# Homework 3 The processor instruction set Answers

1. When a new processor is designed the instruction set must be finalised first. A new processor with a 32-bit word length is being developed for use in a mobile phone.  
   1. It has been decided that the processor will use 60 different instructions. How many bits should be used for the opcode? [1 mark]  
      * 6 bits (26 = 64)
   2. If there are two bits available for the addressing mode what is the maximum value that can be used for the operand? (Show your working.) [3 marks]

1 mark for each point:

* + - 32 – 2 – 6 = 24 bits for operand
    - 224 – 1 is the maximum value
    - Answer: 16,777,215
  1. How much memory, in MiB, can the processor work with, assuming one address references one four-byte word of data? (Show your working.) [3 marks]

1 mark for each point:

* + - 224 possible addresses
    - Which is 16,777,216 x 4 bytes
    - In MiB: 64 MiB
  1. It has been decided that this is not enough addressable memory. The number of bits for the addressing mode cannot change and nor can the word length. Explain how more memory can be addressed by changing the number of bits for the opcode and explain the drawback of doing this. [3 marks]

1 mark for each point:

* + - Reduce bits used for opcode
    - Each additional bit for operand doubles the amount of addresses available
    - Number of operations will be reduced at the same time
    - Functionality or speed of processor will be reduced – with a reduced instruction set, a simple calculation may take two instructions instead of one, for example.

[Total 10 Marks]