

STUDENT NUMBER:

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## **MTHE 224 - Midterm Test**

Wednesday Oct 26, 2022

### **Instructions:**

- Write your name and student number on this page.
- READ EACH QUESTION CAREFULLY.
- Show all of your work for full marks.
- Include units in your answers wherever possible.
- If using numeric values, keep at least 4 significant digits in your answer and during calculations.

Do not start the test until instructed to do so by your proctor.

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**Question 1.** Determine whether each of the following random variables are continuous or discrete. Give a range of possible values for each.

- a.  $X$  = the number of leaves on a randomly selected maple tree.
- b.  $Y$  = the height of a randomly selected maple tree.
- c.  $Z$  = the concentration of mercury in a 1L sample of water taken from Lake Ontario.

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**Question 2.** Billy has a bag of 2 red, 2 blue, and 2 green marbles. He is playing a game with his friends where he grabs two marbles from the bag without looking and tries to guess what colours they are. He wins if he gets both colours right, he gets to try again if he gets one right, and he loses if he gets both wrong. Assume that Billy has guessed red and blue. Write out the set of outcomes and the event space for this game. For each event, write out a description of what the event means for the game.

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**Question 3.** Eggs come in cartons of 12. Suppose that 10% of cartons have one cracked egg, 2% of cartons have two cracked eggs, and the remaining cartons have no cracked eggs. Suppose you pick a carton at random and select 2 eggs to inspect closely. These 2 eggs have no cracks in them. What is the probability that the rest of the eggs in this carton are not cracked?

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**Question 4.** The useful lifetime of rubber o-rings used in plumbing is exponentially distributed with an average lifetime of 500 days.

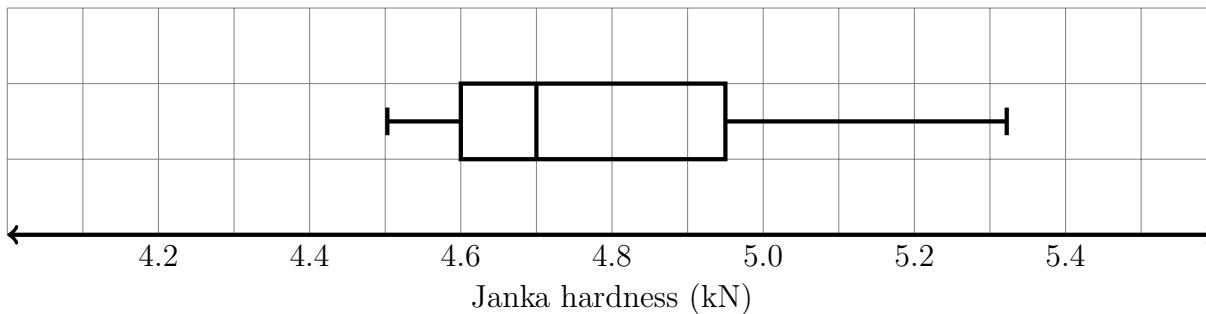
a. A randomly selected o-ring is 1 year (365 days) old. What is the probability it is still useful?

b. Find the time at which the probability an o-ring is still useful is equal to 0.5.

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**Question 5.** The boxplot below summarizes measurements of the hardness of several pieces of oak flooring.



- a. Determine the approximate values of the first, second, and third quartiles, and calculate the interquartile range.
- b. Suppose you measure a piece of oak flooring to have a hardness of 4.2 kN. Would this measurement be an outlier in this data set?

a. What type of random variable is  $X$ ?

b. What is the probability that Anna rejected less than 3 potential sites.

**Question 7.** Let  $X$  be a continuous random variable with probability density function

$$f(t) = \begin{cases} Cte^{-at} & \text{for } t \geq 0 \\ 0 & \text{for } t < 0. \end{cases}$$

**a.** Find the correct value of  $C$ .

**b.** Find the expected value of  $X$ .



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More room for activities

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