CHEMISTRY

Unit 3 – Written examination 1

TSSM
Creating VCE Success

2009 Trial Examination

SOLUTIONS

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

Question 1

Answer: C

Explanation:

An absorbance of 24 corresponds to a concentration of around 13.7. This sample was diluted 1:100 => 1370

Question 2

Answer: C

Explanation:

$$n(Cu^{2+}) = \frac{.00137}{63.5} = 0.0000216$$
$$n(CuCl_2) = 0.0000216$$
$$mass = 0.0000216 x (63.5 + 71) = 2.90$$

Question 3

Answer: A

Explanation:

This is a weak acid and a strong base. The equivalence point will be around pH = 9 hence phenolphthalein.

Question 4

Answer: B

Explanation:

$$mass = 24 x 0.5 = 12 g$$
$$n = \frac{12}{151} = 0.0795$$

Question 5

Answer: D

Explanation:

The H-O is an alkanol and the $N - C$ is an amide group (with O attached as $\overset{\displaystyle O}{\underset{\displaystyle \|}{}}$)

Question 6

Answer: A

Explanation:

$$mass = 160 x 0.15 = 24$$

Question 7

Answer: D

Explanation:

For the pH to change by 2, the volume must change by 100. New volume will be 100 x 100 = 10000 mL. 9900 mL must be added to 100 to give this.
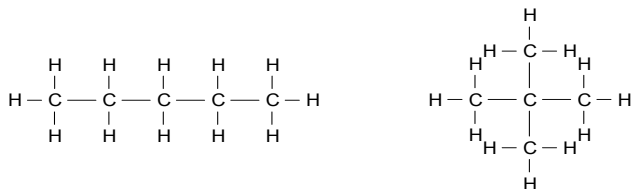
Question 8

Answer: C

Explanation:

$$n(sulfuric) = 0.4 x 0.01 = 0.004 mol$$
$$n(KOH) = 2 x 0.004 = 0.008$$
$$c(KOH) = \frac{n}{v} = \frac{0.008}{0.02} = 0.4 M$$
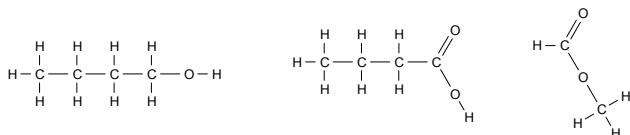$$c(HCl) = \frac{0.008}{0.008} = 1 M$$

Question 9

Answer: C

Explanation:

3 different H and same 3 C   All H's same and 2 different C

Question 10

Answer: A

Explanation:

Molecule B does not have any $-CH_2-$ groups. This weighs 14 and CH_3CH_2- weighs 29. Molecule A should have these peaks but not B.

Question 11

Answer: C

Explanation:

1-butanol to specify the location of the –O-H
butanoic acid does not have a 1, as the carboxylic group can only go on the one spot
the ester is from methanol and methanoic acid = methyl methanoate

Question 12

Answer: C

Explanation:

The molecule is a polymer due to the large value of M. It is not a carbohydrate because it has N and S. It is a protein, due to the S, and an enzyme is an example of a protein.
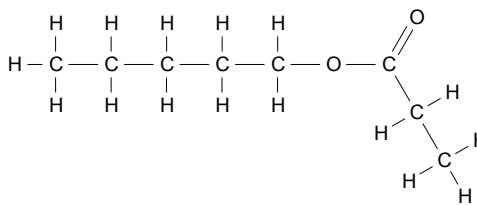
Question 13

Answer: B

Explanation:

Ethene and chlorine gas would contain two chlorine atoms. Ethene plus HCl would give the desired product along with an isomer of it. Substitution on the alkane would require chlorine gas.

Question 14

Answer: A

Explanation:

This requires pentanol and propanoic acid. The propanoic acid can be formed from propanol using dichromate ions.

Question 15

Answer: B

Explanation:

Product is polyethene. It is made from ethene using addition polymerisation.

Question 16

Answer: C

Explanation:

1700 cm^{-1} would correspond to C=O or C=C. This is molecule C

Question 17

Answer: A

Explanation:

The NH_2 is an amine, -COOC- ester, O – H alkanol, -CO-NH - amide

Question 18

Answer: A

Explanation:

  - G – G – C – A – A – T – G – A –
  – C – C – G – T – T – A – C – T -

The complementary bases are thymine with adenine and cytosine with guanine

Question 19

Answer: D

Explanation:

$C_{18}H_{32}O_2$ For C_{18}, H 36 would be all single bonds – hence two double bonds. All fatty acids have a long non polar part with a small polar part. The polar part has a C=O

Question 20

Answer: D

Explanation:

Fructose has the same molecular formula and mass as glucose, $C_6H_{12}O_6$ mass 180.
2200 monomers will release 2199 water molecules.
Mass = $2200x180 - 2199x18 = 356418$

SECTION B – Short answer questions

*An * indicates the allocation of 1 mark*

Question 1

Each technique can only be used once.

Task	Method chosen	Justification
Identification of amino acids present in a health bar	TLC*	Amino acids will move different speeds – develop with ninhydrin*
Concentration of a solution of lithium hydroxide	Acid/base titration*	Standard way to find the concentration of a base*
Distinguish between two isomers of butane	NMR*	Different peak shifts and different splitting patterns*
Concentration of lead ions in waste water	AA*	Lead can be analysed by AA*
Chloride ion concentration in mineral water	Precipitation*	Addition of silver nitrate solution*
Empirical formula of a hydrocarbon molecule	Mass spec*	The exact mass of parent ion will match a particular carbon:hydrogen ratio*

Total   12 marks

Question 2

a. $I_2(aq) + 2e^- \rightarrow 2I^-(aq)$ *

1 mark

b. $C_6H_4O_2(OH)_4(aq) + I_2(aq) \rightarrow C_6H_4O_2(OH)_2(aq) + 2H^+(aq) + 2I^-(aq)$ *

1 mark

c.   **i.**   The blue colour will linger* when iodine is finally in excess*

        ii.   This is not an acid/base indicator hence the K value is irrelevant *

2 + 1 = 3 marks

d.

$$n(I_2) = 0.02 \times 0.104 = 0.00208 mol$$

$$c(ascorbic) = \frac{0.00208}{0.01856} = 0.112M \quad **$$

2 marks

e.   The concentration of an iodine solution does not remain stable*

1 mark

f.

functional group	frequency	
hydroxyl	3400 *	
carbonyl (C=O)	1700 *	(or C=C)

2 marks

g. $C_3H_4O_3$ *

1 mark

Total 11 marks

Question 3

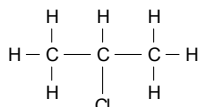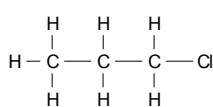**a.**   A   B

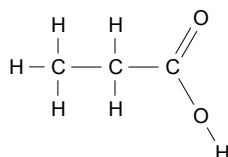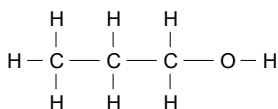1-chloropropane   *   2-chloropropane *

          C   D

1-propanol (propan-1-ol)*   propanoic acid*

4 marks
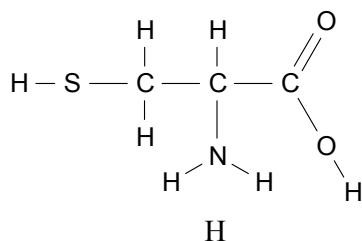
b.   Name the type of reaction that is responsible for

$$C_3H_6 \rightarrow A \qquad \text{addition *}$$

$$A \rightarrow C \qquad \text{substitution *}$$

$$C \rightarrow D \qquad \text{oxidation *}$$

3 marks

c.   **i.** 1H NMR*

    ii. 2-chloropropane has more identical hydrogen atoms – 6* It has one less peak* and the area under the peaks will reflect the 6 equal hydrogens

$$1 + 2 = 3 \text{ marks}$$

d.   **i.** 60 *

    ii. 43   *   - OH   fragment off *

        15   CH_3 - fragment   *

    iii. It contains Cl. Chlorine atoms have two isotopes ^{35}Cl and ^{37}Cl. The mass of these differs by 2. *

$$1 + 2 + 1 = 4 \text{ marks}$$

e. It must be a primary alkanol to form a carboxylic acid. *

1 mark

Total 15 marks

Question 4

a. mass oxygen = 4.111 – 2.667 – 0.555 = 0.889 g

$$\frac{2.667}{12} : \frac{0.555}{1} : \frac{0.889}{16} \qquad * \ = \ C_4H_{10}O \ *$$

$$0.2220 : 0.555 : 0.055$$

3 marks

b. $C_4H_{10}O$ *   1 mark

c.

2 marks

d. That is contains an alkanol group but no carbonyl (C=O) group *

1 mark

e. This matches the molecule above on the right: 2-methylpropan-1-ol**

2 marks

Total 9 marks

Question 5

Carboxyl*

Amine*

a. (The S—H is also a functional group)

2 marks

b.   cysteine *   1 mark

c.

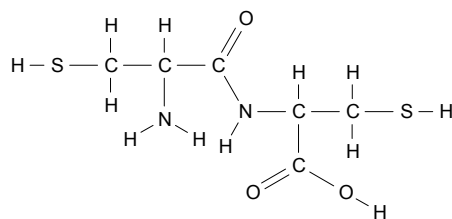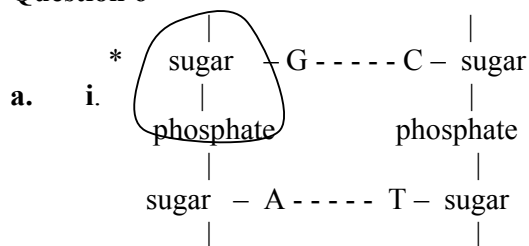**d**.   *   +   H – O – H *

2 marks

e.   **i**.   3.8 ÷x   0.43 = 8.84 cm   *

1 mark

ii.   stationary phase: silica gel*   mobile phase: isobutanol*

2 marks
Total 9 marks

Question 6

a. **i.**

```
    *  ⌒ sugar ⌐ G - - - - - C ─ sugar
         |                      |
       phosphate             phosphate
         |                      |
       sugar  ─ A - - - - - T ─ sugar
         |                      |
```

ii. There are 4 different bases that can be attached to the sugar, hence 4 nucleotides. *

iii. phosphate, deoxyribose sugar and a nitrogenous base. *

$1 + 1 + 1 = 3$ marks

b. **i.** Hydrogen bonding between complementary bases. *

ii. Thymine and adenine are complementary; every instance of one has the other joined to it. *

$1 + 1 = 2$ marks

c. **i.** polymerase chain reaction *

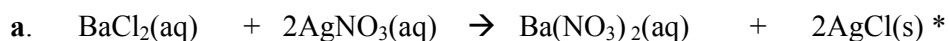**ii.** positive as the phosphate groups are always negative *

iii. the fragments have different masses. The heavy fragments move more slowly *

iv. A child's DNA will have some parts in common with its mother but DNA will not be identical. One strand of a child's DNA comes from each parent. *

$1 + 1 + 1 + 1 = 4$ marks

Total 9 marks

Question 7

a. $BaCl_2(aq) + 2AgNO_3(aq) \rightarrow Ba(NO_3)_2(aq) + 2AgCl(s)$ *

1 mark

b. $n(AgNO_3) = cxv = 0.1 x 0.025 = 0.0025 mol$ * $n(Ba^{2+}) = \dfrac{0.130}{137.3} = 0.000947 \, mol$ *

need twice as much $AgNO_3$, which we have => it is in excess *

3 marks

Total 4 marks