Name: _____

Date: _____

Class: _____

IB Environmental Systems and Societies

6.4 Acid Deposition

Significant ideas:

Acid deposition can impact living systems and the built environment.

The pollution management of acid deposition often involves cross-border issues.

def: Acid coming down from air. Can be DRY / WET

What is Acid Deposition?

It's more common to talk about "acid rain" than acid deposition, but "rain" is only one way in which the acid may be deposited. Make sure you are using appropriate vocabulary and don't mix up the phrases.

1. a) Complete the pH scale below with the labels:

Neutral, more acidic, more alkaline

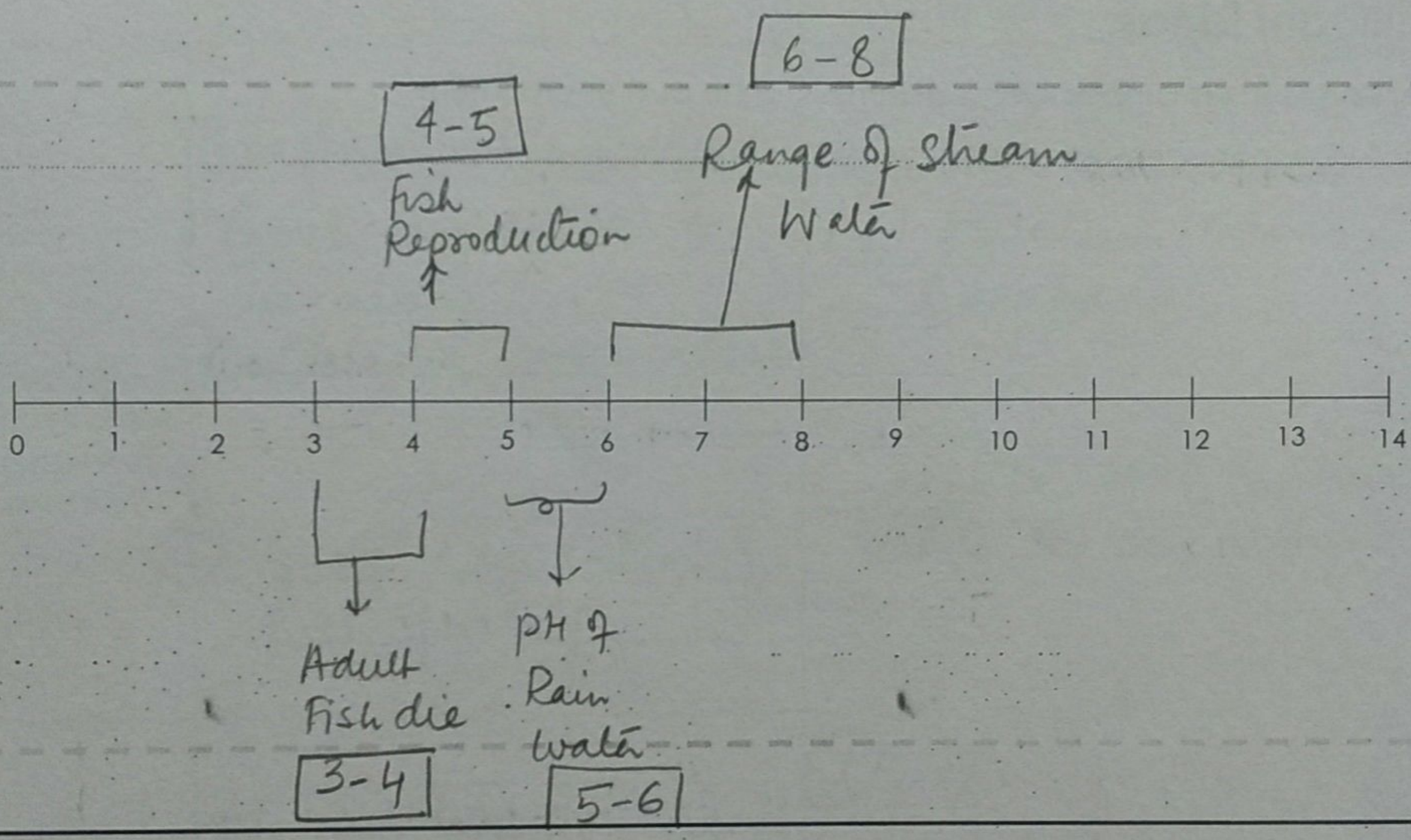
b) On the scale, label the following:

i) the range in which fish reproduction is negatively affected

ii) the range in which adult fish die

iii) The "normal" pH of rainwater

iv) The "normal" range of pH of stream water



2. Outline the **natural** release of **primary pollutants** that can result in acid deposition.

Are released by volcanic eruptions & nitrogen oxides by lightning

3. Outline how human activities result in the release of **primary pollutants** that can result in acid deposition.

Combustion of fossil fuel / Thermal power stations

4. List **three secondary pollutants** of both dry and wet acid deposition

H_2SO_4

HNO_3

Ash / soot

5. Distinguish between "wet deposition" and "dry deposition"

Dry deposition

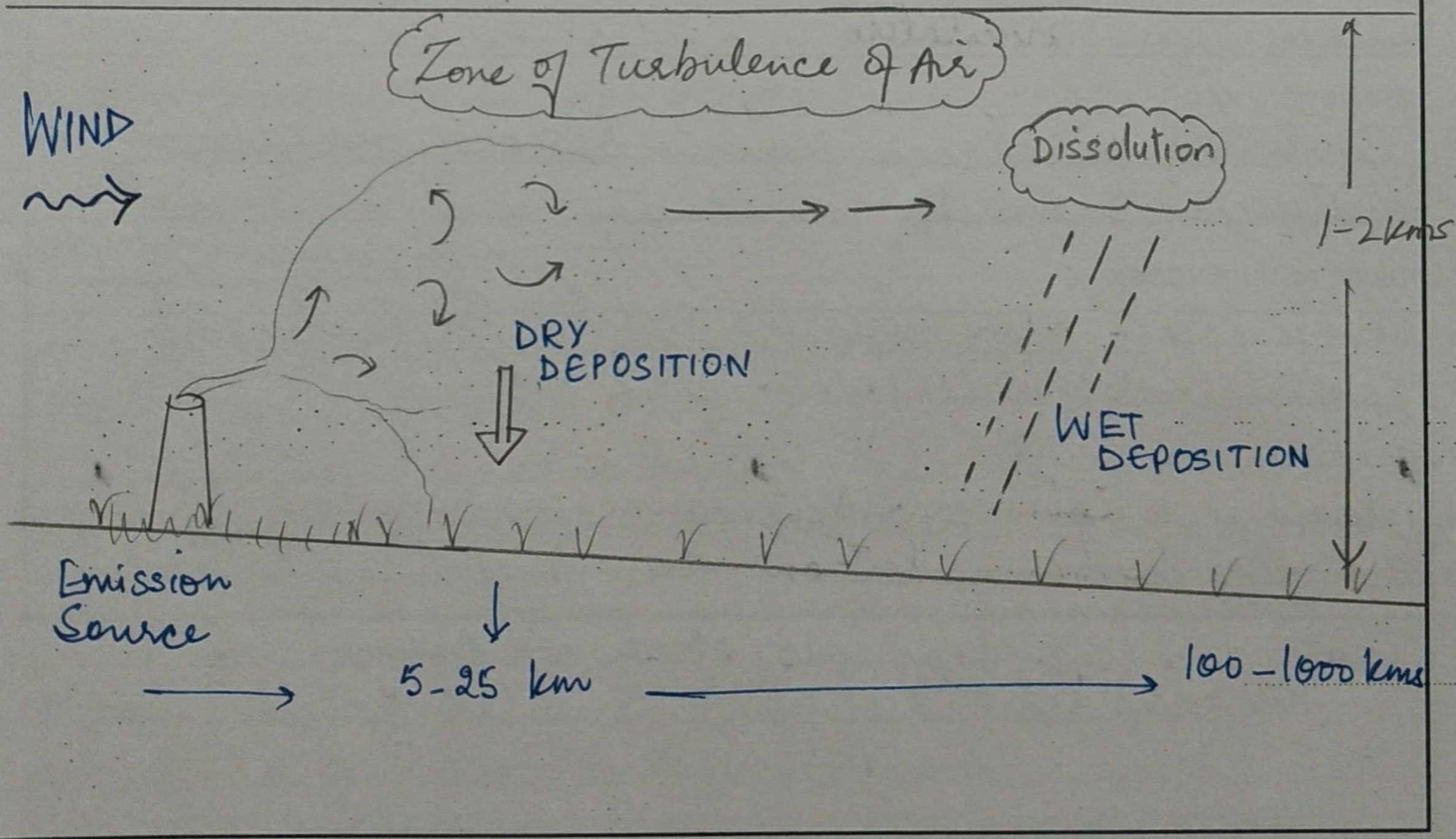
SO_2 & NO_x emitted from industries / vehicle fall directly on ground.

Wet deposition : If they stay longer in air, they react with water vapours to form H_2SO_4 / HNO_3 which reach ground as Rain / Snow.

6. Draw a diagram summarizing acid deposition.

In your diagram you should include the release of *named* primary pollutants, their conversion into *named* secondary pollutants, and their methods of deposition.

Turbulence Limited



Impacts of Acid Deposition

1. With the help of examples and with reference to acid deposition, distinguish between the terms "direct effect" and "indirect effect".

	Direct effects	Indirect effects
(1)	Acidification of Lake; affects aquatic organisms	(1) Toxic effect - Increased solubility of metal ions (Al) on fish
(2)	Coniferous forests - Nutrient leaching, damage to root hairs	(2) Nutrient effect - Leaching of plant nutrients

2. Explain the effects acid deposition on coniferous forest. Use the subheadings to guide your answer.

Leaf and bud yellowing:

Trees absorb toxic aluminium ions from soil. Yellowing due to loss of chlorophyll & thinning of wax cuticles

Reduced growth:

(N) & (P) becomes less available to plants but Copper becomes more available in acidic soils.

Nutrient leaching:

Ca & Mg ions leach from soil & are washed away & pathogens & insects gain entry

Symbiotic root microbes:

Greatly reduces availability of nutrients.
Numbers fall with increasing acidity / Eg. Earthworms can't tolerate Soils with pH < 4.5.

Toxic ions:

Leaching of Calcium & Magnesium ions from soil while metals like Aluminium & Iron are mobilised by acidic water and flushed into streams & lakes.

3. Complete the sentences to outline the effect of acid deposition on aquatic organisms

An increase in soil acidity (a decrease in pH), results in leaching of aluminium (and other toxic metals) as it dissolves more easily in acidic conditions. When aluminium is present in water, it changes the amount of salt and water that a fish can take in. Fish take in O_2 for respiration from water so a change in water intake influences salt intake. The changes in levels of salt, water and oxygen in the body can result in the death of fish (and other aquatic organisms). If Aluminium is present in high concentrations, it can cause direct suffocation of the fish as it causes the build of a solid material on their gills.

4. Outline the effect of acid rain on buildings.

limestone buildings & statues react with acid & dissolve

5. Explain how acid deposition can cause lung diseases

Dry deposition penetrates lungs, can cause Asthma, bronchitis → Death

6. With reference to peat bogs, outline a **positive** effect of acid deposition

Peat bogs with Acid rain produce 40% less methane ∴ methane producing bacteria die and are replaced by sulphur consuming bacteria. [* CH_4 a potent GHG]

7. With reference to named countries/regions, explain why acid deposition if considered a **regional** problem, as opposed to a global one.

Major areas affected by Acid rain are those which are downwind of major industrial regions.
eg Scandinavia downwind from West Europe

Areas increasingly causing Acidification include China & India.

Pollution Management Strategies for acid deposition

1. Complete the table to list some suggestions for pollution management strategies to tackle acid deposition.

Once you have your chosen list of strategies, **evaluate** each of them. Give one "for" and one "against" comment for each if possible

Strategy	Action	Evaluation
Altering human activities causing the pollution	① Use fossil fuel alternate eg Ethanol to run car ② Educational campaign	But demand for power ever increasing due to industrialization.
	③ Public transport ④ low S fuel	
Regulate and reduce at point of emission	① Clean up technology at end of pipe location (point emission) eg Scrubbers in	Tech. expensive & expenses passed on to consumer
	② Chimneys to remove SO_2. ③ Catalytic converters	
Clean-up and restore	Liming of acidified lakes & rivers	Effective in restoring pH but needs to be repeated regularly.
	Liming forestry plantations as trees acidify soil as they remove nutrients	Treats Symptoms & Not Cause