1. Figure 1 shows a byte containing a signed integer. The value of the carry bit is unknown.

| 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 |  |  |  |  | carry bit |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

*Figure 1*

Show the result of performing the following shifts, starting each time with the   
byte given in Figure 1. [4]

| (a) a logical right shift of 2: | |  |  |  |  |  |  |  |  |  |  |  | carry bit | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (b) a logical left shift 1: | |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| (c) an arithmetic left shift 1: | |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| (d) an arithmetic right shift 2: | |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |

2. Using a combination of shifts and addition, multiply 17 by 7 [3]

3. Figure 2 shows an 8-bit byte containing a bit pattern controlling 8 lights.

| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| --- | --- | --- | --- | --- | --- | --- | --- |

*Figure 2*

(a) It is desired to set switches 1- 4 to 0 without altering the other switches. Show how this can be done with a mask and a logical operator. [2]

Switch number 1 2 3 4 5 6 7 8

Current state 1 1 0 1 0 1 1 1

(b) It is now desired to reset the bits to all 1s, except for bit 8, which should be left as it is. Show how this can be done with a mask and a logical operator. [2]

Switch number 1 2 3 4 5 6 7 8

Current state 0 0 0 0 0 1 1 1

5. The ASCII codes for the uppercase letters A - Z are 0100 0001 to 0101 1010. The lowercase letters a – z are represented in ASCII by 0110 0001 to 0111 1010.

Use a mask and a logcal operator to transform an uppercase letter to lowercase. [2]

1 2 3 4 5 6 7 8

code for A 0 1 0 0 0 0 0 1

[Total 13 marks]