Вариант 12

A = 0,632  
B = 8,287

#### 1.1 Формат Ф1 A = (0,632)10 = (0,A1CAC1)16 = (0,A1CAC1)16 · 160

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

B = (8,287)10 = (8,4978D5)16 = (0,84978D5)16 · 161

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| XA | = | – | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| XB | = | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| (XA-XB)доп. | = |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

(XA-XB) = -1; XC = XB = 1

#### а) A>0, B>0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MA | = | + |  | . | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| MB | = |  | . | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| MC | = |  |  | . | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |

Результат сложения нормализован.  
  
MC = . 1 0 0 0 1 1 1 0 1 0 1 0

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

С\* = МС · 16Рс = (0,8EA)16 · 161 = 8,91406.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 8,919 – 8,91406 = 0,00494

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,00494 |  | · 100% = 0,05536% |
| 8,919 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;

#### б) A>0, B<0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MA | = | – |  | . | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| MB | = |  | . | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| MC | = |  |  | . | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |

Результат вычитания нормализован и представлен в дополнительном коде.  
  
MC = . 1 0 0 0 0 1 0 1 1 0 0 0

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

С\* = МС · 16Рс = (-0,7A8)16 · 161 = -7,65625.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -7,655 – (-7,65625) = 0,00125

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,00125 |  | · 100% = 0,01633% |
| -7,655 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;

#### с) A<0, B>0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MB | = | – |  | . | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| MA | = |  | . | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| MC | = |  |  | . | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |

Результат вычитания нормализован.  
  
MC = . 0 1 1 1 1 0 1 0 1 0 0 0

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

С\* = МС · 16Рс = (0,7A8)16 · 161 = 7,65625.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 7,655 – 7,65625 = -0,00125

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,00125 |  | · 100% = 0,01633% |
| 7,655 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;

#### 2.1 Формат Ф2 A = (0,632)10 = (0,A1CAC1)16 = (0,1010000111001011)2 · 20

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

B = (8,287)10 = (8,4978D5)16 = (0,10000100100101111001)2 · 24

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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| XA | = | – | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| XB | = | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| (XA-XB)доп. | = |  | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |

(XA-XB) = -4; XC = XB = 4

#### а) A>0, B>0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MA | = | + |  | . | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| MB | = |  | . | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| MC | = |  |  | . | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |

Результат сложения нормализован.  
  
MC = . 1 0 0 0 1 1 1 0 1 0 1 0

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

С\* = МС · 2Рс = (0,10001110101)2 · 24 = 8,91406.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 8,919 – 8,91406 = 0,00494

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,00494 |  | · 100% = 0,05536% |
| 8,919 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;

#### б) A>0, B<0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MA | = | – |  | . | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| MB | = |  | . | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| MC | = |  |  | . | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |

Результат вычитания денормализован вправо и представлен в дополнительном коде.  
  
MC = . 0 0 0 0 1 0 1 1 0 0 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 1 (ХC = ХC - 1 = 3).

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

С\* = МС · 2Рс = (-0,11110101)2 · 23 = -7,65625.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = -7,655 – (-7,65625) = 0,00125

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | 0,00125 |  | · 100% = 0,01633% |
| -7,655 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;
* потерей значащих разрядов мантиссы результата при его нормализации;

#### с) A<0, B>0:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MB | = | – |  | . | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| MA | = |  | . | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| MC | = |  |  | . | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |

Результат вычитания денормализован вправо.  
  
MC = . 1 1 1 1 0 1 0 1 0 0 0 0  
  
Т.к. выполнен сдвиг мантиссы влево, характеристику результата нужно уменьшить на 1 (ХC = ХC - 1 = 3).

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

С\* = МС · 2Рс = (0,11110101)2 · 23 = 7,65625.  
  
Определим абсолютную и относительную погрешности результата:  
ΔС = 7,655 – 7,65625 = -0,00125

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| δС = |  | -0,00125 |  | · 100% = 0,01633% |
| 7,655 |

Погрешность полученного результата объясняется следующими факторами:

* неточным представлением операндов;
* потерей значащих разрядов мантиссы одного из операндов при уравнивании порядков;
* потерей значащих разрядов мантиссы результата при его нормализации;

В формате Ф2 результаты получились точнее из-за того, что операнды представлены точнее и при нормализации результата сдвиг производился на один двоичный разряд, а не на четыре.