PIPPIN (16 points)

Complete the table below for the PIPPIN assembly program shown at right. Show the command about to be executed and the state of each register before each stage of the fetch-execute cycle. Continue until the program reaches a HLT instruction. The first two lines have been done for you.

0	LOD #3
2	STO X
4	SUB #1
6	STO Y
8	JMZ 18
10	ADD X
12	STO X
14	LOD Y
16	JMP 4
18	HLT

PC	Command	ACC	X	Y
0	LOD #3	0	0	0
2	STO X	3	0	0
…		…	…	…

Information (12 points)

A mad scientist has proposed a new computer that will encode numbers using **trits**, or trinary digits. A trit is analogous to a bit but has three possible values: -1, 0, or +1. You are trying to figure out how such a computer would work. Please answer the following questions.

a.) One trit can hold three different values. Two trits together can create nine different patterns in all. The mad scientist proposes to group trits together in groups of nine trits, called a **tryte**. How many different patterns can be represented in a tryte?

b.) One of the logic circuits proposed by the mad scientist is called COMPARE, which takes two inputs. A COMPARE B should return -1 if A is less than B, 0 if they are equal, and 1 if A is greater than B. Write down a truth table for this circuit.

Circuits (20 points)

Write down a truth table for the circuit shown. A and B are inputs, and W through Z are outputs.

The circuit shown is called a 2x4 decoder. Name a part of the CPU or memory array that might use a circuit like this, and explain its purpose and function.
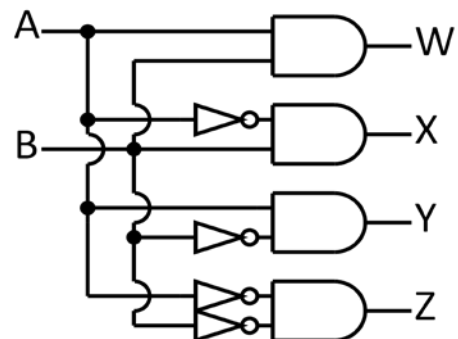
Java (18 points)

Consider the image at right. Design a set of Java drawing commands that could appear inside the method below that would generate the image shown.

```
public void paintComponent(Graphics g) {
    // Your greeting card drawing commands go here.
}
```

To help you, here is some information about size and positions: The window is 240 pixels square. The blue and white circles are centered in the window, and the white is half the diameter of the blue. The red and white stripes are each 24 pixels tall. The text labels are positioned at the following points: (5,15), (200,15), (106,40), (104,100), (5,136), (5,160), (5,184), (5,208) and (5,232).
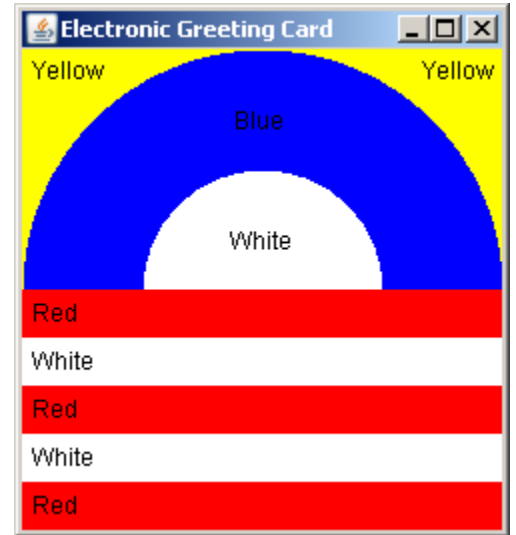
Artificial Intelligence (16 points)

Consider the semantic net at right. Which of the following conclusions are justified **based solely upon the information shown**?

a.) All mammals need food.

b.) Daisy has a calf.

c.) Daisy's calf is an instance of cattle.

d.) Fred Jones has a head.

e.) Daisy needs food.

f.) All herbivores need food.

g.) Some herbivores need food.

h.) All human beings have heads.
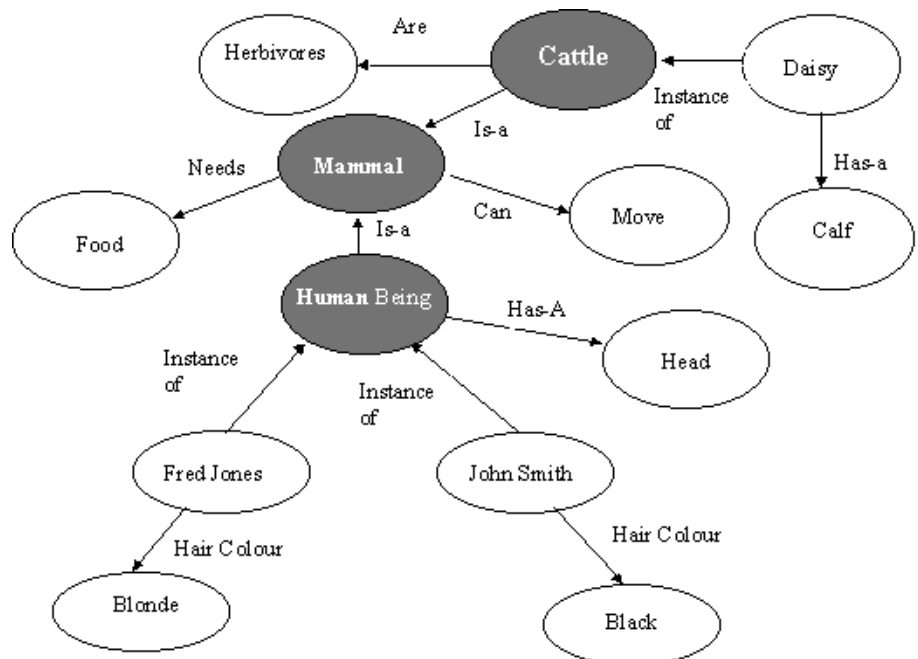
Bits and Bytes (8 points)

You are designing a new character font for a simple computer. Each character is designed on an 8x8 grid, and the character can be displayed on the screen by copying the bytes of the character grid into the video memory area. The image at right shows the character grid for the letter R.
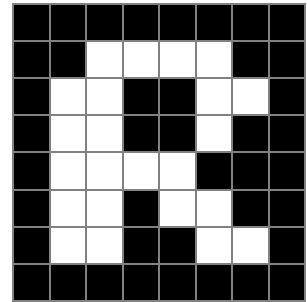
Suppose that the character grid is stored as a sequence of bytes, where each byte represents a row of the grid, in order from top to bottom. Each row is treated as a binary number, with 0 for black and 1 for white. In decimal notation, what are the values that would be stored for the character grid shown?

Computer Hardware (10 points)

Each of the following strategies can improve the speed with which the CPU can retrieve data it requires. Using your knowledge of computer hardware, explain why each of the following strategies can speed up data access.

a.) Use hard disks with a smaller radius.

b.) Spin the hard disk faster.

c.) Put all the data for a particular file on a single cylinder, rather than a single platter.

d.) Put data in the CPU cache.

e.) Turn off virtual memory.