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9701/41

October/November 2009

1 hour 45 minutes

Candidates answer on the Question Paper.

Additional Materials: Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer **all** questions.

You may lose marks if you do not show your working or if you do not use appropriate units.

A Data Booklet is provided.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
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7	
8	
9	
Total	

This document consists of **19** printed pages and **1** blank page.

Section A

For
Examiner's
UseAnswer **all** questions in the spaces provided.

- 1 (a) The Group IV oxides CO_2 and SiO_2 differ widely in their physical properties. Describe these differences and explain them in terms of their structure and bonding.

.....
.....
.....
..... [3]

- (b) What are the properties of a *ceramic* material? Why is silicon(IV) oxide very suitable as a component of ceramics?

.....
.....
.....
..... [2]

- (c) Lead(II) oxide reacts with both acids and bases.

- (i) What is the name given to oxides that have this property?

.....

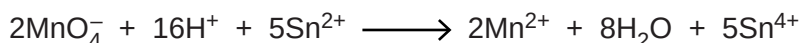
- (ii) Write a balanced equation for the reaction between PbO and NaOH .

..... [2]

(d) Tin forms an oxide, **A**, that contains the metal in both oxidation states II and IV. The formula of **A** can be found by the following method.

- A sample of **A** was dissolved in $\text{H}_2\text{SO}_4(\text{aq})$, producing solution **B**, which was a mixture of tin(II) sulfate and tin(IV) sulfate.
- A 25.0cm^3 sample of solution **B** was titrated with $0.0200\text{ mol dm}^{-3}\text{ KMnO}_4$. 13.5cm^3 of KMnO_4 was required to reach the end-point.
- Another 25.0cm^3 sample of solution **B** was stirred with an excess of powdered zinc. This converted all the tin into tin(II). The excess of zinc powder was filtered off and the filtrate was titrated with $0.0200\text{ mol dm}^{-3}\text{ KMnO}_4$, as before. This time 20.3cm^3 of KMnO_4 was required to reach the end-point.

The equation for the reaction occurring during the titration is as follows.



(i) Write a balanced equation for the reaction between Zn and Sn^{4+} .

.....

(ii) Use the *Data Booklet* to calculate the $E^\ominus$ values for the reactions between

- Zn and Sn^{4+} , ...
- MnO_4^- and Sn^{2+}

(iii) Use the results of the two titrations to calculate

- the number of moles of Sn^{2+} in the first titration sample,

.....
.....

- the number of moles of Sn^{2+} in the second titration sample.

.....
.....

(iv) Use the results of your calculation in (iii) to deduce the $\text{Sn}^{2+}/\text{Sn}^{4+}$ ratio in the oxide **A**, and hence suggest the formula of **A**.

.....
.....
.....

[8]

- (e) A major use of tin is to make 'tin plate', which is composed of thin sheets of mild steel electroplated with tin, for use in the manufacture of food and drinks cans. A tin coating of 1.0×10^{-5} m thickness is often used.

- (i) Calculate the volume of tin needed to coat a sheet of steel $1.0\text{ m} \times 1.0\text{ m}$ to this thickness, on one side only.

.....

.....

- (ii) Calculate the number of moles of tin that this volume represents.
[The density of tin is 7.3 g cm^{-3} .]

.....

.....

.....

- (iii) The solution used for electroplating contains Sn^{2+} ions. Calculate the quantity of electricity in coulombs needed to deposit the amount of tin you calculated in (ii).

.....

.....

.....

[4]

[Total: 19]

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- 2 Calcium chloride, CaCl_2 , is an important industrial chemical used in refrigeration plants, for de-icing roads and for giving greater strength to concrete.

For
Examiner's
Use

- (a) Show by means of an equation what is meant by the lattice energy of calcium chloride.

..... [1]

- (b) Suggest, with an explanation, how the lattice energies of the following salts might compare in magnitude with that of calcium chloride.

- (i) calcium fluoride, CaF_2

.....
.....

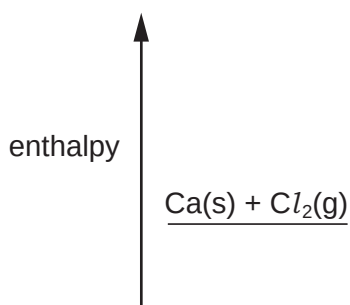
- (ii) calcium sulfide, CaS

.....
.....

[3]

- (c) Use the following data, together with additional data from the *Data Booklet*, to calculate the lattice energy of CaCl_2 .

standard enthalpy change of formation of CaCl_2	-796 kJ mol^{-1}
standard enthalpy change of atomisation of Ca(s)	$+178 \text{ kJ mol}^{-1}$
electron affinity per mole of chlorine atoms	-349 kJ mol^{-1}



lattice energy = ... kJ mol^{-1} [3]

- (d) When a solution of CaCl_2 is added to a solution of the dicarboxylic acid, malonic acid, the salt calcium malonate is precipitated as a white solid. The solid has the following composition by mass: Ca, 28.2%; C, 25.2%; H, 1.4%; O, 45.2%.

For
Examiner's
Use

(i) Calculate the empirical formula of calcium malonate from these data.

(ii) Suggest the structural formula of malonic acid.

[3]

[Total: 10]

- 3 One major difference between the properties of compounds of the transition elements and those of other compounds is that the compounds of the transition elements are often coloured.

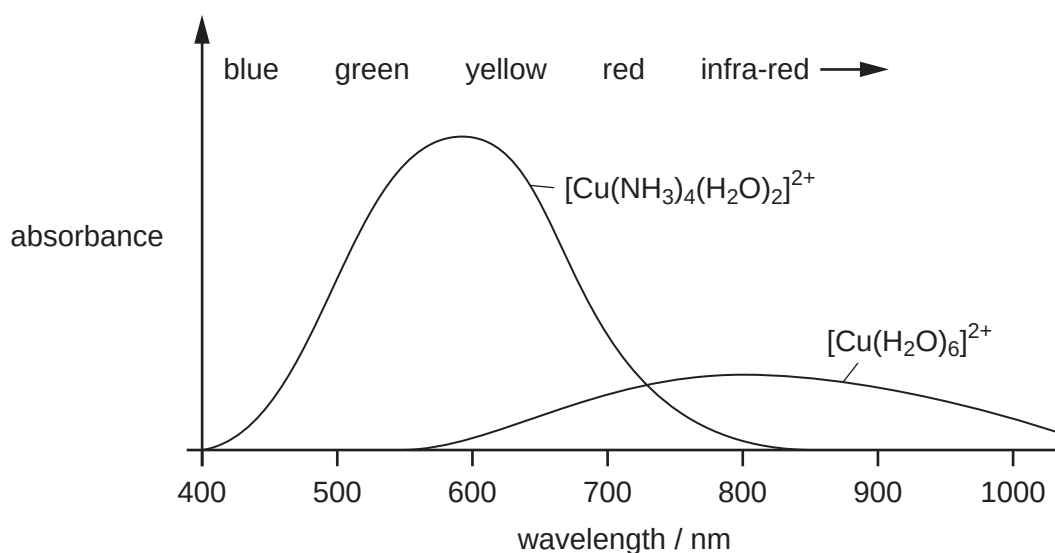
For
Examiner's
Use

(a) Explain in detail why many transition element compounds are coloured.

.....

 [3]

(b) The following graph shows the absorption spectrum of two complexes containing copper.



(i) State the colours of the following complex ions.

$[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$

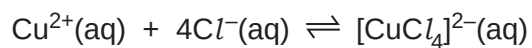
$[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$

(ii) Using the spectra above give **two** reasons why the colour of the $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$ ion is deeper (more intense) than that of the $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ ion.

.....

(iii) Predict the absorption spectrum of the complex $[\text{Cu}(\text{NH}_3)_2(\text{H}_2\text{O})_4]^{2+}$, and sketch this spectrum on the above graph. [6]

- (c) Copper forms a complex with chlorine according to the following equilibrium.



For
Examiner's
Use

- (i) Write an expression for the equilibrium constant, K_c , for this reaction, stating its units.

$K_c =$ units

- (ii) The numerical value of K_c is 4.2×10^5 .
Calculate the $[\text{CuCl}_4]^{2-}/[\text{Cu}^{2+}]$ ratio when $[\text{Cl}^{-}] = 0.20 \text{ mol dm}^{-3}$.

.....

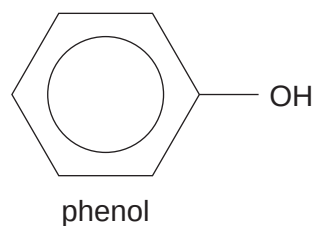
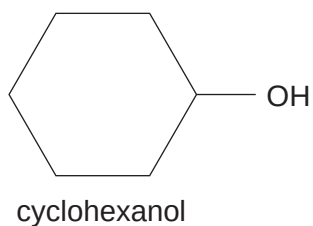
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[3]

[Total: 12]

- 4 Cyclohexanol and phenol are both solids with low melting points that are fairly soluble in water.

For
Examiner's
Use



- (a) Explain why these compounds are more soluble in water than their parent hydrocarbons cyclohexane and benzene.

.....
.....
..... [2]

- (b) Explain why phenol is more acidic than cyclohexanol.

.....
.....
..... [2]

- (c) For **each** of the following reagents, draw the structural formula of the product obtained for **each** of the two compounds. If no reaction occurs write **no reaction** in the box.

For
Examiner's
Use

reagent	product with cyclohexanol	product with phenol
Na(s)		
NaOH(aq)		
Br ₂ (aq)		
I ₂ (aq) + OH ⁻ (aq)		
an excess of acidified Cr ₂ O ₇ ²⁻ (aq)		

[7]

- (d) Choose **one** of the above five reagents that could be used to distinguish between cyclohexanol and phenol. Describe the observations you would make with each compound.

reagent

observation with cyclohexanol

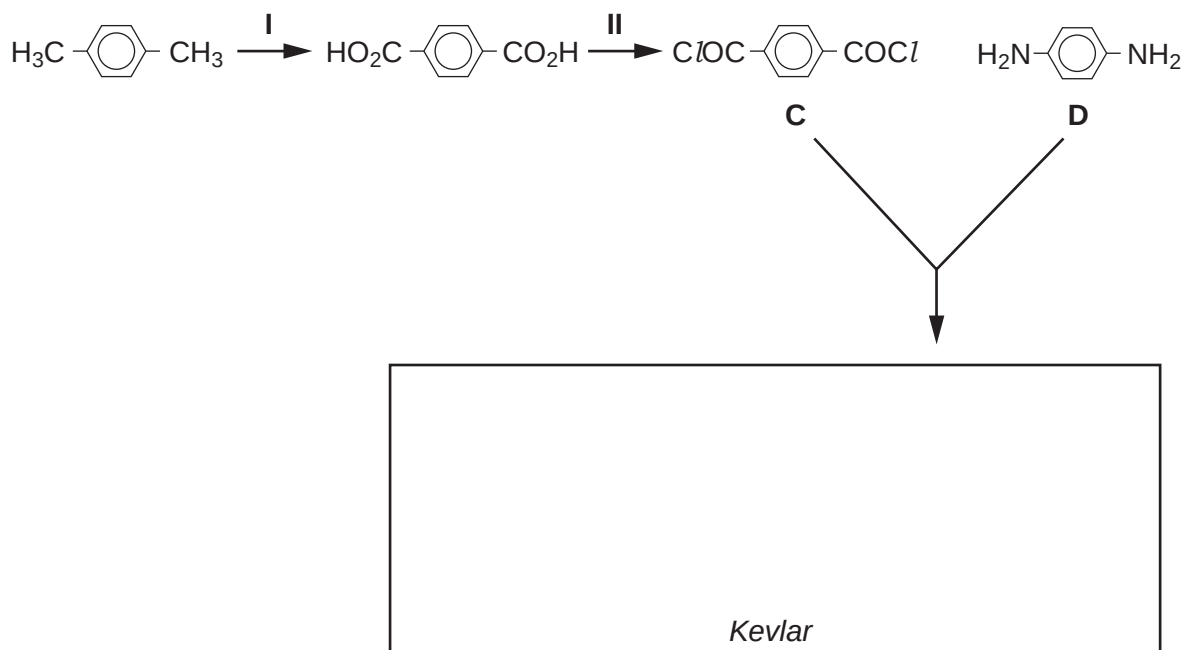
observation with phenol

[2]

[Total: 13]

- 5 *Kevlar* is a tough polyamide used in bullet-proof vests and high-specification bicycle tyres. It can be manufactured by the following process.

For
Examiner's
Use



- (a) (i) Suggest reagents and conditions for

reaction I, ...

reaction II.

- (ii) Draw the structural formula of **one** repeat unit of *Kevlar* in the box above.

[4]

- (b) The di-acid chloride **C** reacts with a variety of reagents. Suggest the structural formulae of the products of the reaction of **C** with

(i) CH_3NH_2 ,

(ii) $\text{HOCH}_2\text{CH}_2\text{OH}$.

[3]

- (c) The diamine **D** also reacts with a variety of reagents. Suggest the structural formulae of the products of the reaction of **D** with

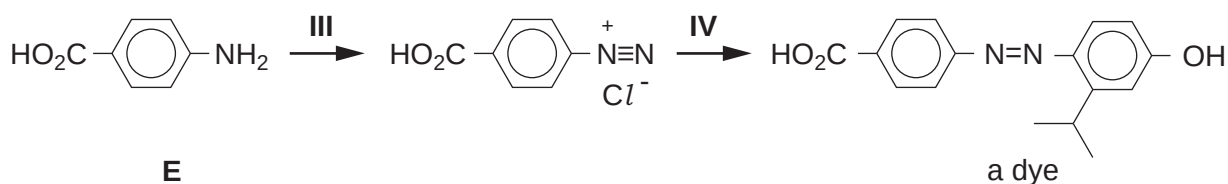
For
Examiner's
Use

(i) HCl(aq) ,

(ii) $\text{Br}_2(\text{aq})$.

[3]

- (d) 4-aminobenzoic acid, **E**, is a useful intermediate for making dyes.



Suggest reagents and conditions for

reaction III, ...

reaction IV.

[4]

- (e) 4-aminobenzoic acid, **E**, forms a zwitterion.

(i) What is meant by the term *zwitterion*?

.....

(ii) Draw the structural formula of the zwitterion formed from 4-aminobenzoic acid.

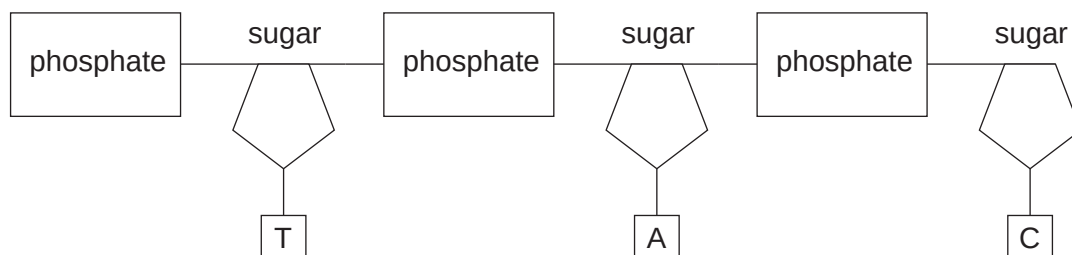
[2]

[Total: 16]

Section B

For
Examiner's
UseAnswer **all** questions in the spaces provided.

- 6 (a) The diagram shows part of one strand of DNA. Draw the complementary strand, labelling the bonds formed to the original strand, and labelling the components of the strand you draw.



[3]

- (b) Briefly describe the roles of each of the following in protein synthesis.

(i) tRNA

.....

.....

(ii) the ribosome

.....

.....

[4]

- (c) Some diseases, such as sickle cell anaemia, are caused by a single mutation in the DNA for a particular gene. This causes the haemoglobin produced to change the shape of red blood cells, reducing their efficiency in carrying oxygen.

For
Examiner's
Use

- (i) What is meant by a *mutation*?

.....

- (ii) Explain why such a mutation could alter the bonding in haemoglobin.

.....

.....

.....

.....

[4]

[Total: 11]

- 7** This question is about the modern techniques of analysis which may be used to determine molecular structures.

(a) In X-ray crystallography X-rays are diffracted by the electron clouds surrounding individual atoms in the structure.

(i) What useful information is provided by X-ray crystallography?

.....
.....

(ii) Why cannot hydrogen atoms in a structure be detected by this technique?

.....

[2]

(b) Suggest how structures of complex molecules such as enzymes, derived from X-ray crystallography, can help explain their biochemical behaviour.

.....
.....
..... [2]

(c) NMR spectroscopy, in contrast to X-ray crystallography, is frequently used to examine protons in organic molecules.

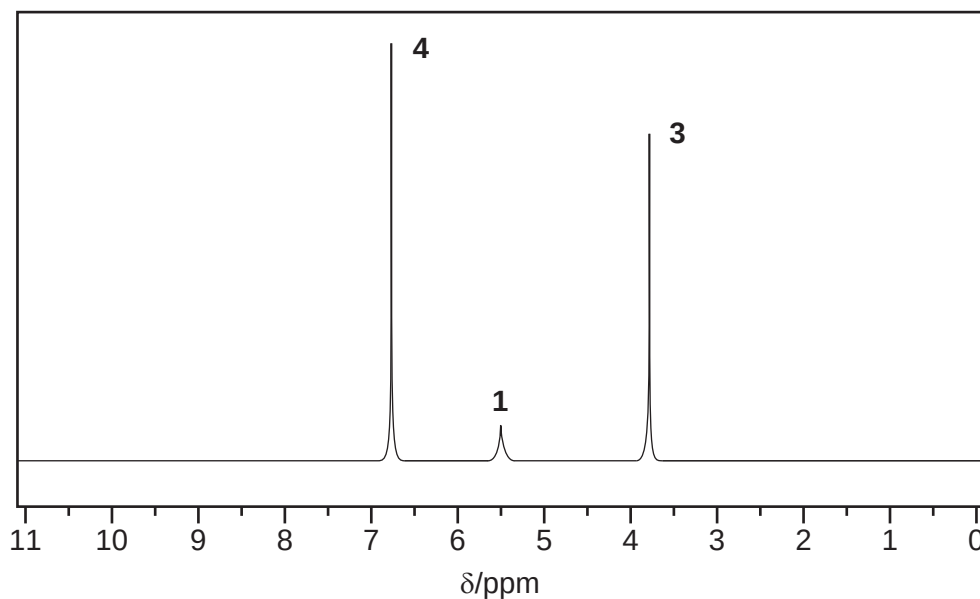
(i) What feature of protons enables their detection by NMR spectroscopy?

.....

- (ii) The NMR spectrum below was obtained from a compound **X**, $C_xH_yO_z$. In the mass spectrum of the compound, the $M : M+1$ ratio was found to be 25:2.

For
Examiner's
Use

Determine the values of x , y and z in the formula of **X** and deduce a possible structure for the compound, explaining how you arrive at your conclusion.



.....

.....

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.....

Possible structure of **X**

[6]

[Total:10]

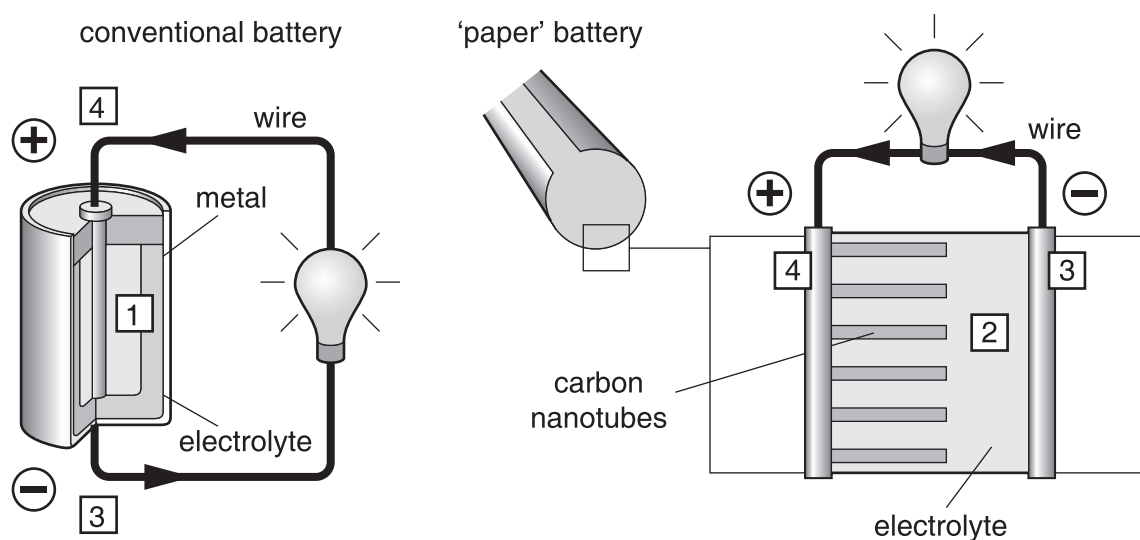
- 8 A new method of making very light, flexible batteries using nanotechnology was announced in August 2007. Read the passage and answer the questions related to it.

For
Examiner's
Use

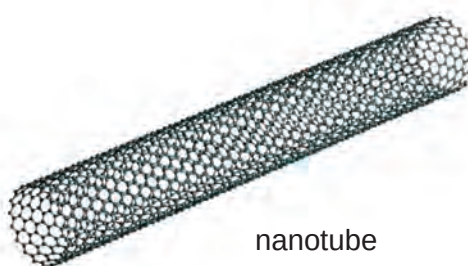
Researchers have developed a new energy-storage device that could easily be mistaken for a simple sheet of black paper. The nano-engineered battery is lightweight, ultra-thin and completely flexible. It is geared towards meeting the difficult design and energy requirements of tomorrow's gadgets, such as implantable medical devices and even vehicles.

Researchers soaked 'paper' in an ionic liquid electrolyte which carries the charge. They then treated it with aligned carbon nanotubes, which give the device its black colour.

The nanotubes act as electrodes and allow the storage devices to conduct electricity. The device, engineered to function as both a battery and a supercapacitor, can provide the long, steady power output comparable to a conventional battery, as well as a supercapacitor's quick burst of high energy. The device can be rolled, twisted, folded, or cut into shapes with no loss of strength or efficiency. The 'paper' batteries can also be stacked, like a pile of printer paper, to boost the total power output.



1. Conventional batteries produce electrons through a chemical reaction between electrolyte and metal.
2. Chemical reaction in the 'paper' battery is between electrolyte and carbon nanotubes.
3. Electrons collect on the negative terminal of a battery.
4. Electrons must flow from the negative terminal, through the external circuit to the positive terminal for the chemical reaction to continue.



nanotube

- (a) From your knowledge of the different structures of carbon, suggest which of these is used to make nanotubes.

..... [1]

- (b) Suggest a property of this structure that makes it suitable for making nanotubes.

.....
..... [1]

- (c) Carbon in its bulk form is brittle like most non-metallic solids. Suggest why the energy storage device described can be rolled into a cylinder.

.....
..... [1]

- (d) Name an example of an 'ionic *liquid* electrolyte' (not a solution).

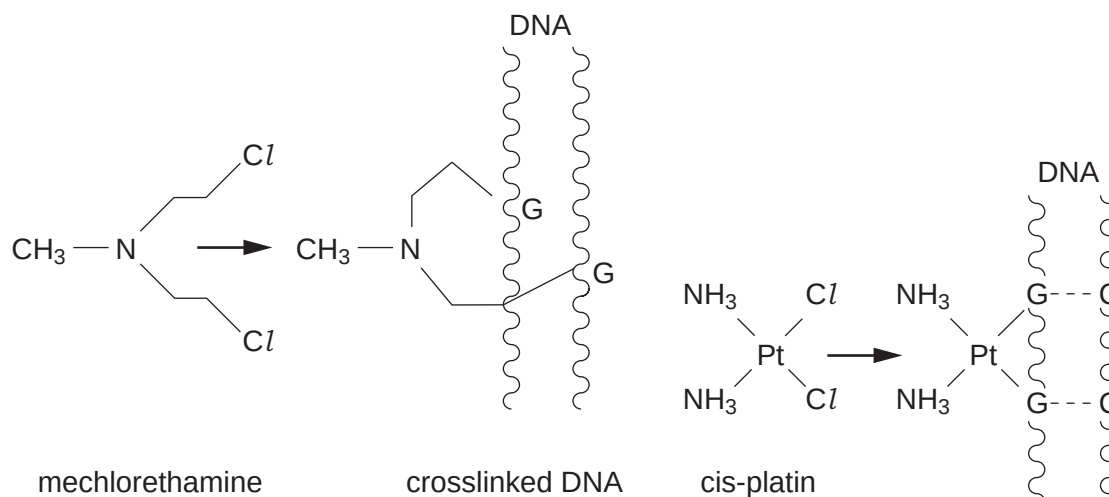
..... [1]

[Total: 4]

- 9 In recent years a great deal of research has been carried out into finding different anti-cancer drugs. Tumours, which are often symptoms of cancer, are produced when cells replicate uncontrollably. This in turn is brought about by the replication of DNA in these cells.

For
Examiner's
Use

Two anti-cancer agents are mechlorethamine and *cis*-platin. They work by binding to the DNA and preventing replication.



- (a) (i) What type of bonding attaches both anti-cancer agents to the DNA?

.....

- (ii) Suggest how **each** of the anti-cancer agents prevents replication of the DNA.

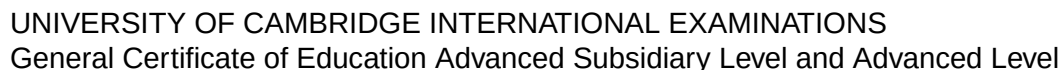
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[5]

[Total: 5]

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9701/42

October/November 2009

1 hour 45 minutes

Additional Materials: Data Booklet

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For Examiner's Use	
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This document consists of **20** printed pages and **4** blank pages.

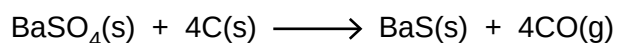
Section A

For
Examiner's
UseAnswer **all** questions in the spaces provided.

- 1 (a) Describe and explain qualitatively the trend in the solubilities of the sulfates of the Group II elements.

.....
.....
.....
.....[3]

- (b) The major ore of barium is barytes, BaSO_4 . This is very unreactive, and so other barium compounds are usually made from the sulfide, BaS . This is obtained by heating the crushed ore with carbon, and extracting the BaS with water.



When 250g of ore was heated in the absence of air with an excess of carbon, it was found that the CO produced took up a volume of 140 dm^3 at 450 K and 1 atm.

- (i) Calculate the number of moles of CO produced.

.....

- (ii) Calculate the number of moles of BaSO_4 in the 250g sample of the ore.

.....

- (iii) Calculate the percentage by mass of BaSO_4 in the ore.

.....

[4]

- (c) (i) Use the following data and data from the *Data Booklet* to construct a Born-Haber cycle and calculate the lattice energy of BaS.

For
Examiner's
Use

standard enthalpy change of formation of BaS(s)	-460 kJ mol^{-1}
standard enthalpy change of atomisation of Ba(s)	$+180 \text{ kJ mol}^{-1}$
standard enthalpy change of atomisation of S(s)	$+279 \text{ kJ mol}^{-1}$
electron affinity of the sulfur atom	-200 kJ mol^{-1}
electron affinity of the S^- ion	$+640 \text{ kJ mol}^{-1}$

lattice energy = ... kJ mol^{-1}

- (ii) Explain whether the magnitude of the lattice energy of BaS is likely to be greater or less than that of BaO.

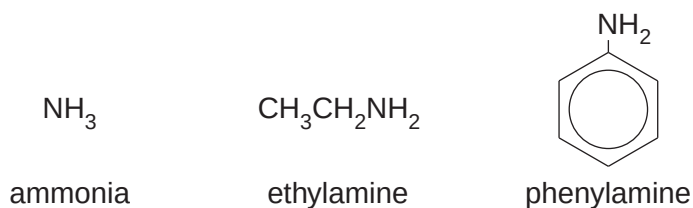
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[4]

[Total: 11]

- 2 (a) Describe and explain how the basicities of ammonia, ethylamine and phenylamine differ.

For
Examiner's
Use



.....

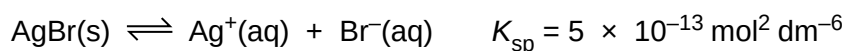
 [3]

- (b) Describe how the use of aqueous silver nitrate and aqueous ammonia can distinguish between aqueous solutions containing chloride, bromide or iodide ions by filling in the following table.

halide	observation when $\text{AgNO}_3(\text{aq})$ is added	observation when dilute $\text{NH}_3(\text{aq})$ is added	observation when concentrated $\text{NH}_3(\text{aq})$ is added
chloride			
bromide			
iodide			

[3]

- (c) Silver bromide is sparingly soluble in water.



- (i) Calculate $[\text{Ag}^+(\text{aq})]$ in a saturated aqueous solution of AgBr.

$$[\text{Ag}^+(\text{aq})] = \dots \text{ mol dm}^{-3}$$

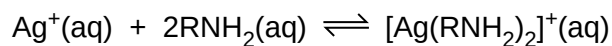
- (ii) State and explain whether AgBr will be less or more soluble in 0.1 mol dm^{-3} KBr than it is in pure water.

.....

[2]

(d) Silver ions form complexes with ammonia and with amines.

For
Examiner's
Use



(i) Write an expression for the K_c for this reaction, and state its units.

$K_c =$ units

K_c has the numerical value of 1.7×10^7 when $\text{R} = \text{H}$.

(ii) Using your expression for K_c calculate the $[\text{NH}_3(\text{aq})]$ needed to change the $[\text{Ag}^+(\text{aq})]$ in a 0.10 mol dm^{-3} solution of silver nitrate to the value that you calculated in (c)(i).

$[\text{NH}_3(\text{aq})] =$ mol dm^{-3}

(iii) Explain whether you would expect the K_c for the reaction where $\text{R} = \text{C}_2\text{H}_5$ to be greater or less than that for the reaction where $\text{R} = \text{H}$.

.....

.....

[5]

[Total: 13]

3 Iron metal and its compounds are useful catalysts in certain reactions.

For
Examiner's
Use

- (a) **Apart from its catalytic activity**, state **two** properties of iron or its compounds that show that it is a transition element.

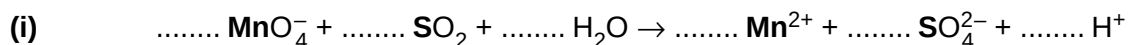
.....
[2]

- (b) You are provided with a solution of KMnO_4 of known concentration in a burette. Outline how you could use this solution to find out the concentration of $\text{Fe}^{2+}(\text{aq})$ in a solution. You should include relevant equations for any reactions you describe.

.....

[4]

- (c) For each of the following equations, write the oxidation number of the element printed **in bold** underneath its symbol, and balance the equation by adding appropriate numbers before each species.



oxidation numbers:

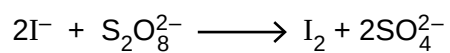


oxidation numbers:

[6]

- (d) Outline the role that Fe^{3+} ions play in catalysing the reaction between iodide ions and peroxydisulfate(VI) ions.

For
Examiner's
Use



.....

.....

.....[2]

[Total: 14]

- 4 (a) What is meant by the term *bond energy*?

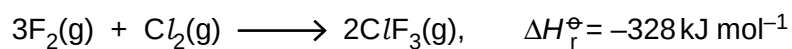
.....
 [2]

- (b) Describe and explain what is observed when a red-hot wire is plunged into separate samples of the gaseous hydrogen halides HCl and HI .
 How are bond energy values useful in interpreting these observations?

.....

 [3]

- (c) The following reaction occurs in the gas phase.



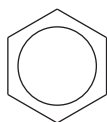
Use these and other data from the *Data Booklet* to calculate the average bond energy of the Cl-F bond in ClF_3 . [2]

[Total: 7]

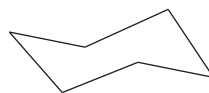
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- 5 (a) All the carbon atoms in benzene lie in the same plane. This means that they are *coplanar*, but this is not the case with cyclohexane.

For
Examiner's
Use

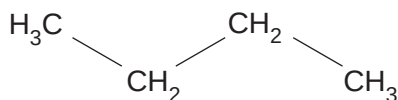


benzene

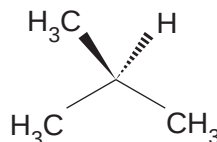


cyclohexane

By rotating the molecule around its several C–C bonds, all the carbon atoms in butane can be made to lie in the same plane, but this is not the case with methylpropane.

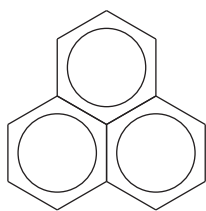


butane

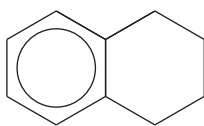


methylpropane

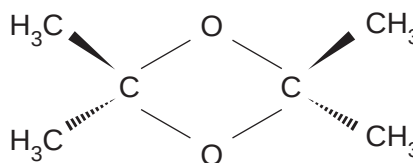
By considering the 3-dimensional geometry of the following five molecules, and allowing rotations around C–C bonds, decide whether or not the **carbon atoms** in each molecule **can be arranged** in a coplanar fashion. Then place a tick in the appropriate column in the table below.



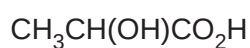
A



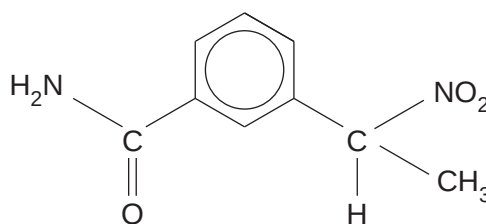
B



C



D



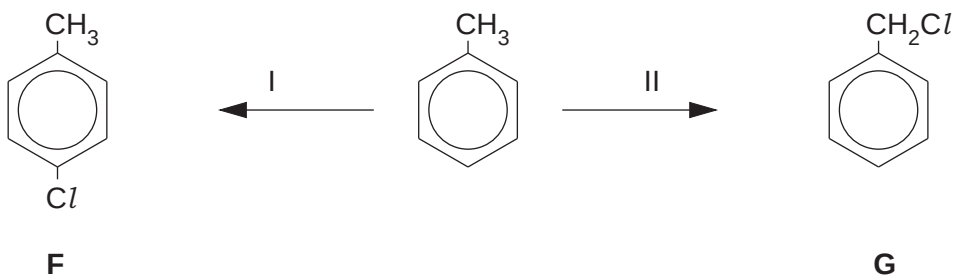
E

compound	all carbon atoms can be coplanar	not all carbon atoms can be coplanar
A		
B		
C		
D		
E		

[3]

- (b) Methylbenzene can react with chlorine under different conditions to give the monochloro derivatives **F** and **G**.

For
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Use



Suggest reagents and conditions for each reaction.

reaction I

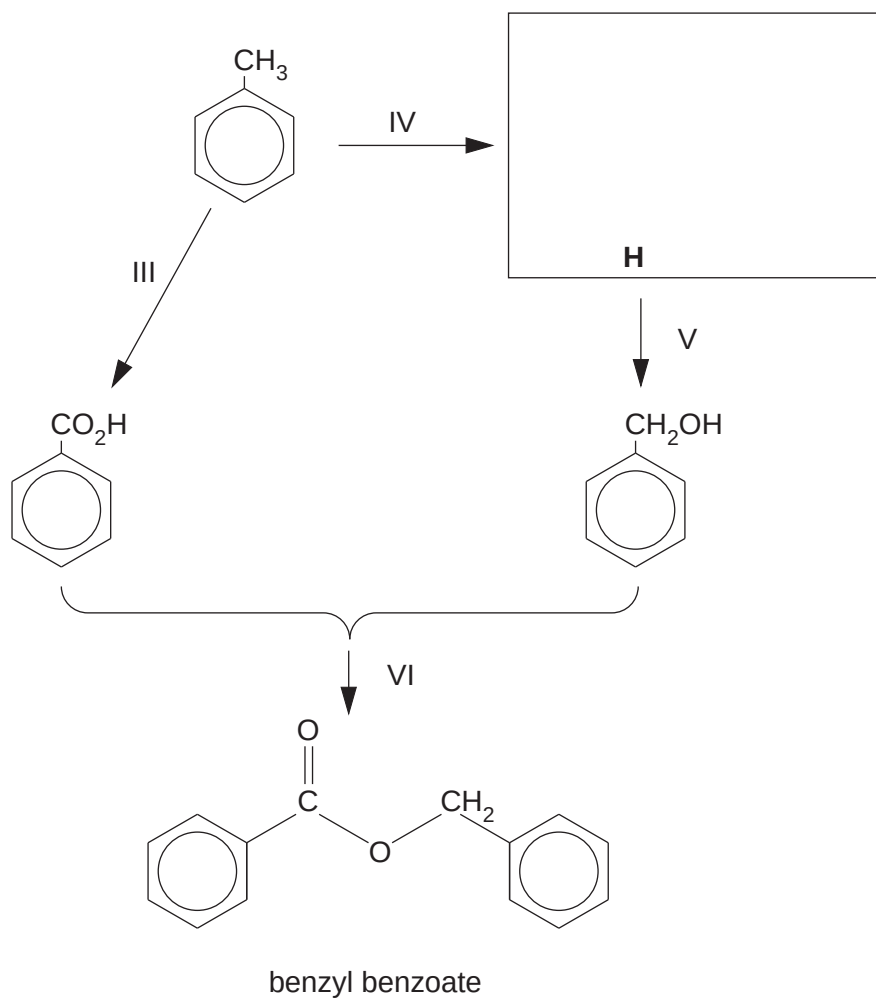
.....

reaction II

..... [2]

- (c) Benzyl benzoate is a constituent of many perfumery products, and has also been used in the treatment of the skin condition known as scabies. It can be made from methylbenzene by the following route, which uses one of the chlorination reactions from (b).

For
Examiner's
Use



- (i) Draw the structural formula of the intermediate **H** in the box above.

- (ii) Suggest reagents and conditions for each reaction.

reaction III

.....

reaction V

.....

reaction VI

.....

- (iii) State the type of reaction occurring during

reaction III,

.....

reaction V.

.....

[6]

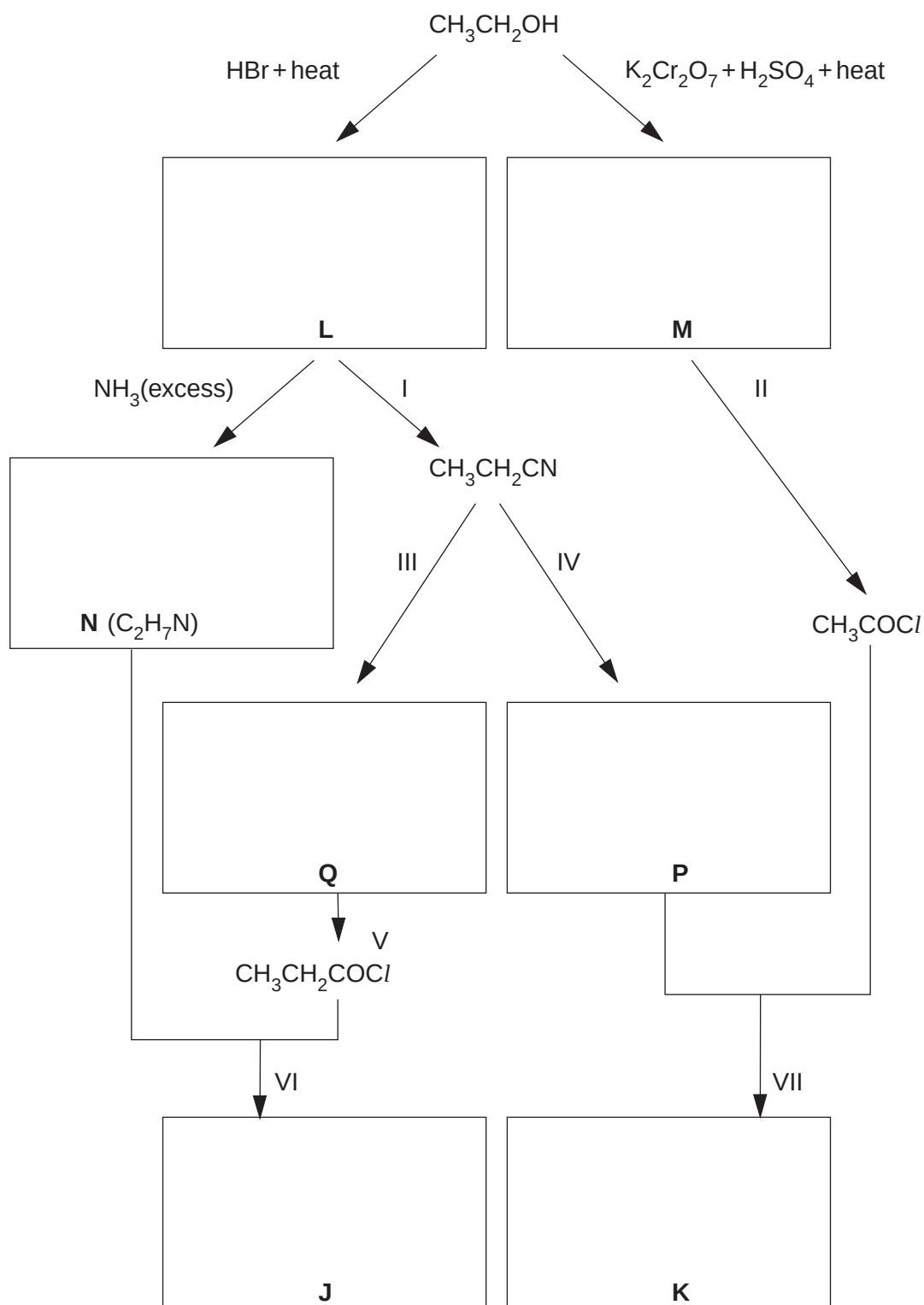
[Total: 11]

For
Examiner's
Use

- 6 Compounds **J** and **K** are isomers with the molecular formula $C_5H_{11}NO$, and they contain the same functional group.

For
Examiner's
Use

They may both be obtained from ethanol by the following routes.



- (a) Draw the structural formulae of the lettered compounds **J** to **Q** in the boxes above. [7]

(b) Suggest reagents and conditions for the following.

reaction I

.....

reaction II

.....

reaction IV

.....[3]

(c) What *type of reaction* is occurring in

reaction IV,

.....

reaction VI?

.....[2]

(d) (i) Name the functional group that is common to compounds **J** and **K**.

.....

(ii) Name the functional group that is common to compounds **N** and **P**.

.....[2]

[Total: 14]

Section B

For
Examiner's
Use

Answer **all** questions in the spaces provided.

- 7 (a) Explain, using diagrams where appropriate, the types of interaction responsible for the primary, secondary and tertiary structure of a protein.

primary structure

.....

.....

.....

secondary structure

.....

.....

.....

tertiary structure

.....

.....

.....

[6]

- (b) Enzymes are particular types of protein molecule. Explain briefly how enzymes are able to help to break down molecules in the body.

For
Examiner's
Use

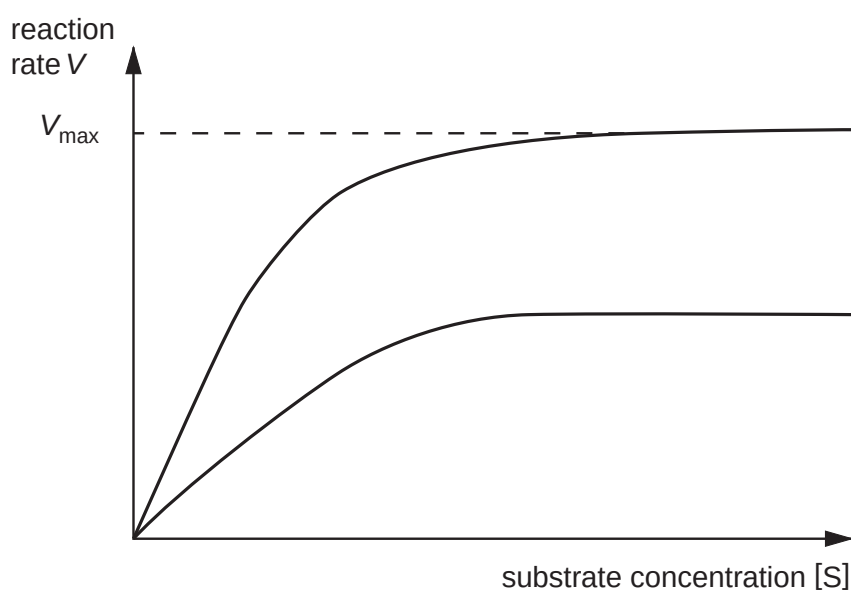
.....

.....

.....

..... [2]

- (c) The graph below shows the effect of inhibition on an enzyme-catalysed reaction.



State the type of inhibition shown, giving a reason to support your answer.

type of inhibition

reason

..... [2]

[Total: 10]

- 8 The residues from organohalogen pesticides are known to be a major cause of the decline in numbers of different birds of prey in many countries. These residues are concentrated in birds at the top of food chains.

- (a) Analysis of the bodies of birds of prey show that the pesticide residues accumulate in the fatty tissues of the birds. This is because of the high partition coefficient between the fat in the tissues and water found in blood.

Explain what is meant by the term *partition coefficient*.

.....
.....
.....[2]

- (b) A particular pesticide has a partition coefficient of 8.0 between the solvent hexane and water. If a 25cm^3 sample of water containing 0.0050 g of the pesticide is shaken with a 25cm^3 sample of hexane, calculate the mass of pesticide that will dissolve in the hexane layer.

[2]

- (c) Compounds used as pesticides may contain bromine or chlorine.

- (i) What would be the difference in the ratio of the M: M+2 peaks if the pesticide contained one chlorine rather than one bromine atom?

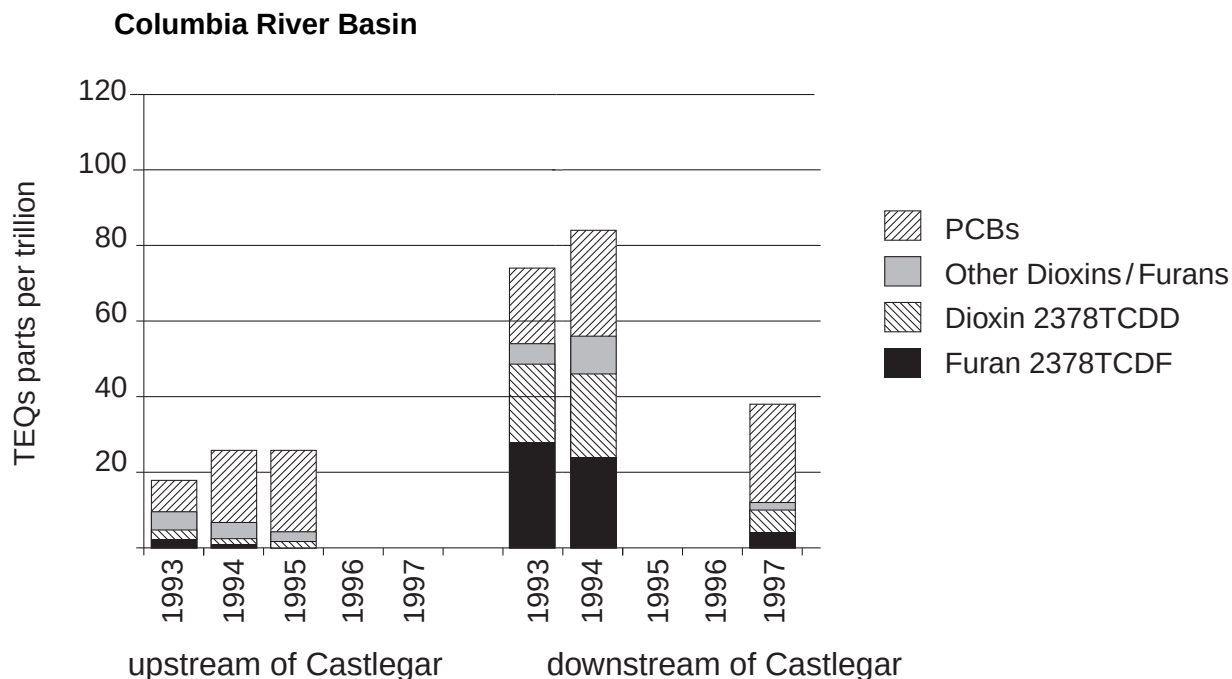
.....

- (ii) If a given pesticide contains **two** chlorine atoms per molecule, deduce the relative heights of the M, M+2 and M+4 peaks.

[3]

- (d) The following graph shows the occurrence of pesticide residues in the eggs of fish-eating birds of prey upstream and downstream of a paper mill at Castlegar on the Columbia River in Canada.

For
Examiner's
Use



PCBs, the dioxin 2378TCDD, and the furan 2378TCDF all come from chemicals containing chlorine.

- (i) Suggest which compounds are present directly as a result of the paper mill.

.....

- (ii) By studying the data for 1994, suggest which chemical(s) come from sources other than the paper mill.

.....

- (iii) Compare the downstream data for 1994 with that for 1997. Suggest what might be responsible for the change.

.....

- (iv) A molecule of 2378TCDD contains four chlorine atoms. How many molecular ion peaks would this compound show in its mass spectrum?

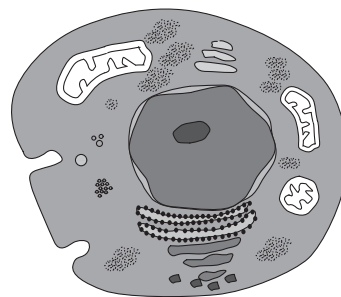
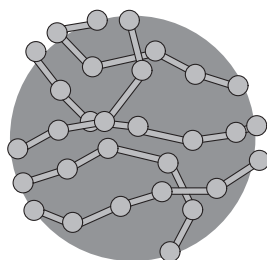
.....

[4]

[Total:11]

- 9 (a) Put the following items in order of **increasing** size. Use the number 1 to indicate the smallest and 3 to indicate the largest.

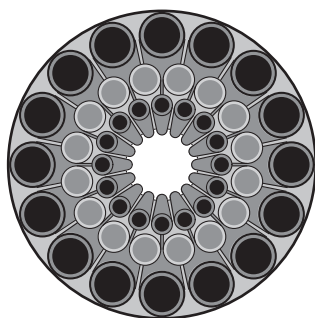
For
Examiner's
Use



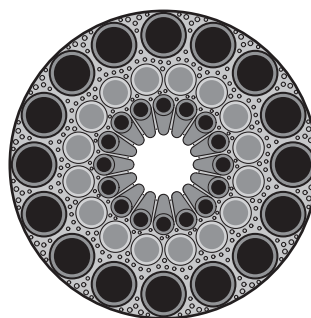
length of DNA molecule in a chromosome	nanosphere diameter	cell diameter

[2]

- (b) Nanotechnology has an increasing range of uses across a number of fields including sport. For example, golf clubs are now being made using nanomaterials.



cross-section of normal
golf club shaft



cross-section of golf club
shaft with nanomaterial fill

Use the diagrams above and your knowledge of nanomaterials to suggest **two** properties of the new shafts. Explain your answers.

(i)

.....

.....

(ii)

.....

.....

[2]

- (c) A mixture of nano-sized particles of tungsten and vanadium(IV) oxide can be applied to the surface of windows and reflects heat whilst letting all light in the visible range through.

Suggest how this variable reflective property is possible using nano-sized particles.

.....
.....
..... [2]

- (d) Although silver is well-known as a precious metal, its medicinal properties have been used for hundreds of years. In ancient Greece silver was used to purify water and until the development of antibiotics, silver was important in the treatment of large wounds.

(i) What property of silver makes it useful for jewellery?

.....

(ii) Suggest the property of silver that makes it useful in the treatment of large wounds.

.....

(iii) Suggest why nano-sized silver particles are more useful in treating wounds.

.....

.....

[3]

[Total: 9]

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