Name:____________________ ID:

Midterm Exam

This exam has 20 questions, for a total of 20 points. The exam is multiple choice with only ONE valid answer per question. You must use the Answer sheet provided on the last page. You MUST also fill in your name and ID on this page and also on the answer sheet. You have sixty minutes, use it wisely.

Question 1 1

Which statement best describes the key requirements for building models for a given problem

A. A mathematical formulation of the model

B. A computer simulation using a programming language

C. A detailed understanding the allows any abstraction (mathematical, physical, etc...)

D. A schematic sketch of the problem

E. A clear understanding of the harmful aspects of the problem

Question 2 1

Which statement best describes the essence of simulation

A. a way of looking at a problem

B. a way of examining a model of problem under different scenarios using code

C. a way of visualizing a model by any means possible (computers programs, physical or mathematical embodiments, etc...)

D. a way defining complex problems that can not be solved using paper and pen

E. a way of testing the model under different circumstances by using any means

Question 3 1

In the bouncing ball model we studied

A. the ball bounces for only 10 seconds

B. the ball keeps bouncing forever

C. the ball gains energy with each bounce

D. the ball bounces a fixed number of time

E. the ball looses energy after each impact

Question 4 1

In the simulation the bouncing ball problem the below code is primarily flawed because

```
function x(t,k)
    delta=0.01
    for t=0:delta:t
        h=h0-0.5*g*t^2
        if h<0
            v=-k*(g*t)
        end
    end
end
```

A. there is no model of energy loss on bouncing

B. the ball does not bounce

C. the ball has no defined mass

D. the specified time is too short

E. the ball falls too fast

Question 5 [1]

In the simulation of the bouncing ball problem the higher coefficient or restitution

A. The slower the ball drops

B. The slower the ball stops bouncing

C. The faster the ball drops

D. The higher the hight goes up after each bounce

E. The smaller the hight drops after each bounce

Question 6 [1]

In the simulation the bouncing ball problem examine the below code

```
"""
Given initial hight h0 and coefficient or restitution c, the function
 will generate a vector of ball postions up until time end_t.
"""
function bouncingBallPositon1(h0,c,end_t, delta=0.01)
    g=9.81 # we will have this fixed
    t1=ti=t_next=sqrt(2*h0/g)
    vi=sqrt(2*h0*g) #Just before the bounce
    time_range=0:delta:end_t
    h_vec=zeros(length(time_range)) #The hight vector
    i=1 # Array Index
    for t in time_range
        if t<=t1
            h_vec[i]=h0-0.5*g*t^2
        else
            if t>t_next #t_next is t_{i+1} in the equations
                ti=t_next
                vi*=c
                t_next+=2*vi/g
            end
```

```
                h_vec[i]=vi*(t-ti)-0.5*g*(t-ti)^2
            end
            i+=1 # Incrementing the array counter
        end
        h_vec # return the vector of heights
    end
```

On touching the ground, the higher the *delta*

A. The more accurate are the results

B. The slower the simulation (more iterations)

C. The smaller the size of *h_vec* The right answer is C

D. The faster the ball drops

E. The larger the size of *h_vec*

Question 7 $\boxed{1}$

One way to simulate the bouncing ball is to check (by an if condition) if the ball touches the ground. In the contrast with the approach where we can calculate the time when the ball touches the ground before hand, the first approach is

A. More accurate

B. Less accurate

C. identical to the second

D. very different from the second model, so we can not compare

E. more sensitive to the weight of the ball

Question 8 $\boxed{1}$

In the heat transfer simulation with the $T_{bottle} < T_{env}$, the coarser the time step

A. the slower that T_{bottle} rises

B. the faster that T_{bottle} rises

C. $T_{bottle} > T_{env}$ after a very long time

D. T_{bottle} stays constant

E. the higher T_{env} increase

Question 9 $\boxed{1}$

In the heat transfer simulation, a closed form solution

A. will solve a third order differential equation

B. is impossible to find, we have can only use simulation

C. can be obtained without defining initial conditions

D. will be very different from the simulation results, even with a fine time step

E. can be easily obtained and compared with the simulation

Question 10 $\boxed{1}$

In the swinging pendulum problem we explored

A. we could only simulate small angles

B. air resistance slowed down the pendulum

C. the model was a first order ODE

D. we did not account for energy loss

E. the Euler methods worked quite well

Question 11 $\boxed{1}$

In the swinging pendulum problem simulation we explored, if we use it for time keeping

A. the initial angle has no affect on the timing accuracy

B. the longer the pendulum the faster the period

C. the pendulum could lose accuracy if swinging through large angles

D. the higher the mass of the pendulum, the more accurate the results

E. air resistance will slow the pendulum down

Question 12 $\boxed{1}$

To generate the set of balls for the urn problem, we make use of the following function

```
"generates a list of balls with color c and and numbers from 1 to n"
labeledBalls(c,n)=[Ball(t[2],t[1]) for t in Base.product(1:n,c)]
```

for 23 balls: 8 white, 6 blue, and 9 red, our urn will contain

A. urn = [labeledBalls(”W”, 8), labeledBalls(”B”, 6) , labeledBalls(”R”, 9)]

B. urn = labeledBalls(”W”, 8)*labeledBalls(”B”, 6) * labeledBalls(”R”, 9)]

C. urn = Base.product(labeledBalls(”W”, 8), labeledBalls(”B”, 6) , labeledBalls(”R”, 9))

D. urn = labeledBalls(”W”, 8)+ labeledBalls(”B”, 6) + labeledBalls(”R”, 9)

E. urn = [labeledBalls(”W”, 8); labeledBalls(”B”, 6) ; labeledBalls(”R”, 9)]

Question 13 $\boxed{1}$

A mass-spring system can be expressed as

$$m\frac{d^2x}{dt^2} + kx = 0$$

using x_1 for the position x and x_2 for the velocity a state space representation of this system will be

A. $\dot{x}_1 = x_2$, $\dot{x}_2 = -\frac{k}{m}x_1$

B. $\dot{x}_2 = x_1$, $\dot{x}_1 = \frac{k}{m}x_2$

C. $\dot{x}_1 = kx_2$, $\dot{x}_2 = \frac{1}{m}x_1$

D. $\dot{x}_1 = mx_2$, $\dot{x}_2 = kx_1$

E. $\dot{x}_1 = -x_2$, $\dot{x}_2 = -\frac{m}{k}x_1$

Question 14 1

In card problems, a flush is defined as having a hand were all the cards are of the same suit, using the below two functions

```
count_hand_suit(hand, suit)=count(x->x.suit==suit, hand)
count_hand_rank(hand, rank)=count(x->x.rank==rank, hand)
```

the flush can be defined in Julia as

A. `flush(hand)=any(count_hand_suit(hand, suit) == 5 for suit in suits)`

B. `flush(hand)=[count_hand_suit(hand, suit) == 5 for suit in suits]`

C. `flush(hand)=all(count_hand_suit(hand, suit) == 5 for suit in suits)`

D. `flush(hand)=any(count_hand_rank(hand, suit) == 5 for suit in suits)`

E. `flush(hand)=any(count_hand_rank(hand, suit) == 5 for rank in ranks)`

Question 15 1

In dealing the probability distributions using our custom type. If we define

```
EG = ProbDist(GG=5, GB=10, BG=20, BB=15)
```

We expect EG["BB"] to be equal to

A. 0.4

B. 0.2

C. 0.5

D. 0.1

E. 0.3

Question 16 1

In "Newton's answer to a problem by Pepys" the function below

```
at_least(k, result)=  s->count(x->x==result, s) >= k
```

A. has syntactic errors

B. outputs a number

C. counts the number of red dots on a die

D. is not relevant to the problem

E. outputs a boolean

Question 17 1

In "Simulating Monopoly", the number of steps

A. needs to less than 10 so the simulation is not too slow

B. needs to be sufficiently high for accurate sampling

C. needs to an odd number

D. needs to be an even number

E. needs to be a prime number

Question 18 $\boxed{1}$

The "Central Limit Theorem" states

A. the sum of collection of random variable will approach a Poisson distribution as the collection grows

B. all random variables are normal distributions

C. all random variables will have a single mean

D. the center of all random variables is one

E. the sum of collection of random variable will approach a normal distribution as the collection grows

Question 19 $\boxed{1}$

A "Geometric distribution"

A. is the sum of many Bernoulli distributions

B. captures the number of trials we have to wait to get a head in a Bernoulli distributions

C. is bigger than the Poisson distribution

D. is less than the exponential distribution

E. is equivalent to the sum of three Bernoulli distributions with low p values

Question 20 $\boxed{1}$

In Julia we, we use shift! function

A. to add to the last element in a collection

B. to remove the last element in a collection

C. to expand a collection by adding some extra elements

D. to remove the first element from a collection

E. to add to the beginning of a collection

Vα Name:____________________ ID:

1	A	B	C	D	E	**11**	A	B	C	D	E
2	A	B	C	D	E	**12**	A	B	C	D	E
3	A	B	C	D	E	**13**	A	B	C	D	E
4	A	B	C	D	E	**14**	A	B	C	D	E
5	A	B	C	D	E	**15**	A	B	C	D	E
6	A	B	C	D	E	**16**	A	B	C	D	E
7	A	B	C	D	E	**17**	A	B	C	D	E
8	A	B	C	D	E	**18**	A	B	C	D	E
9	A	B	C	D	E	**19**	A	B	C	D	E
10	A	B	C	D	E	**20**	A	B	C	D	E