1 Which of the following **cannot** be used to detect alcohol in a breathalyser test?

☒ **A** Fractional distillation

☒ **B** Fuel cell

☒ **C** Infrared spectroscopy

☒ **D** Reduction of dichromate(VI) ions

(Total for Question = 1 mark)

2 Propanal, CH_3CH_2CHO, and propanone, CH_3COCH_3, are carbonyl compounds. When these compounds are compared using physical methods of analysis, which of the following statements is **not** correct?

☒ **A** The compounds produce different patterns in the fingerprint region of the IR spectrum.

☒ **B** The carbonyl groups absorb at frequencies in the same region of the IR spectrum.

☒ **C** The compounds produce different fragmentation patterns in a mass spectrum.

☒ **D** The compounds have molecular ion peaks at different mass to charge ratios in a mass spectrum.

(Total for Question = 1 mark)

3 A sample of propanone, CH_3COCH_3, was heated under reflux with potassium dichromate(VI) acidified with sulfuric acid, and then the mixture was distilled. Apart from the peaks due to the C—C and C—H bonds, what peak(s) would be present in the IR spectrum of the distillate?

☒ **A** A peak due to the C═O only.

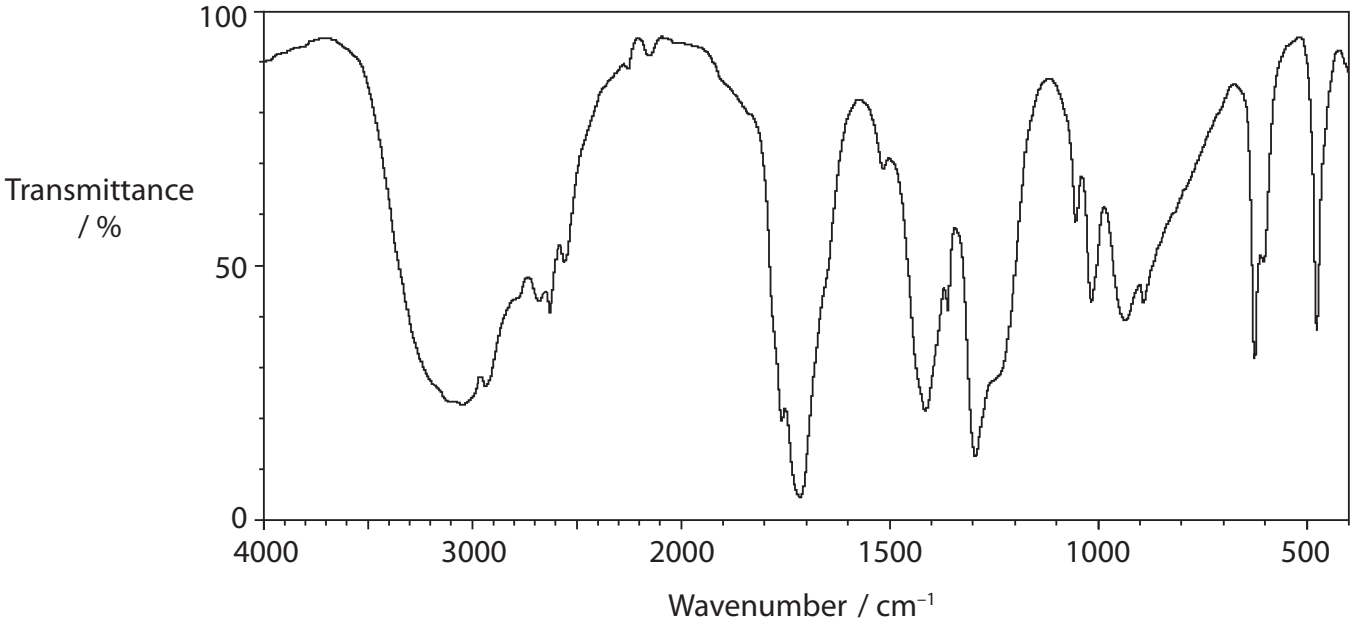
☒ **B** A peak due to the O—H only.

☒ **C** Peaks due to C═O and O—H.

☒ **D** Peaks due to C—O, C═O and O—H.

(Total for Question = 1 mark)

4 Consider the infrared spectrum shown below.



The IR absorption ranges associated with some organic functional groups are given below.

O—H stretching in alcohols (variable, broad)	3750 – 3200 cm^{-1}
O—H stretching in carboxylic acids (weak)	3300 – 2500 cm^{-1}
C═O stretching in aldehydes (strong)	1740 – 1720 cm^{-1}
C═O stretching in ketones (strong)	1700 – 1680 cm^{-1}
C═O stretching in carboxylic acids, alkyl (strong)	1725 – 1700 cm^{-1}
C—H stretching in aldehydes (weak)	2900 – 2820 cm^{-1} and 2775 – 2700 cm^{-1}

Which of the following could have produced the above spectrum?

☒ **A** An aldehyde

☒ **B** An alcohol

☒ **C** A carboxylic acid

☒ **D** A ketone

(Total for Question = 1 mark)

5 Which of the following physical methods of chemical analysis is used in modern breathalysers?

☒ **A** Infrared spectroscopy

☒ **B** Mass spectrometry

☒ **C** Nuclear magnetic resonance

☒ **D** Ultraviolet spectroscopy

(Total for Question = 1 mark)

6 These questions concern the use of infrared (IR) spectra to identify organic compounds. The IR absorption ranges associated with some organic functional groups are given below.

A O—H stretching in alcohols at 3750 3200 cm ^{1}

B C═O stretching in aldehydes at 1740 1720 cm ^{1}

C C═O stretching in ketones at 1700 1680 cm ^{1}

D C═O stretching in carboxylic acids at 1725 1700 cm ^{1}

(a) When propan-2-ol is refluxed with potassium dichromate(VI) and sulfuric acid, the **product** will show a peak due to

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) When propan-1-ol is heated with potassium dichromate(VI) and sulfuric acid, the **product**, that is distilled off as it is formed, will show a peak due to

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 2 marks)

7 For which of the following are both tests acceptable evidence for a driver to be successfully prosecuted for excess alcohol in the blood in many countries?

☒ **A** A dichromate(VI) breath analyser and a blood test.

☒ **B** A dichromate(VI) breath analyser and a fuel cell breath analyser.

☒ **C** A dichromate(VI) breath analyser and an infrared breath analyser.

☒ **D** An infrared breath analyser and a blood test.

(Total for Question 1 mark)

8 For drivers in the UK, the legal limit of the concentration of ethanol (molar mass 46 g mol ^{1}) in the blood is 80 mg per 100 cm^{3}. This is equivalent to a concentration of

☒ **A** 17.4 mol dm ^{3}

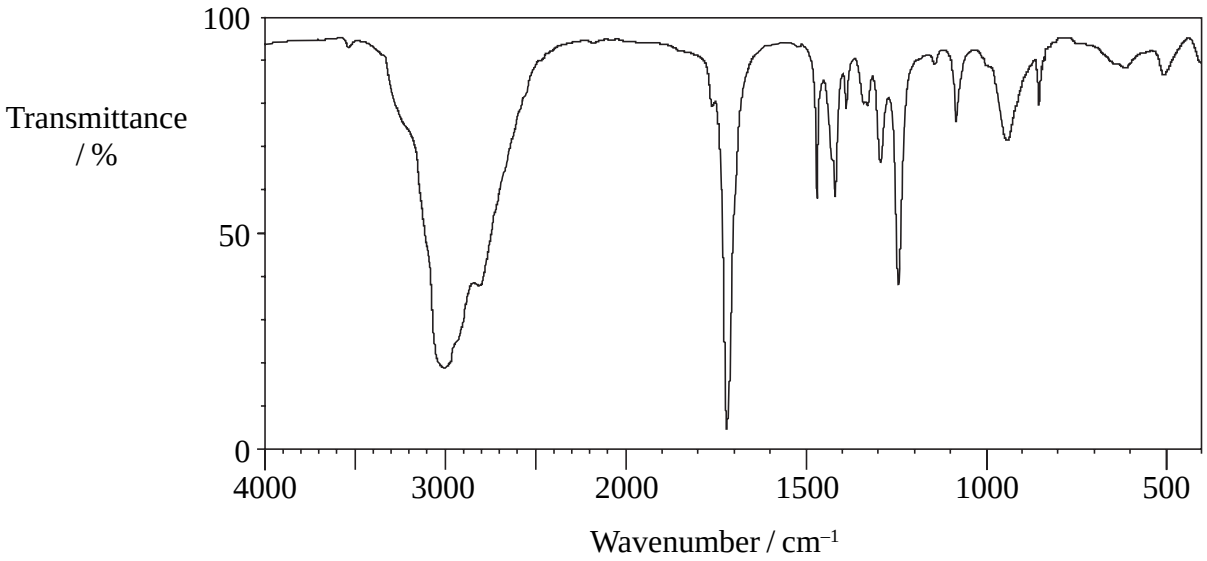
☒ **B** 1.74 mol dm ^{3}

☒ **C** 0.0174 mol dm ^{3}

☒ **D** 0.00174 mol dm ^{3}

(Total for Question 1 mark)

9 The infrared spectrum below is most likely to be that of a member of which homologous series?



C—Cl stretching vibrations 600 – 800 cm^{-1}
O—H stretching vibrations 2500 – 3300 cm^{-1}
C═O stretching vibrations 1680 – 1740 cm^{-1}

☒ **A** Alcohol

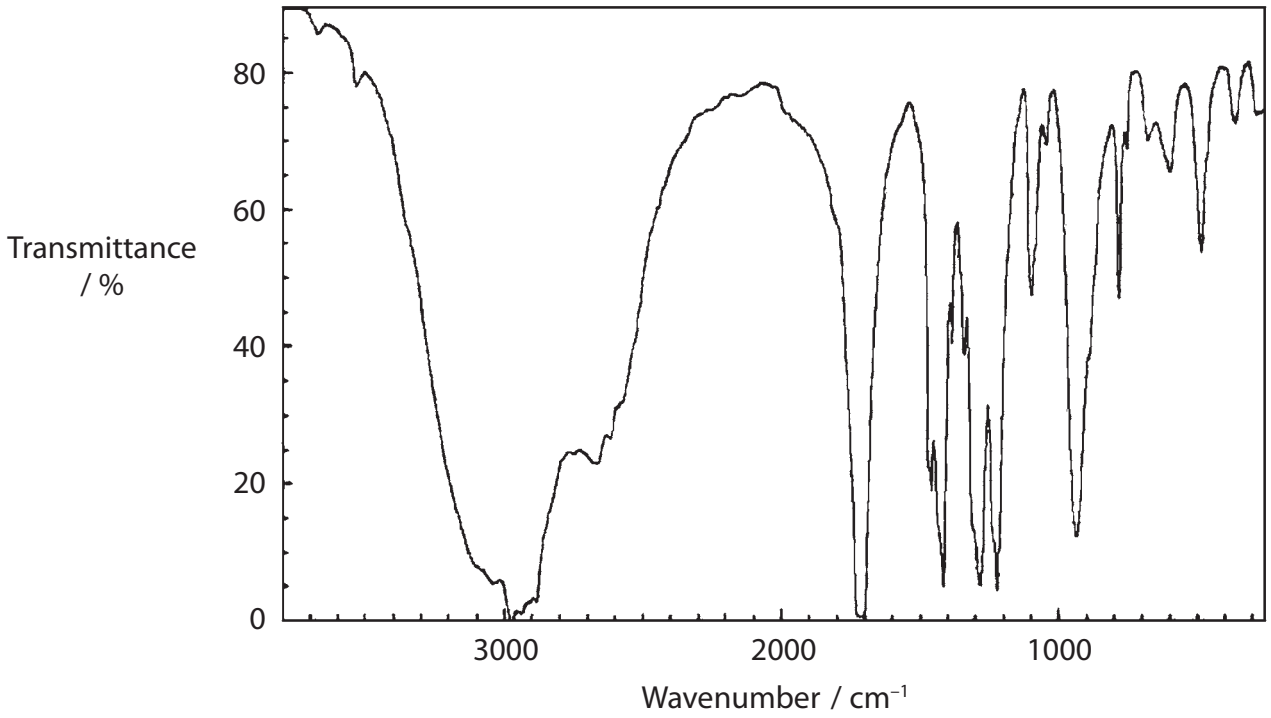
☒ **B** Chloroalkane

☒ **C** Aldehyde

☒ **D** Carboxylic acid

(Total for Question = 1 mark)

10 Under certain conditions, butan-1-ol can be oxidized to the compound with infrared spectrum shown below.



O—H stretching vibrations alcohols	3750 – 3200 cm^{-1}
O—H stretching vibrations carboxylic acids	3300 – 2500 cm^{-1}
C═O stretching vibrations aldehydes and ketones	1740 – 1680 cm^{-1}
C═O stretching vibrations carboxylic acids	1725 – 1700 cm^{-1}

The compound is most likely to be

☒ **A** butan-2-ol.

☒ **B** butanal.

☒ **C** butanone.

☒ **D** butanoic acid.

(Total for Question = 1 mark)

11 When propanal, CH_3CH_2CHO, and propanone, CH_3COCH_3, are compared using physical methods of analysis, which of the following is **not** correct?

☒ **A** The carbonyl groups absorb at very similar frequencies of the IR spectrum.

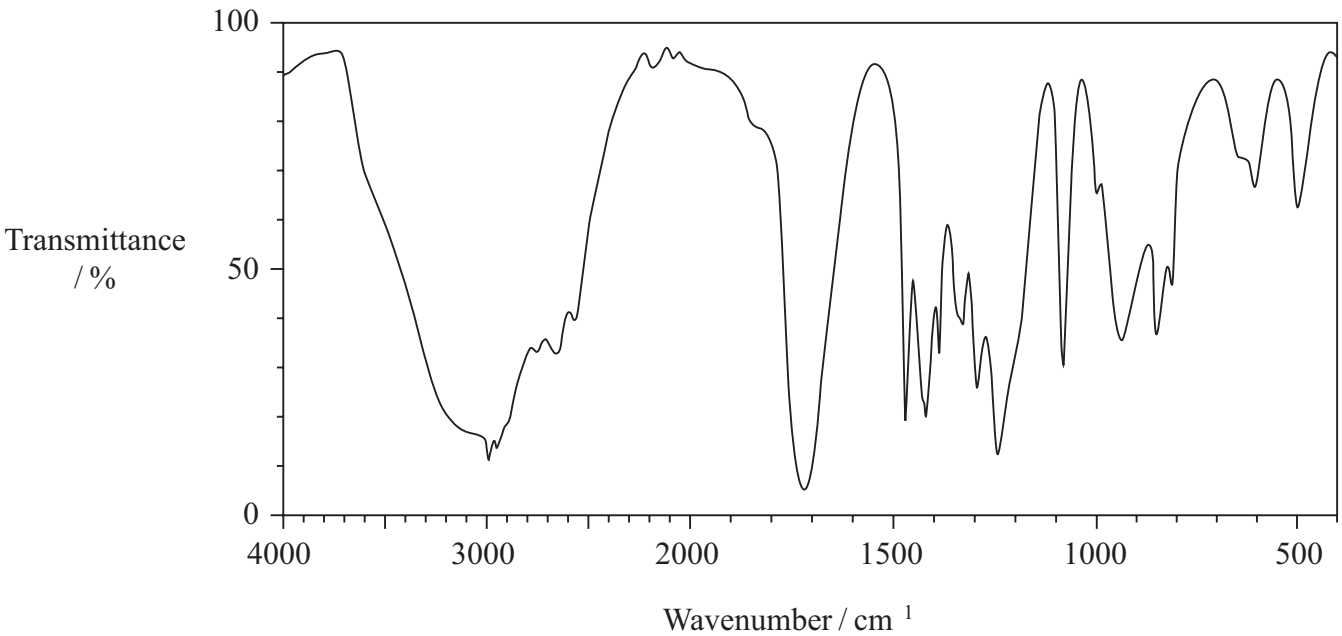
☒ **B** The compounds will have different patterns in the fingerprint region of the IR spectrum.

☒ **C** The compounds will form different fragmentation patterns in a mass spectrum.

☒ **D** The compounds will have molecular ion peaks at different mass to charge ratios in a mass spectrum.

(Total for Question 1 mark)

12 The IR spectrum of a substance is shown below.



Which of the following substances has this spectrum?

You may use the information on page 6 of the data booklet.

☒ **A** Propan-1-ol

☒ **B** Propanal

☒ **C** Propanone

☒ **D** Propanoic acid

(Total for Question 1 mark)

13 Not all molecules will absorb infrared radiation. Those that do

- ☒ **A** change their dipole moment when their bonds stretch or bend.
- ☒ **B** undergo homolytic fission.
- ☒ **C** must be polar.
- ☒ **D** are always organic substances.

(Total for Question = 1 mark)