


Physics		Lesson #18	
Topic of the lesson: Закон сохранения импульса. Conservation of momentum		Aktobe	
Date:		Teacher name: Makarova Y.G.	
CLASS: 10		Number present:	Absent:
Learning objectives(s) that this lesson is contributing to	10.1.4.1 -применять законы сохранения при решении расчетных и экспериментальных задач; 10.1.4.1- apply law of conservation of momentum and energy for solving analytical and experimental problems.		
Lesson objectives	Learners know: - the concepts of momentum; - the principle of conservation of momentum; Learners can: - use the principle of conservation of momentum to explain		
Language objective	- Pronounce the words on the theme. - To act out a dialogue. - Understand some factual questions on the theme. - To ask and answer the questions on the theme in pairs.		
	Key words and phrases: to interact, collision, linear momentum, the law of conservation of momentum, inelastic collision, elastic collisions, common momentum.		
Previous learning	Knowledge from the course of physics class 9: Newton's second law of motion; how to calculate acceleration; the concept of force and its unit; the concept of force and its unit, explain the relationship between force impulse and change in momentum; apply the principle of conservation of momentum, describe the concept of momentum.		
Necessary equipment and devices	Computer, video projector, presentation, information from the textbook.		
Plan			
Planned timings	Planned activities		Resources
Start Warm up. Evaluation of the studied	Good morning, children. I'm glad to see you. Sit down, please. Let's check your home task. Today we begin to study a new section called «Energy and momentum». The topic of our lesson "Conservation of momentum".		p.72 Slide 1
Driving questions motivating students' interest			p.72
Reading, pronunciation, writing terminology	to interact [ɪntər'ækt] - взаимодействовать collision [kə'lɪʒən] - соударение		Vocabulary Slide 2

Middle
Text revealing the main theme

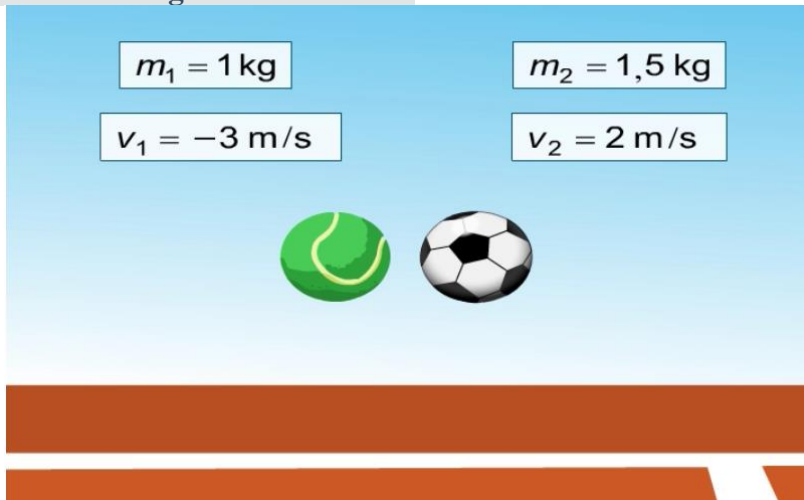
Linear momentum is defined as the product of a system's mass multiplied by its velocity:

Линейный импульс определяется как произведение массы системы на ее скорость:

$$\vec{p} = m\vec{v}$$

<https://bilimland.kz/en/courses/physics-en/mechanics/dynamics/lesson/momentum>

Positive and negative momentum



Application of IT resources

Video

Collisions

The law of conservation of momentum states that, in the absence of external forces, when two or more objects collide with each other, the total momentum before the collision is equal to the total momentum after the collision.

Столкновения

Закон сохранения импульса гласит, что при отсутствии внешних сил, когда два или более объектов сталкиваются друг с другом, суммарный импульс до столкновения равен суммарному импульсу после столкновения.

1. Inelastic collision

Inelastic collision is a collision in which momentum is conserved but kinetic energy is not. Completely inelastic collision is a collision in which colliding objects stick together after collision, Figure 31.

Неупругое столкновение

Неупругое столкновение-это столкновение, при котором сохраняется импульс, но не сохраняется кинетическая энергия. Полностью неупругое столкновение-это столкновение, при котором сталкивающиеся объекты слипаются после столкновения, рис.31.

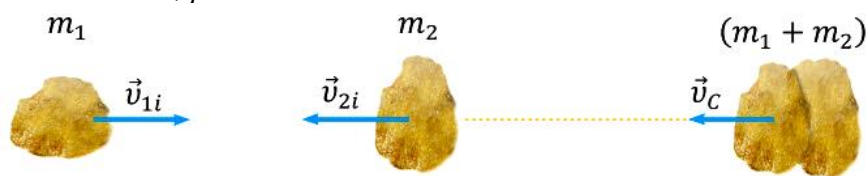


Figure 31

Slide 3

If the law of conservation of momentum is applied to this collision,

$$\vec{p} + \vec{p}_2 = \vec{p}_c$$

where p_1 and p_2 are the momenta of the particles before collision and p_c is the common momentum after collision.

$$m_1\vec{v}_1 + m_2\vec{v}_2 = (m_1 + m_2)\vec{v}_c$$

Since velocity is a vector quantity, the signs of the velocities representing directions must be taken into account. In solving problems, first positive and negative directions must be established, and then the values of velocities must be substituted into the equation along with their signs.

Поскольку скорость является векторной величиной, то необходимо учитывать знаки скоростей, представляющих направления. При решении задач сначала должны быть установлены положительные и отрицательные направления, а затем значения скоростей должны быть подставлены в уравнение вместе с их знаками.

2. Elastic collision

$$m_1\vec{v}_{1i} + m_2\vec{v}_{2i} = m_1\vec{v}_{1f} + m_2\vec{v}_{2f}$$

$$\frac{m_1v_{1i}^2}{2} + \frac{m_2v_{2i}^2}{2} = \frac{m_1v_{1f}^2}{2} + \frac{m_2v_{2f}^2}{2}$$

Collisions in which both momentum and kinetic energy are conserved are called elastic collisions, Figure 32.

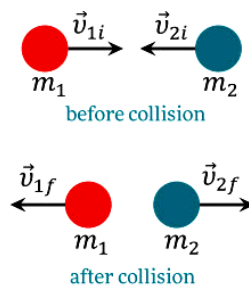


Figure 32

v_{1i} and v_{2i} are velocities before collision (initial), v_{1f} and v_{2f} are velocities after collision (final). After simplification of equations we will obtain:

$$\vec{v}_{1i} + \vec{v}_{1f} = \vec{v}_{2i} + \vec{v}_{2f}$$

As in the inelastic collisions, first the signs for the negative and positive directions must be established, then the values of the velocities must be substituted into the equations with these signs, Figure 33.

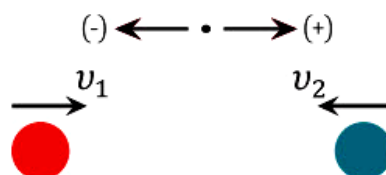
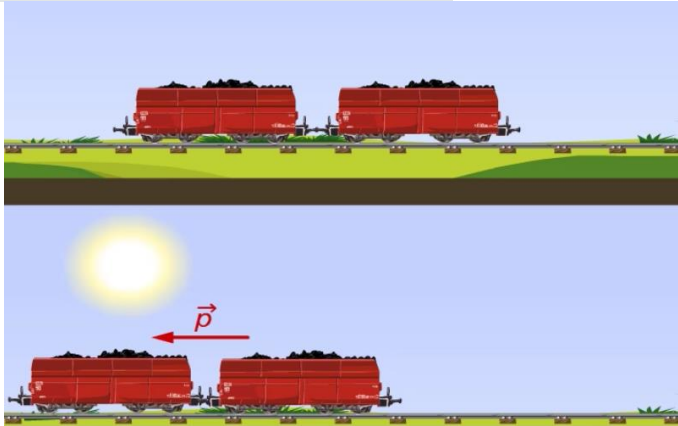

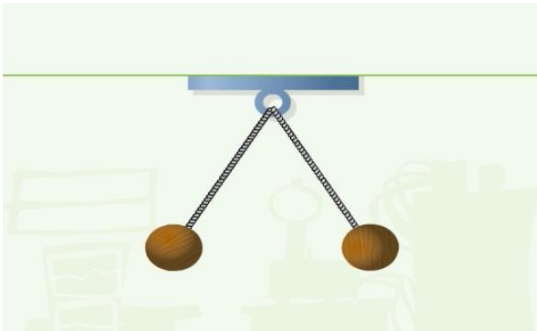
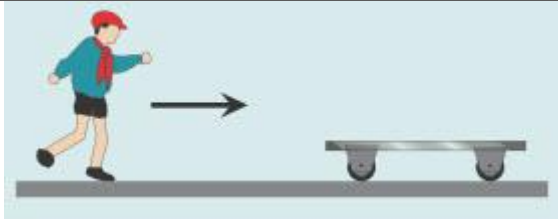


Figure 33

Slide 4

Application
of IT
resources

	<p>Как и в случае неупругих столкновений, сначала должны быть установлены знаки для отрицательного и положительного направлений, затем значения скоростей должны быть подставлены в уравнения с этими знаками, рис. 33.</p> <p>https://bilimland.kz/en/courses/physics-en/mechanics/dynamics/lesson/momentum</p> <p>Momentum before and after the collision</p> 	Video
Questions for fixing the material	<p>https://bilimland.kz/en/courses/physics-en/mechanics/dynamics/lesson/momentum</p> <p>Check how balls which are made of different substances, will collide.</p>  	Video
Important note	Apply conservation of momentum to an isolated system only.	p.73
Career	<p>Professional billiard players are probably the best in the world at understanding conservation of momentum.</p> <p><i>Профессиональные бильярдисты, пожалуй, лучшие в мире в понимании сохранения импульса.</i></p>	p.72
Questions with detailed solutions	<p>Example</p> <p>30 kg child runs with velocity of 4 m/s and jumps on 20 kg stationary cart. What is the velocity of child and cart?</p>	p.73



Given:

$$m_1 = 30kg$$

$$v_1 = 4m / s$$

$$v_2 = 0$$

$$m_2 = 20kg$$

$$v - ?$$

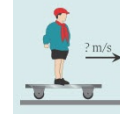
Solution

$$p = mv$$

$$\vec{P}_{before} = \vec{P}_{after}$$

$$m_1v_1 + m_2v_2 = (m_1 + m_2)v_c$$

$$v_c = \frac{m_1v_1 + m_2v_2}{m_1 + m_2} = \frac{30 \cdot 4 + 20 \cdot 0}{30 + 20} = 2.4m / s$$



Physics in life

Air bags in automobiles can minimise the effect of the force on human involved in a collision. Air bags accomplish this by extending the time required to stop the motion of the driver and passenger.

p.73

Подушки безопасности в автомобилях могут свести к минимуму воздействие силы на человека, участвующего в столкновении. Подушки безопасности выполняют это, удлинняя время, необходимое для остановки движения водителя и пассажира.



Is it true?

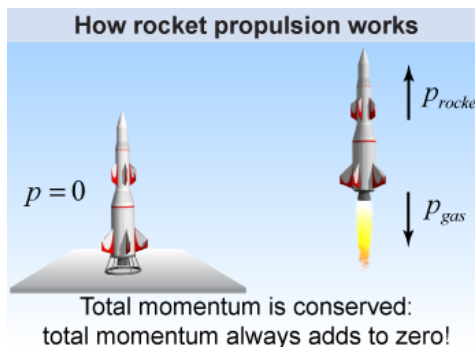
Conservation of momentum is used to rockets. Expressed as percentages, of the rocket is fuel, while payload, engines, fuel tanks, and other components make up only 1.10%.


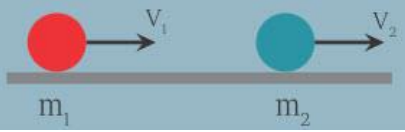



design 98.9%

p.73
Slide 5

Сохранение импульса используется при проектировании ракет. Выраженный в процентах, 98,9% ракеты является топливом, в то время как полезная нагрузка, двигатели, топливные баки и другие компоненты составляют только 1,10%.



<p>Questions for fixing the material</p>	<p>Literacy</p> <p>3. Two objects are connected by coiled spring which has energy of 3 Joules. What will be the velocities of $m_1=1$ kg and $m_2=2$ kg after spring is released?</p>  <p>4. Calculate velocities of $m_1=1$ kg and $m_2=2$ kg that move with $v_1=7$ m/s and $v_2=1$ m/s after they collide elastically.</p> 	<p>p.73</p>				
<p>End</p>	<p>Activity</p> <p>Draw a 10 cm × 10 cm box. Divide into 4 boxes. Into the first, write the word “Conservation”. Into the second, write your own definition. Into the third, draw a picture that resembles the word. Into the fourth, write a translation in your native language.</p> <table border="1" data-bbox="472 842 1139 1057"> <tr> <td data-bbox="472 842 812 949">Word:</td> <td data-bbox="812 842 1139 949">Your own definition:</td> </tr> <tr> <td data-bbox="472 949 812 1057">Picture:</td> <td data-bbox="812 949 1139 1057">Translation:</td> </tr> </table>	Word:	Your own definition:	Picture:	Translation:	<p>p.73</p>
Word:	Your own definition:					
Picture:	Translation:					
<p>Homework</p>	<p>§4.1 Literacy</p> <p>6. Flyboard is a device that uses water stream to fly. Assume mass of flyboard is 20 kg, mass of person is 80 kg, velocity of water stream is 25 m/s. Calculate mass flow rate of water in kg/sec so that person can fly.</p> 	<p>p.73</p>				
<p>Reflection</p>	<p>Students summarize the lesson: What did we do during the lesson? What new information have we got? What terminology was learned in the lesson?</p>					
<p>Summary evaluation The teacher, together with the students, gives an overall assessment of the lesson. Thank you very much for the lesson. All right! That’s all for today, thank you.</p>						