

CHEMISTRY

Unit 4 – Written examination 2



2007 Trial Examination

SOLUTIONS

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

Question 1

Answer: B

Explanation:

Solar cells are not very efficient. Their cost is quite moderate.

Question 2

Answer: A

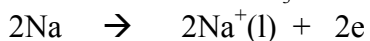
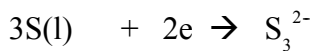
Explanation:

S(l) reacts with Na(l). The sulfur reaction is reduction; reduction at the cathode and the cathode is positive in a galvanic cell.

Question 3

Answer: C

Explanation:



Putting these two half equations together leads to answer C.

Question 4

Answer: B

Explanation:

360g is 2 mole of glucose => the energy released will be $2803 \times 2 = 5606$ kJ

Question 5

Answer: A

Explanation:

Oxidation is a loss of electrons. It always occurs at the anode. Therefore the electrons always flow from the anode.

Question 6

Answer: D

Explanation:

This is the only solution with alkali mentioned, the OH^- . This half equation can be combined with the oxygen half equation at 0.4 V to give the overall equation for methane forming carbon dioxide and water.

Question 7

Answer: A

Explanation:

Z(s) and $\text{X}^+(\text{aq})$ are favourable to react in a galvanic cell. No power supply is required.

Question 8

Answer: C

Explanation:

Bile acids are formed in the liver. They help break lipids to fatty acid molecules that are then transported around the body as emulsions.

Question 9

Answer: B

Explanation:

They all have the formula $C_6H_{12}O_6$.

Question 10

Answer: D

Explanation:

The ammonium ions are gradually changed to NO_2^- , then to NO_3^- and then finally denitrified to N_2

Question 11

Answer: A

Explanation:

In pH 2, there will be excess H^+ ions. Therefore the O^- has a H^+ join to it.

Question 12

Answer: A

Explanation:

Glycerol, urea and glycine.

Question 13

Answer: B

Explanation:

The unsaturated fatty acid is $C_nH_{2n+1}COOH$. Therefore the monounsaturated version is $C_nH_{2n-1}COOH$, as it has two less hydrogens.

Question 14

Answer: A

Explanation:

Sodium, magnesium and sulfur are in the same period. Therefore, sodium is the largest, then magnesium, then sulfur. Oxygen will be less than sulfur as it has one less shell.

Question 15

Answer: B

Explanation:

Fluorine has the highest electronegativity of all. Nitrogen as a non metal comes next. Magnesium in Group II will be higher than lithium in Group I.

Question 16

Answer: C

Explanation:

Electrons have a negative charge, a very low mass and all elements have at least one electron.

Question 17

Answer: B

Explanation:

Period 4 includes the first transition series where a 3d subshell is being filled.

Question 18

Answer: D

Explanation:

It is a metal since its oxide forms a basic solution. Its charge is +2 if the formula is XO. Therefore it is in Group II.

Question 19

Answer: C

Explanation:

To balance the equation, the subscript is 0 and the superscript is 1. This is a neutron.

Question 20

Answer: D

Explanation:

This is an example of nuclear fusion.

SECTION B: Short-answer questions

*An asterisk * indicates 1 mark to be awarded*

Question 1

a. electrolysis

1 mark

b. $\text{K}^+(\text{l}) + \text{e} \rightarrow \text{K}(\text{l})^*$ (phases required)

1 mark

c. endothermic*

1 mark

d. molten solution*. Water will react instead if an aqueous solution is used*.

2 marks

e.

i. $4\text{K}(\text{l}) + \text{O}_2(\text{g}) \rightarrow 2\text{K}_2\text{O}(\text{s})^*$

1 mark

ii. Basic, because it forms KOH in water*

1 mark

Total 7 marks

Question 2

a. monounsaturated *

1 mark

b.

i. ester*

1 mark

ii. circle the three instances of $\begin{array}{c} \text{O} \\ || \\ -\text{O}-\text{C}- \end{array} *$

1 mark

c.

i. Two.*

1 mark

ii. Carboxyl and hydroxyl.*

1 mark

iii. $\text{C}_{20}\text{H}_{38}\text{O}_2$ *

1 mark

iv. $2\text{C}_{20}\text{H}_{38}\text{O}_2 + 57\text{O}_2(\text{g}) \rightarrow 40\text{CO}_2(\text{g}) + 38\text{H}_2\text{O}(\text{l})$ **
1 mark for correct products/ 1 mark for correct balancing

2 marks

d. $\text{energy} = 0.388 \times 39000 = 15132 \text{ joule} *$

$$E = 4.18 \times m \times \Delta T = 15132$$

$$\Delta T = \frac{15132}{(4.18 \times 200)} = 18.1^\circ \text{C} *$$

2 marks

Total 10 marks

Question 3

a. Vitamin C is a polar molecule and Vitamin E is non polar. Vitamin E is used in margarine and oily types of foods*

1 mark

b. Copper is a transition metal. It forms a metal complex with ammonia, but sodium does not. *

1 mark

c. One of - geosequestration of carbon dioxide, drying the coal out, fluidised bed of coal. *

1 mark

d. If the nucleus emits an electron, the atomic number will increase by one. *

1 mark

Total 4 marks

Question 4**a. to e.**

The following table refers to the properties of the three elements fluorine, neon and sodium.

Element	Electron configuration	Atomic size	Electronegativity	First ionisation energy	Ion configuration
fluorine	$1s^2 2s^2 2p^5$	2	1	2	$1s^2 2s^2 2p^6$
neon	$1s^2 2s^2 2p^6$	3	3	1	$1s^2 2s^2 2p^6$
sodium	$1s^2 2s^2 2p^6 3s^1$ *	1*	2 *	3 *	$1s^2 2s^2 2p^6$ *

5 marks

f.

- i. Emission spectrum for neon produces a characteristic spectrum.

1 mark

- ii. The electrons are excited to an outer orbital where they reside for a transient period. Upon their return to the ground state the electrons emit light* which corresponds to exact energy values of a corresponding wavelength which is unique to the element*.

2 marks

Total 8 marks

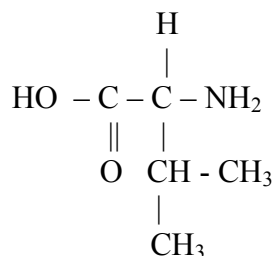
Question 5

a.

i.

*

1 mark



ii. 131 *

1 mark

iii. Hydrophobic*, as they have no polar bonds.

1 mark

b.

i. An enzyme acts as a catalyst*. It has a 3-D shape that matches the molecule reacting – lock and key model or induced fit model*.

2 marks

ii. When a protein is hydrolysed the peptide bonds are broken. The amino acids making up the protein are reformed*.

1 mark

iii. Papain is denatured during cooking of the meat. It loses its particular 3-D structure*.

1 mark

c. NH_4^+ -3 *

NO_3^- + 5 *

2 marks

Total 9 marks

Question 6**a.****i.** Copper and lead will form. Water will react instead in the other cells.*

1 mark

ii. Oxygen.*

1 mark

iii. $72375 \text{ coulombs} = \frac{72375}{96500} \text{ mole of electrons} = 0.75 \text{ mole}^*$

$$\text{ratio of electrons to metal} = \frac{0.75}{0.25} = 3 \Rightarrow \text{Al}^{3+} *$$

2 marks

b.**i.** Charge on a single electron = $\frac{96500}{6.023 \times 10^{23}} = 1.6 \times 10^{-19} \text{ coulomb}^*$

1 mark

ii. charge on metal $\text{M}^+ \Rightarrow 1:1$ ratio between electrons and metal $\Rightarrow 6 \text{ mole metal}$ $\text{M}^{2+} \Rightarrow 2:1$ ratio between electrons and metal $\Rightarrow 3 \text{ mole metal}$ $\text{M}^{3+} \Rightarrow 3:1$ ratio between electrons and metal $\Rightarrow 2 \text{ mole metal}$

1 mark for knowledge of electron: metal ratio; 1 mark for 6, 3, 2

2 marks

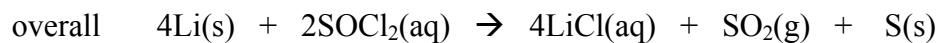
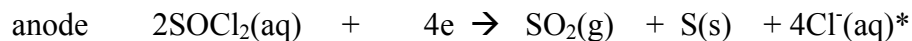
c.**i.** anode $\text{C(s)} + 2\text{O}^{2-}(\text{l}) \rightarrow \text{CO}_2(\text{g}) + 4\text{e}^*$

1 mark

ii. cathode $\text{Al}^{3+}(\text{l}) + 3\text{e} \rightarrow \text{Al(l)}^*$

1 mark

Total 9 marks

Question 7**a.**

2 marks

b. A gas being produced in a closed container would be very dangerous – the pressure would build up*.

1 mark

c. The sulfur cell produces a voltage of 3.4 volts. It would take 3 AA batteries to pass this mark.*

1 mark

d. $Q = IT = 0.2 \times 55 \times 60 = 660 \text{ coulomb}^*$

$$n(\text{e}) = \frac{660}{96500} = 0.00684 \text{ mol}$$

$$n(\text{Li}) = 0.00684 *$$

$$\text{mass Li} = n \times M = 0.00684 \times 7 = 0.0478 \text{ g}^*$$

3 marks

e. $\text{SO}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{SO}_3(\text{aq}) *$

1 mark

f. Sulfur ion is larger*. It has more electrons in the outer shell, therefore the nucleus does not attract those electrons as strongly as sulfur atom.*

2 marks

Total 10 marks