

Name of the Student: _____

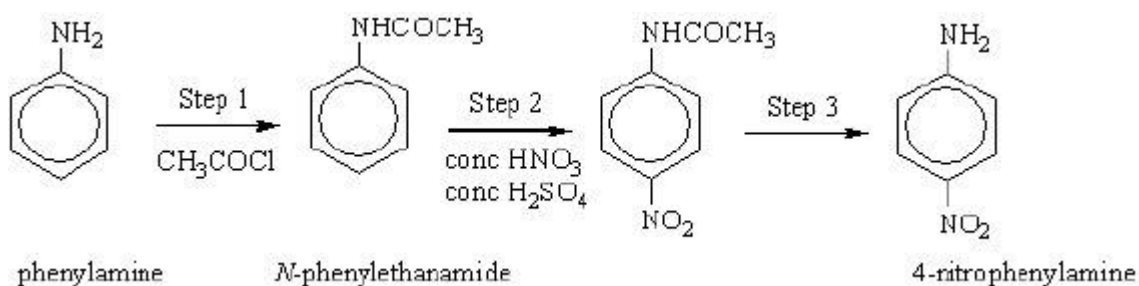
Max. Marks : 25 Marks

Time : 25 Minutes

Q1.

Synthetic dyes can be manufactured starting from compounds such as 4-nitrophenylamine.

A synthesis of 4-nitrophenylamine starting from phenylamine is shown below.



(a) An equation for formation of *N*-phenylethanamide in Step 1 of the synthesis is shown below.



- (i) Calculate the % atom economy for the production of *N*-phenylethanamide ($M_r = 135.0$).

(3)

- (ii) In a process where 10.0 kg of phenylamine are used, the yield of *N*-phenylethanamide obtained is 5.38 kg.

Calculate the percentage yield of *N*-phenylethanamide.

(2)

- (iii) Comment on your answers to parts (i) and (ii) with reference to the commercial viability of the process.

(2)

- (b) Name and outline a mechanism for the reaction in Step 1.

(5)

- (c) The mechanism of Step 2 involves attack by an electrophile. Write an equation showing the formation of the electrophile. Outline a mechanism for the reaction of this electrophile with benzene.

(4)

(Total 16 marks)

Q2.

Iron from the Blast Furnace contains carbon. In the steel-making process, oxygen is blown through molten impure iron. At stages during this process samples of iron are taken and analysed to determine the remaining carbon content. One method of analysis involves a redox titration.

At one stage a 1.27g sample of this impure iron was reacted with an excess of dilute sulphuric acid. All of the iron in the sample was converted into iron(II) sulfate, and hydrogen was evolved. The solution formed was made up to 250 cm³. A 25.0 cm³ sample of this solution reacted completely with exactly 19.6 cm³ of a 0.0220 mol dm⁻¹ solution of potassium manganate(VII).

- (a) Write an equation for the reaction between iron and dilute sulphuric acid.

(1)

- (b) Write an equation for the reaction of iron(II) ions with manganate(VII) ions in acid solution.

(1)

- (c) Assuming that carbon is the only impurity, calculate the percentage by mass of carbon in the 1.27g sample.

(5)

- (d) How would you ensure the reliability of the result obtained in this experiment?

(1)

- (e) Suggest one way in which the reliability of this analysis could be improved.

(1)

(Total 9 marks)