

[ Question 1 Mark Scheme ]

|         |   |                  |
|---------|---|------------------|
| (a) (i) | enumerated  | 1                |
| (ii)    | record  | 1                |
| (iii)   | MyMonthOfBirth ← DateOfBirth.ThisMonth  | 1                |
| (b) (i) | TYPE LocationRainfall   | 1                |
|         | DECLARE LocationName : STRING   | 1                |
|         | DECLARE LocationHeight : INTEGER  | 1                |
|         | DECLARE TotalMonthlyRainfall : <u>ARRAY[1..12]</u> OF REAL  | 1 + 1            |
| ENDTYPE |   |                  |
| (ii)    | <ul style="list-style-type: none"> <li>no need to re-sort data every time new data is added</li> <li>only a small file so searching will require little processing</li> <li>new records can easily be appended</li> </ul> | 1                |
|         |   | 1                |
|         |   | 1                |
|         |   | [max 2]          |
|         |   | <b>Total: 10</b> |

[ Question 2 Mark Scheme ]

|         |  |                  |
|---------|--|------------------|
| (a) (i) | HomeAddress.ThisHouseNo ← 34                         | 1                |
| (ii)    | DECLARE ThisHouseNo: 1..10                           | 1                |
|         | DECLARE ThisTown: [Brightown, Arunde, Shoram]        | 1                |
| (b) (i) | TYPE WeatherStation                                  |                  |
|         | DECLARE StationID : STRING                           | 1                |
|         | DECLARE Latitude : REAL                              | 1                |
|         | DECLARE Temperature : <u>ARRAY[1..15]</u> OF INTEGER | 1 + 1            |
| ENDTYPE |  | 1                |
| (ii)    | StationID is hashed to produce home location         | 1                |
|         | If home location is free insert record               | 1                |
|         | Else use overflow method to find free location       | 1                |
|         |  | <b>Total: 11</b> |

[ Question 3 Mark Scheme ]

| (a)                      | <table border="0"> <thead> <tr> <th style="text-align: left;">File organisation method</th> <th style="text-align: left;">File access method</th> </tr> </thead> <tbody> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">serial</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">direct</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">sequential</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">sequential</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">random</td> <td></td> </tr> </tbody> </table> | File organisation method  | File access method | serial | direct | sequential | sequential | random |  | <p>1</p> <p>2</p> <p>1</p> |
|--------------------------|--|---|--------------------|--------|--------|------------|------------|--------|--|----------------------------|
| File organisation method | File access method   |   |                    |        |        |            |            |        |  |                            |
| serial                   | direct   |   |                    |        |        |            |            |        |  |                            |
| sequential               | sequential   |   |                    |        |        |            |            |        |  |                            |
| random                   |  |   |                    |        |        |            |            |        |  |                            |
| (b) (i)                  | <p>Sequential<br/>As all customers get statement ... // high hit rate<br/>Suitable for batch processing of the records // the records will be processed one after the other<br/>File organised using customer's unique ID (as primary key field)<br/>//<br/>Serial<br/>As all customers get statement ... // high hit rate<br/>Suitable for batch processing of the records // the records will be processed one after the other<br/>Order not important</p>   | <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p><b>Max 3</b></p> |                    |        |        |            |            |        |  |                            |
| (ii)                     | <p>Random<br/>Real-time transaction processing<br/>Requires fastest access to data<br/>No need to search through records</p>   | <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p><b>Max 3</b></p>                                     |                    |        |        |            |            |        |  |                            |
| (iii)                    | <p>Serial<br/>Each new record is appended<br/>Transactions are recorded in chronological order<br/>File re-organisation not required for each new record // no need for the records to be sorted</p>   | <p>1</p> <p>1</p> <p>1</p> <p><b>Max 3</b></p>  |                    |        |        |            |            |        |  |                            |

[ Question 4 Mark Scheme ]

|           |   |                                     |
|-----------|---|-------------------------------------|
| 4(a)(i)   | DECLARE Book : LibraryBookRecord  | 1                                   |
| 4(a)(ii)  | Book.Title ← "Dune"   | 1                                   |
| 4(b)      | <pre> TYPE LibraryBookRecord   DECLARE ISBN      : INTEGER   DECLARE Title     : STRING   DECLARE Genre     : (Fiction, Non-Fiction)   DECLARE NumberOfLoans : 1 .. 99 ENDTYPE </pre> <p>mark for correct declaration and first two fields (<b>note</b>: only if attempt at modification)</p> | <p>3</p> <p>1</p> <p>1</p> <p>1</p> |
| 4(c)(i)   | 6715  | 1                                   |
| 4(c)(ii)  | 8216  | 1                                   |
| 4(c)(iii) | 88  | 1                                   |
| 4(c)(iv)  | FALSE   | 1                                   |
| 4(d)(i)   | Temp2 ← 22  |                                     |
| 4(d)(ii)  | IntPtr1 ← @Temp1  | 1                                   |
| 4(d)(iii) | IntPtr1^ ← Temp2  | 1                                   |

[ Question 5 Mark Scheme ]

|           |   |   |
|-----------|---|---|
| 5(a)(i)   | DECLARE NewFriend : MyContactDetail   | 1   |
| 5(a)(ii)  | NewFriend.HouseNumber ← 129   | 1   |
| 5(b)      | <p>Declaration of Name, Area, HouseNumber<br/>                     Inclusion of three correct values for Area<br/>                     Inclusion of correct range for HouseNumber</p> <p>For example:</p> <pre> TYPE MyContactDetail   DECLARE Name      : STRING   DECLARE Area      : (uptown, downtown, midtown)   DECLARE HouseNumber : 1..499 ENDTYPE                     </pre> | <p>1<br/>1<br/>1<br/>1<br/>1 &amp; 1</p> <p>3</p> |
| 5(c)(i)   | 4402  | 1   |
| 5(c)(ii)  | 33  | 1   |
| 5(c)(iii) | 3427  | 1   |
| 5(c)(iv)  | TRUE  | 1   |
| 5(d)(i)   | IPointer ← @MyInt2  | 1   |
| 5(d)(ii)  | MyInt1 ← 33   | 1   |
| 5(d)(iii) | IPointer^ ← MyInt2  | 1   |

[ Question 6 Mark Scheme ]

| 6(a)                     | <table border="0" style="width: 100%; text-align: center;"> <thead> <tr> <th style="width: 50%;">File organisation method</th> <th style="width: 50%;">File access method</th> </tr> </thead> <tbody> <tr> <td style="border: 1px solid black; padding: 5px;">random</td> <td style="border: 1px solid black; padding: 5px;">sequential</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">serial</td> <td style="border: 1px solid black; padding: 5px;">direct</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">sequential</td> <td style="border: 1px solid black; padding: 5px;"></td> </tr> </tbody> </table> <p>1 mark for random correct<br/>                 1 mark for serial correct<br/>                 2 marks for sequential correct (1 per correct line)</p> | File organisation method     | File access method | random | sequential | serial | direct | sequential |  | <b>4</b> |
|--------------------------|---|------------------------------|--------------------|--------|------------|--------|--------|------------|--|----------|
| File organisation method | File access method  |                              |                    |        |            |        |        |            |  |          |
| random                   | sequential  |                              |                    |        |            |        |        |            |  |          |
| serial                   | direct  |                              |                    |        |            |        |        |            |  |          |
| sequential               |   |                              |                    |        |            |        |        |            |  |          |
| 6(b)(i)                  | File A:<br>Serial<br>Meter readings are submitted over time // added to the end of file<br>Stored chronologically   | 1<br>1<br>1<br><b>3</b>      |                    |        |            |        |        |            |  |          |
| 6(b)(ii)                 | File B:<br>Sequential<br>Any two points from:<br>Each customer has a unique account number<br>Sorted on Account number<br>High hit rate // Suitable for batch processing monthly statements   | 1<br>1<br>1<br>1<br><b>3</b> |                    |        |            |        |        |            |  |          |
| 6(b)(iii)                | File C:<br>Random<br>Login without waiting // Random organisation allows fastest direct access to required record<br>Low hit rate // Suitable for access to individual records  | 1<br>1<br>1<br><b>3</b>      |                    |        |            |        |        |            |  |          |

[ Question 7 Mark Scheme ]

|      |  |   |
|------|--|---|
| 7(a) | <p>1 mark per bullet max 2</p> <ul style="list-style-type: none"> <li>• 0101 = 5 (conversion of exponent to denary)</li> <li>• 1.01110011010 = -0.10001100110 (conversion of mantissa to negative binary number)</li> <li>• -10001.100110 (binary value)// -0.54980469 (denary value of mantissa)<br/>// -563/1024</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• Use exponent to denormalise mantissa</li> </ul> <p>1 mark for correct answer</p> <ul style="list-style-type: none"> <li>• = -17 19/32 // -17.59375</li> </ul> | 3 |
| 7(b) | <p>1 mark per bullet</p> <ul style="list-style-type: none"> <li>• 5.25 = 101.01 (conversion to binary)</li> <li>• = 0.10101 × 2<sup>3</sup> (evidence of shifting binary point appropriately)</li> <li>• 010101000000 0011 (stored as mantissa and exponent)</li> </ul>  | 3 |
| 7(c) | <p>1 mark per bullet</p> <ul style="list-style-type: none"> <li>• (Size of mantissa decreased means that) precision is reduced</li> <li>• (Size of exponent is increased means that) range is increased</li> </ul>   | 2 |

[ Question 8 Mark Scheme ]

|      |   |   |
|------|---|---|
| 8(a) | <p><u>single data type</u> that does not involve a reference to another type/usually built in to a programming language</p>   | 1 |
| 8(b) | <p>1 mark for data type, 1 for definition, max 4, 2 data types</p> <ul style="list-style-type: none"> <li>• Integer</li> <li>• Stores a whole number</li> <li>• Boolean</li> <li>• Stores true or false/1 or 0/on or off</li> <li>• Real/Single/Double/Float/Decimal</li> <li>• Stores decimal numbers</li> <li>• String</li> <li>• Stores zero or more characters</li> <li>• Char</li> <li>• Stores a single character</li> <li>• Pointer</li> <li>• Whole number used to reference a memory location</li> </ul> | 4 |
| 8(c) | <p>data type constructed from other data types</p>  | 1 |

|      |  |   |
|------|--|---|
| 8(d) | <p><b>1 mark for naming, 1 for description, max 4, 2 data types</b></p> <ul style="list-style-type: none"> <li>• Record</li> <li>• collection of related items which may have different data types</li> <li>• Array</li> <li>• (Indexed) collection of items with the same data type</li> <li>• List</li> <li>• (Indexed) collection of items that can have different data types</li> <li>• Set</li> <li>• stores a finite number of different values that have no order // supports mathematical operations</li> <li>• Class/Structure</li> <li>• Gives the properties and methods for an object</li> </ul> | 4 |
|------|--|---|

[ Question 9 Mark Scheme ]

|          |  |   |
|----------|--|---|
| 9(a)     | CollegeStudent.StudentID ← 6539  | 1 |
| 9(b)(i)  | <p><b>1 mark per bullet</b></p> <ul style="list-style-type: none"> <li>• StudentCourse: ARRAY[1:6] OF</li> <li>• All valid string options , for example:<br/>                     DECLARE StudentCourse: ARRAY[1:6] OF ("Computer Science", "Engineering", "Science", "Maths", "Physics", "Chemistry", "Music", "Drama", "English Language")</li> </ul>  | 2 |
| 9(b)(ii) | DECLARE StudentID: 1 .. 8000   | 1 |
| 9(c)(i)  | <p><b>1 mark per bullet</b></p> <ul style="list-style-type: none"> <li>• Type declaration TYPE and ENDTYPE</li> <li>• Declaring Code as STRING</li> <li>• Declaring Mark as ARRAY [1:6] OF INTEGER</li> <li>• AverageMark as REAL</li> </ul> <p>For example:<br/>                     TYPE StudentAssessment<br/>                       DECLARE Code : STRING<br/>                       DECLARE Mark : ARRAY[1:6] OF INTEGER<br/>                       DECLARE AverageMark : REAL<br/>                     ENDTYPE</p> | 4 |
| 9(c)(ii) | <p><b>Any 3 from, 1 mark per bullet</b></p> <ul style="list-style-type: none"> <li>• StudentID/key field is hashed to produce home location</li> <li>• If home location is free, insert record/data</li> <li>• Else use overflow method to find free location to store record / data</li> <li>• If no free location available then file is full and record/data cannot be stored</li> </ul>  | 3 |

[ Question 10 Mark Scheme ]

|       |   |   |
|-------|---|---|
| 10(a) | <p>1 mark per bullet</p> <ul style="list-style-type: none"> <li>• 21.75 = 010101.11 (conversion to correct binary)</li> <li>• <math>0.1010111 \times 2^5</math> (evidence of shifting binary point appropriately)</li> <li>• 01010111 0101 (stored as mantissa and exponent)</li> </ul>   | 3 |
| 10(b) | <p>1 mark per bullet, max 2</p> <ul style="list-style-type: none"> <li>• 1110 = -2 (conversion of exponent to denary)</li> <li>• 1.011000 = -0.101 (conversion of mantissa to negative binary number) // -0.625 (denary value of mantissa) // -5/8</li> <li>• -0.00101 (binary value) //</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• Use exponent to denormalise mantissa</li> </ul> <p>1 mark for correct answer</p> <ul style="list-style-type: none"> <li>• -5/32 // -0.15625</li> </ul> | 3 |

[ Question 11 Mark Scheme ]

- (a) (i) 00101000 00000011  
 =  $0.0101 \times 2^{\uparrow 3}$  [1]  
 = 10.1 [1]  
 = 2.5 [1]
- (ii) For a positive number (mantissa starts with a zero)  
 bit after binary point (second bit from left) should be a one [1]  
 [1]
- (iii) 00101000 00000011  
 = 01010000 00000010 [1+1]
- (b) (i) 01111111 01111111 [1+1]
- (ii) 01000000 10000000 [1+1]
- (iii) number will become too large to represent [1]  
 which will result in overflow [1]
- (c) Any point 1 mark
- 0.1 cannot be represented exactly in binary  
 0.1 represented here by a value just less than 0.1  
 the loop keeps adding this approximate value to counter  
 until all accumulated small differences become significant enough to be seen

[max 3]



[ Question 12 Mark Scheme ]

- (a) (i) 01101000 0011  
 =  $0.1101$  (or  $1/2 + 1/4 + 1/16$ )  $\times 2^3$  [1+1]  
 = 110.1  
 = 6.5 [1]
- (ii) +3.5  
 = 11.1 [1]  
 =  $0.111 \times 2^4$  (or indication of moving binary point correctly) [1]  
 = 01110000 0010 [1]
- (iii) 01110000 Allow f.t. from (ii)  
 10001111 One's complement on mantissa [1]  
 10001111 +1 Two's complement [1]  
 = 10010000 0010 [1]
- (b) (i) Precision/accuracy of numbers represented will increase [1]  
 (ii) Range of numbers represented will increase [1]
- (c) Any point, 1 mark (max. 3)
- 0.1/0.2 cannot be represented exactly in binary // rounding error [1]  
 0.1 represented by a value just greater than 0.1 // 0.2 represented by a value just greater than 0.2 [1]  
 adding two representations together adds the two differences [1]  
 summed difference significant enough to be seen [1]  
 [max. 3]

[Total: 14]

[ Question 13 Mark Scheme ]

- (a) +2.5  
= 010100000000 0010 [3]  
Give full marks for correct answer (normalised or not normalised)
- = 10.1 [1]  
=  $0.101 \times 2^2$  // evidence of shifting binary point appropriately [1]
- [Max 3]

- (b) -2.5  
101100000000 0010  
Give full marks for correct answer
- One's complement of 12-bit mantissa of +2.5 101011111111 – allow f.t. [1]  
+1 to get two's complement 101100000000 [1]
- [Max 3]

- (c) 3 [3]  
Give full marks for correct answer
- =  $0.011 \times 2^3$  // exponent is 3 [1]  
= 11.0 //  $(1/4 + 1/8) \times 8$  [1]
- [Max 3]

- (d) (i) Not normalised [1]
- (ii) First two bits should be different for normalised number [1]  
// because the number starts with 00

- (e) reduced accuracy [1]  
increased range [1]

[ Question 14 Mark Scheme ]

(a) +3.5  
 01110000 00000010 [3]  
 Give full marks for correct answer (normalised or unnormalised)  
 = 11.1 [1]  
 =  $0.111 \times 2^2$  // evidence of shifting binary point appropriately [1]  
**[Max 3]**

(b) -3.5  
 10010000 00000010 [3]  
 3 marks for correct answer  
 One's complement of 8-bit mantissa for +3.5 10001111 – allow f.t. [1]  
 +1 to get two's complement 10010000 [1]  
**[Max 3]**

(c) 14 [3]  
 3 marks for correct answer  
 =  $0.111 \times 2^4$  // exponent is 4 [1]  
 =  $1110.0 / (1/2 + 1/4 + 1/8) * 16$  [1]  
**[Max 3]**

(d) (i) Normalised [1]  
 (ii) Leftmost two bits are different for normalised representation [1]  
 // because the pattern starts with 01 [1]

(e)  

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

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

 [1]  
 [1]

[ Question 15 Mark Scheme ]

|    |   |   |
|----|---|---|
| 15 | (a) Record                              | 1 |
|    | (b) Enumerated                          | 1 |
|    | (c) DECLARE Bestseller : Book           | 1 |
|    | (d) Bestseller.Author ← "John Williams" | 1 |

[ Question 16 Mark Scheme ]

|            |  |          |
|------------|--|----------|
| 16(a)(i)   | <p>1 mark per bullet point:</p> <ul style="list-style-type: none"> <li>• Correct value for exponent identified e.g. <math>(0.0111 \times 2^7)</math></li> <li>• Used to give correct value e.g. <math>111\ 000 (1/4 + 1/8 + 1/16) \times 128, 0.4375</math></li> <li>• Correct answer i.e. 56</li> </ul>   | <b>3</b> |
| 16(a)(ii)  | <p>The two most significant bits are 0 in the mantissa<br/>// In mantissa, 2nd bit is not the inverse of 1st bit</p>   | <b>1</b> |
| 16(a)(iii) | <p>1 mark per bullet point:</p> <ul style="list-style-type: none"> <li>• Mantissa = 01110000</li> <li>• Exponent = 0110</li> </ul>   | <b>2</b> |
| 16(b)(i)   | <p>1 mark per bullet point:</p> <ul style="list-style-type: none"> <li>• Mantissa = 01111111</li> <li>• Exponent = 0111</li> </ul>   | <b>2</b> |
| 16(b)(ii)  | <p>1 mark per bullet point:</p> <ul style="list-style-type: none"> <li>• Mantissa = 01000000</li> <li>• Exponent = 1000</li> </ul>   | <b>2</b> |
| 16(c)(i)   | Precision of numbers represented will increase   | <b>1</b> |
| 16(c)(ii)  | Range of numbers represented will increase   | <b>1</b> |
| 16(d)      | <p>1 mark per bullet point to max 3:</p> <ul style="list-style-type: none"> <li>• 0.1/0.2/0.3 cannot be represented exactly in binary / rounding errors</li> <li>• adding two or more inaccurate representations together <u>increases</u> the probability of <u>inaccuracy</u></li> <li>• giving an answer where the difference is significant enough to be seen</li> </ul> | <b>3</b> |

[ Question 17 Mark Scheme ]

|            |   |   |
|------------|---|---|
| 17(a)(i)   | <p>1 mark per bullet point:</p> <ul style="list-style-type: none"> <li>• Correct value for exponent identified e.g. <math>(0.010101 \times 2^5)</math></li> <li>• Used to give correct value e.g. <math>1010.1</math> or <math>21/64 \times 32</math></li> <li>• Correct answer i.e. <math>10.5</math> // <math>10\frac{1}{2}</math></li> </ul> | 3 |
| 17(a)(ii)  | <p>1 mark per bullet point:</p> <ul style="list-style-type: none"> <li>• Correct binary value i.e. <math>111.1</math></li> <li>• Value for exponent identified e.g. <math>(0.1111 \times 2^3)</math></li> <li>• Correct answer i.e. <math>01111000\ 00000011</math></li> </ul>  | 3 |
| 17(a)(iii) | <p>1 mark per bullet point:</p> <ul style="list-style-type: none"> <li>• Any working method for conversion</li> <li>• Applied accurately</li> <li>• Correct answer i.e. <math>10001000\ 00000011</math></li> </ul>  | 3 |
| 17(b)(i)   | <u>Largest</u> (positive) number (in this format)   | 1 |
| 17(b)(ii)  | Overflow // too large to represent // would become negative   | 1 |

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