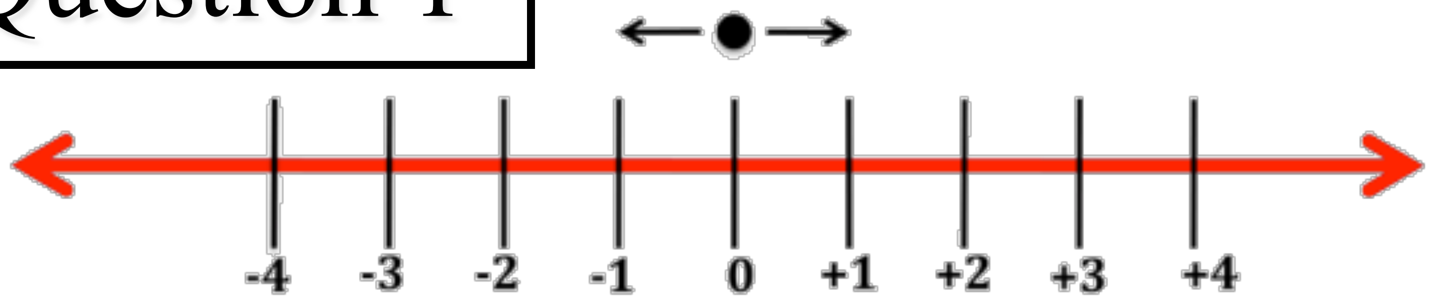
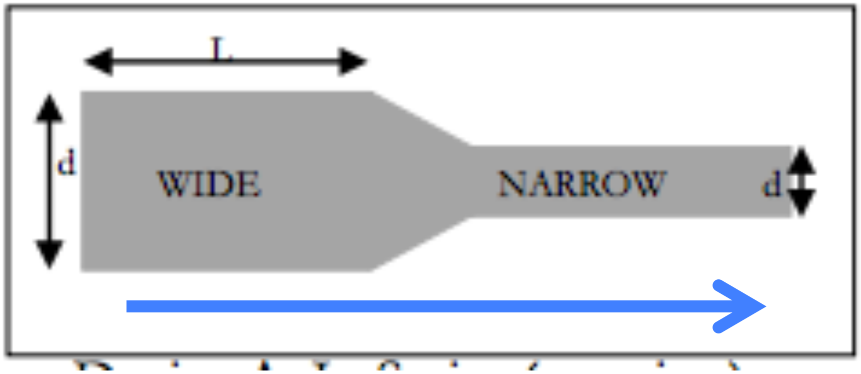
Q3 Question 1



A marker in a game is constrained to move along a one-dimensional grid. It begins at 0 and moves according to a coin flip: left for heads, right for tails. After 3 flips it will be either 1 step away from its starting point or 3. How much more likely is it to be 1 step away than 3 steps? (3 pts)

A. They are equally probable.
B. 3 steps away is three times as probable as 1 step.
C. 1 step away is three times as probable as 3 steps.
D. None of these are correct.

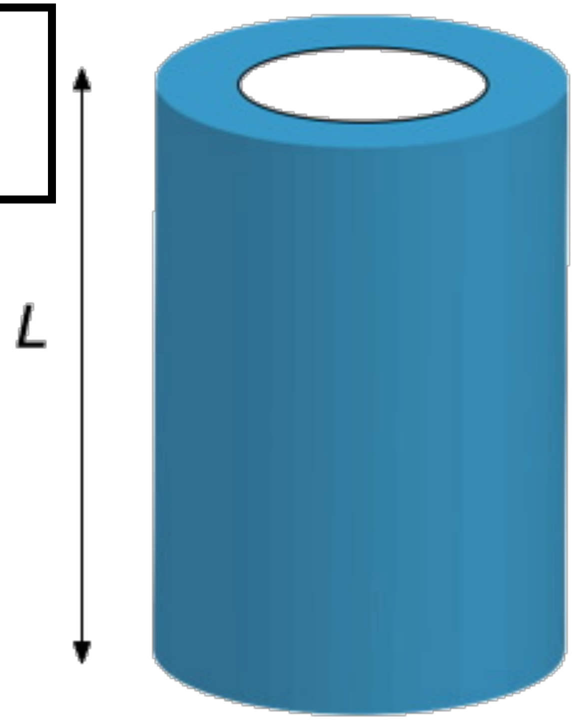
Q3 Question 2

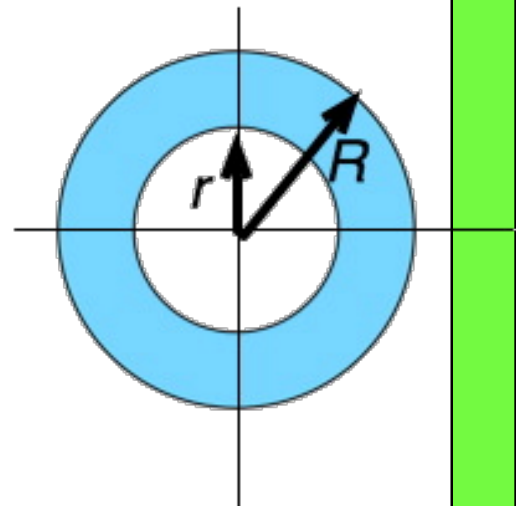


Fluid is flowing in the direction indicated by the blue arrow through a channel that has a wide and a narrow part in series. Is the volume of fluid crossing a plane perpendicular to the flow greater in the wide (W) or narrow (N) part? Is the speed of flow greater in the wide (W) or narrow (N) part? (3 pts)

A. Flow greater in W, speed greater in W.
B. Flow greater in W, speed greater in N.
C. Flow greater in N, speed greater in W.
D. Flow greater in N, speed greater in N.
E. Flow same in both, speed greater in N.
F. Flow same in both, speed greater in W.
G. Speed same in both, flow greater in N.
H. Speed same in both, flow greater in W.

Q3 Question 3





Which is the appropriate formula to use for the volume of a circular pipe given the indicated measurements? (2 pts)

$A.\ V = 2\pi rRL$

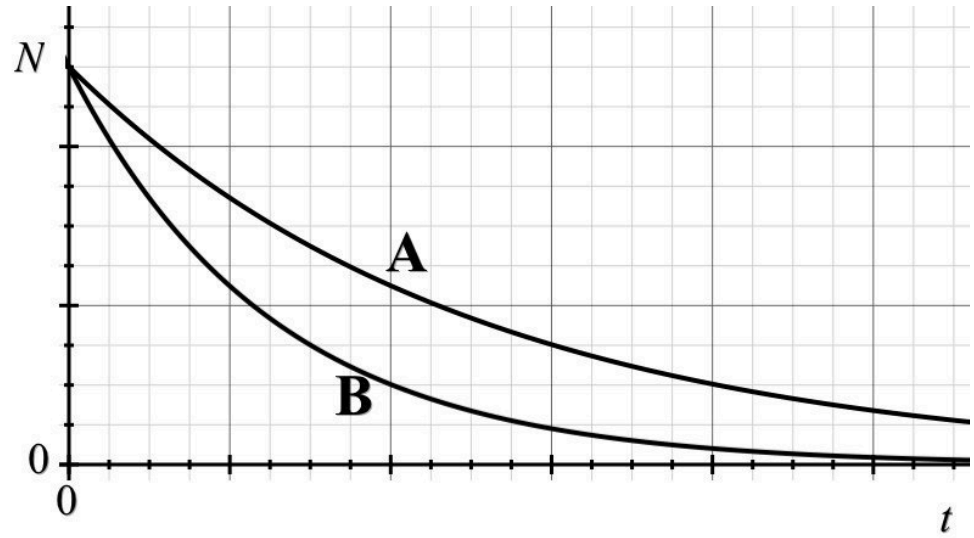
$B.\ V = \pi(R^2 - r^2)L$

$C.\ V = \pi(R^2 + r^2)L$

$D.\ V = \pi(R - r)^2 L$

$E.$ None of these work

Q3 Question 4



The number of atoms of a radioactive element decreases like

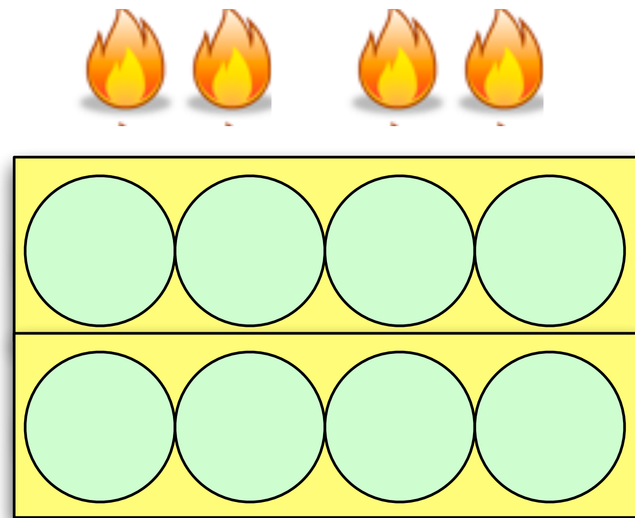
$$N(t) = N_0 e^{-\beta t}$$

where N_0 is the number of atoms at time t = 0 and β is a parameter with units of inverse time. Two radioactive materials start at t = 0 with the same number of atoms. The graphs show how their numbers fall. Which element has the larger value of β? (2 pts)

A. A
B. B
C. They are the same

Suppose I have two blocks of matter, each with 4 two-state “Degrees of Freedom” (bins in which to place energy that can only hold 1 energy packet).

I have 4 packets of thermal energy. How many ways are there to distribute the 4 packets to both blocks compared to the number of ways to distribute the 4 packets to one block ?

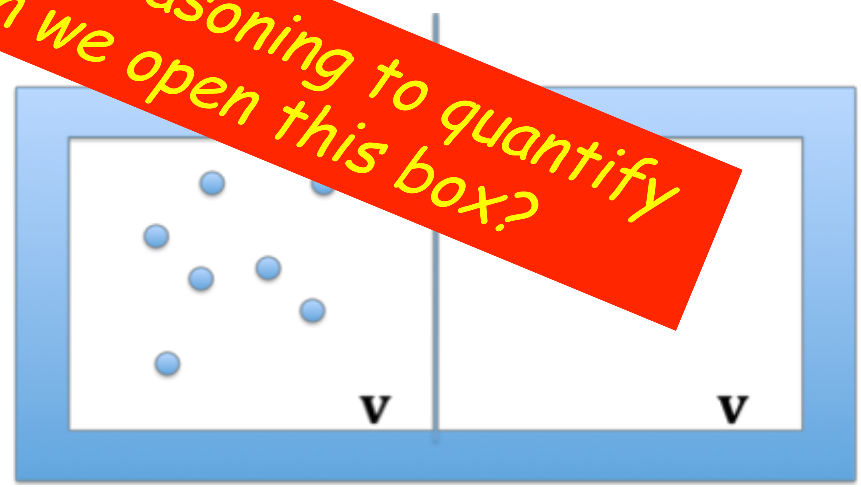


1. Twice as many
2. Four times as many
3. Sixteen times as many
4. More than sixteen times as many
5. There is not enough information to tell

Suppose an isolated box of volume $2V$ is divided into two equal compartments. An ideal gas occupies half of the container and the other half is empty. When the partition separating the two halves of the box is rem[illegible] and the system reaches equilibrium again, how [illegible] **entropy** of the gas compare to the entropy o[illegible]stem?

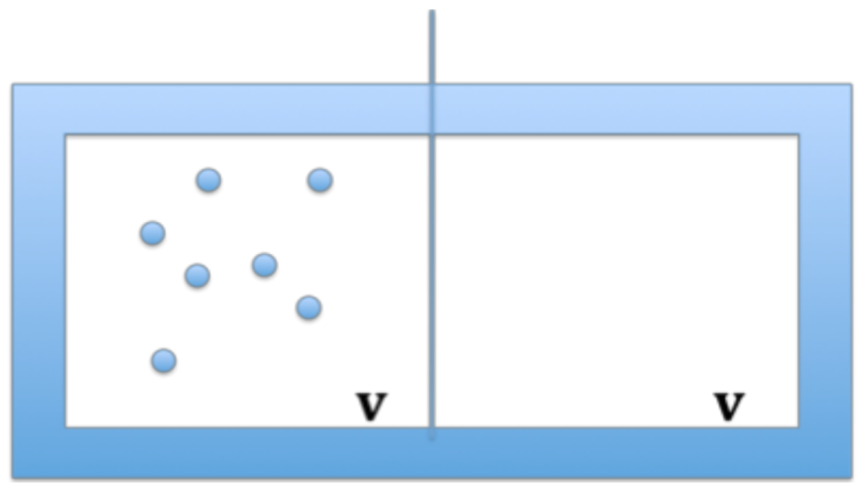
Can we use the same kind of reasoning to quantify the change in entropy when we open this box?

1. The entropy increases
2. The entropy decreases
3. The entropy stays the same
4. There is not enough information to determine the answer



Suppose an isolated box of volume $2V$ is divided into two equal compartments. An ideal gas occupies half of the container and the other half is empty. When the partition separating the two halves of the box is removed and the system reaches equilibrium again, how does the new **free energy** of the gas compare to the entropy of the original system?

1. The free energy increases
2. The free energy decreases
3. The free energy stays the same
4. There is not enough information to determine the answer



Which of the following sets of changes are **guaranteed** to produce a lower *G*, thereby making a process/reaction more likely to be spontaneous?

A. A negative ΔH
B. A positive ΔS
C. A negative ΔH and negative ΔS
D. A negative ΔH and positive ΔS
E. A positive ΔH and positive ΔS
F. A positive ΔH and negative ΔS
G. None of the above

Suppose a certain chemical reaction $AB \rightarrow CD$ is known to have a positive enthalpy change, and the reaction does not spontaneously take place at a temperature T_0. What can you say about the free energy change $\Delta G_{AB \rightarrow CD}$ at T_0?

1. $\Delta G \leq 0$
2. $\Delta G = 0$
3. $\Delta G \geq 0$
4. You can't say anything about ΔG

Suppose a certain chemical reaction AB→ CD is known to have a positive enthalpy change, and the reaction does <u>not</u> spontaneously take place at a temperature T_0. What can you say about whether is will take place at any other T?

1. It could take place at a higher T.
2. It could take place at a lower T.
3. If it doesn't take place at T_0, it won't take place at any T.
4. You can't say anything about other temps.