Answers experiments contest

1. A burning candle is placed in a closed jar.

What will happen if you drop the jar?

    A. the flame stops burning immediately
    B. the flame stops burning when all oxygen is used
    C. the flame will float in the middle of the jar.

Correct answer: A

Explanation: While it is falling, the system inside the jar is in a weightless environment, so convection currents cease. In normal burning, the hot air rises by convection, allowing cooler air containing more oxygen to continuously feed the fire. Without these convection currents the candle immediately goes out.

2. A bullet is shot trough a raw egg.

What will happen to the egg?

    A. there is a small hole in the egg
    B. the egg explodes into all directions

Correct answer: B

Explanation: This is a nice application of Pascal's principle, which is usually stated: Pressure applied to an enclosed fluid is transmitted undiminished to every portion of the fluid and to the walls of the containing vessel.

3. Two identical balls are rolling downhill a small and a wide gutter.

What will happen with the two balls?

    A. the one in the small gutter will be first
    B. the one in the wide gutter will be first
    C. they will finish in the same time

Correct answer: A

Explanation: One ball ('A') rolls with a larger radius than the other ('B'). So 'A' makes less rotations along the ramp than 'B'. That's why ball 'A' needs a smaller part of the available potential energy for its rotation to reach the end of the track and so more energy is available for its translation.

$E_{pot}=E_{transl}+E_{rot}$.

$E_{transl}=1/2mv^2$; $E_{rot}=1/2I\omega^2$, with $I=2/3mR^2$ (thin-walled hollow sphere).

When a ball rolls down the gutter, then $v=\omega r$ (r being the radius of rotation) and we find:

$E_{transl}/E_{rot}=(3/2)(r^2/R^2)$.

When the gutter is very narrow, $r=R$ and $E_{transl}/E_{rot}=3/2$. So 60% of the pot. energy is transformed in translation of the ball and 40% in rotation.

Our wider gutter has dimensions such that $r=1/2R$, and so $E_{transl}/E_{rot}=3/8$. Now 27% of the pot. energy is transformed into translation of the ball and 73% in rotation.

Comparing these two rolling balls, ball 'A' obtains 2.2 times as much energy for its translation as ball 'B' does. This means that ball 'A' has at the end of the gutter a transl. speed almost 50% higher than ball 'B' ($2.2^{1/2}=1.48$). Then the time ball 'B' needs to travel along the gutter will also be 50% higher.

4. The left half of a wheel with rubber spokes is illuminated with a bright light?

What will happen to the wheel after some time?

> A. nothing
> B. the wheel turns clockwise
> C. the wheel turns counter clockwise

Correct answer: B

Explanation: Theoretic background

When expanding the rubber, the work is partially converted in thermal energy. If the expanded rubber is heated, the process reverses: The rubber absorbs the heat and contracts.

Detailed explanation

When the rubber is expanded, the long molecular chains are transformed from a angulated into a linear shape. Now the Brownian motion is less and heat is emitted.

When the rubber is heated, the molecular chains' motion increases, the molecular chains transform from the linear shape to an angulated shape and the rubber contracts.

So if the left half of the wheel is heated, the rubber spokes on the left half are contracting and more of the mass of the wheel comes to the right side of the axis. This makes the wheel 'falling' continuously clockwise.

5. In a glass we pour some drops of a secret liquid. If we add now blue ink into the glass, the ink becomes colourless.

What's the name of the secret liquid?

> A. sodium hypochlorite
> B. phenolphthalein
> C. hydrochloric acid

Correct answer: A

Explanation: Ink contains strongly coloured organic molecules. Such molecules are characterized by a relatively long sequence of alternating double and single bonds. The strongly oxidizing hypochlorite will destroy the double bonds (as these are electron rich, which means they can easily be oxidized by hypochlorite) and consequently also the long sequence of double and single bonds which is necessary for the colour. Thus, the colour disappears.

Name:
School:

Correct answers:
1.A   2.B   3.A   4.B   5.A