

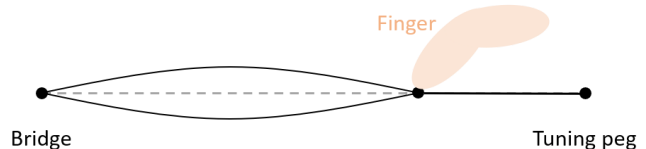
1. A violin is a musical instrument, which produces notes of specific pitch (frequency) using the vibration of a metal string. The violinist controls the pitch by pressing a finger down on the string, which effectively changes the length of the vibrating string.



Completely released

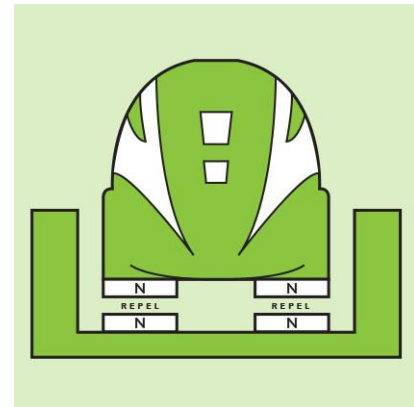


Controlled by violinist



The “A” string on a violin is roughly 330 mm long, and, when released completely, produces a frequency of 440 Hz. Given that the note D is 587.3 Hz, what is the distance between the bridge and the finger at the note D?

- A. 210 to 230 mm
 - B. 230 to 250 mm
 - C. 250 to 280 mm
 - D. 280 to 310 mm
2. The maglev train is a special type of high-speed train, which uses electromagnets to levitate the train over the tracks. Thanks to the complete lack of friction, maglev trains are able to achieve very high speeds.



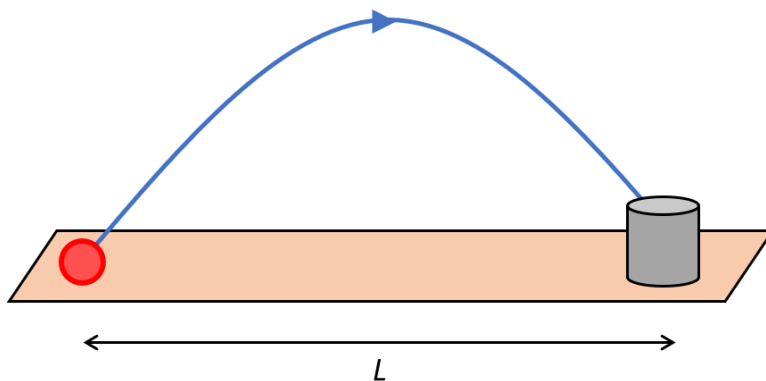
Let us study how the train levitates. There are permanent magnets on the bottom of the train, and electromagnets on the tracks. By providing power to the electromagnets, they generate a magnetic field, thus repelling the permanent magnets and applying an upwards force on the train. Because the magnetic field is stronger at shorter distances, **for the same amount of power, the repulsion is stronger when the train is lower**, and weaker when the train is higher.

Imagine a train that is levitating; the power of the electromagnets is perfectly tuned, so that the train is hovering stationarily at a specific height. Suddenly, the power is decreased by a very small amount.

What happens?

- A. The train will initially accelerate downwards, and then oscillate around a lower height.
- B. The train will continuously accelerate downwards.
- C. The train will initially accelerate downwards, and then oscillate around the original height.
- D. The train will immediately move downwards at constant speed.

3. A ball with mass m is thrown into a basket, at a distance L away.



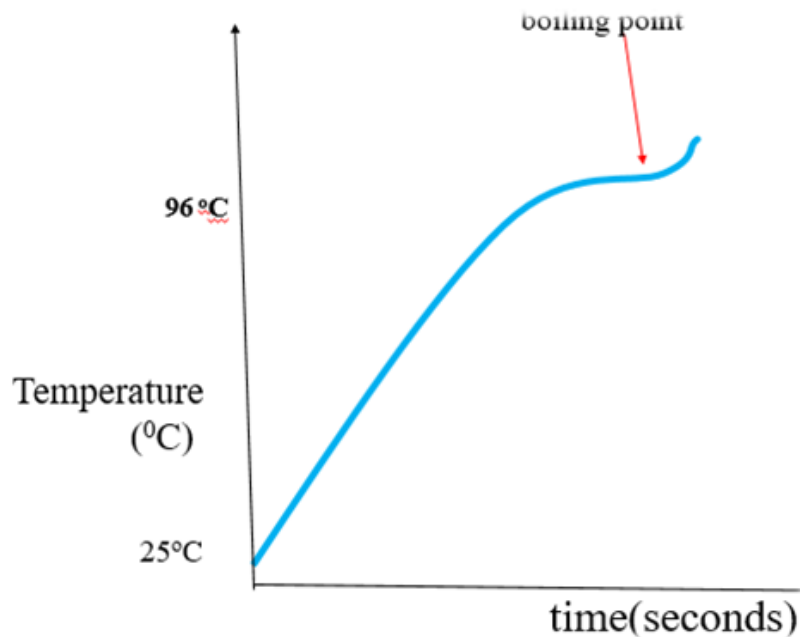
What is the **minimum** amount of kinetic energy needed to achieve this?

- A. mgL
- B. $2 mgL$
- C. $\frac{1}{2}mgL$
- D. 0

4. Diffusion at higher temperatures is faster. This means that the speed of movement of molecules and temperature are related. When the temperature rises, the speed of movement of the molecules increases; when the temperature is low, it decreases.

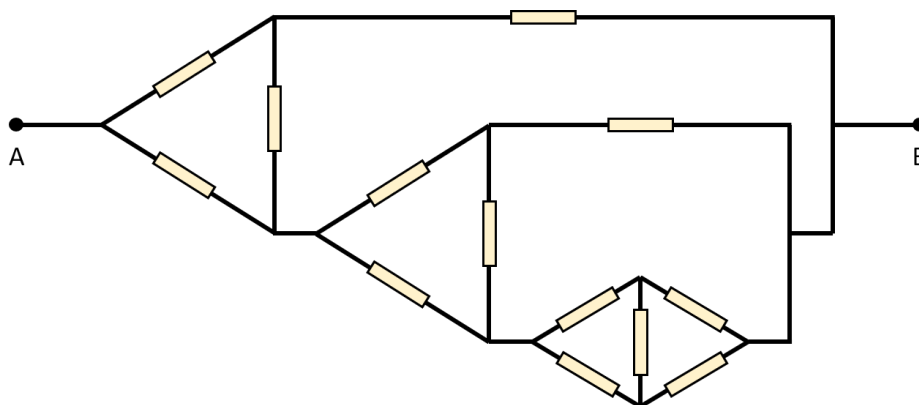
Consequently, the body temperature depends on the speed of movement of the molecules.

Fig 1.0 is the graph of temperature against time.



What of the following is correct?

- A. Molecules and their movement are dependent on time
 - B. Graph rises because temperature is rising
 - C. Temperature increases because someone increases them.
 - D. When the temperature rises, the speed of movement of the molecules increases.
5. Consider the circuit below. All resistors have the same resistance R .



What is the total resistance between points A and B?

(Hint: it is unwise to 'solve' the entire circuit in one go; see if you can identify a simpler subunit, and solve that first.)

- A. R
- B. $4R$
- C. $0.5R$
- D. $13R$

Answers

- 1. B
- 2. A
- 3. C
- 4. D
- 5. A