1. The basic approach to modeling uncertainty in a changing world is to view the world as a series of “snapshots” or time slices. Each time slice includes a set $X$ of state variables assumed be unobservable, and a set $E$ of evidence variables that can be observed.

(a) Explain briefly what the (first-order) Markov assumption is and what it means for the state variables $X$. Be formal.

(b) Explain briefly what a stationary process assumption is and what it means for the state variables $X$. Be formal.

(c) Explain briefly what the (first-order) sensor Markov assumption means for the evidence variables $E$. Be formal.

(d) Explain briefly what a stationary process assumption means for the evidence variables $E$. Be formal.

(e) Give an example of a Bayesian network for a temporal model with a single state variable $X$ and a single evidence variable $E$. Draw a picture. Include formulas describing the conditional probabilities required by the network (no numbers needed).
2. The book (and class) identified four inference tasks for temporal models.

(a) Identify the four tasks and give the posterior distribution that each task needs to compute (or estimate). Use the notation $X$ for the state variables, $E$ for the evidence variables, $e$ for the evidence values (a vector of values of the evidence variables), and $x$ for a vector of values of the state variables, with appropriate subscripts.

(b) Can the basic temporal inference tasks on Bayesian networks be computed efficiently? Why or why not (very briefly)?

(c) Why is this important?