Q1 (a)

110011002 = 1 x 27 + 1 x 26 + 1 x 23 + 1 x 22

= 27 + 26 + 23 + 22

= 20410

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q1 (b)

110011003 = 1 x 37 + 1 x 36 + 1 x 33 + 1 x 32

= 37 + 36 + 33 + 32

= 295210

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q1(c)

110011004 = 1 x 47 + 1 x 46 + 1 x 43 + 1 x 42

= 47 + 46 + 43 + 42

= 2056010

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q1 (d)

110011008 = 1 x 87 + 1 x 86 + 1 x 83 + 1 x 82

= 87 + 86 + 83 + 82

= 235987210

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q2 (a)

1000010 /2 = 500010 R=0

500010 /2 = 250010 R=0

250010 /2 = 125010 R=0

125010 /2 = 62510 R=0

62510  /2 = 31210 R=1

31210  /2 = 15610 R=0

15610  /2 = 7810 R=0

7810  /2 = 3910 R=0

3910  /2 = 1910 R=1

1910  /2 = 910 R=1

910  /2 = 410 R=1

410  /2 = 210 R=0

210  /2 = 110 R=0

110  /2 = 010 R=1

Therefore, = 100111000100002

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q2 (b)

100000010 /2 = 50000010 R=0

50000010 /2 = 25000010 R=0

25000010 /2 = 12500010 R=0

12500010 /2 = 6250010 R=0

6250010 /2 = 3125010 R=0

3125010 /2 = 1562510 R=0

1562510 /2 = 781210 R=1

781210 /2 = 390610 R=0

390610 /2 = 195310 R=0

195310 /2 = 97610 R=1

97610  /2 = 48810 R=0

48810  /2 = 24410 R=0

24410  /2 = 12210 R=0

12210  /2 = 6110 R=0

6110  /2 = 3010 R=1

3010  /2 = 1510 R=0

1510  /2 = 710 R=1

710  /2 = 310 R=1

310  /2 = 110 R=1

110  /2 = 010 R=1

Therefore, = 111101000010010000002

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q3 (a)

FEDC.BA16 = 1111 1110 1101 1100.1011 1010

= 001 111 111 011 011 100.101 110 100

= 177334.564

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q3 (b)

ABCD.EF16 = 1010 1011 1100 1101. 1110 1111

= 001 010 101 111 001 101. 111 011 110

= 125715.736

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q4 (a)

12345.678 = 001 010 011 100 101.110 111

= 0001 0100 1110 0101.1101 1100

= 14E5.DC

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q4 (b)

76543.218 = 111 110 101 100 011.010 001

= 0111 1101 0110 0011.0100 0100

= 7D63.44

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q5 (a)

25r = 1710

2 x r1 + 5 x r0 = 1710

2r + 5 = 17

2r = 17 - 5

r = 12/ 2

r = 6

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q5 (b)

25s = 2310

2 x s1 + 5 x s0 = 2310

2s + 5 = 23

2s = 23 - 5

s = 18/ 2

s = 9

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q5(c)

1010t = 6810

1 x t3 + 1 x t1 = 6810

t3 + t = 68

t3 = 68 – t

t = 4

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q5 (d)

1001u = 12610

1 x u3 + 1 x u0 = 12610

u3 + 1 = 126

u3 = 126 - 1

u3 = 125

u = 5

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q6 (a)

-1234510

1234510 /2 = 617210 R=1

617210 /2 = 308610 R=0

308610 /2 = 154310 R=0

154310 /2 = 77110 R=1

77110  /2 = 38510 R=1

38510  /2 = 19210 R=1

19210  /2 = 9610 R=0

9610  /2 = 4810 R=0

4810  /2 = 2410 R=0

2410  /2 = 1210 R=0

1210  /2 = 610 R=0

610  /2 = 310 R=0

310  /2 = 110 R=1

110  /2 = 010 R=1

Therefore, 1234510 = 0110000001110012

100111111000110

+

000000000000001

100111111000111

Therefore, -1234510 = 1001111110001112

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q6 (b)

-987610

987610 /2 = 493810 R=0

493810 /2 = 246910 R=0

246910 /2 = 123410 R=1

123410 /2 = 61710 R=0

61710  /2 = 30810 R=1

30810  /2 = 15410 R=0

15410  /2 = 7710 R=0

7710  /2 = 3810 R=1

3810  /2 = 1910 R=0

1910  /2 = 910 R=1

910  /2 = 410 R=1

410  /2 = 210 R=0

210  /2 = 110 R=0

110  /2 = 010 R=1

Therefore, 987610 = 0100110100101002

101100101101011

+

000000000000001

101100101101100

Therefore, -987610 = 1011001011011002

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q7 (a)

-12.3456710

1210 /2 = 610 R=0

610 /2 = 310 R=0

310 /2 = 110 R=1

110 /2 = 010 R=1

Therefore, 1210 = 1100

0.3456710 x 2 = 0.6913410 WP=0

0.6913410 x 2 = 1.3826810 WP=1

0.3826810 x 2 = 0.7653610 WP=0

0.7653610 x 2 = 1.5307210 WP=1

0.5307210 x 2 = 1.0614410 WP=1

0.0614410 x 2 = 0.1228810 WP=0

0.1228810 x 2 = 0.2457610 WP=0

0.2457610 x 2 = 0.4915210 WP=0

0.4915210 x 2 = 0.9830410 WP=0

0.9830410 x 2 = 1.9660810 WP=1

Therefore, 0.3456710 is approximately 0.01011000012

Therefore, 12.3456710 is approximately 01100.01011000012

10011.1010011110

+

00000.0000000001

00011.1010011111

Therefore, -12.34567 = 10011.1010011111

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Q7 (b)

-98.7654310

9810 /2 = 4910 R=0

4910 /2 = 2410 R=1

2410 /2 = 1210 R=0

1210 /2 = 610 R=0

610 /2 = 310 R=0

310 /2 = 110 R=1

110 /2 = 010 R=1

Therefore, 9810 = 1100010

0.7654310 x 2 = 1.5308610 WP=1

0.5308610 x 2 = 1.0617210 WP=1

0.0617210 x 2 = 0.1234410 WP=0

0.1234410 x 2 = 0.2468810 WP=0

0.2468810 x 2 = 0.4937610 WP=0

0.4937610 x 2 = 0.9875210 WP=0

0.9875210 x 2 = 1.9750410 WP=1

0.9750410 x 2 = 1.9500810 WP=1

0.9500810 x 2 = 1.9001610 WP=1

0.9001610 x 2 = 1.8003210 WP=1

Therefore, 0.7654310 is approximately .11000011112

Therefore, 98.7654310 = 01100010.11000011112

10011101.0011110000

+

00000000.0000000001

10011101.0011110001

Therefore, -98.7654310 = 10011101.0011110001

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q8 (a)

1010 10102 = 1 x 27 + 1 x 25 + 1 x 23 + 1 x 21

= 27 + 25 + 23 + 21

= 128 + 32 + 8 + 2

= 17010

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Q8 (b)

1010 10102

**1**010 10102 the bold 1 is the sign of the decimal which is -1

010 10102 = 1 x 25 + 1 x 23 + 1 x 21

= 25 + 23 + 21

= 32 + 8 + 2

= 4210

Therefore, 1010 10102 = -4210

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q8 (c)

1010 10102

**1**010 10102 the bold 1 is the sign of the decimal which is -1

1010 10102 2’s complement =

0101 0101

+

0000 0001

0101 0110

0101 01102 = 1 x 26 + 1 x 24 + 1 x 22 + 1 x 21

= 26 + 24 + 22 + 2

= 64 + 16 + 4 + 2

= 8610

Therefore, 1010 10102 = -8610

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q9 (a)

1010.10102

10102 = 1 x 23 + 1 x 21

= 23 + 21

= 8 + 2

= 1010

0.10102 = 1 / 23 + 1 / 21

= 2-3 + 2-1

= 5/810

= 0.62510

Therefore, 1010.10102 = 10.62510

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q9 (b)

1010.10102

**1**010.10102 the bold 1 is the sign of the decimal which is -1

0102 = 1 x 21

= 21

= 210

0.10102 = 1 / 23 + 1 / 21

= 1/23 + 1/21

= 1/8 + 1/2

= 5/810

= 0.62510

Therefore, 1010.10102 = -2.62510

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q9 (c)

1010.10102

**1**010.10102 the bold 1 is the sign of the decimal which is -1

10102 2’s complement =

0101.0101

+

0000.0001

0101.0110

01012 = 1 x 22 + 1 x 20

= 22 + 1

= 4 + 1

= 510

0.01102 = 1 / 22 + 1 / 23

= 1/22 + 1/23

= 1/4 + 1/8

= 3/810

= 0.37510

Therefore, 0101.01102 = -5.37510

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q10 (a)

1010 1010 + 1111 1111 =

1010 1010

+

1111 1111

1010 1001 + 1 CARRY OUT

Therefore, no overflow because the sign of the sum matches sign of operands. The carry out is ignored.

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q10 (b)

0101 1111 + 0111 0101 =

0101 1111

+

0111 0101

1101 0100

Therefore, overflow because the sign of the sum differs from sign of operands.

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q10 (c)

1111 0101 + 0101 0101 =

1111 0101

+

0101 0101

0100 1010 + CARRY OUT

Therefore, overflow is not possible since the signs of the operands differ. The carry out is ignored.

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q11 (a)

-1234.87510

123410 /2 = 67110 R=0

67110 /2 = 30810 R=1

30810 /2 = 15410 R=0

15410 /2 = 7710 R=0

7710 /2 = 3810 R=1

3810 /2 = 1910 R=0

1910 /2 = 910 R=1

910 /2 = 410 R=1

410 /2 = 210 R=0

210 /2 = 110 R=0

110 /2 = 010 R=1

Therefore, 123410 = 10011010010

0.87510 x 2 = 1.7510 WP=1

0.7510 x 2 = 1.510 WP=1

0.510 x 2 = 1.010 WP=1

Therefore, 0.875 = 0.111

Therefore, 1234.875 = 10011010010.111

= 1.0011010010111 x 210

Therefore, the exponent is 127 + 10 = 13710 = 100010012

Therefore, the 32-bit IEEE of -1234.875 is

1 10001001 0011010010111 =

1100 0100 1001 1010 0101 1100 0000 0000

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Q11 (b)

+7654.310

765410 /2 = 382710 R=0

382710 /2 = 191310 R=1

191310 /2 = 95610 R=1

95610 /2 = 47810 R=0

47810 /2 = 23910 R=0

23910 /2 = 11910 R=1

11910 /2 = 5910 R=1

5910 /2 = 2910 R=1

2910 /2 = 1410 R=1

1410 /2 = 710 R=0

710 /2 = 310 R=1

310 /2 = 110 R=1

110 /2 = 010 R=1

Therefore, 765410 = 11101111001102

0.310 x 2 = 0.610 WP=0

0.610 x 2 = 1.210 WP=**1**

0.210 x 2 = 0.410 WP=**0**

0.410 x 2 = 0.810 WP=**0**

0.810 x 2 = 1.610 WP=**1**

**1001** is a repeating pattern.

Therefore, 0.3 = 0.010011001

Therefore, 7654.3 = 1110111100110.0100110012

= 1.110111100110010011001x 212

Therefore, the exponent is 127 + 12 = 13910 = 100010112

Therefore, the 32-bit IEEE of -1234.875 is

0 10001011110111100110010011001 =

0100 0101 1110 1111 0011 0010 0110 0110

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q12 (a)

FEDCBA9816 =

1111 1110 1101 1100 1011 1010 1001 1000

1 11111101 10111001011101010011000

Sign = 1 = negative

Exponent = 11111101

11111101 = 1x27 + 1x26 + 1x25 + 1x24 + 1x23 + 1x22 + 1x20

= 27 + 26 + 25 + 24 + 23 + 22 + 1

= 128 + 64 + 32 + 16 + 8 + 4 + 1

= 253

Exponent = 253 – 127 = 126

Therefore, the binary # = 1.10111001011101010011000 x 2126

12 = 20

= 1

0.101110010111010100110002

= 2-1+2-3+2-4+2-5+2-8+2-10+2-11+2-12+2-14+2-16+2-19+2-20

= 0.7244443893432617187510

Therefore, 1.101110010111010100110002 = 1.7244443893432617187510

2126 = 10x

log 2126 = log 10x

126 log 2 = x log 10 = x

(126 log 2) = x

x = 37.929779453661630596931100735286

Therefore, the decimal value equals

= -1.7244443893432617187510 x 1037 x 100.929779453661630596931100735286

= -1.4669950460731436251582433278051 x 1038

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Q12 (b)

89ABCDEF16 =

1000 1001 1010 1011 1100 1101 1110 1111

1 00010011 01010111100110111101111

Sign = 1 = negative

Exponent = 00010011

11111101 = 1 x 24 + 1 x 21 + 1 x 20

= 24 + 21 + 1

= 16 + 2 + 1

= 19

Exponent = 19 – 127 = -108

Therefore, the binary # = 1.01010111100110111101111 x 2-108

12 = 20

= 1

0. 010101111001101111011112

= 2-2+2-4+2-6+2-7+2-8+2-9+2-12+2-13+2-15+2-16+2-17+2-18+2-20+2-21+2-22+2-23

= 0.3422220945358276367187510

Therefore, 1.010101111001101111011112=1.3422220945358276367187510

2-108 = 10x

log 2-108 = log 10x

-108 log 2 = x log 10 = x

(-108 log 2) = x

x = -32.511239531709969083083800630245

Therefore, the decimal value equals

= -1.3422220945358276367187510 x 10-32 x 10-0.511239531709969083083800630245

= -4.136041158215529190636091546498210 x 10-33

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

Q13 (a)

FEDCBA9816 + 89ABCDEF16 =

**Binary addition:**

1 11111101 10111001011101010011000

Sign = 1 = negative

Exponent = 11111101 = 253

Exponent = 253-127 = 126

FEDCBA9816 = -1.10111001011101010011000 x 2126

1 00010011 01010111100110111101111

Sign = 1 = negative

Exponent = 00010011 = 19

Exponent = 19-127 = -108

FEDCBA9816 = -1.01010111100110111101111 x 2-108

-1.10111001011101010011000 x 2126

+

0.000000000000000000000000 x 2126

-1.10111001011101010011000 x 2126

Therefore, FEDCBA9816 + 89ABCDEF16 =-1.10111001011101010011000x2126

Therefore, the exponent is 127 + 126 = 25310 = 111111012

Therefore, the 32-bit IEEE of FEDCBA9816 + 89ABCDEF16 is

1 11111101 10111001011101010011000 =

1111 1110 1101 1100 1011 1010 1001 1000

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Q13 (b)

00FCD6EB16 + 80FCD6EA16 =

**Binary addition:**

1 11111001 101011011101011

Sign = 1 = negative

Exponent = 11111001 = 249

Exponent = 249-127 = 122

FEDCBA9816 = -1.101011011101011 x 2122

1 00000001 11111001101011011101010

Sign = 1 = negative

Exponent = 00000001 = 1

Exponent = 1-127 = -126

FEDCBA9816 = -1.11111001101011011101010 x 2-126

-1.10101101110101100000000 x 2122

+

0.000000000000000000000000 x 2122

-1.10101101110101100000000 x 2122

Therefore, FEDCBA9816 + 89ABCDEF16 =-1.10101101110101100000000x2122

Therefore, the exponent is 127 + 122 = 24910 = 111111012

Therefore, the 32-bit IEEE of FEDCBA9816 + 89ABCDEF16 is

Therefore, the exponent is 127 + 31 = 15810 = 111110012

Therefore, the 32-bit IEEE of FEDCBA9816 + 80FCD6EA16 is

1 11111001 10101101110101100000000=

1111 1100 1101 0110 1110 1011 0000 0000