Chemistry test 2- Niki

Duration 2 hours

Section A

1. Which one of the following is the electronic configuration of the strongest reducing agent?

A 1s2 2s2 2p5

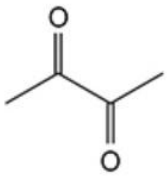
B 1s2 2s2 2p6 3s2

C 1s2 2s2 2p6 3s2 3p5

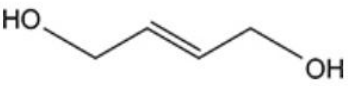
D 1s2 2s2 2p6 3s2 3p6 4s2

2. Which compound has a molecular formula that is different from the others?

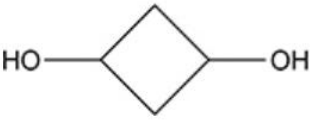
A



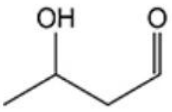
B



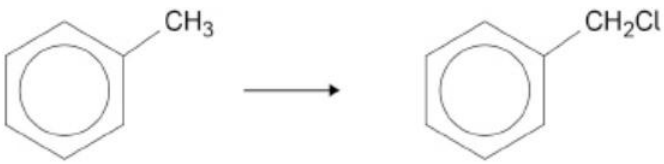
C



D



3. Which is the mechanism for this conversion?



A Addition-elimination

B Electrophilic substitution

C Free-radical substitution

D Nucleophilic substitution

4. Which equation represents a propagation step?

A $\bullet CH_2Cl + Cl\bullet \rightarrow CH_2Cl_2$

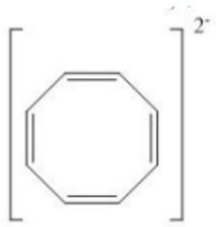
B $\bullet CH_3 + \bullet CH_3 \rightarrow C_2H_6$

C $Cl_2 \rightarrow Cl\bullet + Cl\bullet$

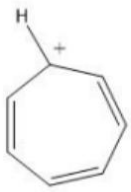
D $CH_3Cl + Cl\bullet \rightarrow \bullet CH_2Cl + HCl$

5. Which of the following is aromatic?

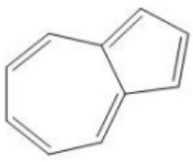
(A).



(B).



(C).



(D).

A (B) and (C) only

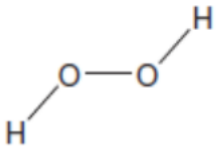
B (A), (B) and (C) only

C (A), (C) and (D) only

D (B), (C) and (B) only

Section B

B1. A hydrogen peroxide molecule can be represented by the structure shown.

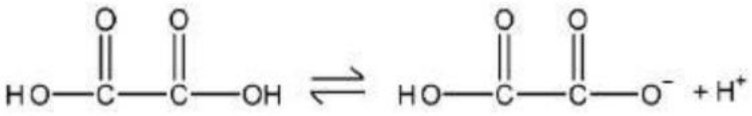


(a) Suggest a value for the H−O−O bond angle.

(b) Hydrogen peroxide dissolves in water. State the strongest type of interaction that occurs between molecules of hydrogen peroxide and water.

(c) Explain, in terms of electronegativity, why the boiling point of H_2S_2 is lower than H_2O_2.

B2. Ethanedioic acid is a weak acid. Ethanedioic acid acts, initially, as a monoprotic acid.



(a) Use the concept of electronegativity to justify **why** the acid strengths of ethanedioic acid and ethanoic acid are different.

(b) A buffer solution is made by adding 6.00×10^{-2} mol of sodium hydroxide to a solution containing 1.00×10^{-1} mol of ethanedioic acid ($H_2C_2O_4$). Assume that the sodium hydroxide reacts as shown in the following equation and that in this buffer solution, the ethanedioic acid behaves as a monoprotic acid.

$$H_2C_2O_4\,(aq) + OH^-(aq) \rightarrow HC_2O_4^-(aq) + H_2O(l)$$

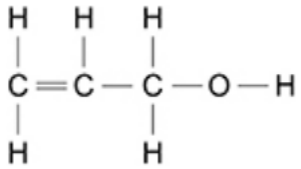
The dissociation constant Ka for ethanedioic acid is 5.89×10^{-2} mol dm^{-3}.

Calculate the value for the **pH** of the buffer solution. Give your answer to the appropriate number of significant figures.

(c) In a titration, the end point was reached when 25.0 cm^3 of an acidified solution containing ethanedioic acid reacted with 20.20 cm^3 of 2.00×10^{-2} mol dm^{-3} potassium manganate (VII) solution.

Deduce an **equation** for the reaction that occurs and use it to calculate the original concentration of the ethanedioic acid solution.

B3. Prop-2-en-1-ol is a natural chemical found in garlic. It is also used in the production of plasticisers.



(a) Prop-2-en-1-ol can be prepared by reacting 3-chloroprop-1-ene with dilute aqueous sodium hydroxide. Name the mechanism for this reaction.
(b) Prop-2-en-1-ol can also be formed from $HOCH_2CH_2CH_2OH$ in the presence of an acid catalyst.

$$HOCH_2CH_2CH_2OH \longrightarrow CH_2{=}CHCH_2OH + H_2O$$

Name and outline a mechanism for this reaction.

(c) Prop-2-en-1-ol forms an addition polymer. Draw the repeating unit of poly(prop-2-en-1-ol).

Section C

C1. Alcohol A $(CH_3)_2CHCH(OH)CH_3$ undergoes reactions separately with acidified potassium dichromate(VI) and with concentrated sulfuric acid.

(a) Deduce the IUPAC name for alcohol A.

(b) Draw the structure of the organic product, B, formed when A is oxidised in the reaction with acidified potassium dichromate(VI).

(c) Two isomeric alkenes, C and D, are formed when A is dehydrated in the reaction with concentrated sulfuric acid. Name the mechanism for this dehydration reaction.

(d) Draw the structure of each isomer.

(e) Name the type of structural isomerism shown by C and D.

(f) List alcohol A, product B and isomer C in order of increasing boiling point.

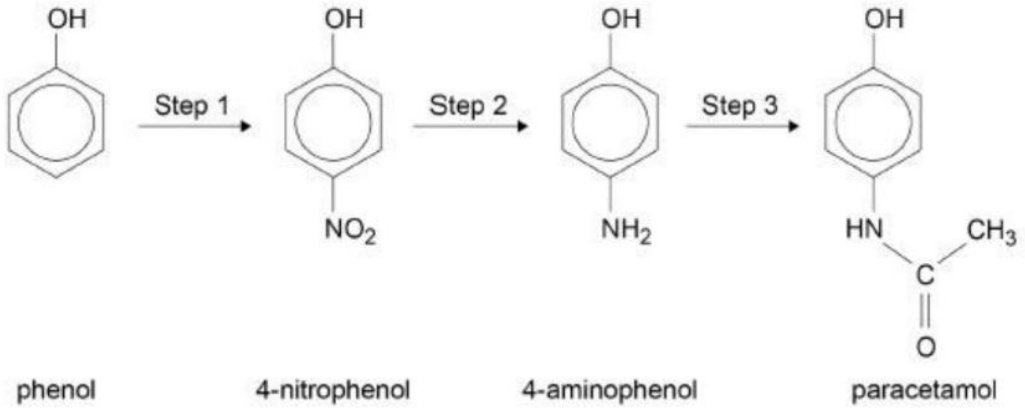
(g) Draw the structure of the isomer of A that is not oxidised by acidified potassium dichromate(VI).

(h) Draw the structure of the isomer of A that cannot be dehydrated to form an alkene by reaction with concentrated sulfuric acid.

Section D

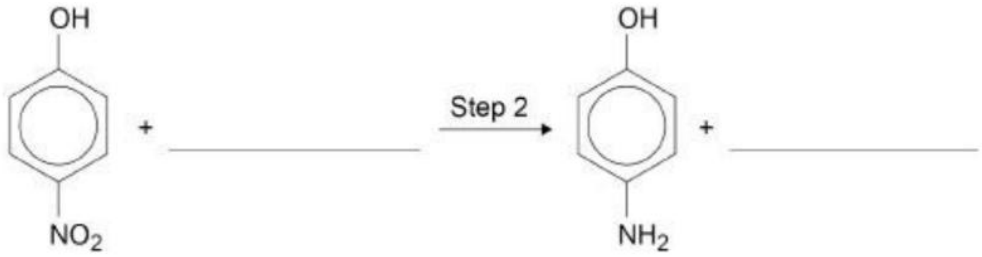
D1. Paracetamol is a medicine commonly used to relieve mild pain.

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

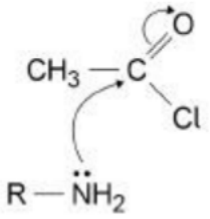


(a) Name the mechanism of the reaction in Step 1.

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



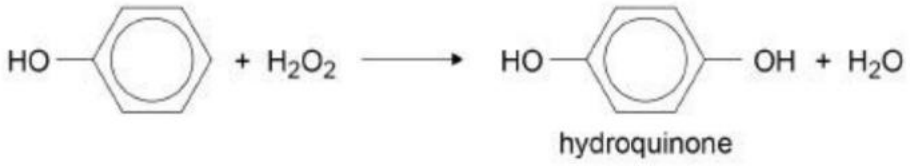
(c) In theory, either ethanoyl chloride or ethanoic anhydride could be used in Step 3. Complete the mechanism for the reaction of 4-aminophenol with ethanoyl chloride. RNH_2 is used to represent 4-aminophenol in this mechanism.



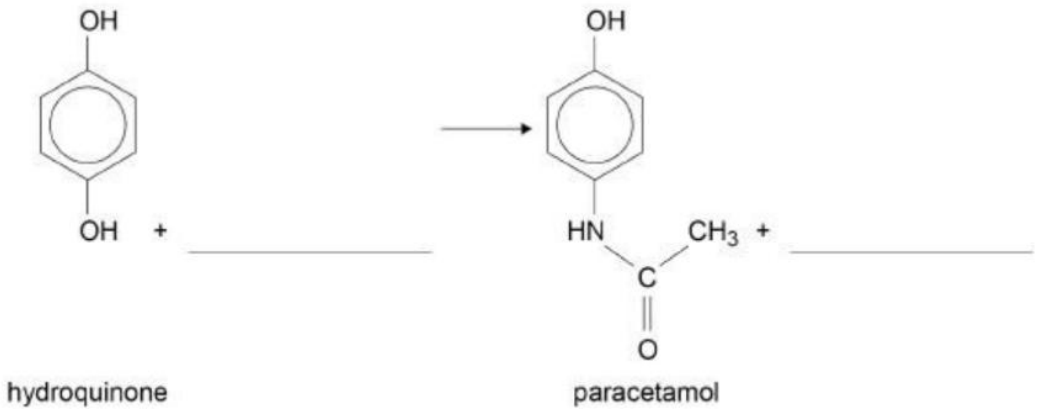
(d) In practice, ethanoic anhydride is used in the industrial synthesis rather than ethanoyl chloride. Give **one** reason why ethanoyl chloride is not used in the industrial synthesis.

(e) In Step 3 other aromatic products are formed as well as paracetamol. Draw the structure of one of these other aromatic products.

(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.



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