Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Physical

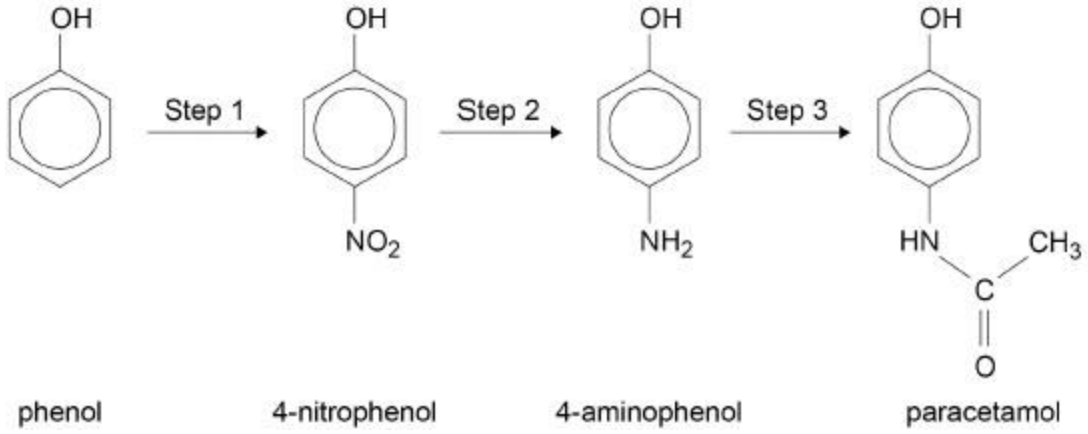
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Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

Paracetamol is a medicine commonly used to relieve mild pain.

Traditionally, paracetamol has been made industrially in a three-step synthesis from phenol.

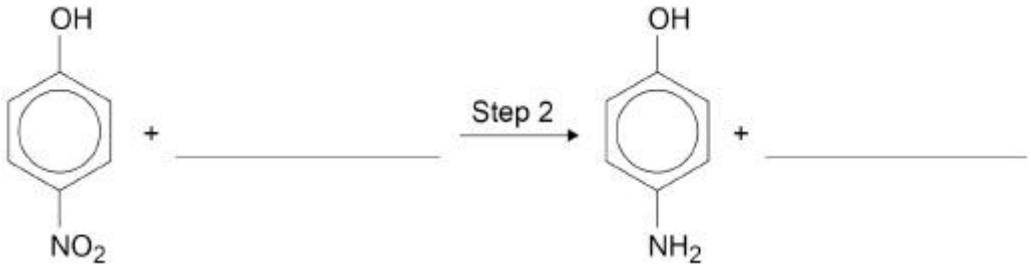


(a) Name the mechanism of the reaction in Step **1**.

_____

(1)

(b) Complete the equation for the reaction in Step **2**.

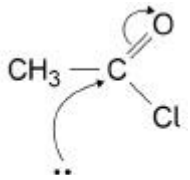


(1)

(c) In theory, either ethanoyl chloride or ethanoic anhydride could be used in Step **3**.

Complete the mechanism for the reaction of 4-aminophenol with ethanoyl chloride.
RNH_2 is used to represent 4-aminophenol in this mechanism.

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(2)

(d) In practice, ethanoic anhydride is used in the industrial synthesis rather than ethanoyl chloride.

Give **one** reason why ethanoyl chloride is **not** used in the industrial synthesis.

_____

_____

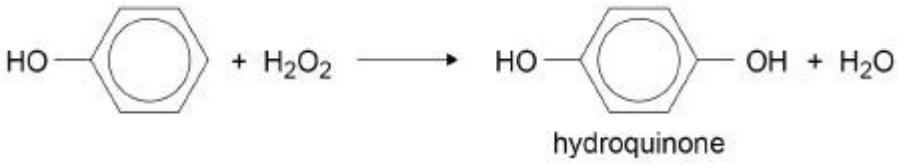
(1)

(e) In Step **3** other aromatic products are formed as well as paracetamol.

Draw the structure of **one** of these other aromatic products.

(1)

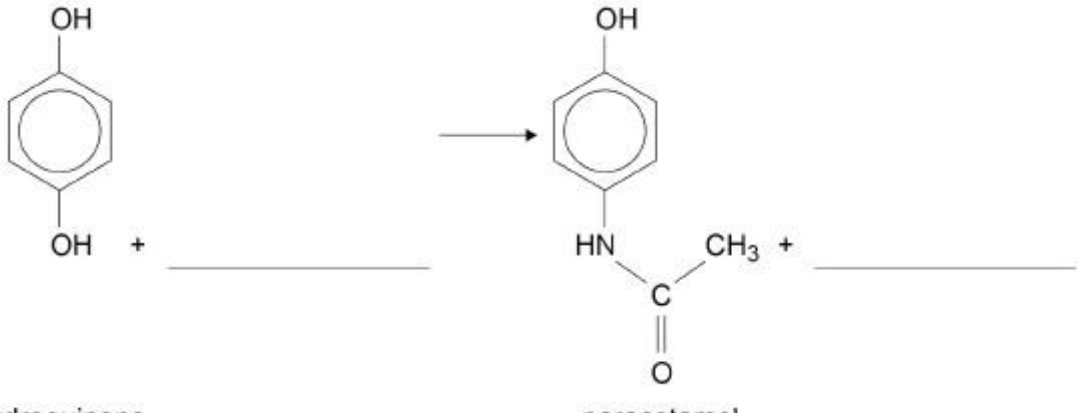
(f) Chemists have recently developed a two-step process to produce paracetamol from phenol.
In the first step, phenol is oxidised to hydroquinone.



In the second step, hydroquinone reacts with ammonium ethanoate to form paracetamol.

Complete the equation for this second step.

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(1)

(g) Calculate the mass, in kg, of hydroquinone (M_r = 110.0) needed to produce 250 kg of paracetamol.

Mass _____ kg

(3)

(Total 10 marks)

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Q2.

Some compounds with different molecular formulas have the same relative molecular mass to the nearest whole number.

(a) A dicarboxylic acid has a relative molecular mass of 118, to the nearest whole number.

Deduce the molecular formula of the acid.

Molecular formula _____

(3)

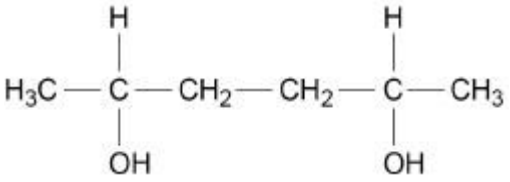
(b) A student dissolved some of the dicarboxylic acid from part (a) in water and made up the solution to 250 cm^3 in a volumetric flask.
In a titration, a 25.0 cm^3 sample of the acid solution needed 21.60 cm^3 of 0.109 mol dm^{-3} sodium hydroxide solution for neutralisation.

Calculate the mass, in g, of the dicarboxylic acid used.
Give your answer to the appropriate number of significant figures.

Mass _____ g

(4)

(c) Compounds with molecular formula $C_6H_{14}O_2$ also have a relative molecular mass of 118 to the nearest whole number. These include the diol shown.



Deduce the number of peaks in the ^1H NMR spectrum of this diol.

_____

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(1)

(d) Draw the structure of a different diol also with molecular formula $C_6H_{14}O_2$ that has a ^1H NMR spectrum that consists of two singlet peaks.

(1)

(e) The dicarboxylic acid in part **(a)** and the isomers of $C_6H_{14}O_2$ in parts **(c)** and **(d)** all have a relative molecular mass of 118

State why the dicarboxylic acid can be distinguished from the two diols by high resolution mass spectrometry using electrospray ionisation.

_____

_____

_____

(1)

(Total 10 marks)

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