1 Chromatography is used to separate the components of a mixture and can be carried out in a range of different ways.

(a) A suitable example of a 'carrier gas' in gas chromatography is

(1)

☒ **A** chlorine.

☒ **B** nitrogen.

☒ **C** steam.

☒ **D** not possible to state, as there should be a vacuum.

(b) Separation is achieved in gas chromatography due to the components in the mixture having different

(1)

☒ **A** interactions with the stationary phase.

☒ **B** interactions with the mobile phase.

☒ **C** colours.

☒ **D** solubility in the moving solvent.

(Total for Question = 2 marks)

2 Which gas is the **least** suitable as a carrier gas in Gas-Liquid Chromatography?

☒ **A** Argon

☒ **B** Carbon dioxide

☒ **C** Oxygen

☒ **D** Nitrogen

(Total for Question = 1 mark)

3 Chromatography may be used to separate mixtures of amino acids. This is best explained by the fact that different amino acids have different interactions with

⊠ **A** the mobile phase only.

⊠ **B** the stationary phase only.

⊠ **C** the mobile phase **and** the stationary phase.

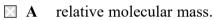⊠ **D** ninhydrin.

(Total for Question = 1 mark)

4 Ninhydrin is used in thin-layer chromatography to help with the identification of amino acids. This is because the ninhydrin

⊠ **A** reacts with amino acids to form a compound which has an intense colour.

⊠ **B** reacts with amino acids to form compounds each of which has a characteristic colour.

⊠ **C** increases the separation of the amino acids on the chromatogram.

⊠ **D** ensures that the mobile phase maintains a nearly constant pH for all the amino acids.

(Total for Question = 1 mark)

5 In one type of high-performance liquid chromatography (HPLC), the stationary phase is non-polar and a polar solvent is used as the eluent. Which of the following would travel through the chromatography column most quickly?

⊠ **A** Tetrachloromethane

⊠ **B** Chloromethane

⊠ **C** Iodomethane

⊠ **D** Hexane

(Total for Question = 1 mark)

6 HPLC stands for

☒ **A**   high pressure liquid column.

☒ **B**   high performance liquid chromatography.

☒ **C**   heterogeneous phase liquid chromatography.

☒ **D**   homogenous phase liquid column.

(Total for Question = 1 mark)

7 In gas chromatography, mixtures are passed through a long tube containing a liquid as the stationary phase. The mixtures are separated into their components because the components differ in

☒ **A**   relative molecular mass.

☒ **B**   melting temperature.

☒ **C**   volatility.

☒ **D**   force of attraction to the liquid.

(Total for Question = 1 mark)

8 The distance on a chromatogram moved by an individual amino acid, in a mixture of different amino acids, mainly depends on

☒ **A**   the molar mass of the amino acid.

☒ **B**   the molar mass of the solvent used.

☒ **C**   the intermolecular forces between the solvent and the stationary phase.

☒ **D**   the intermolecular forces between the amino acid and both the solvent and the stationary phase.

(Total for Question = 1 mark)

9 The spectra of the compounds with the formulae $CH_3CH(OH)CH_3$ and $CH_3CH_2CH_2OH$ can be distinguished by

☒ **A** the value of m/e of the molecular ion in the mass spectrum.

☒ **B** the presence of a fragment with $m/e =15$ in the mass spectrum.

☒ **C** the presence of an absorption peak due to O–H in the infrared spectrum.

☒ **D** the number of peaks in the nmr spectrum.

(Total for Question = 1 mark)

10 Which of the following has two singlet peaks in its nmr spectrum?

☒ **A** Methanal, HCHO

☒ **B** Methanol, CH_3OH

☒ **C** Chloromethane, CH_3Cl

☒ **D** Dichloromethane, CH_2Cl_2

(Total for Question = 1 mark)

11 The nmr spectrum of 2,2-dimethylpropane, $H_3C\!-\!\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}}\!-\!CH_3$, contains

☒ **A** one singlet peak.

☒ **B** four singlet peaks.

☒ **C** one quartet peak.

☒ **D** four quartet peaks.

(Total for Question = 1 mark)

12 In high performance liquid chromatography, HPLC, which of these factors does **not** affect the time taken for a component to pass through the column?

⊠ **A** Type of detector

⊠ **B** Material of stationary phase

⊠ **C** Particle size of stationary phase

⊠ **D** Temperature of column

(Total for Question = 1 mark)

13 How many different peaks due to hydrogen atoms would you expect to see in a **low resolution** proton nmr spectrum of propanoic acid, CH_3CH_2COOH?

⊠ **A** Two

⊠ **B** Three

⊠ **C** Five

⊠ **D** Six

(Total for Question = 1 mark)

14 In a **high resolution** proton nmr spectrum of ethanoic acid, CH_3COOH, the peak due to the hydrogen atoms in the methyl group would be a

⊠ **A** singlet.

⊠ **B** doublet.

⊠ **C** triplet.

⊠ **D** quartet.

(Total for Question = 1 mark)

15 When propanone reacts with iodine in the presence of sodium hydroxide, the crystalline solid product has the formula

⊠ **A** CH_3I

⊠ **B** CHI_3

⊠ **C** CH_3COCH_2I

⊠ **D** CH_3COCI_3

(Total for Question = 1 mark)