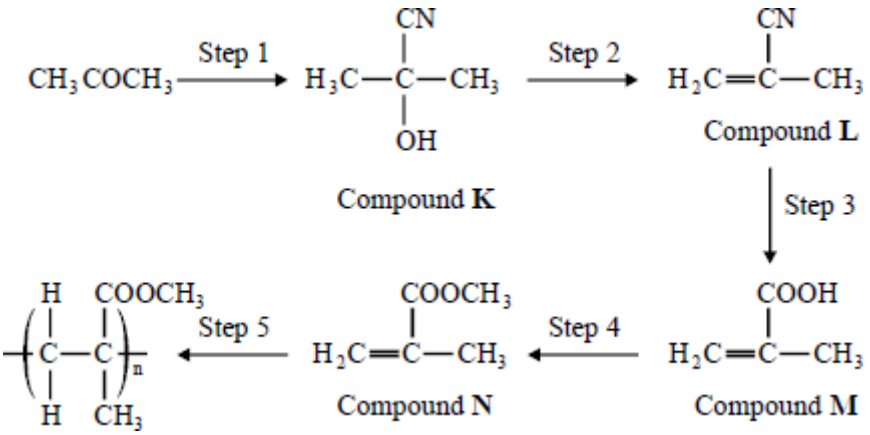
(iii) butanoic acid

(iv) butyl methanoate

(Total 1 mark)

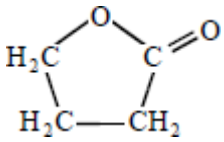
Q11.

This question concerns the preparation of the plastic poly(methyl 2-methylpropenoate) (*Perspex*), starting from propanone.

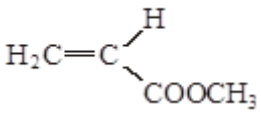


Which one of the following is **not** a structural isomer of Compound **M**?

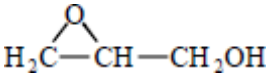
A



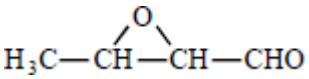
B



C



D



(Total 1 mark)

Q12.

How many different alkenes are formed when 2-bromo-3-methylbutane reacts with ethanolic potassium hydroxide?

A 2

B 3

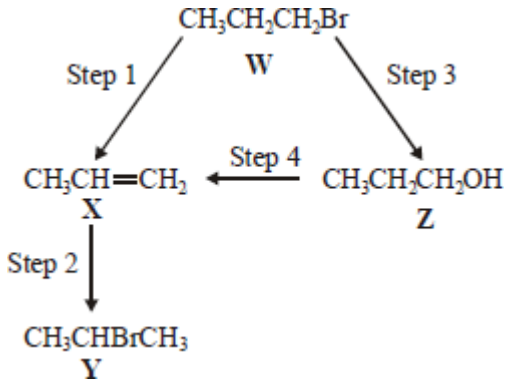
C 4

D 5

(Total 1 mark)

Q13.

For this question refer to the reaction scheme below.



Which one of the following statements is **not** correct?

A **W** and **Y** are structural isomers.

B **Z** is a primary alcohol.

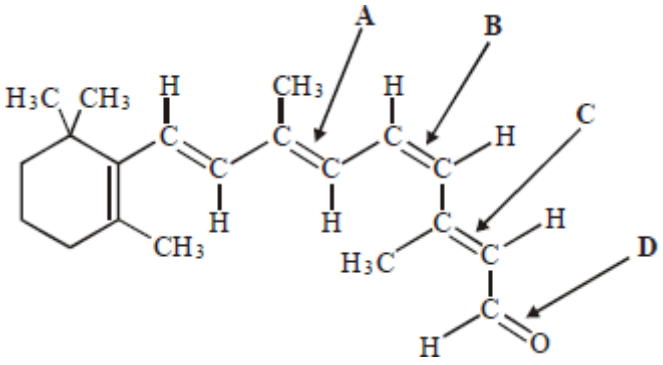
C **Y** gives two peaks in its proton n.m.r. spectrum.

C **X** has geometrical isomers.

(Total 1 mark)

Q14.

The compound *cis*-retinal is shown below.



Which one of the labelled bonds leads to the prefix in the name?

(Total 1 mark)

Q15.

Propanone can be reduced to form an alcohol. A functional group isomer of the alcohol formed is

A $CH_3CH_2CH_2OH$

B CH_3CH_2CHO

C $CH_3OCH_2CH_3$

D CH_3COCH_3

(Total 1 mark)

Q16.

The reaction of bromine with ethane is similar to that of chlorine with ethane. Three steps in the bromination of ethane are shown below.

Step **1** $Br_2 \longrightarrow 2Br^{\bullet}$

Step **2** $Br^{\bullet} + CH_3CH_3 \longrightarrow CH_3CH_2^{\bullet} + HBr$

Step **3** $CH_3CH_2^{\bullet} + Br_2 \longrightarrow CH_3CH_2Br + Br^{\bullet}$

(a) (i) Name this type of mechanism.

_____

(ii) Suggest an essential condition for this reaction.

_____

(iii) Steps **2** and **3** are of the same type. Name this type of step.

_____

(iv) In this mechanism, another type of step occurs in which free-radicals combine. Name this type of step. Write an equation to illustrate this step.

Type of step _____

*Equation*_____

(5)

(b) Further substitution in the reaction of bromine with ethane produces a mixture of liquid organic compounds.

(i) Name a technique which could be used to separate the different compounds in this mixture.

_____

(ii) Write an equation for the reaction between bromine and ethane which produces hexabromoethane, C_2Br_6, by this substitution reaction.

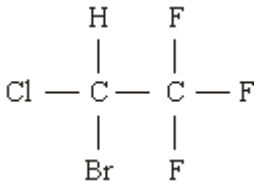
_____

(2)

(c) The compound 1,2-dibromo-1,1,2,2-tetrafluoroethane is used in some fire extinguishers. Draw the structure of this compound.

(1)

(d) Halothane is used as an anaesthetic and has the following structure.



(i) Give the systematic name of *halothane*.

_____

(ii) Calculate the M_r of halothane.

_____

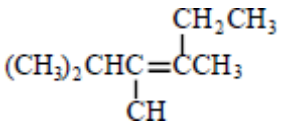
(iii) Calculate the percentage by mass of fluorine in halothane.

_____

(3)

(Total 11 marks)

Q17.

The correct systematic name for  is

A 2-ethyl-3,4-dimethylpent-2-ene

B 4-ethyl-2,3-dimethylpent-3-ene

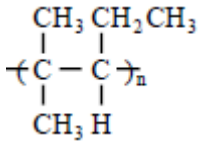
C 2,3,4-trirnethylhex-3-ene

D 3,4,5-trimethylhex-3-ene

(Total 1 mark)

Q18.

The correct name for the alkene monomer which forms the polymer shown below is



A 2-methyl-3-ethylpropene

B 2-methylpent-2-ene

C 2-methylpent-3-ene

D 4-methylpent-2-ene

(Total 1 mark)

Q19.

The alkanes form an homologous series of hydrocarbons. The first four straight-chain alkanes are shown below.

methane	CH_4
ethane	CH_3CH_3
propane	$CH_3CH_2CH_3$
butane	$CH_3CH_2CH_2CH_3$

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

_____

_____

(ii) Give the general formula for the alkanes.

_____

(iii) Give the molecular formula for hexane, the sixth member of the series.

_____

(3)

(b) Each homologous series has its own general formula. State **two** other characteristics of an homologous series.

_____

_____

_____

(2)

(c) Branched-chain structural isomers are possible for alkanes which have more than three carbon atoms.

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

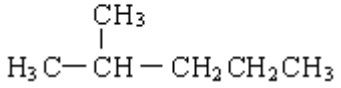
_____

_____

_____

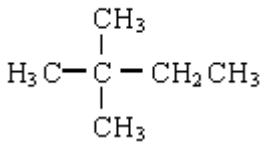
(ii) Name the **two** isomers of hexane shown below.

Isomer 1



Name _____

Isomer 2



Name _____

(iii) Give the structures of **two** other branched-chain isomers of hexane.

Isomer 3 *Isomer 4*

(6)

(d) A hydrocarbon, **W,** contains 92.3% carbon by mass. The relative molecular mass of **W** is 78.0

(i) Calculate the empirical formula of **W**.

_____

_____

_____

_____

(ii) Calculate the molecular formula of **W**.

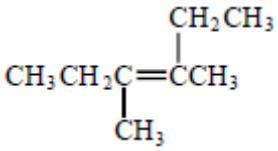
_____

_____

(4)

(Total 15 marks)

Q20.



The correct systematic name for is

A 2,3-diethylbut-2-ene

B 2-ethyl-3-methylpent-2-ene

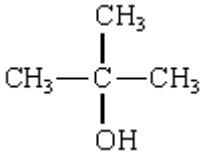
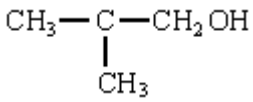
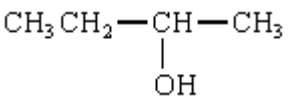
C 4-ethyl-3-methylpent-3-ene

D 3,4-dimethylhex-3-ene

(Total 1 mark)

Q21.

Four isomers with the formula C_4H_9OH are given below.

Isomer	Name
$CH_3CH_2CH_2CH_2OH$	butan-1-ol
	2-methylpropan-2-ol
	
	

(i) Complete the naming of the isomers in the table above.

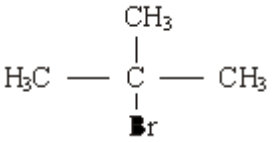
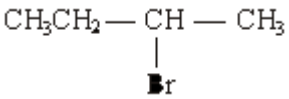
(ii) Name the type of isomerism shown by these four isomers.

_____

(Total 3 marks)

Q22.

The table below gives some of the names and structures of isomers having the molecular formula C_4H_9Br

Structure	Name
$CH_3CH_2CH_2CH_2Br$	
	2-bromo - 2-methypropane
	1-bromo - 2-methypropane
	2-methypropane

Complete the table.

(Total 2 marks)

Q23.

Which is the mechanism for this conversion?

A Addition-elimination ○

B Electrophilic substitution ○

C Free-radical substitution ○

D Nucleophilic substitution ○

(Total 1 mark)

Q24.

Which species can act as a nucleophile?

A NH_4^+ ⬭

B CH_3OH ⬭

C CH_4 ⬭

D H^+ ⬭

(Total 1 mark)

Q25.

Which equation represents an initiation step?

A $CH_3CH_2\dot{C}HBr + Br_2 \longrightarrow CH_3CH_2CHBr_2 + \dot{B}r$ ⬭

B $O_3 + \dot{C}l \longrightarrow O_2 + \dot{C}lO$ ⬭

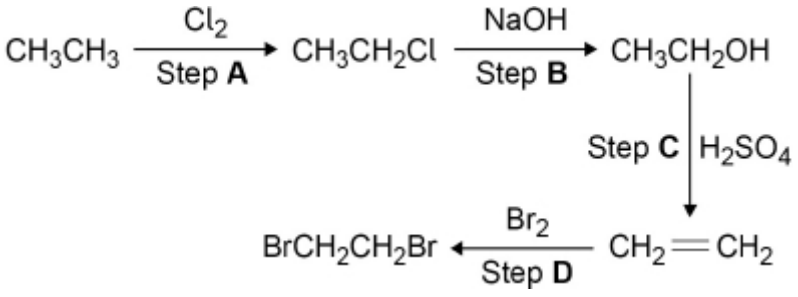
C $RCH_2\dot{C}H_2 + H_2C{=}CH_2 \longrightarrow RCH_2CH_2CH_2\dot{C}H_2$ ⬭

D $CH_3CFCl_2 \longrightarrow CH_3\dot{C}FCl + \dot{C}l$ ⬭

(Total 1 mark)

Q26.

The reaction sequence shows how CH_3CH_3 can be converted into $BrCH_2CH_2Br$



Which step occurs by nucleophilic substitution?

A Step **A** ⬭

B Step **B** ⬭

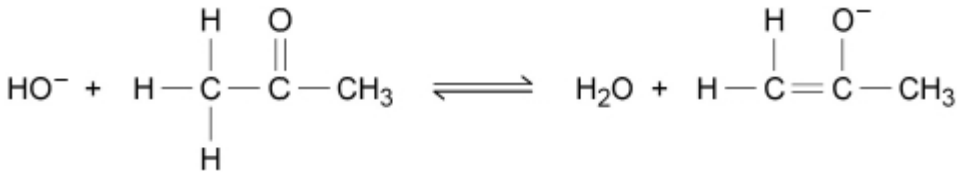
C Step **C** ⬭

D Step **D** ⬭

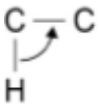
(Total 1 mark)

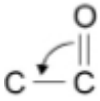
Q27.

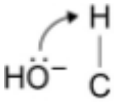
In concentrated alkali, propanone reacts with hydroxide ions to form an equilibrium mixture as shown.

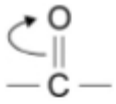


Which curly arrow does **not** appear in the mechanism of this reaction?

A  ⬭

B  ⬭

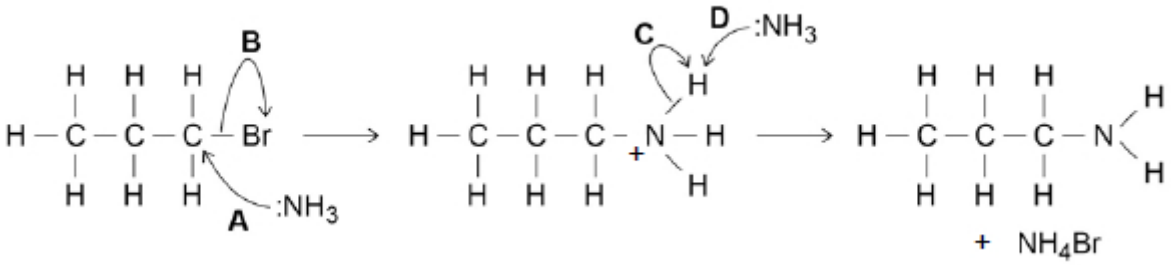
C  ⬭

D  ⬭

(Total 1 mark)

Q28.

Which of the arrows, labelled **A**, **B**, **C** or **D** in the mechanism in the diagram, is **not** correct?



A ⬭

B ⬭

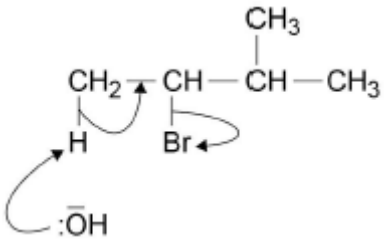
C ⬭

D ⬭

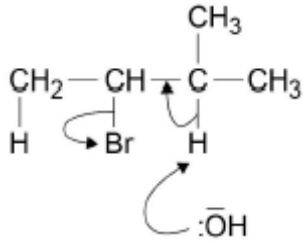
(Total 1 mark)

Q29.

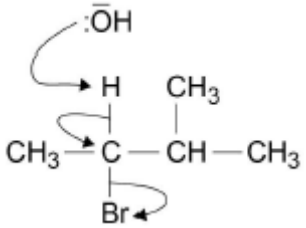
Which of the following is a correct mechanism for the formation of 2-methylbut-2-ene from 2-bromo-3-methylbutane?

A 

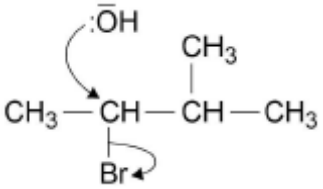
○

B 

○

C 

○

D 

○

(Total 1 mark)

Q30. The following table gives the names and structures of some structural isomers with the molecular formula C_5H_{10}.

	Name of isomer	**Structure**
Isomer **1**	pent-2-ene	$CH_3CH = CHCH_2CH_3$
Isomer **2**	cyclopentane	
Isomer **3**	3-methylbut-1-ene	$(CH_3)_2CHCH = CH_2$
Isomer **4**	2-methylbut-2-ene	$(CH_3)_2C = CHCH_3$
Isomer **5**	2-methylbut-1-ene	$H_2C = C(CH_3)CH_2CH_3$

(a) Isomer **1** exists as E and Z stereoisomers.

(i) State the meaning of the term **stereoisomers**.

_____

_____

_____

_____

_____

(2)

(ii) Draw the structure of the E stereoisomer of Isomer **1**.

(1)

(b) A chemical test can be used to distinguish between separate samples of Isomer **1** and Isomer **2**.

Identify a suitable reagent for the test.
State what you would observe with Isomer **1** and with Isomer **2**.

Reagent _____

Observation with Isomer **1** _____

_____

Observation with Isomer **2** _____

_____

(3)

(c) Use **Table A** on the Data Sheet when answering this question.
Isomer **3** and Isomer **4** have similar structures.

(i) State the infrared absorption range that shows that Isomer **3** and Isomer **4** contain the same functional group.

_____

_____

(1)

(ii) State **one** way that the infrared spectrum of Isomer 3 is different from the infrared spectrum of Isomer **4**.

_____

_____

_____

(1)

(d) Two alcohols are formed by the hydration of Isomer **4**.

Draw the **displayed formula** for the alcohol formed that is oxidised readily by acidified potassium dichromate(VI).

(1)

(e) Isomer **4** reacts with hydrogen bromide to give two structurally isomeric bromoalkanes.

(i) Name and outline a mechanism for the reaction of Isomer **4** with hydrogen bromide to give 2-bromo-2-methylbutane as the major product.

$$(CH_3)_2C = CHCH_3 + HBr \longrightarrow (CH_3)_2CBrCH_2CH_3$$

Name of mechanism _____

Mechanism

(5)

(ii) The minor product in this reaction mixture is 2-bromo-3-methylbutane.

Explain why this bromoalkane is formed as a minor product.

_____

_____

_____

_____

_____

(2)

(f) Name and outline a mechanism for the following reaction to form Isomer **5**.
State the role of the hydroxide ion in this reaction.

$$(CH_3)_2CBrCH_2CH_3 + KOH \longrightarrow H_2C = C(CH_3)CH_2CH_3 + KBr + H_2O$$

Name of mechanism _____

Mechanism

Role of hydroxide ion _____

(5)

(Total 21 marks)

Q31.

The mechanism for the reaction of methane with fluorine is a free-radical substitution similar to the chlorination of methane.

(a) Outline the following steps in the mechanism for the reaction of methane with fluorine to form fluoromethane, CH_3F

Initiation step

_____

First propagation step

_____

Second propagation step

_____

A termination step

_____

(4)

(b) Write an overall equation for the reaction of fluorine with fluoromethane to form tetrafluoromethane.

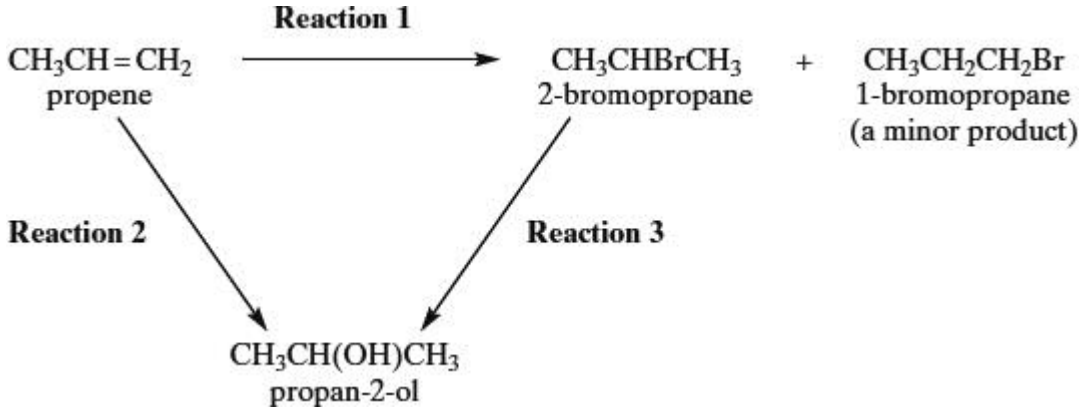
_____

(1)

(Total 5 marks)

Q32.

Consider the following reaction scheme.



(a) (i) Name the mechanism for **Reaction 1**.

_____

(ii) Explain why 1-bromopropane is only a minor product in **Reaction 1**.

_____

_____

_____

(3)

(b) Give a suitable reagent and state the essential conditions required for **Reaction 3**.

Reagent _____

Conditions _____

(2)

(c) The reagent used for **Reaction 3** can also be used to convert 2-bromopropane into propene. State the different conditions needed for this reaction.

_____

(1)

(d) **Reaction 2** proceeds in two stages.

Stage 1 $CH_3CH{=}CH_2 + H_2SO_4 \rightarrow CH_3CH(OSO_2OH)CH_3$

Stage 2 $CH_3CH(OSO_2OH)CH_3 + H_2O \rightarrow CH_3CH(OH)CH_3 + H_2SO_4$

(i) Name the class of alcohols to which propan-2-ol belongs.

_____

(ii) Outline a mechanism for Stage 1 of **Reaction 2,** using concentrated sulphuric acid.

(iii) State the overall role of the sulphuric acid in **Reaction 2**.

_____

(6)

(Total 12 marks)

3.6 Periodicity - Period 3 Elements and their Oxides

Q1.

(a) Explain why the atomic radii of the elements decrease across Period 3 from sodium to chlorine.

_____

_____

_____

_____

_____

_____

(2)

(b) Explain why the melting point of sulfur (S_8) is greater than that of phosphorus (P_4).

_____

_____

_____

_____

_____

_____

(2)

(c) Explain why sodium oxide forms an alkaline solution when it reacts with water.

_____

_____

_____

_____

_____

(2)

(d) Write an ionic equation for the reaction of phosphorus(V) oxide with an excess of sodium hydroxide solution.

_____

(1)

(Total 7 marks)

Q2.

(a) State and explain the trend in electronegativities across Period 3 from sodium to sulfur.

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Explain why the oxides of the Period 3 elements sodium and phosphorus have different melting points. In your answer you should discuss the structure of and bonding in these oxides, and the link between electronegativity and the type of bonding.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(c) A chemical company has a waste tank of volume 25 000 dm^3. The tank is full of phosphoric acid (H_3PO_4) solution formed by adding some unwanted phosphorus(V) oxide to water in the tank.

A 25.0 cm^3 sample of this solution required 21.2 cm^3 of 0.500 mol dm^{-3} sodium hydroxide solution for complete reaction.

Calculate the mass, in kg, of phosphorus(V) oxide that must have been added to the water in the waste tank.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 15 marks)

Q3.

This question is about some Period 3 elements and their oxides.

(a) Describe what you would observe when, in the absence of air, magnesium is heated strongly with water vapour at temperatures above 373 K.
Write an equation for the reaction that occurs.

Observations _____

_____

_____

_____

_____

Equation _____

(3)

(b) Explain why magnesium has a higher melting point than sodium.

_____

_____

_____

_____

(Extra space) _____

_____

(2)

(c) State the structure of, and bonding in, silicon dioxide.
Other than a high melting point, give **two** physical properties of silicon dioxide that are characteristic of its structure and bonding.

Structure _____

Bonding _____

Physical property 1 _____

Physical property 2 _____

(4)

(d) Give the formula of the species in a sample of solid phosphorus(V) oxide.
State the structure of, and describe fully the bonding in, this oxide.

Formula _____

Structure _____

Bonding _____

_____

_____

_____

(4)

(e) Sulfur(IV) oxide reacts with water to form a solution containing ions.

Write an equation for this reaction.

_____

(1)

(f) Write an equation for the reaction between the acidic oxide, phosphorus(V) oxide, and the basic oxide, magnesium oxide.

_____

(1)

(Total 15 marks)

Q4.

Consider the following oxides.

Na_2O, MgO, Al_2O_3, SiO_2, P_4O_{10}, SO_3

(a) Identify one of the oxides from the above which

(i) can form a solution with a pH less than 3 _____

(ii) can form a solution with a pH greater than 12 _____

(2)

(b) Write an equation for the reaction between

(i) MgO and HNO_3

_____

(ii) SiO_2 and $NaOH$

_____

(iii) Na_2O and H_3PO_4

_____

(3)

(c) Explain, in terms of their type of structure and bonding, why P_4O_{10} can be vaporised by gentle heat but SiO_2 cannot.

_____

_____

_____

_____

(4)

(Total 9 marks)

Q5.

(a) The melting points of some of the oxides formed by Period 3 elements are given in a random order below.

Oxide	**A**	**B**	**C**	**D**	**E**
T_m/°C	2852	–73	1610	1275	300

(i) Using the letters **A** to **E,** give **two** oxides which have simple molecular structures.

Explain your answer.

Oxide 1 _____

Oxide 2 _____

Explanation _____

_____

(ii) Give a simple chemical test which could be used to show which of the oxides in the table is sodium oxide. State the observation you would make.

Chemical test _____

_____

Observation _____

(6)

(b) The base calcium oxide can be used to remove sulfur dioxide from flue-gases produced when fossil fuels are burnt in coal-fired power stations. Calcium oxide is produced when calcium carbonate, is decomposed by heat.

(i) Write an equation for the action of heat on calcium carbonate.

_____

(ii) Identify the product formed when sulfur dioxide reacts with calcium oxide.

_____

(iii) Despite the additional cost, operators of power stations are encouraged to remove the sulfur dioxide from flue-gases. Explain why this may not be environmentally beneficial.

_____

_____

(4)

(Total 10 marks)

Q6.

There is a link between the properties of the oxides of the Period 3 elements and their structure and bonding. The table below shows the melting points of the oxides of some Period 3 elements.

	Na_2O	SiO_2	P_4O_{10}
T_m/K	1548	1883	573

(a) In terms of crystal structure and bonding, explain in each case why the melting points of sodium oxide and silicon dioxide are high.

Na_2O _____

_____

_____

SiO_2 _____

_____

_____

(4)

(b) Predict whether the melting point of lithium oxide is higher than, the same as, or lower than the melting point of sodium oxide and explain your prediction.

Prediction _____

Explanation _____

_____

_____

(3)

(c) Phosphorus(V) oxide has a lower melting point than sodium oxide.

(i) State the structure of and bonding in phosphorus(V) oxide.

_____

_____

_____

(2)

(ii) Explain why the melting point of phosphorus(V) oxide is low.

_____

_____

(1)

(d) Separate samples of phosphorus(V) oxide and sodium oxide were reacted with water.
In each case, predict the pH of the solution formed and write an equation for the reaction.

pH with P_4O_{10} _____

Equation _____

pH with Na_2O _____

Equation _____

(4)

(e) Write an equation for the reaction between Na_2O and P_4O_{10}
State the general type of reaction illustrated by this example.

Equation _____

Reaction type _____

(2)

(Total 16 marks)

3.2 Periodicity - Physical Properties of Period 3 Elements

Q1.

(a) Explain why the atomic radii of the elements decrease across Period 3 from sodium to chlorine.

_____

_____

_____

_____

_____

_____

(2)

(b) Explain why the melting point of sulfur (S_8) is greater than that of phosphorus (P_4).

_____

_____

_____

_____

_____

_____

(2)

(c) Explain why sodium oxide forms an alkaline solution when it reacts with water.

_____

_____

_____

_____

_____

(2)

(d) Write an ionic equation for the reaction of phosphorus(V) oxide with an excess of sodium hydroxide solution.

_____

(1)

(Total 7 marks)

Q2.

(a) State the meaning of the term *first ionisation energy* of an atom.

_____

_____

(2)

(b) Complete the electron arrangement for the Mg^{2+} ion.

$1s^2$ _____

(1)

(c) Identify the block in the Periodic Table to which magnesium belongs.

_____

(1)

(d) Write an equation to illustrate the process occurring when the **second** ionisation energy of magnesium is measured.

_____

(1)

(e) The Ne atom and the Mg^{2+} ion have the same number of electrons. Give **two** reasons why the first ionisation energy of neon is lower than the third ionisation energy of magnesium.

Reason 1 _____

Reason 2 _____

(2)

(f) There is a general trend in the first ionisation energies of the Period 3 elements, Na – Ar

(i) State and explain this general trend.

Trend _____

Explanation _____

_____

_____

(ii) Explain why the first ionisation energy of sulphur is lower than would be predicted from the general trend.

_____

_____

_____

(5)

(Total 12 marks)

Q3.

(a) When aluminium is added to an aqueous solution of copper(II) chloride, $CuCl_2$, copper metal and aluminium chloride, $AlCl_3$, are formed. Write an equation to represent this reaction.

_____

(1)

(b) (i) State the general trend in the first ionisation energy of the Period 3 elements from Na to Ar.

_____

(ii) State how, and explain why, the first ionisation energy of aluminium does not follow this general trend.

_____

_____

_____

_____

(4)

(c) Give the equation, including state symbols, for the process which represents the second ionisation energy of aluminium.

_____

(1)

(d) State and explain the trend in the melting points of the Period 3 metals Na, Mg and Al.

Trend _____

Explanation _____

_____

_____

(3)

(Total 9 marks)

Q4.

(a) State the meaning of the term *electronegativity*.

_____

_____

(2)

(b) State and explain the trend in electronegativity values across Period 3 from sodium to chlorine.

Trend _____

Explanation _____

(3)

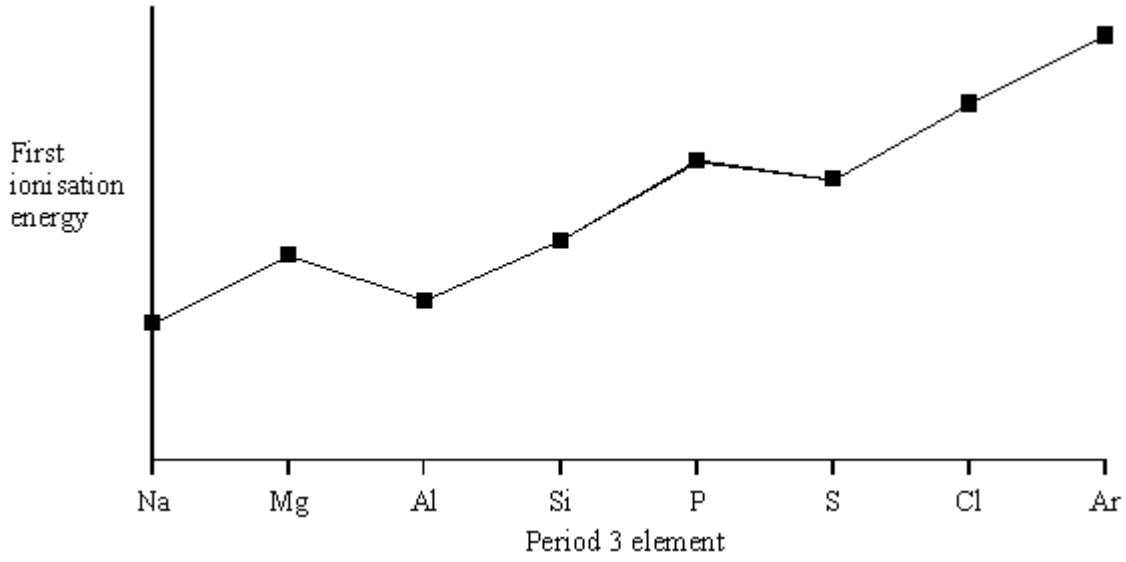
(c) What is meant by the term *first ionisation energy*?

_____

_____

(2)

(d) The diagram below shows the variation in first ionisation energy across Period 3.



(i) What is the maximum number of electrons that can be accommodated in an s sub-level?

_____

_____

(ii) What evidence from the diagram supports your answer to part (d)(i)?

_____

_____

(iii) What evidence from the diagram supports the fact that the 3p sub-level is higher in energy than the 3s?

_____

_____

(iv) What evidence from the diagram supports the fact that no more than three unpaired electrons can be accommodated in the 3p sub-level?

_____

_____

_____

(5)

(Total 12 marks)

Q5.

(a) **P** and **Q** are oxides of Period 3 elements.

Oxide **P** is a solid with a high melting point. It does not conduct electricity when solid but does conduct when molten or when dissolved in water. Oxide **P** reacts with water forming a solution with a high pH.

Oxide **Q** is a colourless gas at room temperature. It dissolves in water to give a solution with a low pH.

(i) Identify **P**. State the type of bonding present in **P** and explain its electrical conductivity. Write an equation for the reaction of **P** with water.

(ii) Identify **Q**. State the type of bonding present in **Q** and explain why it is a gas at room temperature. Write an equation for the reaction of **Q** with water.

(9)

(b) **R** is a hydroxide of a Period 3 element. It is insoluble in water but dissolves in both aqueous sodium hydroxide and aqueous sulphuric acid.

(i) Give the name used to describe this behaviour of the hydroxide.

(ii) Write equations for the reactions occurring.

(iii) Suggest why **R** is insoluble in water.

(6)

(Total 15 marks)

Q6.

This question is about Period 3 of the Periodic Table.

(a) Deduce which of Na^+ and Mg^{2+} is the smaller ion.
Explain your answer.

Smaller ion _____

Explanation _____

_____

_____

_____

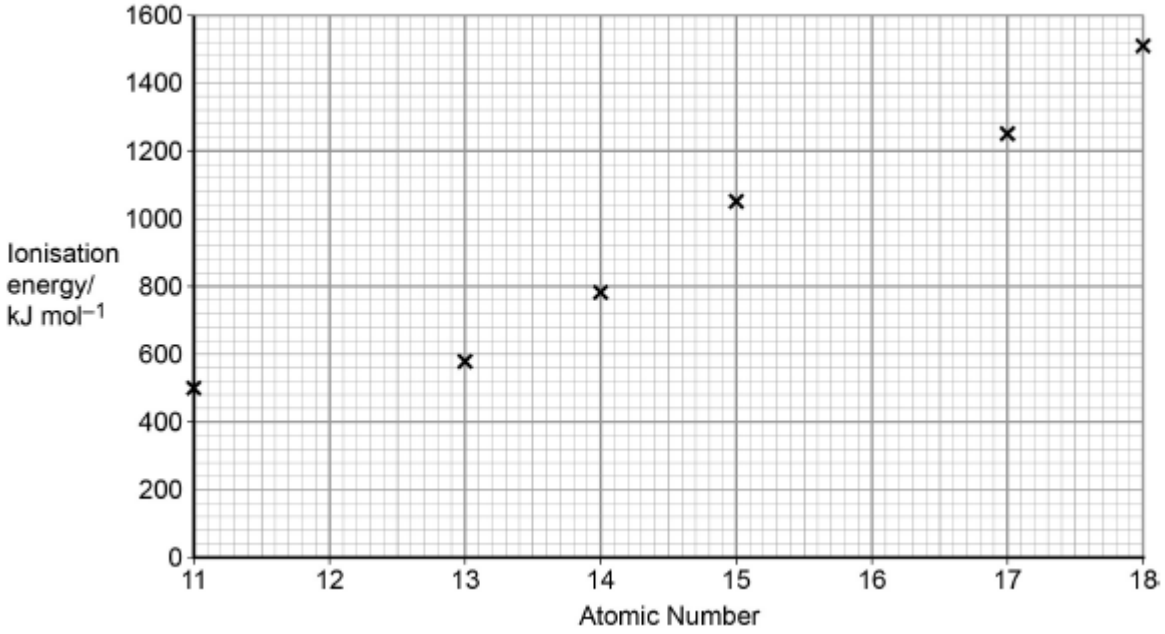
(2)

(b) Write an equation to represent the process that occurs when the first ionisation energy for sodium is measured.

_____

(1)

(c) The first ionisation energies of some Period 3 elements are shown in the following graph.



Complete the graph by plotting the approximate first ionisation energy values for magnesium and sulfur.

Explain why the first ionisation energy of sulfur is different from that of phosphorus.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

Additional Reading/ Supporting Resources

Please record all your additional reading on the attached additional reading log.

Topic 1: Using Plastics in the Body

Available at: https://www.stem.org.uk/system/files/elibrary-resources/2017/05/Using%20plastics%20in%20the%20body.pdf

This Catalyst article looks at how scientists are learning to use polymers for many medical applications, including implants, bone repairs and reduction in infections.

Topic 2: Catching a Cheat

Available at: https://www.stem.org.uk/system/files/elibrary-resources/2017/03/Catching%20a%20cheat.pdf

This Catalyst article looks at analytical chemists who are involved in many kinds of testing, including drug testing to catch cheats in sport.

Topic 3: Diamond: More than just a gemstone

Available at https://www.stem.org.uk/system/files/elibrary-resources/2017/02/Diamond%20more%20than%20just%20a%20gemstone.pdf

This Catalyst article looks at diamond and graphite which are allotropes of carbon. Their properties, which depend on the bonding between the carbon atoms, are also examined.

Topic 4: The Bizarre World of High Pressure Chemistry

Available at: https://www.stem.org.uk/system/files/elibrary-resources/2016/11/Catalyst27_1_the_bizarre_world_of_high_pressure_chemistry.pdf

This Catalyst article investigates high pressure chemistry and discovers that, when put under extreme pressure, the properties of a material may change dramatically.

Topic 5: Microplastics and the Oceans

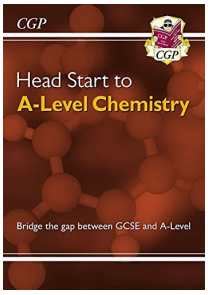
Available at: https://www.stem.org.uk/system/files/elibrary-resources/2016/11/Catalyst27_1_microplastics_%20and_the_oceans.pdf

This Catalyst article looks at microplastics. Microplastics are tiny particles of polymer used in many products. They have been found to be an environmental pollutant especially in oceans.

You can find archived copies of Catalyst magazine here for further reading on a wide range of topics.

https://catalyst-magazine.org/archive/

Book Recommendations

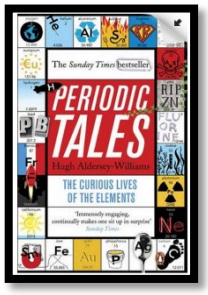


Head Start to A-Level Chemistry

ISBN: 9781782942801

This book goes over crucial topics from GCSE and includes detailed explanations of important A-level topics.

Periodic Tales: The Curious Lives of the Elements (Paperback) Hugh Aldersey-Williams

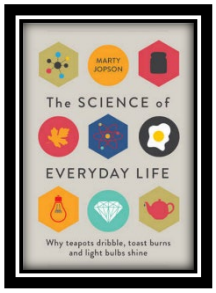


ISBN-10: 0141041455

http://bit.ly/pixlchembook1

This book covers the chemical elements, where they come from and how they are used. There are loads of fascinating insights into uses for chemicals you would have never even thought about.

The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine (Hardback) Marty Jopson

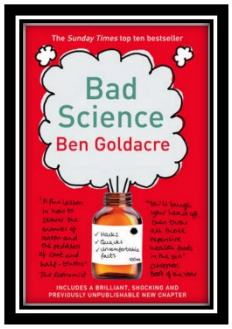


ISBN-10: 1782434186

http://bit.ly/pixlchembook2

The title says it all really, lots of interesting stuff about the things around you home!

Bad Science (Paperback) Ben Goldacre

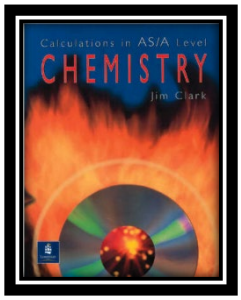


ISBN-10: 000728487X

http://bit.ly/pixlchembook3

Here Ben Goldacre takes apart anyone who published bad / misleading or dodgy science – this book will make you think about everything the advertising industry tries to sell you by making it sound 'sciency'.

Calculations in AS/A Level Chemistry (Paperback) Jim Clark



ISBN-10: 0582411270

http://bit.ly/pixlchembook4

If you struggle with the calculations side of chemistry, this is the book for you. Covers all the possible calculations you are ever likely to come across. Brought to you by the same guy who wrote the excellent chemguide.co.uk website.

Additional Reading Log:

Additional Reading Title	Dates?	Points of interest	How does it link to the course?

There are a number of websites that will be useful to you now and throughout your time studying A-level Chemistry.

These include:

Physics and Maths Tutor

https://www.physicsandmathstutor.com/chemistry-revision/a-level-aqa/

This website allows you to access a range of resources, from course notes, flashcards and tutorial videos to exam question packs and mark schemes for every topic covered at A-level.

Chemguide

https://www.chemguide.co.uk/

This website has detailed notes on all areas of the A-level course and also identifies and addresses common misconceptions.

Seneca Learning

https://senecalearning.com/en-GB/

This website has many subjects linked to the specific exam boards which you can use to support your knowledge. It allows you to study and then test the information you have learnt.

Isaac Physics

Mastering essential pre-university chemistry — Isaac Physics

This website is useful for physical chemistry, particularly the calculation topics.