8.3 Acid Deposition

Question Paper

Course	DP IB Chemistry
Section	8. Acids & Bases
Topic	8.3 Acid Deposition
Difficulty	Hard

Time allowed: 20

Score: /10

Percentage: /100

Question 1

Acid rain can be up to 50 times more acidic than normal rain, which has a pH around 5.5. What is the approximate concentration of H^+ in acid rain?

A. 2.50×10^{-3} mol dm^{-3}

B. 2.50×10^{-4} mol dm^{-3}

C. 2.50×10^{-5} mol dm^{-3}

D. 50.0×10^{-4} mol dm^{-3}

[1 mark]

Question 2

Natural gas contains on average 5.5 mg / m^3 of sulfur in the form of hydrogen sulfide, H_2S (M_r = 34). If a typical household in the UK consumes 0.198 m^3 of gas per day, what is the average annual emission of sulfur in g per household?

A. $5.5 \times 0.198 \times 365$

B. $\frac{5.5 \times 0.198 \times 365 \times 34}{1000 \times 32}$

C. $\frac{5.5 \times 0.198 \times 365}{1000}$

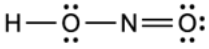
D. $\frac{5.5 \times 0.198 \times 365 \times 32}{1000 \times 34}$

[1 mark]

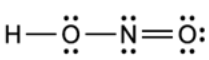
Question 3

Nitrous acid is produced when nitrogen dioxide dissolves in water to produce acid rain. What is the correct Lewis structure for nitrous acid?

A 

B 

C 

D 

[1 mark]

Question 4

Hydroxyl free radicals are thought to be involved in complex reactions converting sulfur dioxide into sulfur trioxide in the atmosphere.

$$OH\bullet + SO_2 \rightarrow \ \bullet HOSO_2$$

$$\bullet HOSO_2 + O_2 \rightarrow \bullet HO_2 + SO_3$$

Which is true?

A. $OH\bullet$ is catalytic

B. $\bullet HOSO_2$ contains 24 electrons

C. Both reactions are redox

D. The first reaction is exothermic

[1 mark]

Question 5

Iron structures can be damaged by dry deposition such as the equation below:

$$Fe(s) + SO_2(g) + O_2(g) \rightarrow \ FeSO_4(s)$$

Given that,

$$\Delta H_f^{\ominus}(SO_2) = -297\ kJ\ mol^{-1}$$

$$\Delta H_f^{\ominus}(FeSO_4) = -929\ kJ\ mol^{-1}$$

What is the enthalpy change for this reaction?

A. -297 - 929

B. 297 + 929

C. -297 + 929

D. 297 - 929

[1 mark]

Question 6

Acid deposition results in leaching of aluminium ions from the soil. Which are true?

I. Al^{3+} ions damage plants roots
II. Al^{3+} ions damage fish gills
III. Al^{3+} ions affect human health

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

[1 mark]

Question 7

The equilibrium constants for the dissociation of nitrous and sulphurous acid found in acid rain are as follows:

$$HNO_2(aq) \rightleftharpoons H^+(aq) + NO_2^-(aq) \quad K_c^1 = 7.2\ 10^{-4}\,mol\,dm^{-3}$$

$$H_2SO_3(aq) \rightleftharpoons H^+(aq) + HSO_3^-(aq) \quad K_c^2 = 1.3\ 10^{-2}\,mol\,dm^{-3}$$

Which is true?

	Stronger acid	**Effect on K_c of mixing the same volume and concentration the acids**
A	Nitrous	No effect
B	Sulfurous	No effect
C	Nitrous	K_c^2 decreases
D	Sulfurous	K_c^1 decreases

[1 mark]

Question 8

How many different types of ions can be found in acid rain, assuming it contains a mixture of sulfuric, sulfurous, nitric and nitrous acids?

A. 4

B. 5

C. 6

D. 7

[1 mark]

Question 9

Historic buildings and statues have frequently suffered chemical corrosion from acid rain. Which building materials would be unaffected by this?

A. Marble

B. Limestone

C. Granite

D. Lime Mortar

[1 mark]

Question 10

Which is true about the hydrogensulfate ion, HSO_4^-, found in acid rain?

I. It is amphiprotic
II. It is amphoteric
III. Sulfur is in its highest oxidation state

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

[1 mark]