Answer all the questions below then check your answers

1. Ethanol can be dehydrated to form ethene.

(a) Write an equation for the dehydration of ethanol. (2 marks)

(b) State the type of reaction taking place. (1 mark)

(c) Describe the conditions needed to dehydrate ethanol using concentrated acid. (2 marks)

2. Propan-2-ol is heated with concentrated phosphoric acid.

(a) Draw or describe the structure of the alkene formed. (1 mark)

(b) Outline the three main steps in the mechanism. (3 marks)

(c) Explain why tertiary alcohols dehydrate more easily than primary alcohols. (2 marks)

3. Pentan-2-ol is dehydrated.

(a) Give the structural formulae of all possible alkene products formed directly by dehydration. (3 marks)

(b) State which alkene is the major product and explain your answer. (2 marks)

(c) Identify any products that show E/Z isomerism. (1 mark)

4. Cyclohexanol is dehydrated in a practical investigation.

(a) State why phosphoric acid is preferred over sulfuric acid. (1 mark)

(b) Explain why cyclohexene can be separated from cyclohexanol by distillation. (2 marks)

(c) After distillation the product is washed with sodium carbonate solution. State the purpose of this step. (1 mark)

(d) Explain why the organic layer is dried before final distillation. (1 mark)

5. Which statement about dehydration of alcohols is correct?

A. It is an addition reaction.
B. It forms an alkane.
C. It is a type of elimination reaction.
D. It requires dilute hydrochloric acid.
(1 mark)

6. Which alcohol would dehydrate most readily under acid conditions?

A. Ethanol
B. Propan-1-ol
C. Propan-2-ol
D. 2-methylpropan-2-ol
(1 mark)

7. A student heats butan-2-ol with concentrated acid.

Discuss the possible products formed. In your answer include:
- The names of possible alkenes
- Which product would be expected to form in the greatest amount
- Any stereoisomerism that may occur
(6 marks)

Answers

1. (a) $CH_3CH_2OH \rightarrow CH_2=CH_2 + H_2O$

(b) Elimination reaction.

(c) Heat to about 170–180°C with concentrated phosphoric or sulfuric acid.

2. (a) Propene.

(b) Step 1: Protonation of the OH group.
Step 2: Loss of water.
Step 3: Loss of a proton to form C=C.

(c) Tertiary alcohols form more stable carbocations, so the reaction occurs more readily.

3. (a) Pent-1-ene, (E)-pent-2-ene, (Z)-pent-2-ene.

(b) Pent-2-ene is the major product because the more substituted alkene is more stable (Zaitsev's rule).

(c) Pent-2-ene shows E/Z isomerism.

4. (a) Sulfuric acid can act as an oxidising agent causing side reactions.

(b) Cyclohexene has a much lower boiling point (83°C) than cyclohexanol (161°C).

(c) To neutralise and remove any remaining acid.

(d) To remove traces of water before final distillation.

5. Correct answer: C

6. Correct answer: D

7. Butan-2-ol forms but-1-ene and but-2-ene. But-2-ene (more substituted) is the major product. But-2-ene exists as E and Z isomers.