Question 1

a. $f(n) = n$ and $g(n) = (n + 1) / 2$.
   f/g -> lim n->inf n/n+1/2 = 2, f(n) = Big Theta(g(n))

b. $f(n) = n^2$ and $g(n) = n^2 + 6n$.
   Lim n-> inf n^2/n^2+6n = 1, f(n) = Big Theta(g(n))

c. $f(n) = log\ n$ and $g(n) = log\ n^2$.
   Lim n-> inf logn/logn^2 = ½, f(n) = Big Theta (g(n))

d. $f(n) = 2^n$ and $g(n) = 2^{2n}$.
   lim n->inf 2^n/2^2n = 0, f(n) = o(g(n))

e. $f(n) = 5n$ and $g(n) = 4n^{3/2}$.
   Lim n->inf 5n/4n^3/4 = 1/infinity = 0, f(n) = o(g(n))

Question 2

a. $(n + 1)^3$ is $O(n^3)$.
   Lim n->inf (n+1)^3/n^3 = 1, f(n)= Big Theta(g(n))
   Growing slower so f(n) =O(g(n)), f(n) = (n^3)

b. 2^{n+1} is $O(2^n)$.
   Lim n->inf 2^2n+1/2^n = 2, same as above, f(n) = O(g(n)), f(n) = O(2^n)

c. n is $o(n \log n)$.
   lim n->inf n/nlogn = 0, f(n) = o(g(n)) -> f(n) = O(nlogn)

d. n^2 is $\omega(n)$.
   lim n-> n^2/n = infinity, f(n) = ω(g(n))

e. $n^3 \log n$ is $\Omega(n^3)$.
   Lim n-> n^3 logn/n^3 = infinity, f(n) = ω(n^3) -> g(n) = o(f(n)) -> f(n) = Ω(n^3)

Question 3

a. Algorithm 1:

```
s = 0
for i = 1 to n
    s = s + i
O(n)
```

b. Algorithm 2:

```
p = 1
for i = 1 to 2 * n
    p = p * i
```

O(3n) -> O(n)

c. Algorithm 3:

```
p = 1
for i = 1 to n ** 2
    p = p * i
```

$O(n^3)$

d. Algorithm 4:

```
s = 0
for i = 1 to 2 * n
    for j = 1 to i
        s = s + i
```

$O(4n^3) \to O(n^3)$

e. Algorithm 5:

```
s = 0
for i = 1 to n ** 2
    for j = 1 to i
        s = s + i
```

$O(n^5)$