1. The following program is written for the Little Man Computer.   
The user enters the values 3, 5, 6.

INP

STA p

INP

STA q

INP

STA r

LDA p

ADD r

SUB q

OUT

HLT

p DAT

q DAT

r DAT

(a) What is the effect of the statement **STA p** in the second line of the program? [1]

(b) What does the statement **SUB** **q** do? [1]

(c) What mathematical expression does the program calculate? [1]

(d) What is the output of the program? [1]

2. The following program is written for the Little Man Computer. The user enters the value 3.

INP

STA a

start  LDA a

OUT

SUB one

STA a

BRZ finish

BRA start

finish LDA a

SUB a

OUT

HLT

a   DAT

one DAT 1

(a) What does the statement **BRZ** finish do? [2]

(b) What does the statement **one DAT 1** do? [1]

(c) What is the output of the program? [2]

(d) Some of the statements are not needed. Rewrite the assembly language program in as few statements as possible. [4]

3. (a) Explain what is meant by the terms **opcode** and **operand.** [2]

Opcode:

Operand:

(b) Explain what is meant by each of the following addressing modes:

(i) Direct [1]

(ii) Indirect [1]

(iii) Immediate [1]

[Total 18 marks]