Multiply 9 x 12

9 → 1001

12 → 1100

here,

multiplier (Q) = 1100

multipicand(B) = 1001

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SC | E | A | Q | operation |
| 4 | 0 | 0000 | 1100 | init |
| 3 | 0 | 0000 | 0110 | Shr EAQ , dcr SC |
| 2 | 0 | 0000 | 0011 | Shr EAQ, dcr SC |
| 0 | 1001 | 0011 | EA ← A+B |
| 1 | 0 | 0100 | 1001 | Shr EAQ , dcr SC |
| 0 | 0 | 1101 | 1001 | EA ← A+B |
| 0 | 0110 | 1100 | Shr EAQ , dcr SC |

Product = 01101100 → 108

Multiply 29 x 42

29 → 011101

42 → 101010

here,

multiplicand(B) = 011101

multiplier(Q) = 101010

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SC | E | A | Q | operation |
| 6 | 0 | 000000 | 101010 | init |
| 5 | 0 | 000000 | 010101 | Shr EAQ , dcr SC |
|  | 0 | 011101 | 010101 | EA ← A+B |
| 4 | 0 | 001110 | 101010 | Shr EAQ , dcr SC |
| 3 | 0 | 000111 | 010101 | Shr EAQ , dcr SC |
|  | 0 | 100100 | 010101 | EA ← A+B |
| 2 | 0 | 010010 | 001010 | Shr EAQ , dcr SC |
| 1 | 0 | 001001 | 000101 | Shr EAQ , dcr SC |
|  | 0 | 100110 | 000101 | EA ← A+B |
| 0 | 0 | 010011 | 000010 | Shr EAQ , dcr SC |

Product = 010011000010 → 1218

Multiply -21 x 7 with booth’s multiplication

here

multiplicand(B) = 010101 → 101011

multplier(Q) = 00111

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SC | A | Q | Qn+1 | operation |
| 6 | 000000 | 000111 | 0 | init |
| 6 | 010101 | 000111 | 0 | Qn Qn+1 = 10  A← A+B’+1 |
| 5 | 001010 | 100011 | 1 | Ashr AQQn+1 scr SC |
| 4 | 000101 | 010001 | 1 | Ashr AQQn+1 scr SC |
| 3 | 000010 | 101000 | 1 | Ashr AQQn+1 scr SC |
|  | 101101 | 101000 | 1 | Qn Qn+1 = 01  A← A+B |
| 2 | 110110 | 110100 | 0 | Ashr AQQn+1 scr SC |
| 1 | 111011 | 011010 | 0 | Ashr AQQn+1 scr SC |
| 0 | 111101 | 101101 | 0 | Ashr AQQn+1 scr SC |

Product = 111101101101 (most significant bit is 1 so complimenting the result and add -ve sign)

= -000010010011 → -147

Questions:

using 1st method :

2 x 9 13 x 7 16 x 17

using 2nd method:

-13 X 6 -8 x -7 21 x -9

1. 2 x 9

here,

multiplicand(B) = 0010

multiplier(Q) = 1001

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SC | E | A | Q | operations |
| 4 | 0 | 0000 | 1001 | Init |
|  | 0 | 0010 | 1001 | EA ← A+B |
| 3 | 0 | 0001 | 0100 | Shr EAQ , dcr SC |
| 2 | 0 | 0000 | 1010 | Shr EAQ , dcr SC |
| 1 | 0 | 0000 | 0101 | Shr EAQ , dcr SC |
| 1 | 0 | 0010 | 0101 | EA ← A+B |
| 0 | 0 | 0001 | 0010 | Shr EAQ , dcr SC |

Product = 00010010 → 18

2. 13 x 7

here,

multiplicand(B) = 1101

multiplier(Q) = 0111

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SC | E | A | Q | operations |
| 4 | 0 | 0000 | 0111 | Innit |
|  | 0 | 1101 | 0111 | EA ← A+B |
| 3 | 0 | 0110 | 1011 | Shr EAQ , dcr SC |
|  | 1 | 0011 | 1011 | EA ← A+B |
| 2 | 0 | 1001 | 1101 | Shr EAQ , dcr SC |
|  | 1 | 0110 | 1101 | EA ← A+B |
| 1 | 0 | 1011 | 0110 | Shr EAQ , dcr SC |
| 0 | 0 | 0101 | 1011 | Shr EAQ , dcr SC |

Product = 01011011 → 91

3. 16 x 17

here,

multiplicand(B) = 10000

multiplier(Q) = 10001

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SC | E | A | Q | operatiom |
| 5 | 0 | 00000 | 10001 | Innit |
|  | 0 | 10000 | 10001 | EA ← A+B |
| 4 | 0 | 01000 | 01000 | Shr EAQ , dcr SC |
| 3 | 0 | 00100 | 00100 | Shr EAQ , dcr SC |
| 2 | 0 | 00010 | 00010 | Shr EAQ , dcr SC |
| 1 | 0 | 00001 | 00001 | Shr EAQ , dcr SC |
|  | 0 | 10001 | 00001 | EA ← A+B |
| 0 | 0 | 01000 | 10000 | Shr EAQ , dcr SC |

Product = 0100010000 → 272

4. -13 x 6

here,

multiplicand(B) = 01101 → 10011

multiplier(Q) = 00110

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SC | A | Q | Qn+1 | operation |
| 5 | 00000 | 00110 | 0 | Innit |
| 4 | 00000 | 00011 | 0 | Ashr AQQn+1 dcr SC |
|  | 01101 | 00011 | 0 | A ← A+B’+1 |
| 3 | 00110 | 10001 | 1 | Ashr AQQn+1 dcr SC |
| 2 | 00011 | 01000 | 1 | Ashr AQQn+1 dcr SC |
|  | 10110 | 01000 | 1 | A ← A+B |
| 1 | 11011 | 00100 | 0 | Ashr AQQn+1 dcr SC |
| 0 | 11101 | 10010 | 0 | Ashr AQQn+1 dcr SC |

Product = 1110110010

= -0001001110 → -78

5. -8 x -7

here,

multiplicand(B) = 01000 → 11000

multiplier(Q) = 00111 → 11001

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SC | A | Q | Qn+1 | operation |
| 5 | 00000 | 11001 | 0 | Innit |
|  | 01000 | 11001 | 0 | A ← A+B’+1 |
| 4 | 00100 | 01100 | 1 | Ashr AQQn+1 dcr SC |
|  | 11100 | 01100 | 1 | A ← A+B |
| 3 | 11110 | 00110 | 0 | Ashr AQQn+1 dcr SC |
| 2 | 11111 | 00011 | 0 | Ashr AQQn+1 dcr SC |
|  | 00111 | 00011 | 0 | A ← A+B’+1 |
| 1 | 00011 | 10001 | 1 | Ashr AQQn+1 dcr SC |
| 0 | 00001 | 11000 | 1 | Ashr AQQn+1 dcr SC |

Product = 0000111000 → 56

6. 21 x -9

here,

multiplicand(B) = 10101 →

multiplier(Q) = 01001→ 10111

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SC | A | Q | Qn+1 | operation |
| 5 | 00000 | 10111 | 0 | Innit |
|  | 01011 | 10111 | 0 | A ← A+B’+1 |
| 4 | 00101 | 11011 | 1 | Ashr AQQn+1 dcr SC |
| 3 | 00010 | 11101 | 1 | Ashr AQQn+1 dcr SC |
| 2 | 00001 | 01110 | 1 | Ashr AQQn+1 dcr SC |
|  | 10110 | 01110 | 1 | A ← A+B |
| 1 | 11011 | 00111 | 0 | Ashr AQQn+1 dcr SC |
|  | 00110 | 00111 | 0 | A ← A+B’+1 |
| 0 | 00011 | 00011 |  | Ashr AQQn+1 dcr SC |

Product = 0001100011