Engage
Education
Foundation

Units 3 and 4 Chemistry

Practice Exam Solutions

Stop!

Don’t look at these solutions until you have attempted the exam.

Any questions?

Check the Engage website for updated solutions, then email practiceexams@ee.org.au.

Section A – Multiple-choice questions

Question 1
The correct answer is A.

Question 2
The correct answer is A.

Question 3
The correct answer is C.

Question 4
The correct answer is B.

Question 5
The correct answer is C.

Question 6
The correct answer is C.

Question 7
The correct answer is D.

Question 8
The correct answer is C.

Question 9
The correct answer is D.

Question 10
The correct answer is C.

Question 11
The correct answer is B.

Question 12
The correct answer is B.

Question 13
The correct answer is D.

Question 14
The correct answer is B.

Question 15
The correct answer is D.

Question 16
The correct answer is C.

Question 17
The correct answer is C.

Question 18
The correct answer is C.

Question 19
The correct answer is D.

Question 20
The correct answer is B.

Question 21
The correct answer is C.

Question 22
The correct answer is A.

Question 23
The correct answer is B.

Question 24
The correct answer is C.

Question 25
The correct answer is D.

Question 26
The correct answer is A.

Question 27
The correct answer is C.

Question 28
The correct answer is D.

Question 29
The correct answer is B.

Question 30
The correct answer is B.

Section B – Short-answer questions

Marks allocated are indicated by a number in square brackets, for example, [1] indicates that the line is worth one mark.

Question 1a
Different compounds display different adsorption and desorption to the stationary and mobile phase and can be separated as a result.

Question 1b
The smaller particles allow for more frequent adsorption and desorption, giving a better result, as the compounds appear more separated on the chromatogram.

Question 1c
The use of smaller particles restricts the flow the mobile phase. The use of high pressure overcomes this.

Question 1d
i. Adsorption – the attraction of one substance to the surface of another [1]
ii. Desorption – the breaking of the bonds between a substance and the surface to which it is adsorbed. [1]
iii. Eluent – the name given to the solvent as it passes out of the column in any column chromatography. [1]

Question 2a
Pb^{2+} (aq) + $2Cl^{-}$ (aq) → $PbCl_2$ (s)

Question 2b
m($PbCl_2$) = 0.607g. n($PbCl_2$) = 0.607/ 278.2 = 0.00218mol [1]

n(Pb^{2+} (aq) = n($PbCl_2$ (s) = 0.00218mol. [Pb^{2+}] = n/V = 0.00218/0.1 = 0.0218M [1]

[1 mark for 3 significant figures]

Question 2c
not dried to constant mass [1]

not all chloride ions were washed out [1]

Question 3a
E = calibration factor x temp change

n(C_2H_6) = 3/ 30 = 0.1mol

E released = 0.1 x 1557 = 155.7kJ

155.7 = calibration factor x 2.45

CF = 155.7/2.45 = 63.6kJ/°C

Question 3b
Density = m/V

0.98 = m/3

m = 3 x 0.98 = 2.94g [1]

Question 3c
Energy = CF x temp change

= 63.55kJ/°C x 2.237

= 142.145kJ [1]

Question 3d
n(unknown) = m/M = 2.94/86 = 0.034186mol [1]

0.034186 x Δ H = 142.145kJ [1]

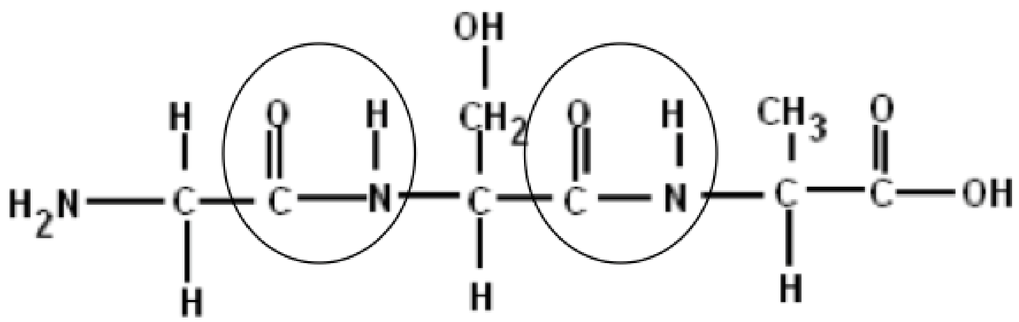
Δ H = 4158kJ/mol

Unknown hydrocarbon = hexane C_6H_{14} [1]

Question 3e
The second student's calorimeter may not have been insulated enough. This would mean some of the energy released by the unknown hydrocarbon was allowed to escape so the resultant temperature change would have been less. So the calculated energy released would have been less, making the ΔH calculation smaller. Pentane has a smaller ΔH than hexane.

Question 4a
glycine, serine and alanine [1]

Question 4b



Question 4ci
Hydrolysis [1]

Question 4cii
[H+] = 2 x 0.1 = 0.2M

pH = -log(0.2) = 0.69897 = 0.7

At low pH levels amino acids as bases and gain a proton.

Glycine - $^+H_3NCH_2COOH$
Alanine - $^+H_3NCH(CH_2OH)COOH$
Serine – $^+H_3NCH(CH_3)COOH$

Question 4d
Condensation [1]

Question 4e
Rf = distance travelled by amino acid / distance travelled by solvent front.

- Alanine = 14/14 = 1
- Glycine = 11.5/14 = 0.82
- Methionine = 9/14 = 0.64
- Serine = 5/14 = 0.36
- Glutamine = 1/14 = 0.07

[1 mark each for the correct calculation of two of the above]

Question 4f
Rf(methionine) = 0.64
0.64 = d/12
d = 7.68cm [2]

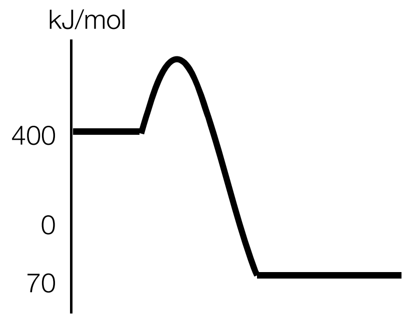
Rf(serine) = 0.36
0.36 = d/12
d = 4.32cm [2]

Question 4g
Primary structure refers to the sequence of amino acids in the peptide. [1]

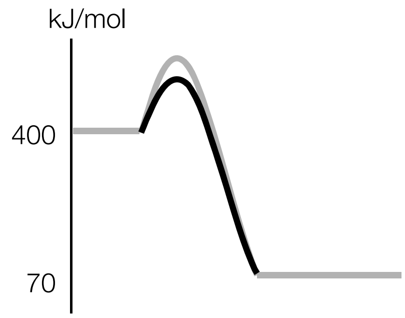
Question 4h
The TLC plate shows which amino acids are present in the peptide [1] but does not provide information about the order of the amino acids [1].

Question 5a
CH_3CHO (g) → CH_4 (g) + CO (g), ΔH = -20kJ/mol

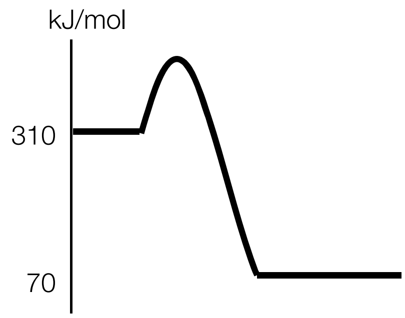
Question 5b



Question 5c



Question 5d



Note: the vertical axis measures energy in kJ/mol, so the amount of reactants does not change on the diagram, as the energy released by one mole remains the same.

Question 6a

$3Ba^{2+}$ (aq) + $2PO_4^{3-}$ (aq) → $Ba_3(PO_4)_2$ (s)

Question 6b

$m(Ba_3(PO_4)_2)$ = 1.2g
$n(Ba_3(PO_4)_2)$ = 1.2/601.9 = 0.000199mol
$n(Ba^{2+})$in 20mL = $n(Ba_3(PO_4)_2)$ x 3 = 0.000199mol x 3 = 0.0059808mol
$n(Ba^{2+})$in 250mL = 0.0059808 x 250/25 = 0.059808mol
n(BaCl) = 0.059808mol
m(BaCl) = 0.059808mol x 208.3 = 12.458006g
m(Sample) = 12.458006/0.85 = 14.66g

Question 7a

Ethanoic acid is a weak acid. As such is does not dissociate completely. It exists in a state of equilibrium. The double headed arrow represents this equilibrium state. [1]

Question 7b

$Ka = [H^+]^2 / [CH_3COOH] = 1.7 X 10^{-5}$
$[H^+]^2 = 0.5 x 1.7 X 10^{-5}$
$[H^+]^2 = 8.6 x 10^{-6}$
$[H^+] = 2.92 x 10^{-3}$
pH = 2.54

Question 7c

HOCl(l) + H_2O(l) ⇋ OCl–(aq) + H_3O+(aq)

Question 7d
n(HOCl) = 0.003/52.5 = 5.7×10^{-5} mol
[HOCl] = 5.7×10^{-5} / 0.1 = 5.7×10^{-4} M

Ka = $[H^+]^2$ / [HOCl] = 2.9×10^{-8}
$[H^+]^2 = 5.7 \times 10^{-4}$ M x 2.9×10^{-8}
$[H^+]^2 = 1.7 \times 10^{-11}$
$[H^+] = 4.1 \times 10^{-6}$
pH = 5.4

Question 8a
it must have a known concentration of sodium [1]

it must not contain any other metals [1]

Question 8b
No answers provided

Question 8c
Concentration = 0.524ppm in 10mL [1]
[Na+] in 250mL = [Na+] in 10mL = 0.524ppm = 5.24mg/L [1]
m(Na+) in 250mL = 5.24 x 0.25 = 1.31g [1]
% Na = 1.31/5 x 100 = 26.2% [1]

Question 9a
20 seconds [1]

Question 9b

	Initial		Equilibrium	
	Concentration	Amount	Concentration	Amount
X	1M	0.5mol	4M	2mol
Y	2M	1mol	3M	1.5mol
Z	4M	2mol	2M	1mol

[1 mark for each correct column]

Question 9c
2Z (g) ⇋ 3X (g) + Y (g)
K = $[X]^3[Y]/[Z]^2$ = (64 x 3)/4 = 48M

Question 9d
Students received one mark for showing each of the following on the graph:

- The concentration of each gas initially doubles [1]
- The concentration of Z increasing further and the concentration of X and Y decreasing [1]
- The correct molar ratios for increases and decreases in concentration [1]

Question 10a
The battery is dead because the lead acid battery is a rechargeable battery that gets recharged by the car's engine while the car is running. [1] When Jane left the light on the battery was being used, thus was discharging. [1] Because the engine wasn't on the battery was not being recharged and therefore died.

Question 10b

Anode: $PbO_2(s) + HSO_4^-(aq) + 3H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

Cathode: $PbSO_4(s) + H^+(aq) + 2e^- \rightarrow Pb(s) + HSO_4^-(aq)$

[2] for each half equation including states