HW-6

1.

(a)
This can be formulated as a 3-way Bayesian network:

Oil Gas

Test

Given,

If T, Pr(Oil) = 0.5 and thus, if F, Pr(Oil) = 0.5

If T, Pr(Gas) = 0.2 and thus, if F, Pr(Gas) = 0.8

This can be represented with Test in the following table:

Test	Oil	Gas	Pr(Test | Oil, Gas)
T	T	T	0
T	T	F	0.9
T	F	T	0.3
T	F	F	0.1

(b)

In this question, we need to find

$Pr(Oil \mid Test)$

First, we find Pr(Test)

$Pr(Test) = Pr(Test, Oil) + Pr(Test, \neg Oil)$
Given the values above, we can compute this as
$= 0.5*0.9 + 0.4*0.5$

Now, $Pr(Oil \mid Test) = Pr(Test \mid Oil) * Pr(Oil) / Pr(Test) = 0.9*0.5/ 0.5*0.9 + 0.4*0.5 =$ **0.69.**

2.

(a)
$Pr(A, B, C, D, E, F, G, H) =$

$Pr(A)* Pr(B)* Pr(C|A)* Pr(E|B)* Pr(G|F)* Pr(D|A,B)* Pr(F|C,D)* Pr(H|F,E)$

(b)
Pr(E, F, G, H) =

Pr(E|B)* Pr(G|F)* Pr(F|C,D)* Pr(H|F,E)

(c)

Pr(a, ¬b, c, d, ¬e, f, ¬g, h) =

0.2*0.3*0.6*0.1* Pr(c|a)* Pr(f|c,d)* Pr(¬g |f)* Pr(h|f,¬e)

The values in placeholders don't have assigned CPT values.

(d)

For Pr(¬a|b), since a and b are independent,
Pr(¬a|b) = Pr(¬a) * Pr(b) = 0.8*0.7 = 0.56

For Pr(¬e|a), we know that e and a are independent. Thus,

Pr(¬e|a) = Pr(¬e)*Pr(a)/Pr(a) = Pr(¬e).

Since e depends on b, Pr(¬e) = Pr(¬e, b). + Pr(¬e, ¬b).
= 0.9*0.7 + 0.1*0.3 (Given values)
= 0.66

(e)

The assumptions are as follows:
I(A, NULL, BE)
I(B, NULL, AC)
I(C, A, DBE)
I(D, AB, CE)
I(E, B, ACDFG)
I(F, CD, ABE)
I(H, EF, ABCG)

(f)

The blanket is = {A, B, C, F}

(g)

A	B	D	P(D|AB)
T	T	T	0.2
T	T	F	0.8
T	F	T	0.9
T	F	F	0.1

F	T	T	0.4
F	T	F	0.6
F	F	T	0.5
F	F	F	0.5

B	E	P(E|B)
T	T	0.1
T	F	0.9
F	T	0.9
F	F	0.1

A	B	D	E	P(D|AB)* P(E|B)
T	T	T	T	0.02
T	T	T	F	0.18
T	T	F	T	0.08
T	T	F	F	0.72
T	F	T	T	0.81
T	F	T	F	0.09
T	F	F	T	0.09
T	F	F	F	0.01
F	T	T	T	0.04
F	T	T	F	0.36
F	T	F	T	0.06
F	T	F	F	0.54
F	F	T	T	0.45
F	F	T	F	0.05
F	F	F	T	0.45
F	F	F	F	0.05