Section One: Multiple-choice (16 marks)

This section has **8** questions. Answer **all** questions on the grid below

Each question has only one correct answer. Select your answer by placing a cross in the box on the answering grid below. Attempt all questions.

Please mark the correct answer with an 'x' on the answer grid below.

Question				
1 ~~B~~	A	B	C	D ~~B~~
2 ~~D~~	A	B	C	D ~~D~~
3 ~~B~~	A	B	C	D
4 ~~D~~	A	B	C	D
5 ~~B~~	A	B	C	D
6 ~~B~~	A	B	C	D
7 ~~A~~ ~~B~~	A	B	C	D
8 ~~A~~	A	B	C	D

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1. Two solutions of equal concentration, A and B, have a pH of 3 and 6 respectively. Which of the following statements about the solutions is/are true?

    (i) They will show the same colour in universal indicator. ✗

    (ii) The concentration of H^+ is higher in B than it is in A. ✗

    (iii) B is a weaker acid than A.

    (a) (ii) only

    (b) (iii) only

    (c) (i) and (ii) only

    (d) (i), and (iii) only

    $pH = -\log[H^+]$

    $pH\ A = 3 \quad [H^+] \uparrow$

    $pH\ B = 6 \quad [H^+] \downarrow$

2. The following questions relate to this equation:

    base   acid   ba   cb

    $$HPO_4{}^{2-}(aq) + H_2O(l) \rightleftharpoons H_2PO_4{}^-(aq) + OH^-(aq)$$

    Which of the following statements is **false**?

    a) The $HPO_4{}^{2-}$ behaves as a base. ✓

    b) The water is acting as an acid.. ✓

    c) The $H_2PO_4{}^-$ is acting as an acid. ✓

    d) The hydroxide ion is acting as a conjugate acid ✗

electronegativity increases

3. Which of the following groups is ranked in order of increasing molecular polarity?
   a) CH_2Cl_2, CH_2F_2, CH_2I_2 ✗
   b) H_2Te, H_2Se, H_2S ✓
   c) HBr, HF, HI ✗
   d) CH_3F, CH_4, CF_4

most polar *polar* ↑*non* ✗

4. Which one of the following could be true in an aqueous solution of sodium hydroxide?

   a) $[H^+] = [OH^-]$ ✗   *more* $[OH^-]$
   b) $pH = -\log_{10} [OH^-]$
   c) $pH = 1.2$ — *acid*
   d) $pH = 12.8$ — *base would be an*
   ↳ *base*

5. Which one of the following is the change in units of pH which occurs when 10.0mL of a 1.0 M solution of a strong monoprotic acid are made up to 1.0 L with water?

   1st   *2nd* $.010/_1$ $c = \frac{n}{v}$

   a) 1   *1m HCl*
   b) 2 $pH = -\log [1]$ $pH = -\log [0.01]$
   c) 3 $= 2$
   d) 5   *only 1% of water $= 0$*

   not HNO_3, HCl *or* H_2SO_4

6. 10.0 mL of water is added to one litre (1L) of pure ethanoic acid. The resulting solution is:

   a) A dilute solution of a weak acid
   b) A concentrated solution of a weak acid
   c) A dilute solution of a strong acid
   d) A concentrated solution of a strong acid

   $c_1 = \frac{n}{v} = \frac{n}{1L}$

   $c_2 = \frac{n}{1.01 L}$
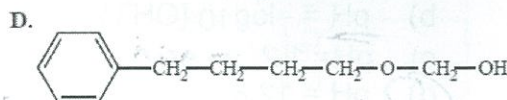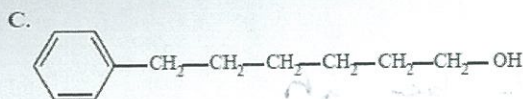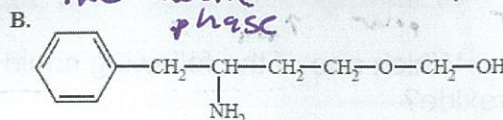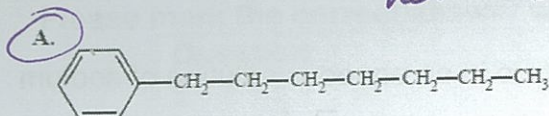
(handwritten annotations)

Most polar
will not adsorb *(strongly)*

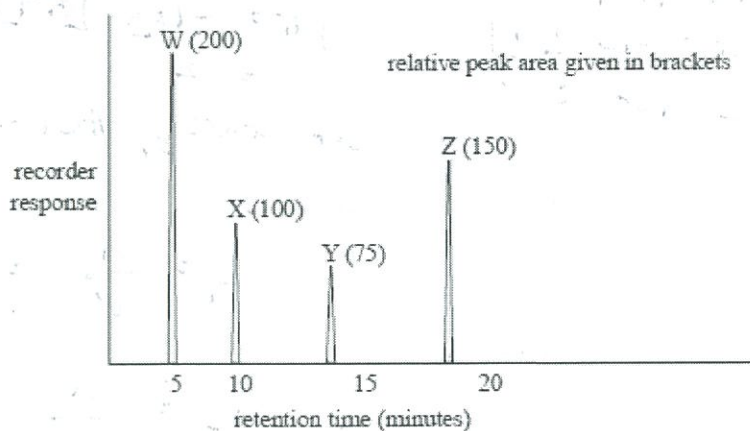Non-polar — stationary phase
Polar — mobile phase

7. Reverse phase high pressure liquid chromatography uses a non-polar stationary phase and a polar mobile phase. Which of the following would have the longest retention time on the reverse phase column?

(handwritten) non-polar will not dissolve into the mobile phase

(handwritten) R_t inc w/ dec. polarity

A. *(circled)*

$-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$

(handwritten) [no]

B.

$-CH_2-CH-CH_2-CH_2-O-CH_2-OH$
       |
       NH_2

C.

$-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-OH$

D.

$-CH_2-CH_2-CH_2-CH_2-O-CH_2-OH$

8. The diagram below shows the chromatogram for large straight chain alkanes (hydrocarbons containing only carbons and hydrogens). *(handwritten)* $C_n H_n$

W (200)

relative peak area given in brackets

Z (150)

recorder response

X (100)

Y (75)

(handwritten) R_E ↑ then they are less volatile (higher bp)

5   10   15   20

retention time (minutes)

The following statements refer to the chromatogram.

 I. The boiling points are arranged in increasing boiling point W> X>Y> Z.

 II. The retention times will remain the same, if the temperature at which the chromatogram is recorded is increased, all other conditions remaining constant. *(handwritten)* tem

 III. Hydrogen gas could have been used as a carrier gas to obtain this chromatogram.

(handwritten) ↓ only inert gases

Which of the above statements are true?

 a) I only *(circled)*

 b) I and II only

 c) I and III only

 d) II and III only

(handwritten) temp will impact bpt hence volatility on GC or HPLC

END OF SECTION ONE

Mostly

Section 2: Extended Answers   (34 MARKS)

Question 1

a) Using an equation, define pH: (1)

....

b) 100.0 L of a 0.010 mol L-1 solution of hydrochloric acid is concentrated by careful evaporation of the water to a final volume of 10.0 L. Calculate the final pH of the solution. Be sure to show all working.   (2)

.... 1st find [H+] ....

....

....

Question 2

Naming!

Write balanced equations (ionic where appropriate) to represent the following reactions: (9)

a) Lead (II) oxide solid and dilute nitric acid are mixed

Observation: ...... no names of compounds, just what you would see, no abbrev, w/o definitions

Equation: .... ① (mark for molecular) .... ie c/c = clear and colourless

....

b) A piece of magnesium carbonate is reacted with dilute hydrochloric acid.

Observation: ....

Equation: ..... ① (mark for molecular) ....

....

c) Some small pieces of calcium are added to dilute phosphoric acid

Observation: ....

Equation: ...... gave 1 mark if you wrote ionic for Ca^{2+} PO_4^{3-} (insoluble) ....

Question 4 (4 marks)

For each of the solid substances state the two most important types of bonding acting within that substance. The first one has been done for you.

Substance	Two strongest bonding forces
Oxygen (O_2)	Covalent: dispersion
Hydrogen chloride	
Sodium hydroxide	
Water	
Graphite	

Question 5 (4 marks)

With reference to strength and types of intermolecular forces account for the difference in the boiling points of the following pairs of compounds.

a. methanol (65 °C) and methane, CH_4 (-162 °C) (2 marks)

OH
↑ must say hydrogen - bonding
for full marks

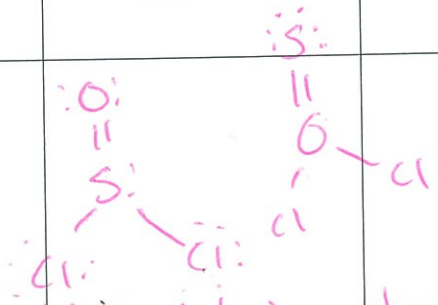b. methanol (65 °C) and octane, C_8H_{18} (126 °C) (2 marks)

need to discuss more electrons in
octane - NOT more bonds to break
for ___ point

and hydrogen- bonding or at least dipole-dipole
in methanol is weaker in
this case

Question 3

For each species listed in the table below show the bond diagram *showing the shape* or molecular geometry. No marks will be given for the electron dot diagram but may aid in your structural diagram. For each identify the species as polar or non-polar.

Species	Electron dot diagram	Structure Diagram (1 mark each)	Polar or Non-polar (1 mark each)
Phosphate ion (PO_4^{3-})			
Phosphine (PH_3)			
Thionyl chloride $SOCl_2$			

both pyramidal & planar accepted

must show shapes

Question 6   **(4 marks)**

Consider the following situations and suggest the BEST chromatographic technique.
You must use each at least once. Briefly state a reason for your choice.

Gas chromatography

High Pressure Liquid Chromatography

Thin Layer Chromatography

a. A technique suitable for analysing minute samples of volatile fuel residues
extracted from the burnt remains at a suspected arson scene.

GC   —   TLC not accepted

b. A pharmacological analysis of a mixture of a very high molar mass proteins and
polypeptides present in biological fluids.

HPLC

c. Analysis of air sample for pollutants like sulphur dioxide, nitrogen oxides and
various hydrocarbon compounds.

GC

d. Analysis of the sugar content of a fruit juice.

TLC   HPLC accepted

Question 7 (4 marks)

A 2.89 g sample of sandstone, containing only calcium carbonate and silicon dioxide, is analysed by reacting it with hydrochloric acid.

A volume of 10.7 ml of 2.50 mol L-1 hydrochloric acid solution is required for complete reaction.

a) Write an ionic equation for the reaction (1)

gave mark if balanced and included SiO_2 -even though it would not react

b) Calculate the mass of calcium carbonate that is used up in the reaction. (3)

this was practice of stoichiometry & doesn't go away

END OF TEST