PROBLEM No. 1

a. 0.5p

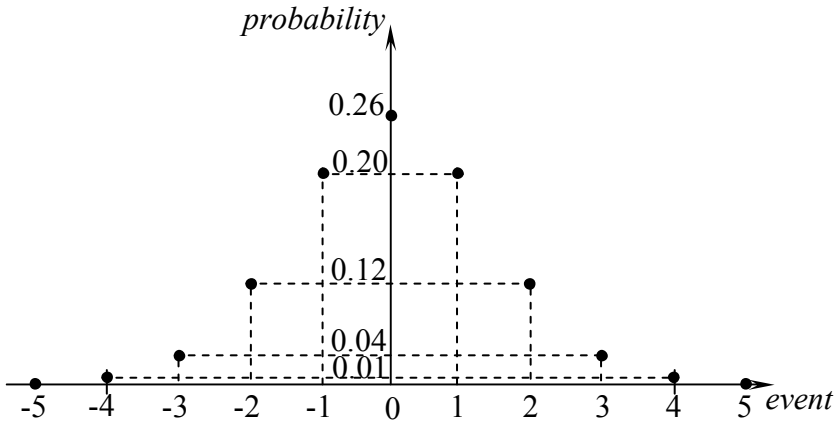
$[f]_{SI} = m^{-1}s$

b. 0.5p

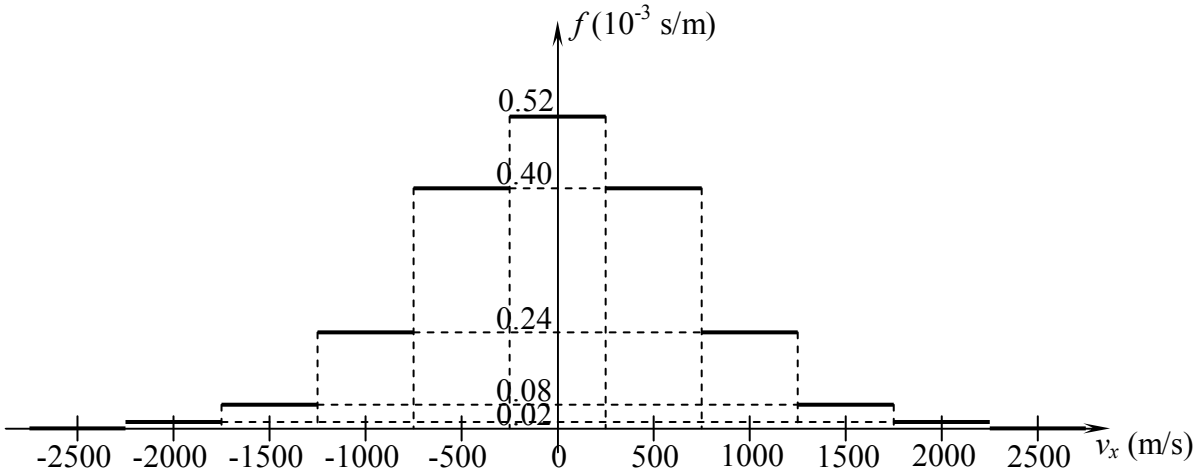
$$e^{-\frac{\mu v_{x\max}^2}{2RT}} = 0.01 \Rightarrow -\frac{\mu v_{x\max}^2}{2RT} = \ln\frac{1}{100} \Rightarrow v_{x\max} = \sqrt{\frac{4RT\ln 10}{\mu}} = \sqrt{\frac{4\cdot 8.31\frac{J}{molK}\cdot 300K\cdot 2.5}{4\cdot 10^{-3}\frac{kg}{mol}}}$$

$v_{x\max} = 2500$ m/s

c. 2p



d. 2p



e. 0.5p

$\eta = 0.13$

f. 0.5p

$\eta = 0.0022$

g. 0.5p

$$\left(v^2\,\mathrm{e}^{-\frac{\mu v^2}{2RT}}\right)' = 0 \Rightarrow 2v\,\mathrm{e}^{-\frac{\mu v^2}{2RT}} = v^2\,\frac{2\mu v}{2RT}\,\mathrm{e}^{-\frac{\mu v^2}{2RT}} \Rightarrow v^2 = \frac{2RT}{\mu}$$

$$v_\mathrm{p} = \sqrt{\frac{2RT}{\mu}} = \sqrt{\frac{2\cdot 8.31\frac{\mathrm{J}}{\mathrm{molK}}\cdot 300\mathrm{K}}{4\cdot 10^{-3}\frac{\mathrm{kg}}{\mathrm{mol}}}} \approx 1125\frac{\mathrm{m}}{\mathrm{s}}$$

$$v \in [1000\,;\,1250]\,\frac{\mathrm{m}}{\mathrm{s}}$$

h. 0.5p

$P(0,0,0) = 0.0022$

i. 2p

magnitude of the velocity component (m/s)	*magnitude of the velocity component* (m/s)	*magnitude of the velocity component* (m/s)	*number of occurrences*	*P*
0	0	1000	6	0.00100
0	0	1250	6	0.00068
0	250	1000	24	0.00090
0	500	1000	24	0.00078
0	750	750	12	0.00083
0	750	1000	24	0.00062
250	250	1000	24	0.00079
250	500	1000	48	0.00069
250	750	750	24	0.00074
500	500	750	24	0.00080
500	500	1000	24	0.00060

j. 1p

$\eta = 0.17868$