

Name of the Student: _____

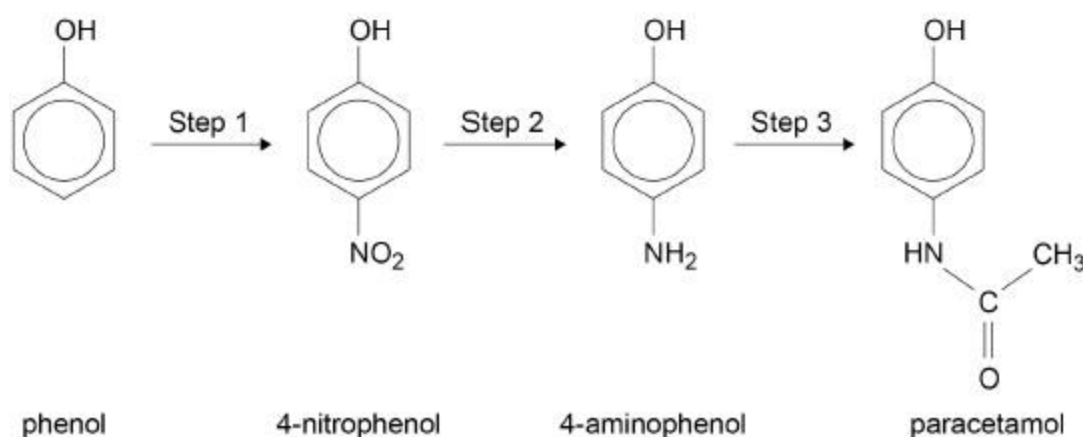
Max. Marks : 22 Marks

Time : 22 Minutes

Q1.

Paracetamol is a medicine commonly used to relieve mild pain.

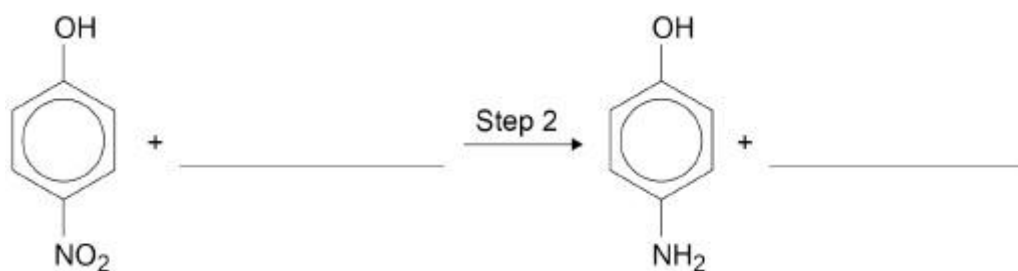
Traditionally, paracetamol has been made industrially in a three-step synthesis from phenol.



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

(1)

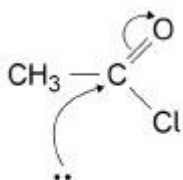
(b) Complete the equation for the reaction in Step 2.



(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.



(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.

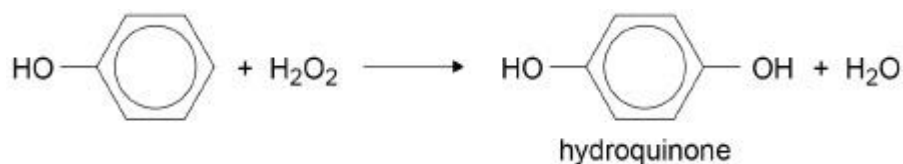
(1)

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

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

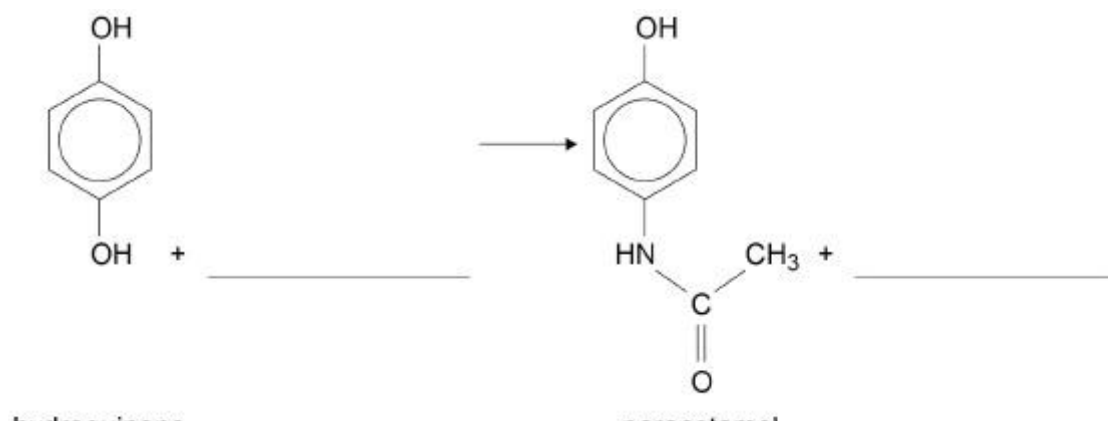
(1)

- (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.



(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)

Q2.

Aqueous solutions of ammonia, ethylamine and phenylamine are prepared.
Each solution has the same concentration.

Which is the correct order for the pH values of these solutions?

A ammonia > ethylamine > phenylamine

☐

B ammonia > phenylamine > ethylamine

☐

C ethylamine > ammonia > phenylamine

☐

D ethylamine > phenylamine > ammonia

☐

(Total 1 mark)

Q3.

Methylamine reacts with bromoethane by substitution to produce a mixture of products.

Which compound is not a possible product of this reaction?

A $\text{C}_2\text{H}_5\text{NHCH}_3$ ☐

B $(\text{C}_2\text{H}_5)_2\text{NCH}_3$ ☐

C $[(\text{C}_2\text{H}_5)_3\text{NCH}_3]^+ \text{Br}^-$ ☐

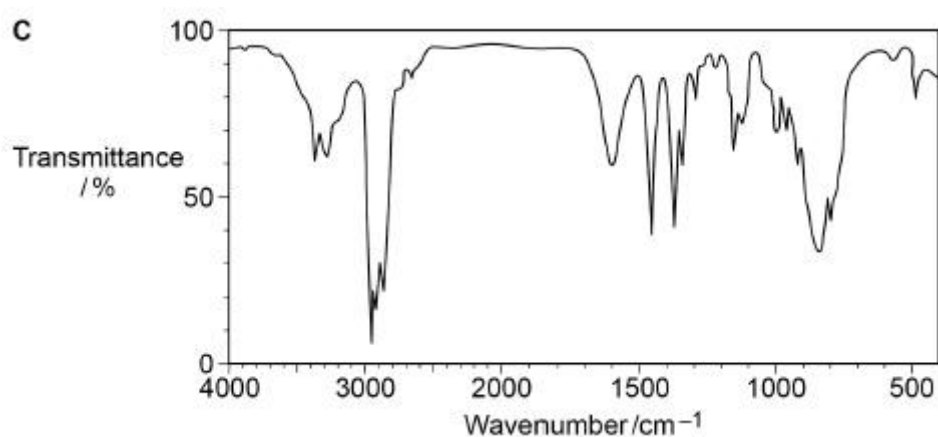
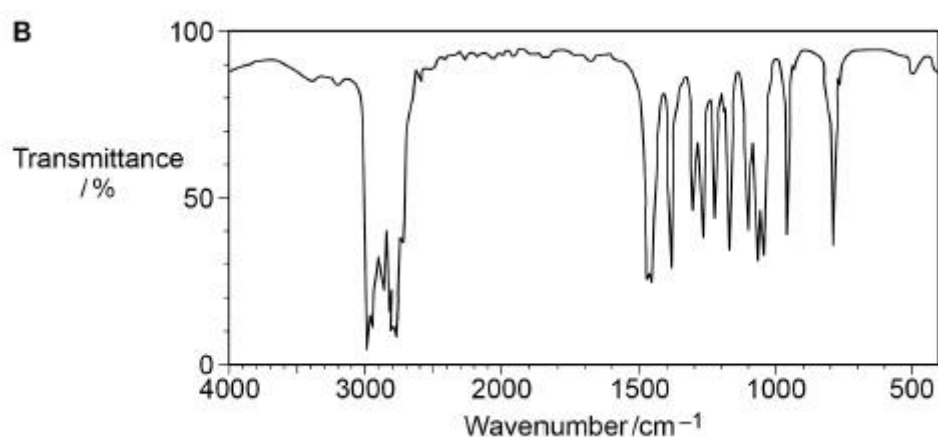
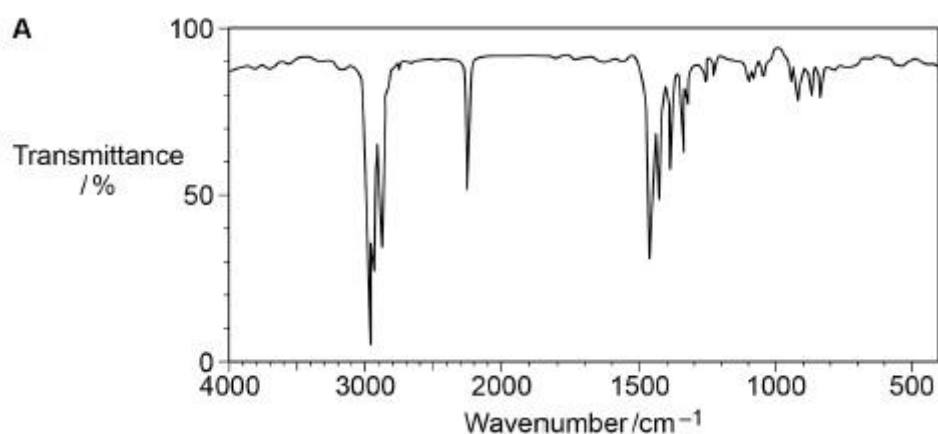
D $[(\text{C}_2\text{H}_5)_2\text{N}(\text{CH}_3)_2]^+ \text{Br}^-$ ☐

(Total 1 mark)

Q4.

This question is about amines.

- (a) The infrared spectra **A**, **B** and **C** are those of a primary amine, a tertiary amine and a nitrile, but not necessarily in that order.



Give the letter of each compound in the correct box.

primary amine	tertiary amine	nitrile

(1)

- (b) There are **three** secondary amines that contain four carbon atoms per molecule.

Draw the skeletal formulas of these **three** secondary amines.

(2)

- (c) Primary amines can be prepared by the reaction of halogenoalkanes with ammonia or by the reduction of nitriles.

Justify the statement that it is better to prepare primary amines from nitriles rather than from halogenoalkanes.

(2)

- (d) Draw the structure of a primary amine with four carbon atoms that **cannot** be formed from a nitrile.

(1)

- (e) A student dissolves a few drops of propylamine in 1 cm³ of water in a test tube.

Give an equation for the reaction that occurs.

Describe what is observed when Universal Indicator is added to this solution.

Equation _____

Observation _____

(2)

- (f) Phenylamine can be prepared by a process involving the reduction of nitrobenzene using tin and an excess of hydrochloric acid.

Give an equation for the reduction of nitrobenzene to form phenylamine. Use [H] to represent the reducing agent.

Explain why an aqueous solution is obtained in this reduction even though phenylamine is insoluble in water.

Equation _____

Explanation _____

(2)
(Total 10 marks)