Example Midterm Question: Match up the following *Mathematica* inputs to outputs (note that the inputs may or may not contain errors):

INPUT:	OUTPUT:
`Integrate[Sin(x), x]`	$\int \sin[\mathrm{x}]\,d\mathrm{x}$ [Third one, note that lower case sin is not evaluated as the sine function]
`D[Sin[x], x]`	`-Cos[x]`[Fifth one]
`Integrate[sin[x], x]`	$\dfrac{\text{Sin } x^2}{2}$ [First one, note that Sin(x) is interpreted as Sin times x, because square brackets aren't used]
`D[Sin(x), x]`	`Cos[x]` [Second one]
`Integrate[Sin[x], x]`	`sin` [Fourth one, note that Sin(x) is interpreted as Sin times x, because square brackets aren't used]

Example Midterm Question: Match up the following *Mathematica* inputs to outputs (note that the inputs may or may not contain errors):

INPUT:	OUTPUT:
`Integrate[2 - 3 x + x^2, x]`	`Solve::eqf: 2 - 3 x + x^2 is not a well-formed equation` [Second one, note the lack of "== 0"]
`Solve[2 - 3 x + x^2, x]`	$2 - 3x + x^2$ [Fifth one, note the lack of ", x" at the end to indicate which derivative should be taken]
`Integrate[2 - 3 x + x^2, {x,0,1}]`	$2x - \dfrac{3x^2}{2} + \dfrac{x^3}{3}$ [First one]
`Solve[2 - 3 x + x^2== 0, x]`	$\dfrac{5}{6}$ [Third one]
`D[2 - 3 x + x^2]`	$\{\{x \to 1\},\{x \to 2\}\}$ [Fourth one]

Example Final Question: Figure out what the following *Mathematica* simulation does by reading the code and deducing what sort of process is being modeled.

<<Statistics`ContinuousDistributions`

?UniformDistribution

UniformDistribution[min, max] represents the uniform distribution on the interval {min, max}

Clear[num]
num[t_,a_,b_,n0_] := num[t,a,b,n0] = num[t-1,a,b,n0]*Random[UniformDistribution[a,b]]
num[0,a_,b_,n0_] := n0

(a) This model is (circle one each):

                        Discrete time   or   continuous time

                        Deterministic   or   stochastic

(b) This model is a variant of which model studied in class (circle one):

    Exponential growth   or   Logistic growth   or   Haploid selection   or   Spread of disease

(c) Describe a research question that you could address using this simulation program?

A population is growing in an environment where the resources fluctuate from year to year, causing the number of surviving offspring per parent, R, to fluctuate randomly.

Sample questions: How will the population size grow over time? What is the risk that the population will go extinct within a certain time frame? On average, will the population tend to be smaller or larger than the equivalent deterministic model?

Example Final Question: A fellow student has written *Mathematica* code to run a simulation, but is getting very frustrated because *Mathematica* fails to produce a plot. The following codes include three incorrect versions and one correct version. In each case, state whether or not the code would work and, for the codes that do not work, point out the error:

(a)   x[t_, a_, b_] := x[t, a, b] = x[t-1, a, b] + a x[t-1, a, b] /(1+ x[t-1, a, b] b)

        x[0, a_, b_] =1.0

        ListPlot[Table[x[t, a, b] , {t, 0, 200}]]

This won't work because the values of a and b are not specified.

(b)   x[t_, a_, b_] := x[t, a, b] = x[t-1, a, b] + a x[t-1, a, b] /(1+ x[t-1, a, b] b)

        x[0, a_, b_] =1.0

        ListPlot[Table[x[t, 0.1, 100] , {t, 0, 200}]]

This should work.

(c)   x[t_, a_, b_] := x[t, a, b] = x[t, a, b] + a x[t, a, b] /(1+ x[t, a, b] b)

        x[0, a_, b_] =1.0

        ListPlot[Table[x[t, 0.1, 100] , {t, 0, 200}]]

This won't work because x[t] on the left is mapped back to x[t] on the right (should be t-1 on the right).

(d)   x[t_, a_, b_] := x[t, a, b] == x[t-1, a, b] + a x[t-1, a, b] /(1+ x[t-1, a, b] b)

        x[0, a_, b_] == 1.0

        ListPlot[Table[x[t, 0.1, 100] , {t, 0, 200}]]

This won't work because the "==" in the equation for x at time 0 will not set the value to 1.0 ("==" is used for testing if the left and right are equal, not for setting the left to the right side)