2.9 Trace Tables and Binary/Hex Conversions: Test Pack

Total Marks

OCR J277 · Calculators not allowed · about 25 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Convert each of the following 8 bit binary numbers to denary.

(a) Convert 01011010 to denary. Show your working. **(2)**

(b) Convert 11000011 to denary. Show your working. **(2)**

(Total for Question 1 is 4 marks)

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2 Computers store all data using binary (only 0s and 1s) rather than denary.

(a) State two reasons why computers use binary to represent data, rather than denary. **(2)**

(Total for Question 2 is 2 marks)

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3 Two 8 bit two's complement numbers, representing -23 and +40, are to be added together in a register.

(a) Calculate the 8 bit two's complement binary result of adding -23 and +40, showing your working. **(3)**

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(b) Verify your answer by converting the binary result back to denary and comparing it to -23 + 40. **(1)**

(Total for Question 3 is 4 marks)

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4 The algorithm below uses OCR reference language pseudocode:

```
word <- "COMPUTER"
vowelCount <- 0
FOR position <- 1 TO LEN(word)
    letter <- MID(word, position, 1)
    IF letter = "A" OR letter = "E" OR letter = "I" OR letter = "O" OR letter
        vowelCount <- vowelCount + 1
    ENDIF
NEXT position
OUTPUT vowelCount
```

(a) Complete the trace table below to show the value of letter and vowelCount at each position, and state the value that is output. **(8)**

position	letter	vowelCount
(start)	-	0
1		
2		
3		
4		
5		
6		
7		
8		

```
OUTPUT =
```

(Total for Question 4 is 8 marks)

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5 A control system for a school greenhouse's ventilation stores the number of degrees the vent has opened as an 8 bit unsigned binary number in a register. Each time the vent opens further, 15 is added to the stored value. After several additions, the true total exceeds 255, which is more than 8 bits can store.

(a) Explain what happens to the stored value when this overflow occurs, and state one consequence this could have for the greenhouse control system. **(3)**

(Total for Question 5 is 3 marks)

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Mark scheme · 2.9 Trace Tables and Binary/Hex Conversions: Test Pack

Question 1

(a) Correct place values used, e.g. 128, 64, 32, 16, 8, 4, 2, 1 with the correct subset selected (64, 16, 8, 2), oe **M1**

(a) 90, cao **A1**

(a) Answer: 90

(b) Correct place values used with the correct subset selected (128, 64, 2, 1), oe **M1**

(b) 195, cao **A1**

(b) Answer: 195

Question 2

(a) the electronic components (transistors/switches) inside a computer only have two reliable states, e.g. on/off or high voltage/low voltage, which map directly to 1 and 0, oe **B1**

(a) using only two states is more reliable/less prone to error than trying to distinguish between ten different voltage levels for denary, oe **B1**

(a) Answer: Transistors only have two reliable states (on/off), which map to 1 and 0; using two states is more reliable than trying to detect ten different voltage levels.

Question 3

(a) correct two's complement values used for -23 (11101001) and +40 (00101000), oe **M1**

(a) correct addition process shown, with carries propagated, oe **M1**

(a) 00010001, cao **A1**

(a) Answer: 00010001

(b) 00010001 = 16+1 = 17, which matches -23+40 = 17, confirming the addition is correct, oe **B1**

(b) Answer: 17, which matches -23 + 40

Question 4

(a) position 1: letter = C, vowelCount = 0, cao **B1**

(a) position 2: letter = O, vowelCount = 1, cao **B1**

(a) position 3: letter = M, vowelCount = 1, cao **B1**

(a) position 4: letter = P, vowelCount = 1, cao **B1**

(a) position 5: letter = U, vowelCount = 2, cao **B1**

(a) position 6: letter = T, vowelCount = 2, cao **B1**

(a) position 7: letter = E, vowelCount = 3, cao **B1**

(a) position 8: letter = R, vowelCount = 3, cao **B1**

(a) Answer: letters: C,O,M,P,U,T,E,R; vowelCount: 0,1,1,1,2,2,3,3; OUTPUT = 3

Question 5

(a) only the lowest 8 bits of the true total are kept; any carry out of bit 7 is lost/discarded, so the stored value wraps around back towards 0 rather than continuing to increase, oe **B1**

(a) this means the value stored no longer matches the true total number of degrees the vent has opened, oe **B1**

(a) valid consequence, e.g. the control system could believe the vent is only slightly open when it is actually fully open (or vice versa), causing it to make an incorrect decision, e.g. opening the vent further when it should not, or not opening it when it should, oe **B1**

(a) Answer: The overflow bit is lost, so the stored value wraps around and no longer matches the true vent angle, which could cause the control system to make an incorrect decision.

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