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Education with Innovative Technology

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Topic-Arrhenius Theory
Lecture-01
Puruda Sir

Zinedu hai to...possible hai!

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Arrhenius Theory

$$k = Ae^{-E_a/RT}$$

$e^{-E_a/RT}$

$H_2 + I_2 \rightarrow 2HI$

H + H I + I → HI

k = rate constant

A = Arrhenius constant
Preexponential factor

E_a = Activation Energy

R = universal gas constant

T = Temperature in kelvin

effective collision

H --- I
H --- I

↓

A = pZ

collission frequency

H H
I I

✗

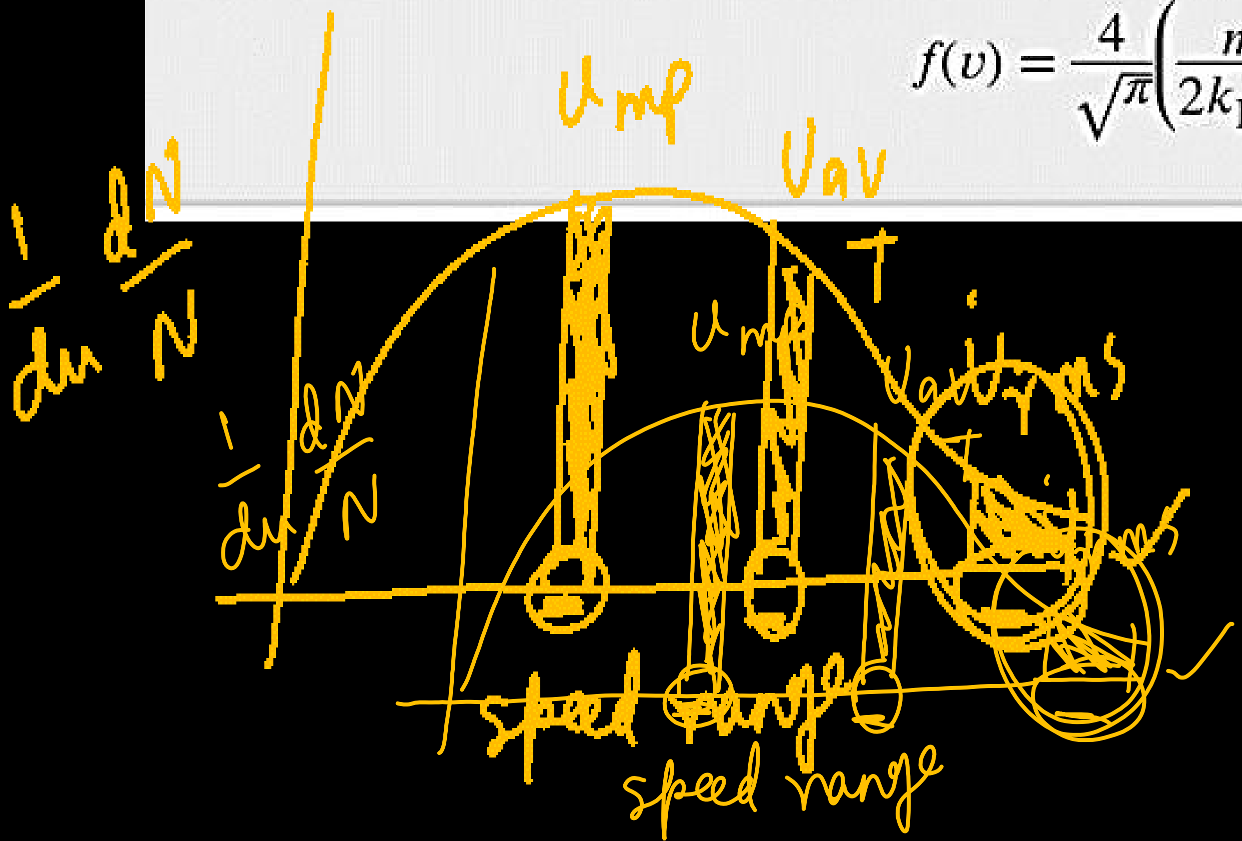
Collission with proper orientation

p = steric factor

MAXWELL-BOLTZMANN DISTRIBUTION OF SPEEDS

The distribution function for speeds of particles in an ideal gas at temperature T is

$$f(v) = \frac{4}{\sqrt{\pi}}\left(\frac{m}{2k_B T}\right)^{3/2} v^2 e^{(-mv^2/(2k_B T))}.$$



$U \propto \sqrt{T}$

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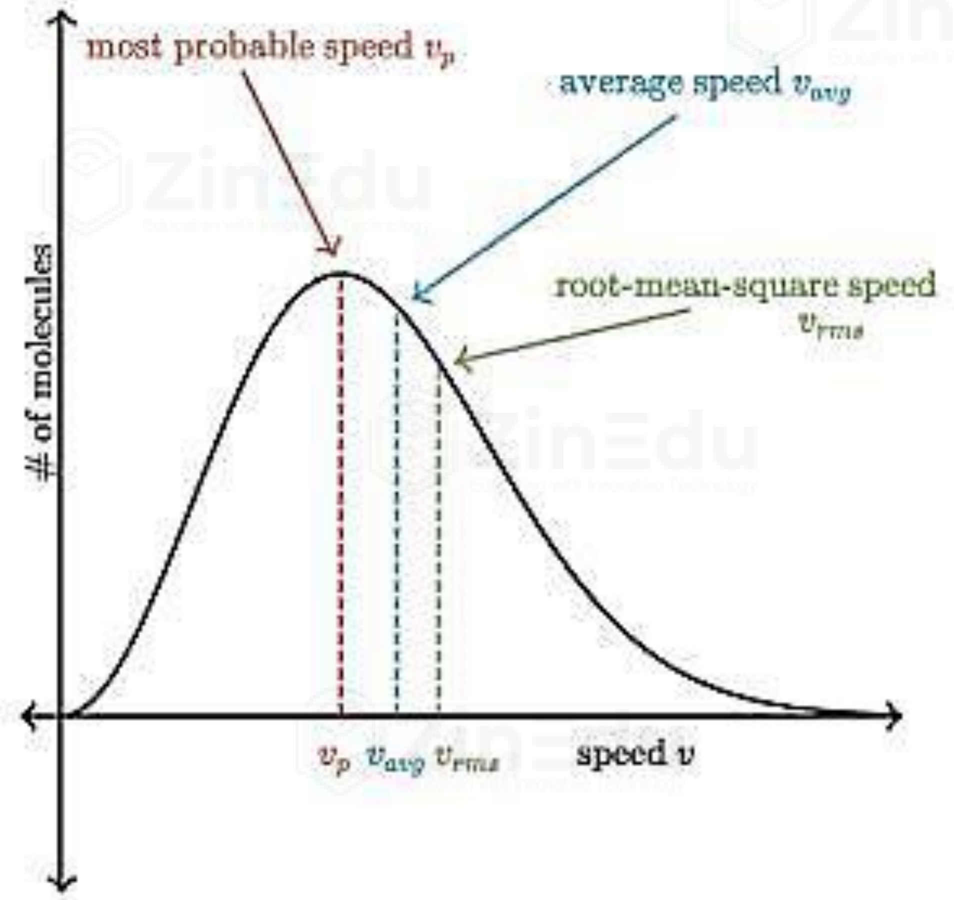
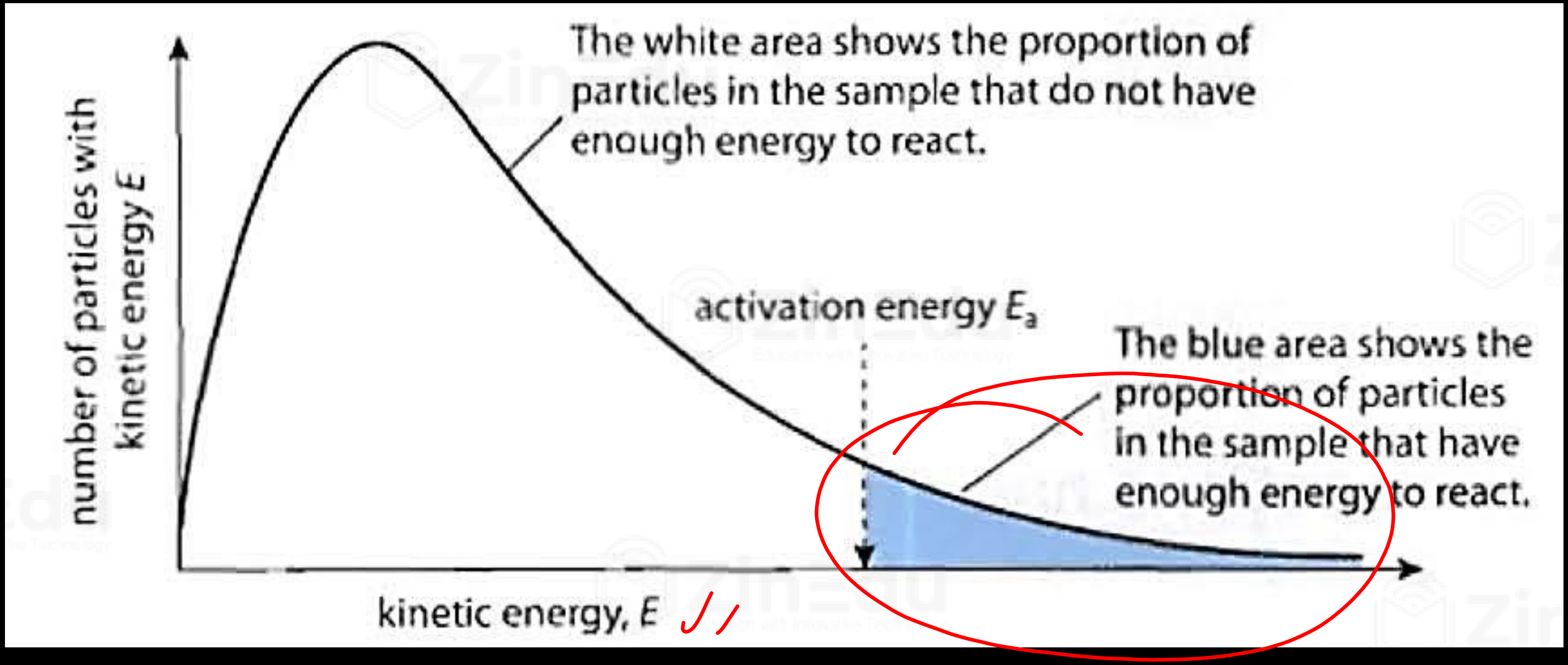

most probable speed v_p
average speed v_{avg}
root-mean-square speed v_{rms}
# of molecules
v_p v_{avg} v_{rms}
speed v



The white area shows the proportion of particles in the sample that do not have enough energy to react.
number of particles with kinetic energy E
activation energy E_a
The blue area shows the proportion of particles in the sample that have enough energy to react.
kinetic energy, E

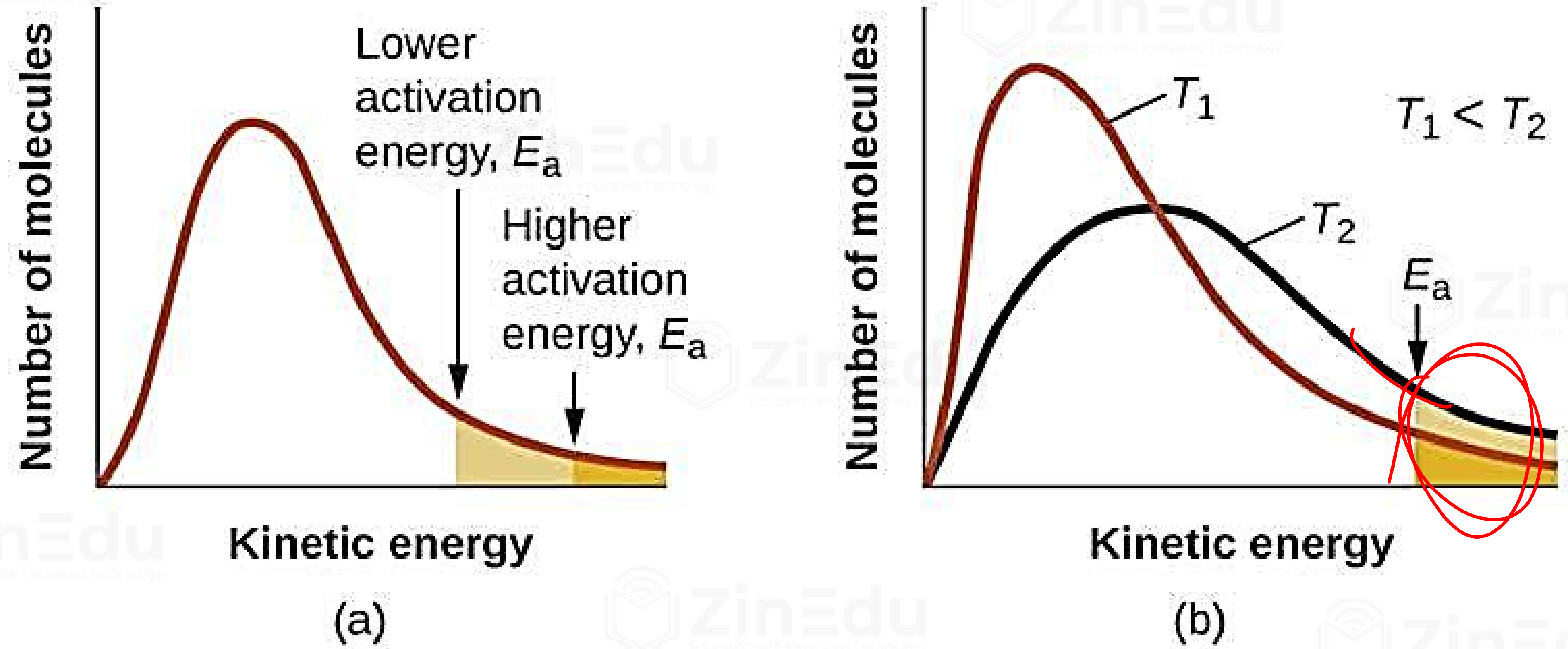
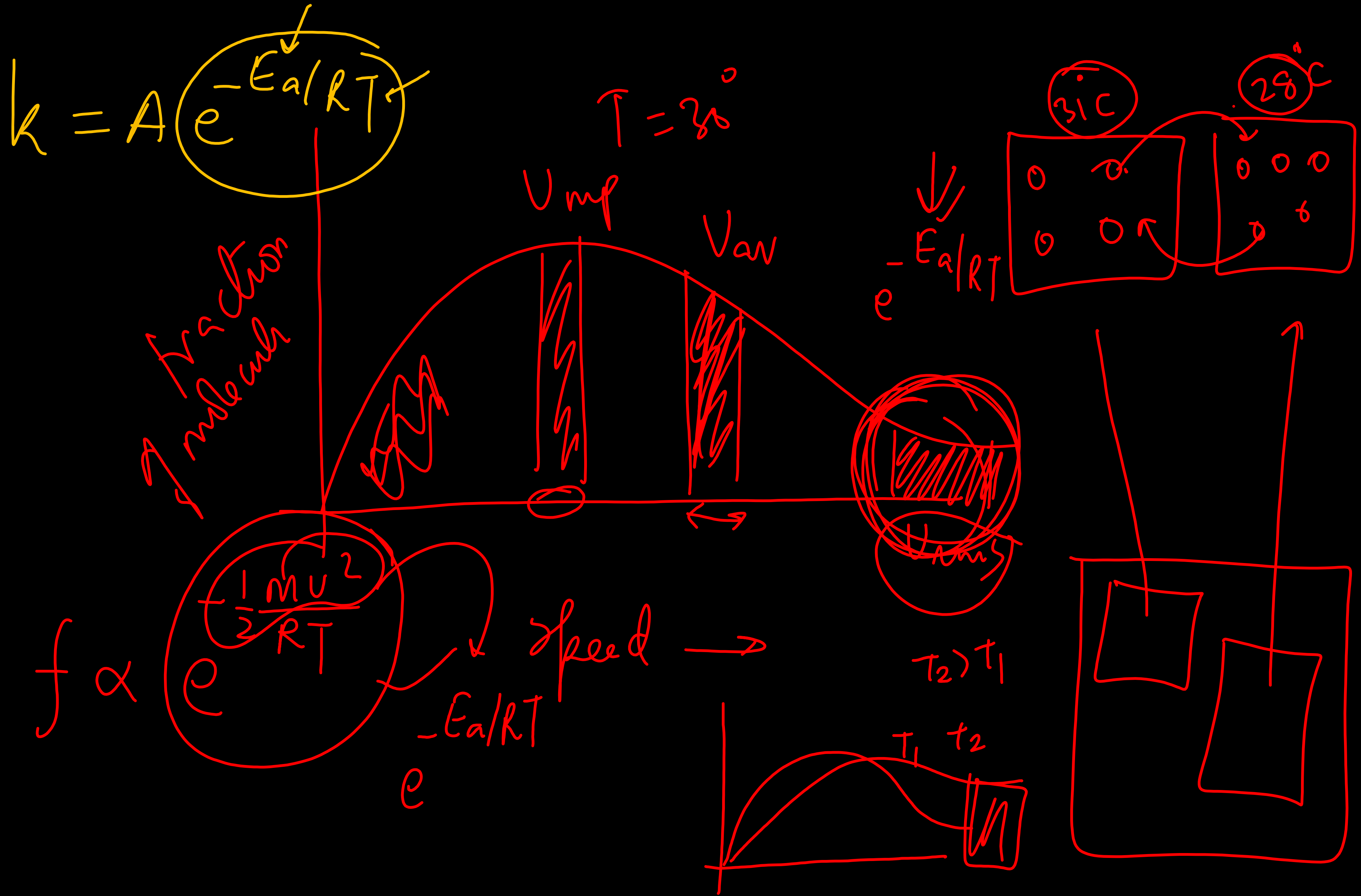


Figure 4. (a) As the activation energy of a reaction decreases, the number of molecules with at least this much energy increases, as shown by the shaded areas. (b) At a higher temperature, T_2, more molecules have kinetic energies greater than E_a, as shown by the yellow shaded area.


$k = A e^{-E_a/RT}$
$T = 30°$
U_{mp}
V_{av}
Fraction of molecule
$f \propto e^{-\frac{1}{2}mu^2/RT}$
speed →
$e^{-E_a/RT}$
U_{rms}
$e^{-E_a/RT}$
31°C
28°C
$T_2 > T_1$
T_1 T_2

$$k = A e^{-E_a/RT}$$

$$k = \frac{A}{e^{E_a/RT}}$$