※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Please provide complete and detailed calculations. If answers only are provided, then no credits are to be given.

A. (20% with 5% each)

Suppose an influenza epidemic strikes a city. In 10% of families the mother has influenza; in 10% of families the father has influenza; and in 2% of families both the mother and father have influenza. Suppose there is a 20% chance each child will get influenza, whereas in 10% of two-child families both children get the disease.

1. Are the events A_1 = {mother has influenza} and A_2 = {father has influenza} independent?
2. What is the probability that at least one child will get influenza?
3. What is the conditional probability that the father has influenza given that the mother has influenza?
4. What is the conditional probability that the father has influenza given that the mother does not have influenza?

B. (20% with 5% each)

Estimates of the prevalence of Alzheimer's disease have recently been provided. The estimates are given in the table, which presents the prevalence of Alzheimer's disease (cases per 100 population). Suppose an unrelated 77-year-old man, 76-year-old woman, and 82-year-old woman are selected from a community.

1. What is the probability that at least one of the three people has Alzheimer's disease?
2. What is the probability that exactly one of the three people has Alzheimer's disease?
3. Suppose we know one of the three people has Alzheimer's disease, but we don't know which one. What is the conditional probability that the affected person is a woman?
4. Suppose we know two of the three people have Alzheimer's disease. What is the conditional probability that they are both women?

Age group	Males	Females
65–69	1.6	0.0
70–74	0.0	2.2
75–79	4.9	2.3
80–84	8.6	7.8
85+	35.0	27.9

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C. (20% with 10% each)

Assume the number of episodes per year of otitis media, a common disease of the middle ear in early childhood, follows a Poisson distribution with parameter $\lambda = 1.6$ episodes per year.

1. Find the probability of getting 3 or more episodes of otitis media in the first 2 years of life.
2. Find the probability of not getting any episodes of otitis media in the first year of life.

D. (20% with 10% each)

The presence of bacteria in a urine sample (bacteriuria) is sometimes associated with symptoms of kidney disease in women. Suppose a determination of bacteriuria has been made over a large population of women at one point in time and 5% of those sampled are positive for bacteriuria.

1. If a sample size of 5 is selected from this population, what is the probability that 1 or more women are positive for bacteriuria?
2. Suppose 100 women from this population are sampled. What is the probability that 3 or more of them are positive for bacteriuria?

E. (20% with 10% each)

Suppose that the joint probability density function of the two-dimensional random variable (X,Y) is given by $f(x, y) = x^2 + \frac{xy}{3}$ for $0<x<1$, $0<y<2$; $f(x, y) = 0$, elsewhere. Compute the following.

1. $\Pr(X > 0.5)$
2. $\Pr(Y < X)$