SOLUTIONS - 2008 MHS Unit 3 Trial Exam

1	B	6	C	11	A	16	D
2	D	7	D	12	C	17	B
3	D	8	B	13	B	18	B
4	A	9	D	14	D	19	D
5	C	10	C	15	A	20	D

Question 1.

a $pH = -log10[H_3O^+]$
$[H_3O^+] = 10^{-11.1}$ M *
$[OH^-] = 10^{-14} / [H_3O^+] = 10^{-14} / 10^{-11.1} = 10^{-2.9}$
$[OH^-] = 1.26 \times 10^{-3}$ M *

b   Sodium ethanoate ionises in solution. The ethanoate (acetate) ions in solution react with the water molecules forming OH^- ions, as there are more OH^- ions than H^+ ions in the solution, it is basic. *
$CH_3COO^-_{(aq)} + H_2O_{(l)} \leftrightarrow CH_3COOH_{(aq)} + OH^-_{(aq)}$ * (either arrow acceptable here)

Question 2.

a $CH_3CH_2COOH_{(aq)} + H_2O_{(l)} \leftrightarrow CH_3CH_2COO^-_{(aq)} + H_3O^+_{(aq)}$ *(only double arrow acceptable here)
b   Propanoic acid is a weak acid, and a direct reaction with a base will not give a sharp end point. A back titration will mean that the titration occurs between a strong acid and a strong base, giving a sharp end point to the titration. *
c   i $CH_3CH_2COOH_{(aq)} + NaOH_{(aq)} \rightarrow CH_3CH_2COONa_{(aq)} + H_2O_{(aq)}$ *
ii $n(NaOH)_{initial} = C \times V = 0.196 \times 0.05000 = 0.00980$ mol   *
iii $n(HCl) = C \times V = 0.298 \times 0.01864 = 0.00555$ mol   *
iv $n(NaOH)_{XS} = n(HCl) = 0.00555$ mol   *
v $n(NaOH)_{rxt} = n(NaOH)_{initial} - n(NaOH)_{XS} = 0.00980 - 0.00555 = 0.00425$ mol   *
vi $n(prop\ acid) = n(NaOH)_{rxt} = 0.00425$ mol
$C(prop\ acid) = n / V = 0.00425 / 0.0200 = 0.212$ M *

Question 3.

a $CO_2 - m(C) = 12/44 \times 1.78 = 0.485$ g
$H_2O - m(H) = 2/18 \times 0.730 = 0.0811$ g
$m(O) = 1.00 - 0.485 - 0.081 = 0.434$ g   *

C	:	H	:	O
0.485 / 12		0.0811 / 1		0.434 / 16
0.040 / 0.027		0.081 / 0.027		0.027 / 0.027
1.48		2.96		1
3	:	6	:	2 *

Empirical formula : $C_3H_6O_2$ *
b $C_3H_6O_2$ *
c   * ^1H attached to adjacent carbon atoms affect the magnetic field experienced by each proton, which leads to splitting of the signal, as they are either aligned or against the applied field.
* only 1% of carbon is ^{13}C, and therefore it is unlikely to have 2 atoms of ^{13}C in the same molecule. They will not therefore influence each other.

d
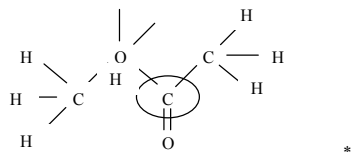
methyl ethanoate (methyl acetate) *   (must be the right molecule)
e   as shown above *
(carboxyl C must be marked)

f
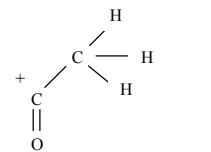
Question 4.

a $n(EDTA^{4-}) = c \times V = 0.0200 \times 0.02400 = 0.000480$ mol   *
b $n(Ca^{2+}) = n(EDTA^{4-}) = 0.000480$ mol *
$m(Ca^{2+}) = .000480 \times 40.1 = 0.019248$ g *
$c(Ca^{2+}) = n/V = 0.019248 / 0.0500 = 0.385g/L = 385mg/L$ *
c   AAS uses light specific to the electronic transition of Ca, and will only detect Ca at this wavelength. EDTA will react with Mg^{2+} ions as well as Ca^{2+}, and therefore will have a higher concentration.   *

Question 5

a $Rf = 0.6$ *
Isoleucine or Leucine * (both required for mark, only possiblities)
b   arginine *
c   A two way chromatogram allows the use of 2 different solvents.   *   As some compounds will interact differently with these solvents, and adsorb and desorb at different rates, it allows better separation of the compounds being analysed. *
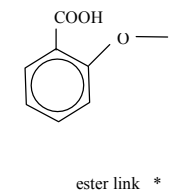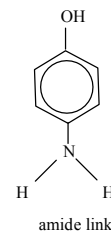d   Compound C * or proline

Question 6

a

Reaction class	Pathway
Substitution reaction	II *
Addition reaction	III *
Fractional distillation	I *
Condensation	VI *
Oxidation	IV *
Hydrolysis	V *

b

Functional Group	Neither molecule	Paracetamol	Aspirin	Both molecules
hydroxyl		@		
amide		@		
ester			@	
ether	@			

c

amide link *   ester link *

Question 7

a

*

b   water *

c   ester *

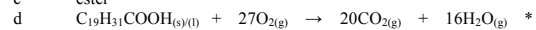d $C_{19}H_{31}COOH_{(s)/(l)} + 27O_{2(g)} \rightarrow 20CO_{2(g)} + 16H_2O_{(g)}$ *
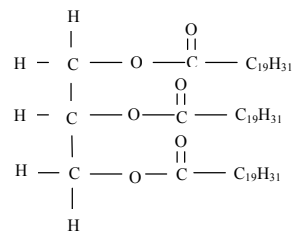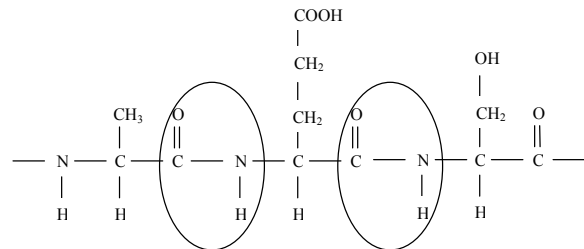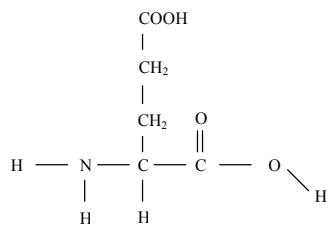
Question 8

a   * (both required for mark)

b   alanine, glutamic acid, serine

c

*

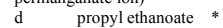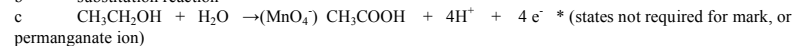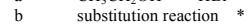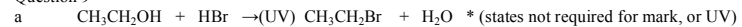d   i   (1 of) threonine or tyrosine *

ii   aspartic acid   *

iii   (1 of) arginine, asparagine, glutamine, histidine, tryptophan, or lysine   *

(d ii and iii – the question should have read "will form a 2- charged ion"   and "a 2 + charged ion"
As it didn't, all answers for ii and iii are correct (that are amino acids) EXCEPT for alanine, glutamic acid and serine, as they have been mentioned previously in question.

Question 9

a $CH_3CH_2OH + HBr \rightarrow (UV) \ CH_3CH_2Br + H_2O$ * (states not required for mark, or UV)

b   substitution reaction   *

c $CH_3CH_2OH + H_2O \rightarrow (MnO_4^-) \ CH_3COOH + 4H^+ + 4 \ e^-$ * (states not required for mark, or permanganate ion)

d   propyl ethanoate   *

END of SOLUTIONS