1. $E_k = 5\,eV$ $\quad E_k = p^2/2m \Longrightarrow p = \sqrt{2mE_k}$

$$p = h/\lambda \Longrightarrow \lambda = h/p = \frac{h}{\sqrt{2mE_k}} \cdot \frac{c}{c} = \frac{hc}{\sqrt{2mc^2E_k}}$$

$$= \frac{12{,}400\ \mathring{A}\cdot eV}{\left[(2)(0.51\times10^6 eV)(5eV)\right]^{1/2}} = \underline{5.49\ \mathring{A} = \lambda}$$

$$p = \sqrt{2mE_k} = \frac{1}{c}\left(2mc^2E_k\right)^{1/2} = \frac{1}{c}\left(2\cdot(0.51\times10^6 eV\cdot 5eV\right)^{1/2}$$

$$= 2.26\ \frac{keV}{c} = mv \Longrightarrow v = \frac{2.26\ keV}{mc^2}\cdot c$$

$$\Longrightarrow v = \frac{2.26\ keV}{0.51\times10^6 eV}\cdot c = 4.43\times10^{-3}c$$

$$= 4.43\times10^{-3}\left(3\times10^8\ m/s\right) = \underline{1.33\times10^6\ m/s}$$

After throwing two legal dice you calculate the sum of the two results. Find

1) Probability function.

2) Mean of the sum.

3) Given that at least one of the results was 1, what is the probability that the sum is even?

1) For a single dice the probability function $P_1(n)$ is given by

$$P_1(n) = \begin{cases} \frac{1}{6} & \text{for } n \in (1,2,...,6) \\ 0 & \text{else} \end{cases} \tag{1}$$

Thus for the sum the probability function is given by

$$P(N) = \sum_{n=1}^{6} P_1(n) P_1(N-n) \tag{2}$$

Explicitly this gives

N	2	3	4	5	6	7	8	9	10	11	12
$P(N)$	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$

2) The mean is given by

$$< n > = \sum_{n=2}^{12} n \cdot P(n) = 7 \tag{3}$$

3) If we define event A as having at least one of the dice being 1 and event B as having an even sum we know:

$$P(B|A) = \frac{P(B \cap A)}{P(A)} \tag{4}$$

$$P(B \cap A) = \frac{5}{36} \quad , \quad P(A) = \frac{11}{36} \tag{5}$$

$$P(B|A) = \frac{5}{11} \tag{6}$$

For certain computers it is known that probability density for the computers lifetime is given by $f(t) = \lambda e^{-\frac{t}{100_{\mathbf{hours}}}} \quad , \quad t \geq 0$.

1) What is the probability for a computer to work less then 100 hours?

2) What is a computer's mean life expectancy?

1) First, we have to normalize the probability density.

$$1 = P(\Omega) = \int_0^\infty \lambda e^{-\frac{t}{100_{\text{hours}}}} dt = 100\lambda \quad \Rightarrow \quad \lambda = \frac{1}{100} \tag{1}$$

The probability for a computer to work less then 100 hours is given by

$$P(t < 100) = \int_0^{100} \frac{1}{100} e^{-\frac{t}{100_{\text{hours}}}} dt = 1 - \frac{1}{e} \tag{2}$$

2)The computer's life expectancy is given by:

$$< t >= \int_\Omega t \cdot f(t) dt = 100_{\text{hours}} \tag{3}$$