Brian Bowers

1) $FAC3_{16}$ = 1111 1010 1100 0011

binary	hex	dec
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	A	10
1011	B	11
1100	C	12
1101	D	13
1110	E	14
1111	F	15

2) 1 3 7 15 31 62 125 250 501 1003 2006 4012 8024 16048 32097

64195 = 64195

3) (-) 1111 1010 1100 0011 = 0000 0101 0011 1100 + 1

= 1 2 5 10 20 41 83 167 335 670 1340 = -1341

4) 0064_{16} = 0000 0000 0110 0100

5) $0064_{16} = 6 \cdot 16^1 + 4 \cdot 16^0 = 96 + 4 =$ 100

6) (+) 0064 = 100

7) 8000 = 1000 0000 0000 0000

8) $8000 = 2^{15} =$ 32768

9) (-) 1000 0000 0000 0000 = 0111 1111 1111 1111 + 1 = 1000 0000 0000 0000 = -32768

10)

8000_{10} / 2 = 0
4000 / 2 = 0
2000 / 2 = 0
1000 / 2 = 0
500 / 2 = 0
250 / 2 = 0
125 / 2 = 1
62 / 2 = 0
31 / 2 = 1
15 / 2 = 1
7 / 2 = 1
3 / 2 = 1
1 1

11) 8000_{10} = (+) 0001 1111 0100 0000

= $1F40_{10}$

8000_{10} = 11111 0100 0000$_{16}$

= 0001 1111 0100 0000

= 1 F 4 0

= $1F40_{10}$

12) (-) F11 = 0000 0000 0000 1011 → 1111 1111 1111 0100 + 1 = 1111 1111 1111 0101 = FFF5

13) $-32717 = 0111\ 1111\ 1100\ 1101 \rightarrow 1000\ 0000\ 0011\ 0010 + 1 = 1000\ 0000\ 0011\ 0011 = \boxed{8033}$

2 | 32717	1
2 | 16358	0
2 | 8179	1
2 | 4089	1
2 | 2044	0
2 | 1022	0
2 | 511	1
2 | 255	1
2 | 127	1
2 | 63	1
2 | 31	1
2 | 15	1
2 | 7	1
2 | 3	1
	1

14) $1011\ 1101 = \boxed{BD}$

15) $1011\ 1101\ 0000\ 0001 = 1\ 2\ 5\ 11\ 23\ 47\ 94\ 189\ 378\ 756\ 1512\ 3024\ 6048\ 12096\ 24192$

$= \boxed{48385}$

16) $-1011\ 1101\ 0000\ 0001 = 0100\ 0010\ 1111\ 1110 + 1 = 0100\ 0010\ 1111\ 1111 = 0\ 1\ 2\ 4\ 8\ 16\ 33\ 66$

$133\ 267\ 535\ 1071\ 2143\ 4287\ 8575\ 17151 = \boxed{-17151}$

17) smallest 20 - when we invert it 0→1 so $1000\ 0000\ 0000\ 0000\ 0000 = 0111\ 1111\ 1111\ 1111\ 1111 + 1$

$= 1000\ 0000\ 0000\ 0000\ 0000 = 2^{19} = \boxed{-524288}$

18) positive so 0... $= 0111\ 1111\ 1111\ 1111\ 1111 = 2^{19} - 1 = \boxed{524287}$

19) Modular → cutoff

$$\begin{array}{r} {}^{1}\,{}^{1}3511 \\ +\ 4FFC \\ \hline 840D \end{array} = 840D$$

~~1000 0100 0000 1101~~

so $0000\ 0100\ 0000\ 1101 = \boxed{0400}$

0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F

20) 840D

$0111\ 1111\ 1111\ 1111 = \boxed{7FFF}$

21) $\begin{array}{r} {}^{1}\,{}^{1}3511 \\ +\ 4FFC \\ \hline 850D \end{array}$

$21 - 16 = 5$

① 0011
② 0100
-1000

No

22) Yes

B - level problems

2) 61S9 + F702 = 585B

21 − 16 = 5

3) FFFF

4) Yes

5) 06110 + 1111 — No

6) EEEE + C00C = FEFA

14 + 12 = 26 − 16 = 10

7) FFFF

8) 9EEE + ABOC = 1 4A0A

14 + 12 = 26 − 16 = 10

14 + 11 = 25 − 16 = 10

Yes

9) 01001 + 01010 = 0 — Yes

0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F

10) BooF = 1011 0000 0000 1111 → 0100 1111 1111 0001 = 4FF1

11) 2232 = 0010 0010 0011 0010 → 1101 1101 1100 1101 = DDCD

12) 8000 = 1000 0000 0000 0000 → 0111 1111 1111 1111 = 7FFF

13) FFF329BA + 1110E756 = 111DE756

14)

s	e	f
1bit	8bits	23bits

96.03125

.03125 × 2 = 0.0625 → 0
.0625 × 2 = 0.125 → 0
.125 × 2 = 0.25 → 0
.25 × 2 = 0.5 → 0
.5 × 2 = 1.0 → 1

96 = 1100000

.03125 = 00001

96.03125 = 1100000.00001 = $1.10000\,00001 \cdot 2^6$

6 ⇒ 0000 0110 + 0111 1111 = 1000 0101

↑ exponent + 127

⇒ 0100 0010 1100 0000 0001 0000 0000 0000 ⇒ 42C01000

15) $-16777216 = 1000\ 0000\ 0000\ 0000\ 0000\ 0000 \quad 1 \times 2^{24}$

$\Rightarrow 1100\ 1011\ 1000\ 000\ldots$

CB800000

24 + 127 = 151

151 = 10010111

16) $43700000 = 0\ 100\ 0011\ 0\ 111\ 0000\ 0000\ 0000\ 0000\ 0000$

$+ 1.\_\_\_\_ \times 2^{7}$

128 + 6 = 134; 134 − 127 = 7

$11110000 = 1\ 3\ 7\ 15\ 30\ 60\ 120\ 240 =$ **240**

17) $C0FF0000 = \ominus\ 1\ 100\ 0000\ 1\ 111\ 1111\ 0000\ 0000\ 0000$

$-1.\_\_\_\_ \times 10^{2}$

129 − 127 = 2

$\frac{31}{32} = .96875$

$-111.11111 =$ **−7.96875**

$1\ 3\ 7 \quad \frac{1}{2}\ \frac{1}{4}\ \frac{1}{8}\ \frac{1}{16}\ \frac{1}{32}$

A-level problems

2) Largest value of 1111 1111 is for NaN while 1111 1110 is 127

0 1111 1110 1111 → 28 = **7F7FFFFF**

3) 1 1111 1110 1111 → 28 = **FF7FFFFF**

4) Greatest ≠ 0 = 1 0000 0000...1 = **800000001**

largest $\underline{0} - 127$

5) 0 0000 0000...1 = **000000001**

6) $\ominus -5.125 \times 2^{90} = 101.001 \times 2^{90}$

1.01001×2^{92}

92 + 127 = 219

.125 × 2	0.25	0	2 | 219 1
.25 × 2	0.5	0	2 | 109 1
.5 × 2	1	1	2 | 54 0
			2 | 27 1
			2 | 13 1
			6 0
			2 | 3 1
			1

exp = 11011011

$1\ 11011011\ 01001000\ldots$

E D A 4 0000 = EDA40000

7) 1×2^{-138}

$= 2^{-12}$ (would be all zeros b/c 2^{-134} too big)

$= .00000000001.$ mantissa

-138
$+127$
-11

exponent = 00000000
$= 2^{-126}$

+

0 00000000 00000000000010... = 00000800

8) 1.5×2^{-143}

-143
$+127$
-16

1.1×2^{-145} $1.1 \times 2^{-17} \times 2^{-126}$

.00000000000000011

sign exponent 2^{-126} 13

0 00000000 000...(6x...)011 = 00000060

0 0 0 0 6 0