

# 1998 Paper 10 Question 7

## Computer Design

How can a pipeline be used to improve processor performance? [5 marks]

Explain, with reference to the 5-stage pipeline diagram below, how feed-forwarding (also called bypassing) can be used to reduce the effects of load delays but cannot eliminate them.

|                      |                   |         |                  |                        |
|----------------------|-------------------|---------|------------------|------------------------|
| instruction<br>fetch | register<br>fetch | execute | memory<br>access | register<br>write back |
|----------------------|-------------------|---------|------------------|------------------------|

[10 marks]

Most instructions in old accumulator machines read an operand from memory which is then combined with the accumulator. The only exception is usually the **store** instruction which writes the accumulator (without modification) to the memory. If you were to pipeline an accumulator machine, where would the memory access stage go? [5 marks]