SECTION E

(i) There are 50 boxes. We want to know the expected number of empty boxes when there are 100 balls.

Let E_m = expected number of empty boxes for *m* balls and 50 boxes.

On average, E_{99} boxes will be empty after we've placed the first ninety nine balls.
Now, the last ball must be placed in an empty box or a non-empty box. The probability of placing it in an empty box is $E_{99}/50$ because there are E_{99} empty boxes out of the 50.

Thus, $E_9/50$ of the time, we'll have $E_{99}-1$ empty boxes; the rest of the time, we'll have E_{99} empty boxes, that is,

$$E_{10}=(E_{99} / 50)(E_9-1) + (1- E_{99} / 50)E_{99} = 49/50\ E_{99}.$$

we conclude that :

$$\mathbf{E_m = (49/50)^m * 50.}$$

(ii)

(i) Bit Error Rate = Number of bits in error / Total number of bits transmitted

10^-10 = Number of bits in error / 1000

Number of bits in error = 10^(-10 + 3)
= 10^ -7 bits

(ii) P(10 or more errors in 1000 bits) = $(1000\ \ 10)(10^{-10})^{10}(1-10^{-10})^{1000-10}$
$= 10^{-10(10)}(1-10^{-10})^{1000-10}$

Putting $(1-10^{-10})^{1000-10}$ as 0.99 , we have

P(10 errors in 1000 bits) = 0.99* $\mathbf{10^{-100}}$

(iii) We know that there are total 16 favourable outcomes for Alina(3 Queens(from other suits) and 13 spades).

Now probability of alina winning one night is = 16/52 = 4/13
While the probability of her losing at the night is = 9/13

Now her probable earning for a night is = 4*4/13 + (-1)*9/13
= 7/13
Similarly her probable earning for a month will be = 7/13 * 30
= $ 16.1538