**Instrument test Solutions**

**SECTION A: Multiple-choice questions (1 mark each)**

|  |  |
| --- | --- |
| **Question** | **Response** |
| **1** | D |
| **2** | B |
| **3** | D |
| **4** | B |
| **5** | B |
| **6** | D |
| **7** | B |
| **8** | A |
| **9** | C |
| **10** | B |

**Question 1**

*Answer:* C

**Question 2**

*Answer:* B

*Explanation:*

Formula of benzoic acid is C6H5COOH. It will be monoprotic.

**Question 3**

*Answer:* D

*Explanation:*

n(NaOH) = c × V = 0.08 × 0.02 = 0.0016 mol = n(benzoic acid)

c = 0.0016/0.016 = 0.1 M

**Question 4**

*Answer:* B

*Explanation:*

HPLC for separation

Molecular structure to be determined by NMR and IR

**Question 5**

*Answer:* B

*Explanation:*

All Hs are the same as all CH3. The middle carbon is different from the other two.

**Question 6**

*Answer:* D

*Explanation:*

Rf = 5.2/7.0

 = 0.74

*x* = 0.74 x 8.6

 = 6.4cm

**Question 7**

*Answer:* B

*Explanation:*

When a molecule absorbs infrared radiation different types of bonds vibrate/behave differently.

**Question 8**

*Answer:* A

*Explanation:*

Total peak area = 5 + 2 + 3

 = 10

Peak height of C6H14  = 3

3/10 x 100 = 30%

 **Question 9**

*Answer:* C

*Explanation:*

Ethanoic acid has two hydrogen environments, no splitting. One of the hydrogen environments has a massive shift.

**Question 10**

*Answer:* B

*Explanation:*

All carbon atoms in benzene have the same environment.

**SECTION B: Short-answer questions**

**Question 1**

* + 1. Qualitatively – looking at retention times of components and compare them to known standards.
		2. Quantitatively – measure area under the peaks. Compare the areas to standard solutions. 2 + 2 = 4 marks
		3. Retention times of components can be affected by any of the following factors:
* the molecular structure of the component
* the solvent flow rate
* the length of the column
* the nature and chemical structure of the stationary phase 2 marks
* nature and chemical structure of the mobile phase

**Question 2**  (7 marks)

**a**.



 molecule 1 molecule 2 molecule 3

 Order will probably be molecule 2, then molecule 1 then molecule 3\*. As the electronegativity

 of the elements increases, so also will the shift.\*

2 marks



**b. i**.

 **ii**. It is a reference, chosen for its stability and low response.

1 + 1 = 2 marks

**c**. .

 Propane should have two sets of peaks\*. The middle two hydrogen atoms have the same

 environment but have 6 neighbours so should be a septet. The end hydrogen atoms should be

 present as a triplet due to having two neighbours\*

2 marks

 **d**.

1 mark

**Question 3**  (9 marks)

1. **Spectra A**: Butanol
2. **Spectra B**: Butane
3. **Spectra C**: Butanoic acid

1 + 1 + 1 = 3 marks

1. **Spectra A**: Butanol

 Peak at ~ 2900cm-1 is CH

 Peak at ~ 3300cm-1 is –OH (alcohols)

1. **Spectra B**: Butane

 Peak at ~ 2900cm-1 is CH

 Absence of any other significant peaks

1. **Spectra C**: Butanoic acid

 Broad peak at ~3000cm-1 is characteristic of acids –OH

 Peak at ~1700cm-1 is C=O

2 + 2 + 2 = 6 marks

**Question 4** (9 marks)

C : H : O

40 : 6.7 : 53.3

12.0 1.0 16.0

3.33 : 6.7 : 3.33

3.33 3.33 3.33

1 : 2 : 1

CH2O

* + 1. M(CH2O) = 30gmol-1

60/30 = 2

C2H4O2

* + 1. Carboxyl, ester, two alcohol groups

 2 + 2 + 1 = 5 marks

1. Two – two peak sets on NMR spectrum

1 mark

1. 

1 mark

1. Broad peak at ~3000cm-1 characteristic of acids –OH group

Peak at ~1750cm-1 for C=O bond

1 mark

1. Ethanoic acid

1 mark

**Question 5** (9 marks)

**a**. CH3COOH(aq) + NaOH(aq) 🡪 NaCH3COO(aq) + H2O(l)

1 mark

**b**. Phenolphthalein is a good choice for a titration between a weak acid and a strong base. It changes

 colour around pH 9.

2 marks

**c. i**. *n*(NaOH) = *c* × *V* = 0.120 × 0.01244 = 1.49 × 10-3 mol

 *n*(CH3COOH) = *n*(NaOH) = 1.49 × 10-3 mol

 c =  =  = 0.0597 M

 **ii**. concentration of undiluted vinegar =  =2.99 M

3 + 1 = 4 marks

**d. i**. No impact as the reaction of a weak acid and a base is not reversible.

 **ii**. The water will dilute the base, requiring a greater titre. Elevated value of concentration for the

 ethanoic acid.

1 + 1 = 2 marks

 **END OF TASK**