

## Question 2

### Part A: Flight to Oklahoma

Since the plane is built to be able to fly on one engine, the only way it can fail to complete a four-hour flight is if no engine were working, or equivalently both the engines failed in the given flight. This condition is both necessary and sufficient.

$$P(\text{plane fails to complete the flight}) = P(\text{engine 1 fails} \cap \text{engine 2 fails}) \quad (1)$$

Since the two engines operate independently, their failures (an event in their operation cycle) too are independent of each other. Thus, we get

$$P(\text{plane fails to complete the flight}) = P(\text{engine 1 fails}) \cdot P(\text{engine 2 fails}) \quad (2)$$

Substituting  $P(\text{engine 1 fails}) = P(\text{engine 2 fails}) = \frac{1}{100}$ , we get

$$P(\text{plane fails to complete the flight}) = \frac{1}{10000} = 0.01\% \quad (3)$$

### Part B: Birthday Paradox

$$\begin{aligned} &P(\text{atleast two people have same birthday}) \\ &= 1 - P(\text{no two people have the same birthday}) \\ &= 1 - P(\text{all 30 people have distinct birthday}) \end{aligned} \quad (4)$$

Since the birthdays are uniformly distributed over 365 days,

$$\begin{aligned} &= 1 - \frac{\text{\#permutations of distinct 30 birthdays}}{\text{\#permutations of 30 birthdays}} \\ &= 1 - \frac{365!}{(365 - 30)! \cdot 365^{30}} \\ &\approx 1 - 0.294 \\ &= 0.706 \end{aligned} \quad (5)$$