Task 1

Knowns given problem statement: (M=Maine, S=Sahara, H=Hot(>=80), C=Cold(<80))

* P(M) = 0.0500
* P(S) = 0.9500
* P(H|M) = 0.2000, P(C|M) = 0.8000
* P(H|S) = 0.9000, P(C|S) = 0.1000

Calculated values:

* P(H) = P(H|M)\*P(M)+P(H|S)\*P(S) = 0.8650
* P(C) = P(C|M)\*P(M)+P(C|S)\*P(S) = 0.1350

1. P(M|C) = P(C|M)\*P(M)/P(C) = **0.2963**
2. If you know the previous day showed a cold temperature, the probabilities for the locations changes for the second calculation: P(M) <- P(M|C) = 0.2963, P(S) <- P(S|C)= 0.7037. Now just do sum rule again but replace the probabilities of the locations.  
   P(C) = P(C|M)\*P(M|C)+P(C|S)\*P(S|C) = **0.3074**
3. There are two scenarios: the sensor is in Maine or the Sahara. Do the sum rule over these possibilities:  
   P(C3) = P(C|M)3\*P(M)+P(C|S)3\*P(S) = **0.0266**

The notation used to show what the answer is asking is probably slightly wrong, but the answers should be correct.

Task 2

**P is possibly a probability function.** A probability function must sum up to 1.0 over all possibilities. since P(A)+P(B)=0.9, as long as P(C)+P(D)<=0.1 then its valid, but if not then its invalid.

Task 3

**P is definitely not a probability density function.** Probability density functions have a cumulative sum of 1.0. The total probability of P is 0.3\*(10-0) = 3.0. Since this is larger than 1.0 and negative probabilities don’t exist, P is invalid.

Task 4

Knowns given problem statement:

* p(B=r) = 0.4
* p(B=b) = 0.6
* p(F=a | B=r) = 0.25
* p(F=o | B=r) = 0.75
* p(F=a | B=b) = 0.75
* p(F=o | B=b) = 0.25

Calculated values:

* P(F=a) = p(F=a | B=r)\*p(B=r) + p(F=a | B=b)\*p(B=b) = 0.5500
* P(F=o) = p(F=o | B=r)\*p(B=r) + p(F=o | B=b)\*p(B=b) = 0.4500
* P(B=b | F=a) = P(F=a | B=b)\*P(B=b)/P(F=a) = 0.8182 <-
* P(B=r | F=a) = P(F=a | B=r)\*P(B=r)/P(F=a) = 0.1818
* P(B=b | F=o) = P(F=o | B=b)\*P(B=b)/P(F=o) = 0.3333
* P(B=r | F=o) = P(F=o | B=r)\*P(B=r)/P(F=o) = 0.6666 <-

The classifier will choose B=b when given F=a and will choose B=r when given F=o. To find the probability of success we need use sum rule over all the successful scenarios:  
P(correct) = P(F=a | B=b)\*P(B=b) + P(F=o | B=r)\*P(B=r) = **0.7500**  
P(wrong) = P(F=a | B=r)\*P(B=r) + P(F=o | B=b)\*P(B=b) = 0.2500

There is a 75% chance that the classifier is correct.

Task 5

Completed in naive\_bayes.py.