a) **Definition:** Let X be the number of cracked lenses in a sample.
Distribution: $X \sim$ Binomial (n, p), where n=n= the sample size and p=0.0065 (probability of a lens being cracked).

i. **For a sample of 500 lenses:**
Probability: $P(X{=}7)$

```
> prob <- dbinom(7, size=500, prob=0.0065)
> prob
[1] 0.02925457
```

Probability of exactly 7 cracked lenses in 500: 0.02925457

ii. **For a sample of 3000 lenses:**
Probability: $P(20 \leq X \leq 25)$

```
> prob <- sum(dbinom(20:25, size=3000, prob=0.0065))
> prob
[1] 0.3944213
```

Probability of 20 to 25 cracked lenses in 3000: 0.3944213

b) **Definition:** Let Y be the number of significant earthquakes in a 10-year period
Distribution: $Y \sim$ Poisson(λ), where λ=4.8×10=48λ=4.8×10=48 (since the average rate is 4.8 per year over 10 years).
Probability: $P(Y{=}50)$

```
> prob <- dpois(50, 48)
> prob
[1] 0.05405699
```

Probability of exactly 50 earthquakes in 10 years: 0.05405699

c) **Definition:** Let Z be the zinc content in a human hair sample.
Distribution: $Z \sim$ Normal (μ, σ), where μ = 159 and σ = 13.1.
Probability: $P(160 \leq Z \leq 165)$

```
> # Define parameters
> mu <- 159
> sigma <- 13.1
> # Calculate probability
> prob <- pnorm(165, mean=mu, sd=sigma) - pnorm(160, mean=mu, sd=sigma)
> prob
[1] 0.1461052
```

Probability of zinc content between 160 and 165 μg/g: 0.1461052

d) **Definition:** Let W be the lifespan of a Plasmodium.
Distribution: $W \sim$ Gamma (α, β), where α=3.4 and β=2.8.
Probability: $P(W \leq 7)$

R code and output:

```
# Define parameters
alpha <- 3.4
beta <- 2.8

# Calculate probability
prob <- pgamma(7, shape=alpha, scale=beta)
prob
[1] 0.3619324
```

Probability of lifespan no more than 7 days: 0.3619324