

Paper 3 Overall Theory Test 1

- Full marks: 40
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1. Temperature data from a number of weather stations are to be processed. The following data are to be stored:
 - weather station ID(a unique four-letter code)
 - latitude (to 2 decimal places)
 - average temperature(to the nearest whole number) for each year from 2001 to 2015 inclusive
 - A programmer designs a composite data type WeatherStation. A variable of this type can be used to store all the data for one particular station.
 - (i) Write the definition for the user-defined data type **WeatherStation**. [5]
 - (ii) The programmer decides to store all the data in a file. The number of weather stations could grow to reach 200000, but not all stations will be present at first. The programmer decides on random file organization for the file. Describe **three** steps which show how a new weather station record is added to the file. [3]
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2. In a particular number system, real numbers are stored using floating point representation using:
 - 8 bits for mantissa
 - 8 bits for exponentTwo's complement form is used for both mantissa and exponent.
 - (i) A real number is stored as the following two bytes:
 - Mantissa: 00101000
 - Exponent: 00000011Calculate the denary value of this number. Show working. [3]
 - (ii) Explain why the floating point number is not normalized. [2]
 - (iii) Normalize the floating-point number. [2]
 - (iv) Write the largest positive number that can be written as a normalized number in this format. [2]
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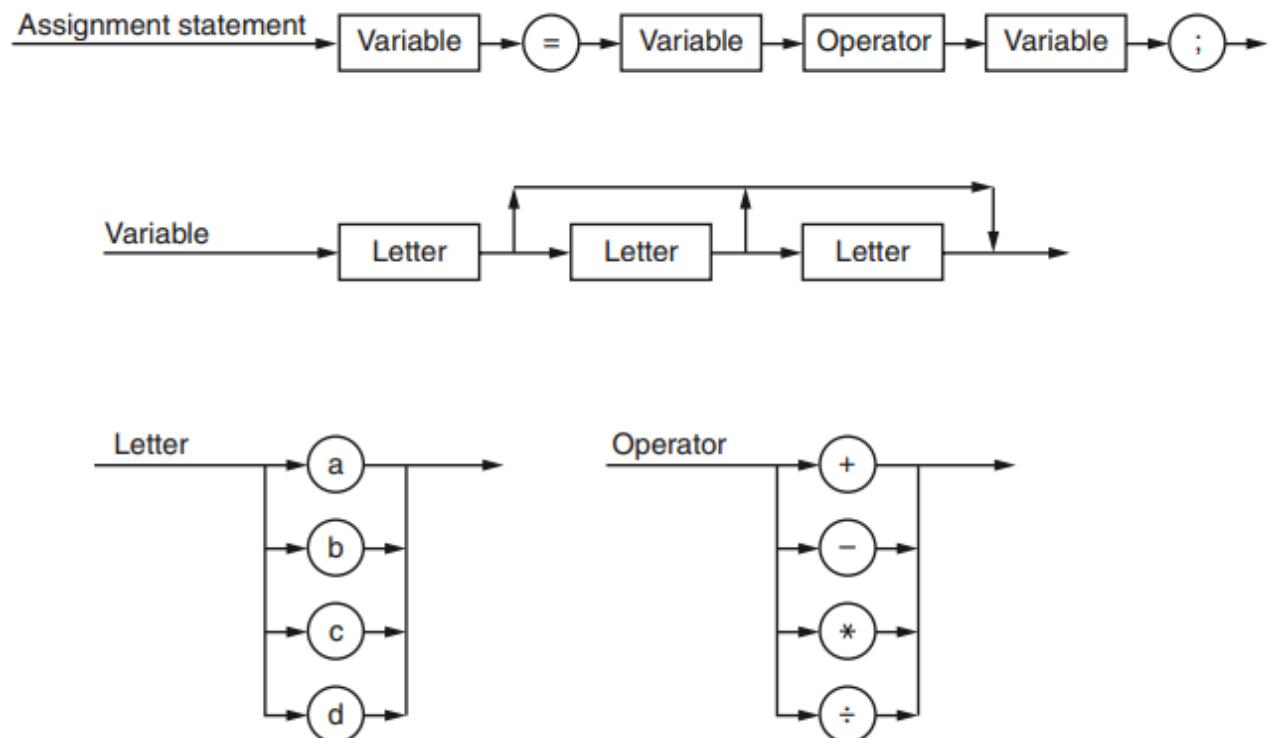
3. In packet switching:
 - (i) State **two items** that are contained in an email packet apart from the data. [2]
 - (ii) Explain the role of routers in packet switching. [3]
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INPUT				OUTPUT
A	B	C	D	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1

4. For the logic circuit with following truth table:

- (i) Construct K-map. [4]
- (ii) Draw loops around appropriate groups of 1's to produce an optimal sum-of-products. [2]
- (iii) Write the simplified sum-of-products Boolean function using the grouping in part (ii). [2]

5. The following syntax diagrams are for a particular programming language:



- (i) State with reason if the following statements are valid: [3]

- $a = b+c$
 - $a = b-2;$
 - $a = dd*cce;$
 - (ii) Write the Backus-Naur Form (BNF) for the syntax diagrams shown above. [6]
 - (iii) Programmers working for the software company prefer to debug their programs using an interpreter. Give **one** possible reason why. [1]
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