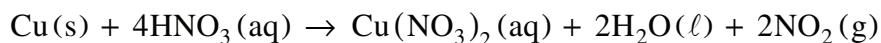


Chemistry 12
Resource Exam A
Scoring Guide

1. (4 marks)

In a fume hood, a student reacted copper and nitric acid in a flask according to the following equation:



The following data was collected:

Time (min)	Mass of flask and contents (g)
0.0	250.50
2.5	249.25
5.0	248.24
7.5	247.44

Calculate the overall rate of reaction in grams NO_2 per minute.

(1 mark)

How much time will it take to react 0.50 g of Cu at this rate?

(3 marks)

Solution:

For Example:

Calculate the overall rate of reaction in grams NO_2 per minute.

$$\text{rate} = \frac{(250.50 \text{ g} - 247.44 \text{ g})}{7.5 \text{ min}} = 0.41 \text{ g/min}$$

← 1 mark

How much time will it take to react 0.50 g of Cu at this rate?

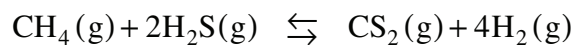
$$\text{time(min)} = 0.50 \text{ g Cu} \times \frac{1 \text{ mol Cu}}{63.5 \text{ g Cu}} \times \frac{2 \text{ mol NO}_2}{1 \text{ mol Cu}} \times \frac{46.0 \text{ g NO}_2}{1 \text{ mol NO}_2} \times \frac{1 \text{ min}}{0.41 \text{ g NO}_2}$$

$$= 1.8 \text{ min}$$

← 3 marks

2. (4 marks)

Consider the following equilibrium:



Initially, 0.120 mol CH_4 and 0.280 mol H_2S were placed in a 2.00 L flask. At equilibrium, $[\text{CS}_2] = 0.030 \frac{\text{mol}}{\text{L}}$. Calculate K_{eq} .

Solution:

For Example:

	$\text{CH}_4(\text{g})$	+	$2\text{H}_2\text{S}(\text{g})$	\rightleftharpoons	$\text{CS}_2(\text{g})$	+	$4\text{H}_2(\text{g})$	← 1 mark
I	0.0600		0.140		0		0	
C	-0.030		-0.060		+0.030		+0.120	
E	0.030		0.080		0.030		0.120	← 1 mark

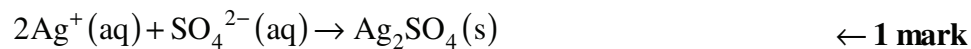
$$\begin{aligned}
 K_{eq} &= \frac{[\text{CS}_2][\text{H}_2]^4}{[\text{CH}_4][\text{H}_2\text{S}]^2} \\
 &= \frac{(0.030)(0.120)^4}{(0.030)(0.080)^2} \quad \left. \vphantom{\frac{(0.030)(0.120)^4}{(0.030)(0.080)^2}} \right\} \leftarrow 1 \text{ mark} \\
 &= 0.032 \quad \leftarrow 1 \text{ mark}
 \end{aligned}$$

3. (4 marks)

Write the net ionic equation for the reaction that occurs when 40.0 mL of 1.50 M AgNO_3 is mixed with excess Na_2SO_4 solution, and calculate the mass of the precipitate that forms.

Solution:

For Example:



$$\text{moles of Ag}^+ : 1.50 \frac{\text{mol}}{\text{L}} \times 0.0400 \text{ L} \times \frac{1 \text{ mol Ag}^+}{1 \text{ mol AgNO}_3} = 0.0600 \text{ mol} \quad \leftarrow 1 \text{ mark}$$

$$\text{Moles of Ag}_2\text{SO}_4 : 0.0600 \text{ mol} \times \frac{1 \text{ mol Ag}_2\text{SO}_4}{2 \text{ mol Ag}^+} = 0.0300 \text{ mol Ag}_2\text{SO}_4 \quad \leftarrow 1 \text{ mark}$$

$$\text{Mass of Ag}_2\text{SO}_4 : 0.0300 \text{ mol} \times 311.9 \frac{\text{g}}{\text{mol}} = 9.36 \text{ g} \quad \leftarrow 1 \text{ mark}$$

4. (3 marks)

Identify an amphoteric substance and write two balanced equations that demonstrate its amphoteric nature.

Solution:

For Example:

Amphoteric substance: H_2O ← 1 mark

H_2O behaving like an acid: $\text{H}_2\text{O} + \text{F}^- \rightleftharpoons \text{OH}^- + \text{HF}$ ← 1 mark

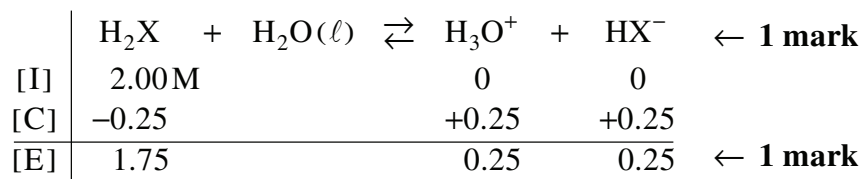
H_2O behaving like a base: $\text{H}_2\text{O} + \text{HF} \rightleftharpoons \text{H}_3\text{O}^+ + \text{F}^-$ ← 1 mark

5. (5 marks)

A 2.00 M diprotic acid (H_2X) has a pH of 0.60. Calculate its K_a value. Start by writing a general equation for the predominant equilibrium.

Solution:

For Example:



pH = 0.60; $[\text{H}_3\text{O}^+] = 0.25 \text{ M}$ ← 1 mark

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{HX}^-]}{[\text{H}_2\text{X}]}$$

$$= \frac{(0.25)(0.25)}{1.75} \quad \leftarrow 1 \text{ mark}$$

$$= 0.036 \quad \leftarrow 1 \text{ mark}$$

6. (3 marks)

A titration was performed by adding 0.125 M NaOH to a 25.00 mL sample of H₂SO₄. Calculate the [H₂SO₄] from the following data.

	Trial #1	Trial #2	Trial #3
Initial volume of NaOH (mL)	4.00	17.05	8.00
Final volume of NaOH (mL)	17.05	28.00	19.05

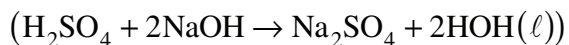
Solution:

For Example:

	Trial #1	Trial #2	Trial #3
NaOH added (mL)	13.05	10.95	11.05

↑ discard

average NaOH added = 11.00 mL = 0.01100 L

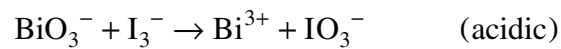


$$[\text{H}_2\text{SO}_4] = \frac{0.125 \text{ mol NaOH}}{\text{L}} \times 0.01100\text{L} \times \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol NaOH}} \times \frac{1}{0.02500 \text{ L}}$$

= 0.0275 M ↑ 1 mark ↑ 1 mark ↑ 1 mark

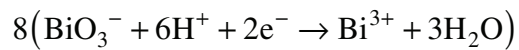
7. (4 marks)

Balance the following in acidic solution.

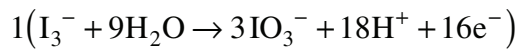


Solution:

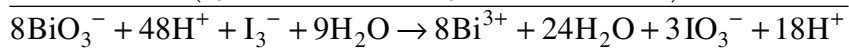
For Example:



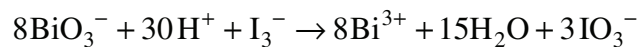
← 1 mark



← 1 mark



← 1 mark for balancing



← 1 mark

8. (3 marks)

Draw an operating electrolytic cell used in the electrolysis of molten sodium chloride, NaCl.
Label the anode and cathode.

Solution:

For Example:

