



## **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](mailto: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.

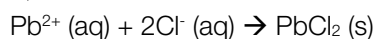
### Question 1c

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

### Question 1d

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

### Question 2a



### Question 2b

$$m(\text{PbCl}_2) = 0.607\text{g}. n(\text{PbCl}_2) = 0.607 / 278.2 = 0.00218\text{mol} [1]$$

$$n(\text{Pb}^{2+}(\text{aq})) = n(\text{PbCl}_2(\text{s})) = 0.00218\text{mol}. [\text{Pb}^{2+}] = n/V = 0.00218/0.1 = 0.0218\text{M} [1]$$

[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

$$n(\text{C}_2\text{H}_6) = 3 / 30 = 0.1\text{mol}$$

$$E \text{ released} = 0.1 \times 1557 = 155.7\text{kJ}$$

$$155.7 = \text{calibration factor} \times 2.45$$

$$\text{CF} = 155.7/2.45 = 63.6\text{kJ}/^{\circ}\text{C}$$

### Question 3b

$$\text{Density} = m/V$$

$$0.98 = m/3$$

$$m = 3 \times 0.98 = 2.94\text{g} [1]$$

**Question 3c**

Energy = CF x temp change

$$= 63.55 \text{ kJ/}^{\circ}\text{C} \times 2.237$$

$$= 142.145 \text{ kJ} \quad [1]$$

**Question 3d**

$$n(\text{unknown}) = m/M = 2.94/86 = 0.034186 \text{ mol} \quad [1]$$

$$0.034186 \times \Delta H = 142.145 \text{ kJ} \quad [1]$$

$$\Delta H = 4158 \text{ kJ/mol}$$

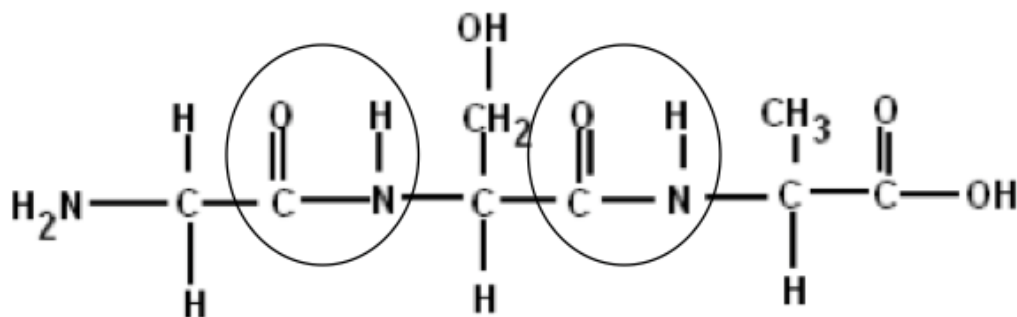
Unknown hydrocarbon = hexane  $\text{C}_6\text{H}_{14}$  [1]

**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  $\Delta H$  calculation smaller. Pentane has a smaller  $\Delta H$  than hexane.

**Question 4a**

glycine, serine and alanine [1]

**Question 4b****Question 4ci**

Hydrolysis [1]

**Question 4cii**

$$[\text{H}^+] = 2 \times 0.1 = 0.2 \text{ M}$$

$$\text{pH} = -\log(0.2) = 0.69897 = 0.7$$

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

Glycine -  $^+\text{H}_3\text{NCH}_2\text{COOH}$

Alanine -  $^+\text{H}_3\text{NCH}(\text{CH}_2\text{OH})\text{COOH}$

Serine -  $^+\text{H}_3\text{NCH}(\text{CH}_3)\text{COOH}$

**Question 4d**

Condensation [1]

**Question 4e**

$R_f$  = 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**

$R_f(\text{methionine}) = 0.64$

$$0.64 = d/12$$

$$d = 7.68\text{cm} \text{ [2]}$$

$R_f(\text{serine}) = 0.36$

$$0.36 = d/12$$

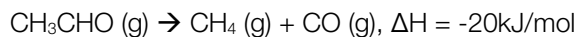
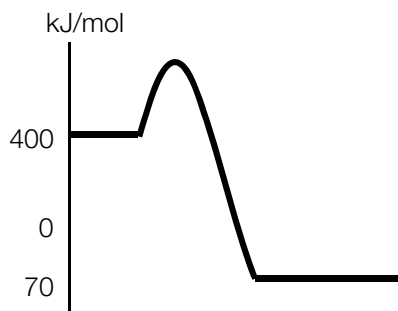
$$d = 4.32\text{cm} \text{ [2]}$$

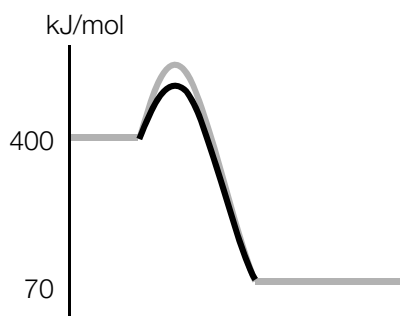
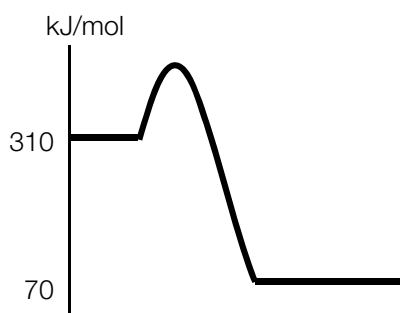
**Question 4g**

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

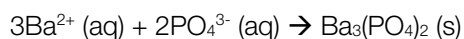
**Question 4h**

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****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****Question 6b**

$$m(\text{Ba}_3(\text{PO}_4)_2) = 1.2\text{g}$$

$$n(\text{Ba}_3(\text{PO}_4)_2) = 1.2/601.9 = 0.000199\text{mol}$$

$$n(\text{Ba}^{2+})\text{in } 20\text{mL} = n(\text{Ba}_3(\text{PO}_4)_2) \times 3 = 0.000199\text{mol} \times 3 = 0.000598\text{mol}$$

$$n(\text{Ba}^{2+})\text{in } 250\text{mL} = 0.000598 \times 250/20 = 0.007475\text{mol}$$

$$n(\text{BaCl}) = 0.007475\text{mol}$$

$$m(\text{BaCl}) = 0.007475\text{mol} \times 208.3 = 1.557\text{g}$$

$$m(\text{Sample}) = 1.557/0.85 = 1.83\text{g}$$

**Question 7a**

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

**Question 7b**

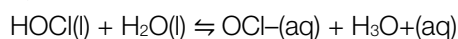
$$K_a = [\text{H}^+]^2 / [\text{CH}_3\text{COOH}] = 1.7 \times 10^{-5}$$

$$[\text{H}^+]^2 = 0.5 \times 1.7 \times 10^{-5}$$

$$[\text{H}^+]^2 = 8.5 \times 10^{-6}$$

$$[\text{H}^+] = 2.92 \times 10^{-3}$$

$$\text{pH} = 2.54$$

**Question 7c**

**Question 7d**

$$n(\text{HOCl}) = 0.003/52.5 = 5.7 \times 10^{-5} \text{ mol}$$

$$[\text{HOCl}] = 5.7 \times 10^{-5} / 0.1 = 5.7 \times 10^{-4} \text{ M}$$

$$K_a = [\text{H}^+]^2 / [\text{HOCl}] = 2.9 \times 10^{-8}$$

$$[\text{H}^+]^2 = 5.7 \times 10^{-4} \text{ M} \times 2.9 \times 10^{-8}$$

$$[\text{H}^+]^2 = 1.7 \times 10^{-11}$$

$$[\text{H}^+] = 4.1 \times 10^{-6}$$

$$\text{pH} = 5.4$$

**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]

$[\text{Na}^+]$  in 250mL =  $[\text{Na}^+]$  in 10mL = 0.524ppm = 5.24mg/L [1]

$m(\text{Na}^+)$  in 250mL =  $5.24 \times 0.25 = 1.31\text{g}$  [1]

% Na =  $1.31/5 \times 100 = 26.2\%$  [1]

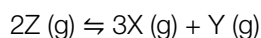
**Question 9a**

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**

$$K = [\text{X}]^3[\text{Y}]/[\text{Z}]^2 = (64 \times 3)/4 = 48\text{M}$$

**Question 9d**

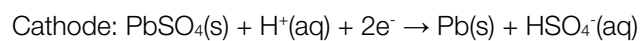
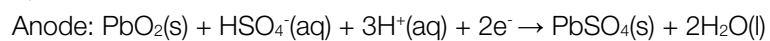
Students received one mark for showing each of the following on the graph:

- 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**

[2] for each half equation including states