8.3 Acid Deposition

Question Paper

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

Time allowed: 50

Score: /36

Percentage: /100

Question 1a

a) Outline the difference between **acid rain** and **acid deposition**, and state the names of the two types of acid deposition.

[3 marks]

Question 1b

b) Nitric acid is one component of acid rain that mainly comes from the emissions of internal combustion engines.
Describe, using suitable equations, the formation of acid rain from internal combustion engine emissions.

[4 marks]

Question 1c

c) The removal of sulfur dioxide is an important strategy in the fight to combat acid rain. It can be achieved pre- or post-combustion.
Outline one technique used in the two processes.

[2 marks]

Question 1d

d) Discuss the impact of acid rain or acid deposition on human health and on plant life.

[2 marks]

Question 2a

a) Identify two substances that can be affected by the corrosive effects of acid deposition.

[1 mark]

Question 2b

b) Sulfuric(VI) acid, H_2SO_4, and sulfur dioxide, SO_2, are known components of acid deposition. Write equations for their reactions with calcium carbonate.

[2 marks]

Question 2c

c) Calcium nitrate(V) can be detected in the run-off water from limestone buildings that have been impacted by acid rain.

Write an equation to account for its formation and suggest why this is particularly damaging buildings.

[2 marks]

Question 2d

d) Aluminium has a protective oxide layer on its surface which can be weakened and damaged by the effects of acid rain.

i) Write a balanced equation to show the effect of nitric(V) acid on aluminium oxide.

ii) The statue of Eros in London is made from aluminium and has stood for more than 100 years, but shows little sign of damage from acid rain. Suggest a reason why.

[2 marks]

Question 3a

a) Nitrogen oxides produced by combustion are largely nitrogen monoxide or nitrogen dioxide.

Draw Lewis diagrams for nitrogen monoxide and nitrogen dioxide and use the diagrams to explain the meaning of the term free radical.

[3 marks]

Question 3b

b) Platinum and rhodium are found in catalytic converters and facilitate the conversion of Carbon monoxide and nitrogen monoxides to nitrogen and carbon dioxide.

Write an equation for the reaction and state the changes in oxidation state for each carbon and nitrogen.

[2 marks]

Question 3c

c) Use your answer to part (c) and the bond enthalpy data given in **Table 1** to determine the enthalpy change for the reaction between carbon monoxide and nitrogen monoxide.

Table 1

C≡O	N=O	N≡N	C=O
1070 kJ mol^{-1}	587 kJ mol^{-1}	945 kJ mol^{-1}	804 kJ mol^{-1}

[4 marks]

Question 3d

d) Acid deposition can be produced by the reaction of NO_2 in the atmosphere. State the equation for the reaction.

[1 mark]

Question 4a

a) Natural sources as well as human activities can contribute the formation of acid deposition. Name one natural source of acid deposition.

[1 mark]

Question 4b

b) Sulfur from volcanic eruptions can produce sulfurous acid, H_2SO_3, in a two step reaction.

Write equations for the reaction.

[2 marks]

Question 4c

c) A sample of sulfur is converted to H_2SO_3 using the reactions in part (b). If the % yield in both reactions is 75% determine the mass of sulfur needed to make 2 dm^3 of 0.05 mol dm^{-3} H_2SO_3,

[3 marks]

Question 4d

d) Studies show that sulfurous acid, H_2SO_3, does not actually exist in solution but is the result of an equilibrium between sulfur dioxide and water:

$$SO_2\ (g) + H_2O\ (l) \rightleftharpoons HSO_3^-\ (aq) + H^+\ (aq)$$

Write an equilibrium expression for this reaction and suggest, with a reason, whether sulphurous is likely to be strong or weak acid.

[2 marks]