Exam question Hydrology of Catchments river basins and Deltas

Regarding the articles studied and discussed

1. In an exponentially shaped estuary the tidal average salinity S can be described by:

$$\frac{\partial S}{\partial t}+\frac{Q}{A}\frac{\partial S}{\partial x}+\frac{1}{A}\frac{\partial}{\partial x}\left(DA\frac{\partial S}{\partial x}\right)=-\frac{Sr}{h} \qquad (1)$$

1a.   Which term in Eq.(1) causes hypersalinity to occur
1b.   Explain how the variables in this term influence hypersalinity
1c.   Give an estimate of the time scale of the process of salinization due to evaporation?

2. In an exponentially shaped estuary tidal damping can be described by the following equation:

$$\frac{1}{H}\frac{\partial H}{\partial x}\left(1+\frac{gH}{2c\upsilon\sin\varepsilon}\right)=\frac{1}{b}-f\frac{\upsilon\sin\varepsilon}{hc} \qquad (2)$$

with:
$$B=B_0\exp(-x/b) \qquad (3)$$

2a.   In Eq.(2) explain what the two terms on the right hand side represent and how they influence tidal damping or amplification.
2b.   Explain the special case of an ideal estuary

3. In the Pungue estuary in Mozambique, it appears that by alternated pumping more fresh water can be diverted for irrigation than if a constant amount is pumped from the estuary.

3a.   What is the physical explanation for this surprising result? Keep your answer short.