

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS
A LEVEL**

H433/03

CHEMISTRY B (SALTERS)

Practical skills in chemistry

WEDNESDAY 20 JUNE 2018:

Morning

**TIME ALLOWED: 1 hour 30 minutes
plus your additional time allowance**

MODIFIED ENLARGED 24pt

First name						Last name					
Centre number						Candidate number					

YOU MUST HAVE:

the Insert

the Data Sheet for Chemistry B (Salters)

YOU MAY USE:

a scientific or graphical calculator

READ INSTRUCTIONS OVERLEAF



INSTRUCTIONS

Use black ink. You may use an HB pencil for graphs and diagrams.

The practical insert is needed with this paper.

Complete the boxes on the front page with your name, centre number and candidate number.

Answer ALL the questions.

Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION

The total mark for this paper is 60.

The marks for each question are shown in brackets [].

Quality of extended responses will be assessed in questions marked with an asterisk (*).

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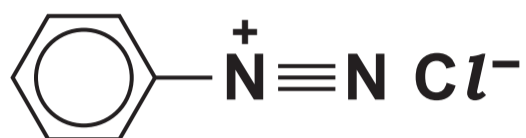
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Answer ALL the questions.

1 A student decides to use a microscale method to synthesise an azo dye and dye a fabric.

(a) The student initially makes a small amount of a solution of the diazonium compound shown below, starting from an aromatic amine.

diazonium compound



Name the reagents and conditions needed to make this compound.

Reagents

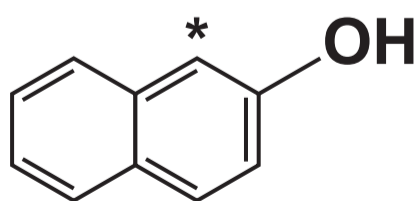
Conditions

[3]

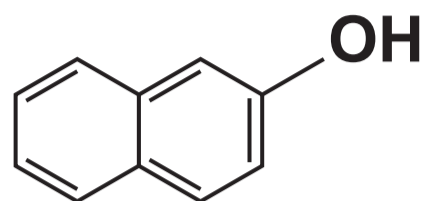
(b) Naphthalen-2-ol, shown below, is used to make the dye. A piece of cotton is dipped into naphthalen-2-ol dissolved in sodium hydroxide. The diazonium solution is then added to dye the cotton red.

The coupling reaction involves the carbon atom marked with an asterisk, *.

naphthalen-2-ol



- (i) Complete the structure of the azo dye formed in this coupling reaction. [1]



- (ii) The azo dye formed above has an extended delocalised system.

Describe the bonding occurring in a delocalised system and explain why this can lead to organic compounds being coloured.

[4]

(c) Other functional groups can be attached to dye molecules and these can modify the properties of the dye.

(i) Give ONE property of the dye that might be affected if nitro, NO_2 , groups are attached.

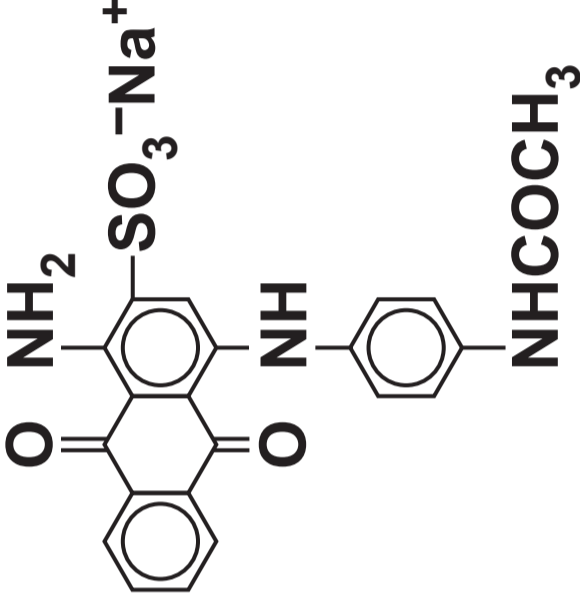
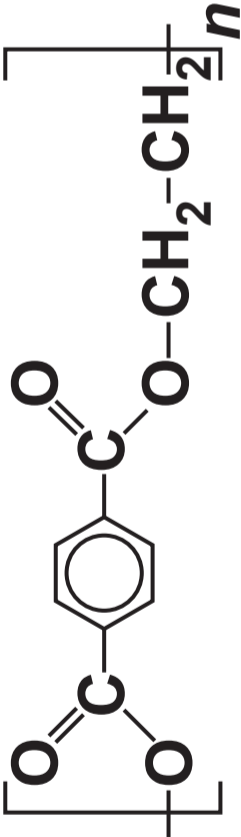
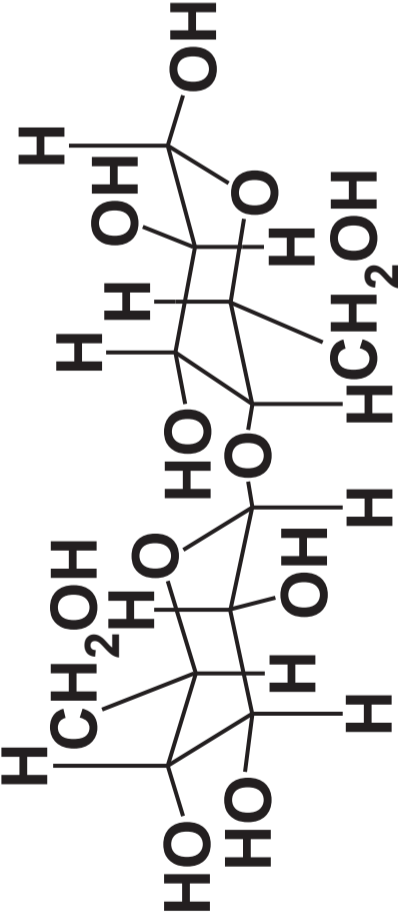
_____ **[1]**

(ii) Give a DIFFERENT property affected by the attachment of sulfonate, SO_3^- , groups.

_____ **[1]**

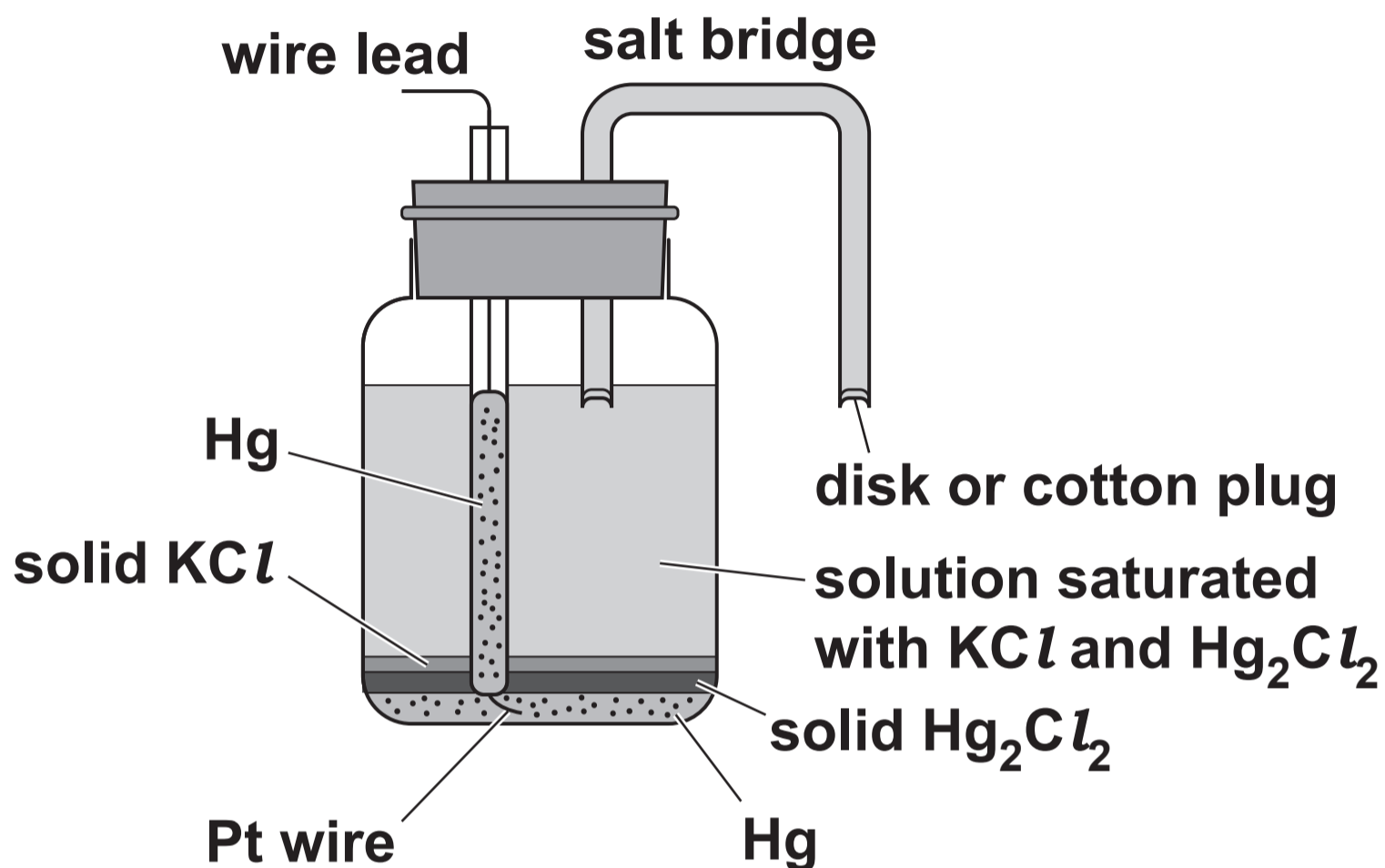
(d) Attractions between dye molecules and polymer molecules in fabric fibres can be ionic, covalent or intermolecular bonds.

Use your knowledge of molecular interactions to fill in the empty boxes in the following table opposite. [2]

Type of fabric	Structure/features of polymer molecule	Structure/features of dye molecule	Strongest type of attraction between polymer and dye
Wool	A protein chain with --NH_3^+ groups at the end of side chains when dyed in acid solution		
		Few polar groups on dye molecule	
Cotton		Several --NH_2 groups. Linear molecule	

- 2 The use of a standard hydrogen electrode for measuring standard electrode potentials is often not practicable. The diagram below shows a calomel electrode. This is often used in preference to the standard hydrogen electrode and has a standard electrode potential, E^\ominus , of +0.27 V.

calomel electrode



(a) The electrode is based on mercury metal, Hg, in contact with a saturated solution of Hg_2Cl_2 .

- (i) Suggest ONE advantage and ONE disadvantage of using a calomel electrode over a standard hydrogen electrode.

Advantage _____

Disadvantage _____ [1]

- (ii) Give the oxidation state of mercury in Hg_2Cl_2 .

oxidation state = _____ [1]

(b) A 25.0 g sample of Hg_2Cl_2 is vaporised at 400°C and a pressure of 101 kPa.

A student assumes that the formula of the gaseous mercury chloride molecules is Hg_2Cl_2 .

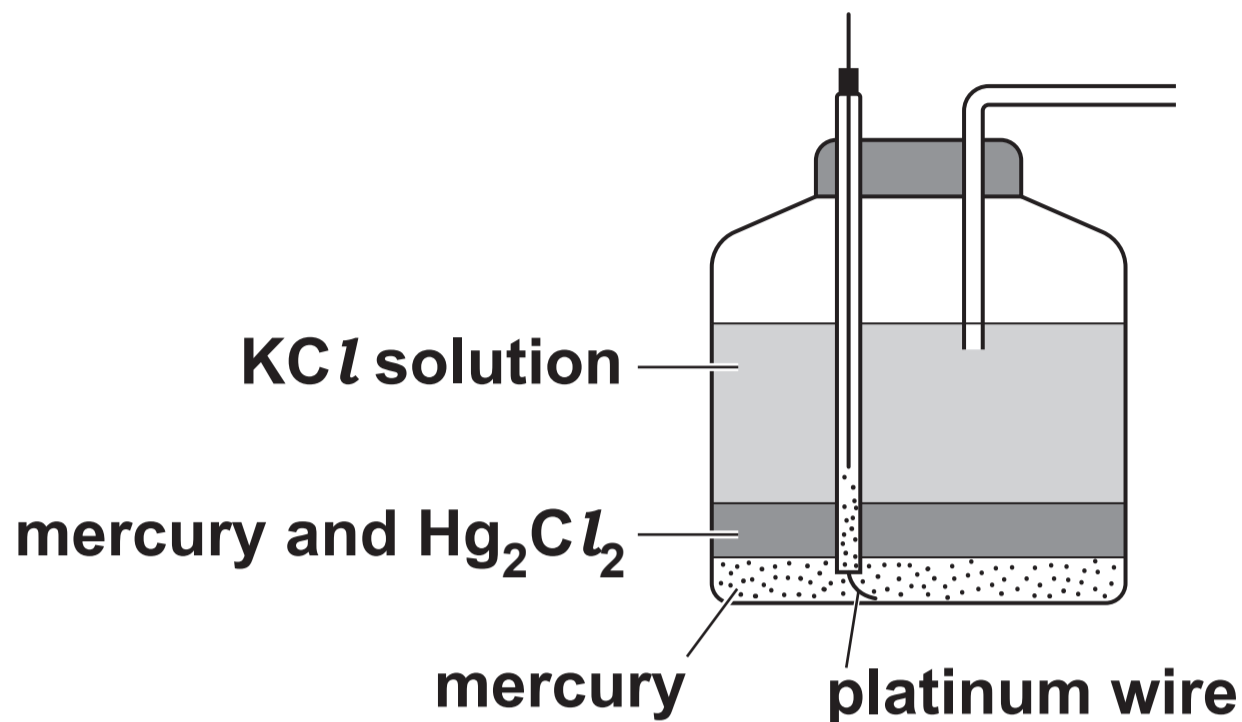
Calculate the volume of gas, in dm^3 , that would be expected under these conditions.

volume of gas = _____ dm^3 [3]

(c)*A student investigating the rusting of iron is given a calomel electrode.

The diagram shows a simplified calomel electrode.

simplified calomel electrode



The student wants to use this electrode to measure the standard electrode potential of a $\text{Fe}^{2+}(\text{aq})|\text{Fe}(\text{s})$ half-cell.

Give instructions on how to do this, justifying the uses of the pieces of apparatus you name.

You may add to the diagram above to illustrate your answer. [6]

- (d) An equilibrium, represented by equation 2.1, exists between the solid Hg_2Cl_2 and its ions in solution.

Equation 2.1



The solubility of the solid Hg_2Cl_2 in a saturated solution at 298 K is $3.5 \times 10^{-4} \text{ g dm}^{-3}$.

Calculate the solubility product, K_{sp} , for Hg_2Cl_2 at 298 K. Include the units.

Give your answer to an APPROPRIATE number of significant figures.

solubility product, $K_{\text{sp}} =$ _____ units _____ [5]

- 3 Iodine, I_2 , is an essential dietary element. The recommended maximum daily intake of iodine for an adult is $1.5 \times 10^{-4} \text{ g}$ ($150 \mu\text{g}$).**

A group of chemistry students read that fish is a good source of iodine in the form of iodide ions.

They decide to extract the iodine from 600 g of fish.

The students blend the fish in a food processor with 100 cm^3 of water, leave it to stand overnight and then filter the mixture into a beaker.

- (a) One of the students suggests that if they add silver nitrate solution they can confirm the presence of iodide ions in the solution.**

- (i) Describe what the students would observe if the only halide ion present in the solution was the iodide.**

_____ **[1]**

- (ii) Write an IONIC equation for this reaction. Include state symbols. Use the space below. [1]**

- (b) The students pour the filtered mixture into a separating funnel containing 20 cm^3 of hexane, 5 cm^3 of dilute sulfuric acid and 5 cm^3 of hydrogen peroxide solution.

Iodine is formed and dissolves in the hexane layer which goes purple. The purple layer is separated from the aqueous layer and transferred to a conical flask.

The purple coloured solution is titrated with standard $0.0010\text{ mol dm}^{-3}$ sodium thiosulfate solution. The end point is indicated by the disappearance of the purple colour.

- (i) The hydrogen peroxide oxidises the iodide ions in the fish to iodine.

Write a half equation for this oxidation reaction.
Explain why this reaction is classified as oxidation.

Half equation _____

Explanation _____ [1]

- (ii) The equation for the titration reaction is given below.



Name the element oxidised in this reaction. Give its oxidation state before and after the reaction.

Element oxidised _____

Oxidation state before reaction _____

oxidation state after reaction _____ [2]

- (iii) The students obtained an average titre of 5.30 cm^3 of $0.0010 \text{ mol dm}^{-3}$ sodium thiosulfate.

Calculate the MASS of iodine in μg in a 120 g portion of fish.

Give your answer to TWO significant figures.

mass of iodine = _____ μg [4]

- (iv) One of the students suggests that the titre value is too small and will lead to an unacceptably high percentage error.

Calculate the percentage error based on the students' titre value.

percentage error = _____ % [1]

- (v) Suggest how the experiment could be modified to improve the accuracy of the result.

 [1]

(c)*The mass of the iodine in the hexane solution could also have been determined using colorimetry.

Suggest a suitable method that could be used to measure the mass of iodine in the hexane solution using a colorimeter or visible spectrophotometer.

Show how you would process the results.

[illegible]

4 This question refers to the PRACTICAL INSERT that is provided as an insert to this paper.

(a) The equation for the reaction producing phenyl benzoate is as follows:



(i) Draw a structural formula for phenyl benzoate, showing the bonding in the ester group. Use space below [1]

(ii) Use the student results to calculate the percentage yield of phenyl benzoate obtained from the practical.

percentage yield = _____ % [3]

- (b) (i) In STEP 8 of the procedure the water reacts with any remaining benzoyl chloride.**

Write the equation for this reaction. Use the space below. [1]

- (ii) Suggest and explain the reason for STEP 13 in the procedure.**

_____ **[1]**

- (iii) Describe the practical procedure used to measure the melting point of an organic solid.
You DO NOT need to discuss the type of melting point apparatus you use.**

_____ **[3]**

- (iv) What information can the students get from their melting point?**

_____ **[1]**

(v) The recrystallisation procedure uses ethanol as the solvent.

Give the key properties needed by a solvent to be effective in recrystallisation.

_____ [1]

**(c) The students carry out thin layer chromatography of the phenyl benzoate formed.
One student states that this will enable them to assess the purity of their product.**

**Comment on the validity of this statement.
You should describe any possible observations to back up your comments.**

_____ [4]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

This image shows a blank sheet of white paper with horizontal ruling lines. A single vertical line runs down the left side, creating a narrow margin. There are 20 horizontal lines in total, evenly spaced across the page. The lines are thin and black.

