Some Practice Heap Problems Solutions. Name:

1. Suppose that we receive a series of `malloc( )` requests. The memory allocator enforces 8-byte alignment (*i.e.*, that the allocator will make sure that all blocks have size that's a multiple of 8), and that headers and footers are 4 bytes each. Fill in the remainder of the table:

request	**data bytes allocated**	**block size**	**block header (in hex)**
malloc(9)	16	24	0x19
malloc(48)	48	56	0x39

2. The table on the back page shows the addresses and contents of some selection of blocks on a heap on a big-endian machine. The header/footer struct is exactly as the one we've described in class, *i.e.*,

```
struct header {
   unsigned int length :29,
   unsigned int NOT_USED :2,
   unsigned int allocated :1 /* 1 means ALLOCATED */
};                           /* 0 means FREE */
```

any additional pointers, if they exist, would be stored in the order: `PREVIOUS`, `NEXT`.

(a) 2 points What is the address of the header of the first allocated block?

(a) **0x1770**

(b) 2 points What is its length?

(b) **24**

(c) 2 points How much user-data can be stored in this block?

(c) **16**

(d) 2 points What was the address returned by `malloc( )` when this header was set?

(d) **0x1774**

(e) 2 points What is the address of the header of the first free block?

(e) **0x1788**

(f) 2 points What is its length (including header and footers)?

(f) **24**

(g) 2 points How much data could potentially be stored in this block?

(g) **16**

(h) 2 points If this heap uses a simple *explicit free list*, what is the address of the next *free* block?

(h) **0x17C0**

Address	**Value**	**Comment**
0x1770	0x00000019	HEADER: size=24, allocated
0x1774	0x00000086	random garbage
0x1778	0x00000082	random garbage
0x177c	0x00000093	random garbage
0x1780	0x000000b9	random garbage
0x1784	0x00000019	FOOTER: size=24, allocated
0x1788	0x00000018	HEADER: size=24, free
0x178c	0x00000000	explicit free list PREV ptr
0x1790	0x000017c0	explicit free list NEXT PTR
0x1794	0x0000007c	random garbage
0x1798	0x00000076	random garbage
0x179c	0x00000018	FOOTER: size=24, free
0x17a0	0x00000021	HEADER: size=32, allocated
0x17a4	0x000000b8	random garbage
0x17a8	0x00000011	random garbage
0x17ac	0x000000d0	random garbage
0x17b0	0x0000009a	random garbage
0x17b4	0x000000e6	random garbage
0x17b8	0x000000b3	random garbage
0x17bc	0x00000021	FOOTER: size=32, allocated
0x17c0	0x00000010	HEADER: size=16, free
0x17c4	0x00001788	explicit free list PREV ptr
0x17c8	0x00000000	explicit free list NEXT PTR
0x17cc	0x00000010	FOOTER: size=16, free