READING COMPREHENSION

GALILEO, NEWTON, EINSTEIN

The geometry collected together by Euclid (who lived between the fourth and third centuries B.C.) in his *Elements* remains practically intact to this day.

Mathematics has gradually evolved over the centuries, but its fundamentals have never changed.

In the transition between the ancient and the modern world, however, physics has been completely revolutionised and rebuilt from scratch. What the ancients understood about the structure of the Universe, about the motion of bodies or about forces is very different from what we understand today.

There were primarily two authors of this profound rethinking: Galileo and Newton.

The first, resting on Kepler's ideas, attacked the fundamentals of Aristotelian physics. With his observations and his brilliant experiments he disproved the ancient beliefs and laid the foundations of the new science.

In the same year that Galileo died, 1642, Newton was born.

Newton did not have the experimental talents of Galileo, but he possessed an unparalleled mathematical genius. Over the years, he invented and refined the necessary mathematical tools and then used them to unite all the known laws of physics in an exceptional theoretical structure: universal gravitation. This theory provided explanations of diverse phenomena using the same principles: phenomena such as the motions of the planets, forces on Earth, and the laws of Kepler and Galileo. The mechanics we study in this book is still that of Newton, starting with the three laws of dynamic motion.

For centuries no one dared to question it, even if at time some calculations did not add up and some experiments did not produce the expected results. Then, at the beginning of the twentieth century, an unknown patent office clerk in Bern named Albert Einstein began publishing a series of works that culminated in 1915 with the general theory of relativity.

The immense new theory didn't invalidate Newton's mechanics, but looked on it as a special case of more extensive laws. As long as speeds are low and energies limited, Newton's theory works fine, but if we approach the speed of light and the energy of stars, then we have to resort to Einstein's theory.

You can read the first chapter of the book *Sette brevi lezioni di Fisica* by Carlo Rovelli (ed. Adelphi) to learn more about Einstein's theory of relativity.

EXERCISES

1 **True or false?**

a. Galileo and Newton collaborated with each other in their scientific studies. T F

b. With his observations and his brilliant experiments, Kepler disproved the fundamentals of Aristotelian physics and laid the foundations of the new science. T F

c. Albert Einstein published his general theory of relativity in 1905. T F

2 **Complete with:**

Kepler • general • special • speeds • phenomena • limited • invalidate • Newton • theoretical • principles • mathematical • planets

_____ invented and refined the necessary _____ tools he used to unite all the laws of physics of the time in his exceptional _____ structure: universal gravitation. This theory provided explanations of diverse _____ using the same _____: phenomena such as the motions of the _____, forces on Earth, and the laws of _____ and Galileo. Albert Einstein's _____ theory of relativity did not _____ Newton's mechanics, but looked on it as a _____ case of more extensive laws. As long as _____ are low and energies _____, Newton's theory works fine.

3 **Match questions and answers.**

QUESTIONS	ANSWERS
A. Whose three laws of motion are used in this book and why?	1. Yes, Newton's theory can be considered as a particular case of the general theory of relativity at low speeds and limited energies.
B. Is Newtonian mechanics compatible with Einstein's general theory of relativity?	2. Galileo and Newton thought that objects have a natural tendency to resist changes in their state of motion (inertia) whereas before them the belief was that objects have a natural tendency to come to a rest position.
C. What idea about motion and force did Galileo and Newton share that was so different than their predecessors?	3. They are Newton's laws: taken together they fully describe non-relativistic dynamic motion.

A. _____ B. _____ C. _____