

**Q1.**The following pairs of compounds can be distinguished by simple test-tube reactions.

For each pair of compounds, give a reagent (or combination of reagents) that, when added separately to each compound, could be used to distinguish between them. State what is observed in each case.

(a) Butan-2-ol and 2-methylpropan-2-ol

Reagent .....

Observation with butan-2-ol

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Observation with 2-methylpropan-2-ol

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(3)

(b) Propane and propene

Reagent .....

Observation with propane

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Observation with propene

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(3)

(c) Aqueous silver nitrate and aqueous sodium nitrate

Reagent .....

Observation with aqueous silver nitrate

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Observation with aqueous sodium nitrate

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(3)

(d) Aqueous magnesium chloride and aqueous barium chloride

Reagent .....

Observation with aqueous magnesium chloride

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Observation with aqueous barium chloride

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(3)

(Total 12 marks)

**Q2.** In each of the following questions, you should draw the structure of the compound in the space provided.

(a) Draw the structure of the alkene that would form 1,2-dibromo-3-methylbutane when reacted with bromine.

(1)

(b) Draw the structure of the alcohol with molecular formula  $C_4H_{10}O$  that is resistant to oxidation by acidified potassium dichromate(VI).

(1)

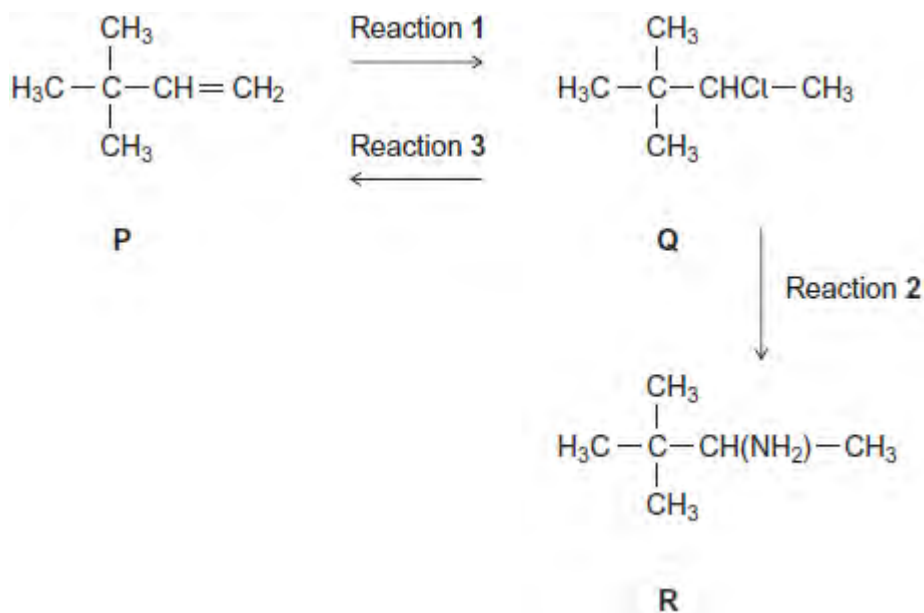
- (c) Draw the structure of the alkene that has a peak, due to its molecular ion, at  $m/z = 42$  in its mass spectrum.

(1)

- (d) Draw the structure of the organic product with  $M_r = 73$ , made from the reaction between 2-bromobutane and ammonia.

(1)  
(Total 4 marks)

**Q3.** Consider the following scheme of reactions.



- (a) Give the IUPAC name for compound **P** and that for compound **Q**.

**P** .....

Q ..... (2)

(b) The conversion of P into Q in Reaction 1 uses HCl

Name and outline a mechanism for this reaction.

..... (5)

(c) The conversion of Q into R in Reaction 2 uses NH<sub>3</sub>

Name and outline a mechanism for this reaction.

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(d) State the type of reaction shown by Reaction 3.

Identify a reagent for this reaction.

Give **one** condition necessary for a high yield of product when Q is converted into P.

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(e) Hydrogen bromide (HBr) could be used in the overall conversion of P into R, instead of using HCl

Hydrogen bromide is made by the reaction of NaBr with concentrated phosphoric acid.

Concentrated sulfuric acid is **not** used to make HBr from NaBr

Write an equation for the reaction of NaBr with H<sub>3</sub>PO<sub>4</sub> to produce HBr and Na<sub>3</sub>PO<sub>4</sub> only.

Identify **two** toxic gases that are formed, together with HBr, when NaBr reacts with concentrated H<sub>2</sub>SO<sub>4</sub>

State the role of  $\text{H}_2\text{SO}_4$  in the formation of these two toxic gases.

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(4)  
(Total 19 marks)

**Q4.** What is the major product of the reaction between but-1-ene and  $\text{DBr}$ ?  
(D is deuterium and represents  $^2\text{H}$ )

- A**     $\text{CH}_2\text{DCH}_2\text{CH}_2\text{CH}_2\text{Br}$
- B**     $\text{CH}_2\text{DCH}_2\text{CHBrCH}_3$
- C**     $\text{CH}_3\text{CH}_2\text{CHBrCH}_2\text{D}$
- C**     $\text{CH}_3\text{CH}_2\text{CHDCH}_2\text{Br}$

(Total 1 mark)

**Q5.** But-1-ene reacts with a reagent of the form  $\text{HY}$  to form a saturated compound.

- (a) Suggest a reagent of the form  $\text{HY}$  which reacts with but-1-ene.

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(1)

- (b) Name and draw a mechanism for the reaction in part (a).

Name of mechanism .....

Mechanism

(5)

(c) Explain how three isomeric products are formed when HY reacts with but-1-ene.

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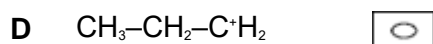
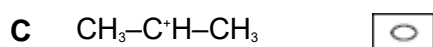
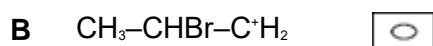
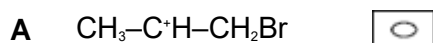
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(Total 9 marks)

**Q6.** Consider the reaction between propene and hydrogen bromide to form the major product.

Which species is formed in the mechanism of this reaction?



(Total 1 mark)

**Q7.** A student carried out an experiment to determine the number of C=C double bonds in a

molecule of a cooking oil by measuring the volume of bromine water decolourised.

The student followed these instructions:

- Use a dropping pipette to add 5 drops of oil to 5.0 cm<sup>3</sup> of inert organic solvent in a conical flask.
- Use a funnel to fill a burette with bromine water.
- Add bromine water from a burette to the solution in the conical flask and swirl the flask after each addition to measure the volume of bromine water that is decolourised.

The student's results are shown in the table below.

Experiment	Volume of bromine water / cm <sup>3</sup>
1	39.40
2	43.50
3	41.20

- (a) In a trial experiment, the student failed to fill the burette correctly so that the gap between the tap and the tip of the burette still contained air.

Suggest what effect this would have on the measured volume of bromine water in this trial. Explain your answer.

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(2)

- (b) Other than incorrect use of the burette, suggest a reason for the inconsistency in the student's results.

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(1)

- (c) Outline how the student could improve this practical procedure to determine the number of C=C double bonds in a molecule of the oil so that more consistent results are obtained.

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**(4)**

- (d) The oil has a density of  $0.92 \text{ g cm}^{-3}$  and each of the 5 drops of oil has a volume of  $5.0 \times 10^{-2} \text{ cm}^3$ .  
The approximate  $M_r$  of the oil is 885.  
The concentration of bromine water used was  $2.0 \times 10^{-2} \text{ mol dm}^{-3}$ .

Use these data and the results from experiment 1 to deduce the number of C=C double bonds in a molecule of the oil.  
Show your working.

**(5)**  
**(Total 12 marks)**