Q2) What are data hazards? Enumerate different classes of data hazards & how they can be tackled in a pipelined processor architecture design

→ Data hazards: Dependencies in data which can cause errenous computation by the pipeline

Data dependencies: Result computed by one instruction is used as data for the following instruction

Classes of data hazard:

Two types of data manipulation exists, reading the data and writing to it. Hazards can occur when two adjacent instructions both manipulate data.

Let two instructions a & b both manipulate data, then the classes are:

i) Read after ~~wrig~~ write
→ The follow instruction (b) tries to read the memory location before preceding istruction (a) ~~tries~~ writes it.

ii) Write after write
→ b tries to append the data even before it is written by a.

iii) Write after read
→ b tries to write to memory before a reads it, thus feeding it wrong data.

iv) Read after read

→ This case can be a passible hazard but pipelining eliminates the possibility

Tackling the hazards

Tackling data hazards can be done in the following manner:

i) Stalling

→ Stalling the proccesor from processing new instruction till the instruction containing hazard is completed

ii) Forwarding

→ There is a possible pending write instruction in the write back stage, instead of stalling till its complete, pass the value in write back stage to the source operod.

⇒ All data hazards can be tackled with stalling, forwarding or in the case of load data hazard, a combination of both.