Unit 3: Systems Software
(3b. Programming Languages, AS Content)

Marks: /21

Answer **all** the questions.

1(a). The following assembly code in Fig. 1 is written for the Little Man Computer instruction set.

```
     INP
     STA  arg1
     INP
     STA  arg2
     LDA  arg1
loop SUB  arg2
     BRP  loop
     ADD  arg2
     OUT
arg1 DAT
arg2 DAT
```

Fig.1

State the output when the inputs are 13 followed by 5.

---------- [1]

(b). In the line:

```
loop  SUB   arg2
```

(i) State what opcode SUB does.

---------- [1]

(ii) Name the register in which the result of this line is stored.

---------- [1]

(c).

(i) State what the program in Fig. 1 does.

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[1]

(ii) Using pseudocode write a program for a procedural language that takes in two inputs and gives the same output as the program in Fig. 1.

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[2]

2(a). The program, as shown in Fig.2 below, is written in assembly code using the Little Man Computer instruction set. It is *supposed* to take in two numbers and output the higher.

```
      INP
      STA   NUMA
      INP
      STA   NUMB
      SUB   NUMA
      BRP   NOTA
      LDA   NUMB
      BRA   QUIT
NOTA  LDA   NUMA
QUIT  OUT
      HLT

NUMA  DAT
NUMB  DAT
```

Fig.2

State what type of translator program would be needed to convert the code above into machine code.

---------- [1]

(b). Explain how you would correct the program so it outputs the higher of the two numbers entered.

---------- [2]

(c). The program does not work correctly. Describe what the program actually does, using the numbers 4 and 9 being entered as an example.

---------- [2]

(d). Programs can also be written in high level languages. In pseudocode write a procedural program that takes in two numbers and outputs the higher of them.

[4]

3(a). A burglar alarm runs on a processor with the Little Man Computer (LMC) instruction set.

One of the instructions in the set is Branch if Positive (BRP).

A numeric PIN code entered into the burglar alarm is compared with the code stored at the memory location `passcode`.

If the codes match, the program jumps to the part of the program labelled `deactivate`.

If the codes do not match, the program jumps to the part of the program labelled `alarm`.

Write the LMC code to meet the requirements above. (You don't have to write the code for labels `deactivate` and `alarm`, as you can assume this has already been written elsewhere.)

[4]

(b). Describe what the instruction BRP does.

[2]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		• It outputs 3 (1).	1	For 1 mark.
	b	i	• Performs subtraction (1).	1	For 1 mark.
		ii	• The accumulator (1).	1	For 1 mark.
	c	i	• Calculates the remainder of two numbers when the second is divided by the first (1).	1	For 1 mark. Accept finds modulo / modulus.

		ii	• Code takes in two values and provides an output (1).
			• The output is the modulus of the two inputs (1).
				2	For 2 marks.
					
					Allow follow through for second mark if output matches answer to (i).
					Accept MOD, % or any existing alternative.
					Accept if candidate has calculated modulus using alternative method (e.g. using a loop).
					
					Example:
					
					`arg1=input("Enter first number")`
					`arg2=input("Enter another number")`
					`ans=arg1 MOD arg2`
					`print(ans)`

			Total	6	
2	a		• An assembler (1).	1	For 1 mark.
	b		Award first mark: Changing LDA NUMB to LDA NUMA (1). Award second mark: Changing NOTA LDA NUMA to NOTA LDA NUMB (1).	2	For 2 marks. Accept changes annotated on provided code. Accept any other amendment that fixes program.
	c		• Program outputs smaller number (1) so in the case of 4 and 9 outputs 4 (1).	2	Up to 2 marks for a valid description.

Question			Answer/Indicative content	Marks	Guidance

	d		• Takes in two numbers (1).
			• Compare the numbers (1).
			• If first number is biggest outputs first number (1).
			• If second number is biggest outputs the second number (1).
				4	For 4 marks – 1 mark for each correct step in process.
					
					Example:
					`INPUT "Please enter Number A" numA`
					`INPUT "Please enter Number A" numB`
					`IF numA>numB THEN`
					`  PRINT numA`
					`ELSE`
					`  PRINT numB`
					`ENDIF`

			Total	9	

Question			Answer/Indicative content	Marks	Guidance
3	a		• Inputs the PIN • compares it with the passcode stored in memory using SUB • the correct PIN results in a jump to `deactivate` • incorrect PIN resulting in a jump to `alarm`	4	Example code: INP SUB passcode BRZ deactivate BRA alarm **Examiner's Comments** The specification clearly outlines the LMC mnemonics which are acceptable in learners' responses. Some candidates used LMC mnemonics correctly, gaining some credit. Other candidates answered using procedural pseudocode gaining no credit. Centres are advised to ensure candidates have the range of LMC mnemonics at their disposal prior to sitting the examination.
	b		• The program flow jumps to a (designated) label / another point in the program • If the value in the accumulator is positive.	2	Do not to accept '…branch…' for BP 1 **Examiner's Comments** Many candidates failed to gain credit on this question due to the lack of attention to detail in their response, which is essential at this level of study. Some candidates responded with answers such as: 'the code branches if the result is positive'. Many candidates did not demonstrate understanding that it is the value in the accumulator which is being tested for whether it is positive or not.
			Total	6	