ВИДЫ ДВИЖЕНИЯ, ОБЪЯСНЯЮЩИЕ РАБОТУ МЕХАНИЗМОВ

Task 1

Прочитайте текст, объясняющий понятие движения в физике.

Motions

In physics, motion is a change in position of an object with respect to time. Motion is typically described in terms of velocity, acceleration, displacement, and time. Motion is observed by attaching a frame of reference to a body and measuring its change in position relative to another reference frame.

A body which does not move is said to be *at rest*, *motionless*, *immobile*, *stationary*, or to have constant (time-invariant) position. An object's motion cannot change unless it is acted upon by a force, as described by Newton's first law. An object's momentum is directly related to the object's mass and velocity, and the total momentum of all objects in a closed system(one not affected by external forces) does not change with time, as described by the law of conservation of momentum.

As there is no absolute frame of reference, *absolute motion* cannot be determined. Thus, everything in the universe can be considered to be moving.

More generally, the term motion signifies a continuous change in the configuration of a physical system. For example, one can talk about motion of a wave or a quantum particle (or any other field) where the configuration consists of probabilities of occupying specific positions.

Task 2

Прочитайте текст, раскрывающий содержание законов Ньютона.

Laws of motions

Mechanics

In physics, motion in the universe is described through two sets of apparently contradictory laws of mechanics. Motions of all large scale and familiar objects in the universe (such as projectiles, planets, cells, and humans) are described by classical mechanics. Whereas the motion of very small atomic and sub-atomic objects is described by quantum mechanics.

Classical mechanics

Classical mechanics is used for describing the motion of macroscopic objects, from projectiles to parts of machinery, as well

as astronomical objects, such as spacecraft, planets, stars, and galaxies. It produces very accurate results within these domains, and is one of the oldest and largest subjects in science, engineering, and technology.

Classical mechanics is fundamentally based on Newton's Laws of Motion. These laws describe the relationship between the forces acting on a body and the motion of that body. They were first compiled by Sir Isaac Newton in his work *Philosophiæ Naturalis Principia Mathematica*, first published on July 5, 1687. These three laws are:

1. In the absence of a net external force, a body either is at rest or moves with constant velocity.
2. The net external force on a body is equal to the mass of that body times its acceleration; $F = ma$. Alternatively, the acceleration is directly proportional to the force causing it, and inversely proportional to the mass.
3. Whenever one body exerts a force F onto a second body, the second body exerts the force −F on the first body. F and −F are equal in magnitude and opposite in sense.

Newton's three laws of motion, along with his law of universal gravitation, explain Kepler's laws of planetary motion, which were the first to accurately provide a mathematical model or understanding orbiting bodies in outer space. This explanation unified the motion of celestial bodies and motion of objects on earth.

Classical mechanics was later further enhanced by Albert Einstein's special relativity and general relativity. Special relativity explains the motion of objects with a high velocity, approaching the speed of light; general relativity is employed to handle gravitation motion at a deeper level.

Task 3

Прочитайте текст, раскрывающий содержание природы движения с точки зрения теории квантовой механики и кинематики.

Quantum mechanics

Quantum mechanics is a set of principles describing physical reality at the atomic level of matter (molecules and atoms) and the subatomic (electrons, protons, and even smaller particles). These descriptions include the simultaneous wave-like and particle-like behavior of both matter and radiation energy, this described in the wave–particle duality.

In contrast to classical mechanics, where accurate measurements and predictions can be calculated about location and velocity, in the quantum mechanics of a subatomic particle, one can never specify its state, such as its simultaneous location and velocity, with complete certainty (this is called the Heisenberg uncertainty principle).

In addition to describing the motion of atomic level phenomena, quantum mechanics is useful in understanding some large scale phenomenon such as superfluidity, superconductivity, and biological systems, including the function of smell receptors and the structures of proteins.

Kinematics

Kinematics applies geometry to the analysis of movement, or motion, of a mechanical system.

Task 4

Прочтите текст о каждом виде движения. Выпишите краткую характеристику каждого вид движения. Приведите примеры из текста и свои собственные, в которых можно наблюдать разные виды движения.

1. Linear motion (rectilinear motion) – motion which follows a straight linear path, and whose displacement is exactly the same as its trajectory.

2. Reciprocating (i.e. vibration)

3. Rotary motion – a motion about a fixed point. (e.g. Ferris wheel).

4. Oscillation or simple harmonic motion – (e.g. pendulum).

We can also say about:

- Brownian motion (i.e. the random movement of particles)
- Circular motion (e.g. the orbits of planets)
- Rolling motion - (e.g. the wheel of a bicycle)

Four basic types of motions

Linear motion

Linear motion (also called rectilinear motion) is motion along a straight line, and can therefore be described mathematically using only one spatial dimension. The linear motion can be of two types: uniform linear motion, with constant velocity or zero acceleration; non uniform linear motion, with variable velocity or non-zero acceleration. The motion of a particle (a point-like object) along a line can be described by its position x, which varies with t (time).

Linear motion is the most basic of all motion. According to Newton's first law of motion, objects that experience no net force will continue to move in a straight line with a constant velocity until they are subject to a net force. Under everyday circumstances, external forces such as gravity and friction can cause an object to change the direction of its motion, so that its motion cannot be described as linear

One may compare linear motion to general motion. In general motion, a particle's position and velocity are described by vectors, which have a magnitude and direction. In linear motion, the directions of all the vectors describing the system are equal and constant: objects move along the same axis and do not change direction. The analysis of such systems may therefore be simplified by neglecting the direction components of the vectors involved and dealing only with the magnitude.

Neglecting the rotation and other motions of the Earth, an example of linear motion is that of a ball thrown straight up and falling back straight down.

Reciprocating motion

Reciprocating motion, also called reciprocation, is a repetitive up-and-down or back-and-forth motion. It is found in a wide range of mechanisms, including reciprocating engines and pumps. The two opposite motions that comprise a single reciprocation cycle are called strokes.

A crank can be used to convert circular motion into reciprocating motion, or conversely turn reciprocating motion into circular motion.

For example, inside an internal combustion engine (a type of reciprocating engine), the expansion of burning fuel in the cylinders periodically pushes the piston down, which, through the connecting rod, turns the crankshaft. The continuing rotation of the crankshaft drives the piston back up, ready for the next cycle. The piston moves in a reciprocating motion, which is converted into circular motion of the crankshaft, which ultimately propels the vehicle or does other useful work. The vibrations felt when the engine is running are a side effect of the reciprocating motion of the pistons.

Reciprocating motion is clearly visible in early steam engines, particularly horizontal stationary engines and outside-cylindered steam locomotives, as the crank and connecting-rod usually are not enclosed.

Mathematically, reciprocating motion is approximately sinusoidal simple harmonic motion. Technically, however, the reciprocating motion produced by a rotating crank departs slightly from simple harmonic motion due to the changing angle of the connecting rod during the cycle.

Rotation

Rotation around a fixed axis is a special case of rotational motion. The fixed axis hypothesis exclude the possibility of a moving axis, and cannot describe such phenomena. According to Euler's rotation theorem, simultaneous rotation around

more than one axis at the same time is impossible. If two rotations are forced at the same time, a new axis of rotation will appear.

Oscillation

Oscillation is the repetitive variation, typically in time, of some measure about a central value (often a point of equilibrium) or between two or more different states. Familiar examples include a swinging pendulum and AC power. The term vibration is sometimes used more narrowly to mean a mechanical oscillation but sometimes is used to be synonymous with "oscillation". Oscillations occur not only in physical systems but also in biological systems and in humansociety.

Чтение – просмотр содержания текста

Просмотр – это лучший способ чтения при поиске информации в тексте. Перемещая глаза сверху вниз по тексту, вы находите слова или словосочетания, которые вас интересуют. Одновременно, вы имеете возможность пропускать не интересующую вас информацию.

Task 11

Прочтите и самостоятельно переведите текст со словарем.

Imperceptible human motions

Humans, like all things in the universe are in constant motion, however, aside from obvious movements of the various external body parts and locomotion, humans are in motion in a variety of ways which are more difficult to perceive. Many of these "imperceptible motions" are only perceivable with the help of special tools and careful observation. The larger scales of "imperceptible motions" are difficult for humans to perceive for two reasons: 1) Newton's laws of motion (particularly Inertia) which prevent humans from feeling motions of a mass to which they are connected, and 2) the lack of an obvious frame of reference which would allow individuals to easily see that they are moving. The smaller scales of these motions are too small for humans to sense.