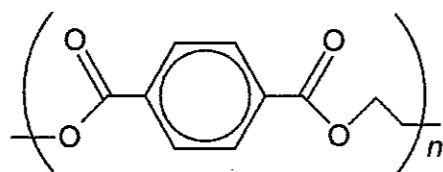


- 3 X-ray film is made by coating a plastic sheet with a silver halide. The plastic sheet is made from a mixture of a polyester and a nylon.

(a) A typical polyester used in the making of films is PET. A repeating unit is shown below.

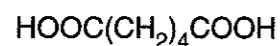


PET

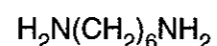
Draw the **full structural** formula of the alcohol used as a monomer to make PET.

[2]

(b) A nylon can be made by polymerising a mixture of the monomers **D** and **E**.



D



E

(i) Give the systematic name of compound **E**.

..... [2]

(ii) Nylon polymers are formed by a condensation reactions. Use the reaction between compounds **D** and **E** to explain the meaning of *condensation*.

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

(c) Nylon is added to polyester to make X-ray film stronger. Explain, in terms of intermolecular attractions, why the addition of nylon strengthens the film.

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

(d) (i) Large amounts of used film are disposed of every year. After the silver halide has been removed from the film, the remaining polymer sheets can be disposed of by burning or by burying them in the ground.

Give **one** advantage for each method relative to the other.

burning

.....

burying

..... [2]

(ii) Chemists are developing methods to convert some waste polymers into useful chemicals.

Polyesters can be broken down by hydrolysis into organic acids and alcohols.

Give the conditions and reagent used for hydrolysing an ester link.

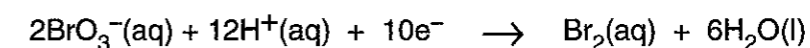
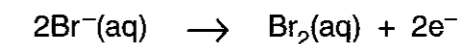
conditions

reagent [2]

(iii) Unused silver bromide can be recovered from waste films.

The amount of silver bromide in a sample can be determined by oxidising the bromide ions (Br^-) to bromine (Br_2), using bromate(V) ions (BrO_3^-) as the oxidising agent.

Give an overall balanced equation for this redox reaction by combining the half-equations given below.



working space

→

[2]

2 Steel alloys containing large amounts of titanium are corrosion resistant, have low densities and good strength properties.

(a) Suggest how adding a large amount of an alloying element to iron affects the **structure** of iron.

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

(b) Titanium alloys are often used for reaction vessels in the chemical industry because of their high chemical resistance. However, they cannot be used with concentrated hydrochloric acid. This reacts with titanium to form a mixture of coloured ions.

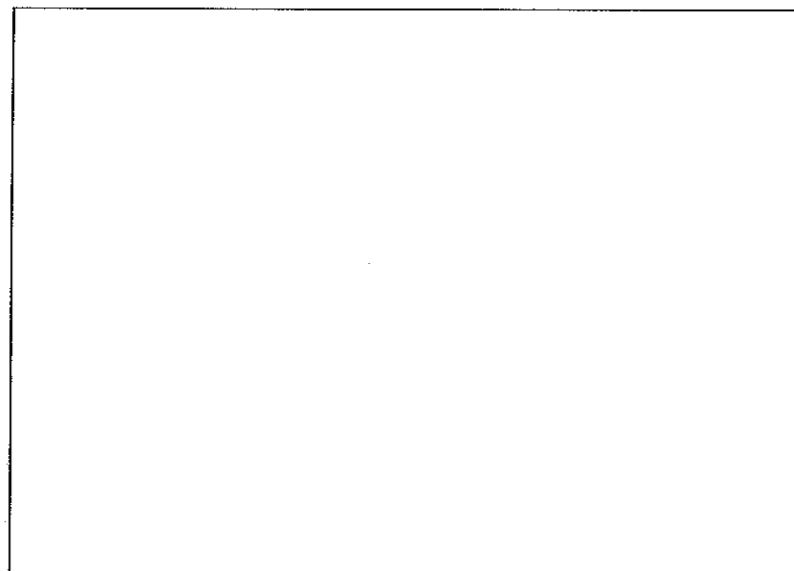
(i) Why do many transition metal ions appear coloured?

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

(ii) One of the coloured ions formed when titanium reacts with hydrochloric acid is the hexaaquatitanium(III) ion, $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}(\text{aq})$.

In the box below, draw the shape of this complex ion indicating the charge on the ion.

Give the name for the shape of this complex ion.



shape of complex ion [3]

(i) Complete the table below, stating the order of reaction with respect to each reactant.

reactant	order
bromide ion, Br^-	
bromate(V) ion, BrO_3^-	
acid, H^+	

[3]

(ii) Use your answers to (i) to complete the rate equation for this reaction. Give the units of the rate constant if the rate of reaction is measured in $\text{mol dm}^{-3} \text{s}^{-1}$.

rate =

units of rate constant

[2]

[Total: 23]

- (d) In this question, one mark is available for the quality of spelling, punctuation and grammar.

A solid sample is thought to be impure acetanilide. The sample is soluble in ethanol.

Describe how thin-layer chromatography would be carried out to show that acetanilide is present in the sample.

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[6]

Quality of Written Communication [1]

- (e) At the start of the 20th century, the discovery and testing of a new medicine was a very random process. Today, medicine development is much longer and costs more. Often it takes 10 to 12 years to get a new product on the market.

Describe **two** ways in which **chemists** are involved in the development of a new medicine.

.....

.....

.....

.....

.....

.....

.....

[2]

[Total: 23]

- (c) A standard hydrogen electrode is used to measure the standard electrode potential of a silver half-cell.

Give the equation for the reaction taking place at the hydrogen electrode when the standard electrode potential of the silver half-cell is being measured.

→

[2]

- (d) Zinc is a d-block element.

Complete the electronic configuration for zinc and explain why it does not readily form Zn^{3+} ions.

Zn $1s^2 2s^2 2p^6$

explanation

.....

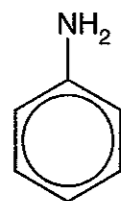
.....

[3]

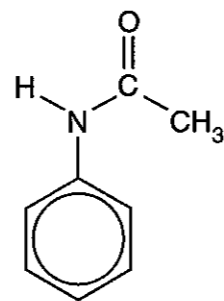
[Total: 14]

Answer **all** the questions.

- 1 Acetanilide was introduced in the 1880s as a medicine for reducing the pain and high temperature effects of a fever. It can be made from phenylamine.



phenylamine



acetanilide

- (a) (i) Name the functional group in acetanilide that is attached to the benzene ring.

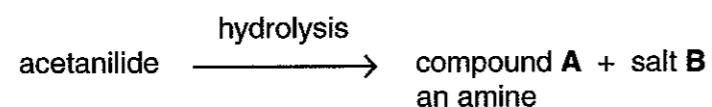
..... [1]

- (ii) What reagent would you use to convert phenylamine into acetanilide?

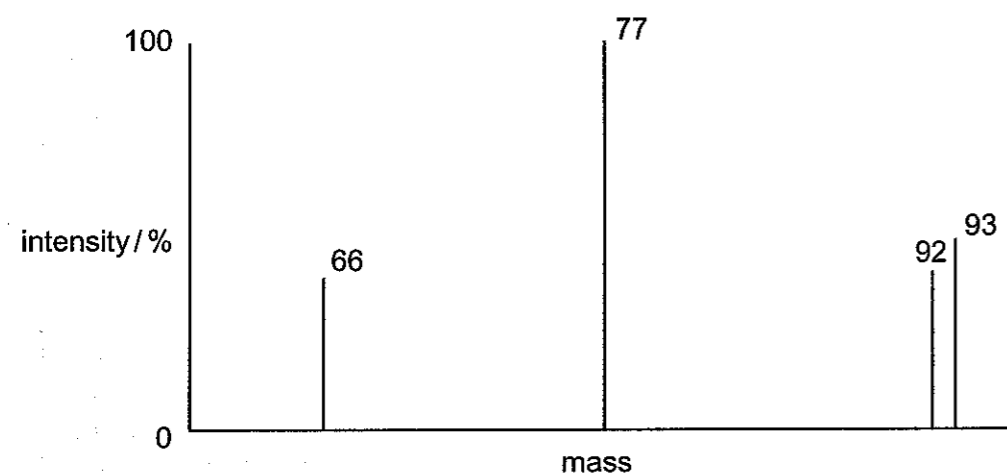
..... [1]

- (b) Acetanilide is readily hydrolysed by heating with an aqueous solution of sodium hydroxide.

Two organic products are formed, compound **A** and a salt **B**.



A mass spectrum of compound **A** is shown below.



- (c) Genetic engineering can be used to produce sufficient quantities of a pure protein so that its tertiary structure can be studied.

- (i) Outline the role played by enzymes in isolating the gene responsible for the synthesis of the protein.

.....

 [2]

- (ii) Explain how the gene is used to synthesise the required protein.

.....

 [3]

- (d) The composition of the protein in wool or silk can be determined by hydrolysing the protein and identifying the individual amino acids.

- (i) Give the reagent needed to hydrolyse a protein.

..... [1]

- (ii) The reagent and protein are *heated together under reflux*. Describe what this means.

.....

 [2]

- (e) Another method for investigating structures of proteins is n.m.r. spectroscopy.

What information can be obtained from n.m.r. spectra?

.....
 [2]

[Total: 18]

END OF QUESTION PAPER