CHEMISTRY

Unit 3 – Written examination 1

2007 Trial Examination

SOLUTIONS

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

Question 1

Answer: D

Explanation:

The polymer is polystyrene. This is an addition polymer. The monomers can join in random orientations.

Question 2

Answer: A

Explanation:

The polymer is an ester formed from a dialcohol with two CH_2 groups and a diacid with one CH_2 in the middle.

Question 3

Answer: C

Explanation:

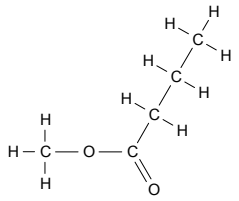
This is polyethene. The molar mass is a multiple of ethene as addition polymers give off no small molecules.

Question 4

Answer: B

Explanation:

Heptanoic acid has 14 H's = $CH_3CH_2CH_2CH_2CH_2CH_2COOH$



Question 5

Answer: A

Explanation:

methylbutanoate has the same formula

Question 6

Answer: B

Explanation:

$$n(I) = c \times V = 0.1 \times 0.0282 = 0.00282 \text{ mol} \quad c = \frac{n}{V} = \frac{0.00282}{0.025} = 0.113 \text{ M}$$

Question 7

Answer: B

Explanation:

$$mass = n \times M = 0.00282 \times 176 = 0.496 \text{ g}; \quad \% = \frac{0.496}{2} \times 100 = 24.8 \%$$

Question 8

Answer: C

Explanation:

The burette and pipette should be rinsed with the solution to go in them. The flask should be rinsed with water.

Question 9

Answer: C

Explanation:

$$K_a = 6.2\times10^{-10} = \frac{\left[H^+\right]^2}{0.01} \Rightarrow \left[H^+\right]^2 = 6.2\times10^{-12} \Rightarrow \left[H^+\right] = 2.46\times10^{-6} \Rightarrow \text{pH} = 5.6$$

Question 10

Answer: A

Explanation:

0.6 mole of NOCl used $\Rightarrow$ 0.6 mole NO formed and 0.3 mole Cl. 1.0 mol
NOCl Total = 1.9 mol

Question 11

Answer: B

Explanation:

As temp goes up from 0 to 25 C, the value of K increases. Therefore the reaction is endothermic.

Question 12

Answer: B

Explanation:

H^+ takes OH^- out of the equilibrium. The system moves to the right to replace this. Therefore the concentration of HOCl increases.

Question 13

Answer: D

Explanation:

$H = +1$, $O = -2 \times 4 = -8 \Rightarrow Cl = +7$

Question 14

Answer: B

Explanation:

Catalysts lower the activation energy of a reaction., by providing an easier pathway for the reaction.

Question 15

Answer: C

Explanation:

Radiation from the lamp is absorbed by electrons in the sample jumping to outer shells.

Question 16

Answer: A

Explanation:

As a metal reacts with acid, hydrogen is released lowering the mass of the flask.

Question 17

Answer: D

Explanation:

The molecules with higher boiling points will generally be slower moving through a column.

Question 18

Answer: C

Explanation:

16 g of sulfur is ½ a mole $\Rightarrow$ 20 g of metal is also ½ a mole $\Rightarrow$ 1 mole = 40 g = calcium

Question 19

Answer: B

Explanation:

67.2 dm^3 of HCl at STP is 3 mole. Concentration will be $\frac{3}{30} = 0.1\,\text{M} \Rightarrow \text{pH} = 1$

Question 20

Answer: C

Explanation:

$CH_3CH_2COOH \quad \% = \frac{32}{74} \times 100 = 43.2\,\%$

SECTION B: Short-answer questions

*An asterisk * indicates 1 mark to be awarded*

Question 1

a. $K = \frac{[NO]^2[Br_2]*}{[NOBR]^2} = \frac{(2.05\times10^{-2})^2 \times 5.14\times10^{-2}}{(5.85\times10^{-2})^2} = 0.00643*$

This is < K, therefore the system needs to move in the forward direction* to increase K.

3 marks

b.

i. Darker = more $Br_2 \Rightarrow$ system went forward* increase in K with increasing temperature $\Rightarrow$ reaction is endothermic*

2 marks

ii. volume halved = double pressure $\Rightarrow$ system tries to make less molecules $\Rightarrow$ back reaction favoured $\Rightarrow$ NOCl increases*

1 mark

iii. P ½ $\Rightarrow$ system moves to make more molecules $\Rightarrow$ goes to the right making more NO*.

1 mark

Total 7 marks

Question 2

a. The units do not matter* because a ratio is being calculated (as long as you make both measurements in the same unit) *

2 marks

b. It will not be the same as the R_f value is different for both spots*.

1 mark

c. We have no way of knowing because a different solvent is used. Further testing would be required*.

1 mark

d. Yellow is probably less polar as it does not move as far in a polar solvent as red*.

1 mark

Total 5 marks

Question 3

a. $AgNO_3(aq) + NaNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$*

1 mark

b. The volume of silver nitrate must be in excess. The exact volume does not matter.*

1 mark

c.

i. Filter paper wet $\Rightarrow$ mass of precipitate is high*. Concentration of NaCl will come out high*.

2 marks

ii. Mass of precipitate will be low $\Rightarrow$ concentration of the NaCl will come out low.*

1 mark

d.

i. If the reaction is reversible, then the AgCl is not completely insoluble. If some dissolves, accuracy of the answer is lost*. It is also a reminder to rinse the flasks with as little water as possible*.

2 marks

ii. The reaction is endothermic. Therefore, as T increases, K increases. This means more precipitate dissolves and the result is less accurate*.

1 mark

Total 8 marks

Question 4

a.

i. $n(CaF_2) = \frac{4.1}{78} = 0.0526$ mol $\quad C(CaF_2) = \frac{n}{V} = \frac{0.0526}{4} = 0.0131$ M

Concentration	Ca^{2+} ions	F^- ions	CaF_2
M	0.0131*	0.0262*	0.0131*
g L^{-1}	0.524*	0.498*	1.025*

6 marks

ii. $c(F^-) = 0.0262$ M $\Rightarrow$ 1 litre is 0.0262 mol*.

number of ions = $0.0262 \times 6.023 \times 10^{-23} = 1.58 \times 10^{-24}$ *

2 marks

b. atomic emission spectrometer or atomic absorption spectrometer.

1 mark

Total 9 marks

Question 5

a.

i.  *

1 mark

ii. solvent, alcohol, fuel *

1 mark

b.

i. substitution*
ii. addition*
iii. substitution*
iv. oxidation*

4 marks

c.

i. $CH_3CH_2OH(l) + H_2O(l) \rightarrow CH_3COOH(l) + 4H^+(aq) + 4e$* 1 mark

ii. $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e \rightarrow 2\ Cr^{3+}(aq) + 7H_2O(l)$*

1 mark

d. ethyl ethanoate *

1 mark
Total 9 marks

Question 6

a. Elemental Sulphur, often in the form of S_8.*

1 mark

SO_2 will be +4*

1 mark

SO_3, $H_2S_2O_7$ or H_2SO_4 will be + 6*

1 mark

b. Sulphur dioxide is a waste product from mining ores like ZnS and hence is readily available. *

1 mark

c.

i. $Ca(s) + H_2SO_4(aq) \rightarrow CaSO_4(aq) + H_2(g)$*

1 mark

ii. $Ca(s) \rightarrow Ca^{2+}(aq) + 2e$*

1 mark

d.

i. $H_2SO_4(l) + H_2O(l) \rightarrow HSO^-_4(aq) + H_3O^+(aq)$*
$HSO^-_4(aq) + H_2O(l) \rightleftharpoons SO_4^{2-}(aq) + H_3O^+(aq)$

1 mark

ii. $K_a = \dfrac{[H_3O^+][SO_4^{2-}]}{[HSO_4^-]}$ *

1 mark

iii. The pH is difficult because the first step of the ionisation goes to completion, but the second step is only around 10%. Therefore it is difficult to calculate the concentration of H_3O^+. The pH will also be temperature dependent.*

1 mark

Total 9 marks

