

Предмет	Физика
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Школа, класс	г. Астана, школа-лицей «NURORDA», 10 класс
Тема урока	Uniform circular Motion (Finding optimum tangential speed)



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Learning aims	<ul style="list-style-type: none"> • Learn to make a connection between theory and practice • Empower the students through providing new technical knowledge and practical skills related to Mechanics • Improve and consolidate science English vocabulary • Learn to solve complex problems that are combination of two or more different topics (in our Schumacher's problem we combine Circular motion (Kinematics) and Dynamics)
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Learning objectives	<ul style="list-style-type: none"> • Apply Uniform Circular Motion in daily life by the solving Schumacher (F1 racer) problem after self-recorded video • Distinguish two different terms like Period and Frequency by watching an interactive presentation from Bilimland.kz source (School Subjects – Physics – Upper Secondary – Kinematics – Circular motion) • Differentiate tangential and angular speeds by watching an interactive presentation from Bilimland.kz source (School Subjects – Physics – Upper Secondary – Kinematics – Circular motion) • Review difference of two different speeds (tangential and angular) by practising on interactive presentation from Bilimland.kz source (Physics course – Mechanics – Kinematics – Angular velocity. Angular acceleration) • Identify suitable formulas to solve problems related to the topic, demonstrated by the ability to solve at least 2 or 3 workbook problems in a period of 10 minutes • Translate specific physics terminology related to Circular motion by working with hand-outs and training vocabulary with teacher
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Previous learning (background)	Students already know the Uniform Circular Motion and the main concepts of Dynamics from 9 th grade.
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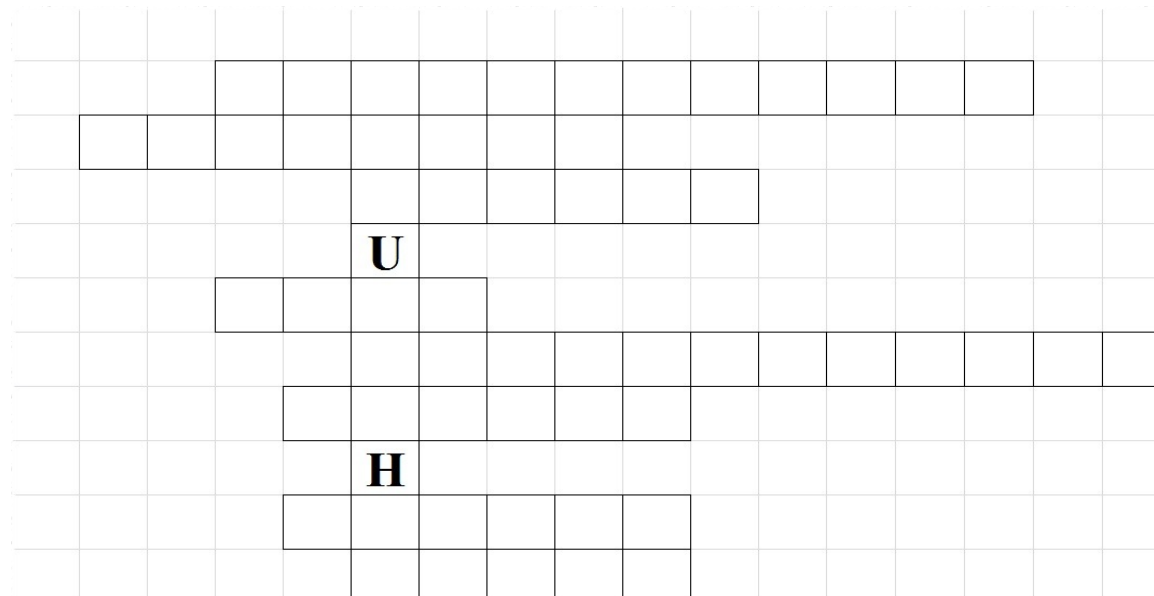
Plan

Time	Content and teacher activity	Learner activity	Formative assessment (On-going assessment)	Learning materials and resources
5	Explaining a task - revision of first two lessons (motion in one and two dimensions) and playing crossword game	Working in groups of 4. Solving crossword (Appendix A) Finding Key word to guess lesson topic	Observing pupils' work and results during crossword activity Q&A	Projector, Ipad, activity papers, smart board
5	Schumacher (F1 racer) video (teacher records) Note: <u>Schumacher</u> is the crossword Key word. Schumacher's problem is he crashed when passing a turn; find the optimum	Watching and guessing the name of new topic in groups	Q&A	Projector, Ipad, smart board, video - https://www.youtube.com/watch?v=NuID8sBZWA0&t=3s

Time	Content and teacher activity	Learner activity	Formative assessment (On-going assessment)	Learning materials and resources
	speed to help him			
12	Presenting interactive presentation about uniform circular motion, giving hand-outs with new terminology (revision of 9 th grade) (Appendix B)	Watching presentation (Appendix C) and taking notes, solving examples, using hand-outs with new vocabulary	Observation, Q&A (training terminology)	Projector, smart board, PPP from Bilimland.kz (School Subjects – Physics – Upper Secondary – Kinematics – Circular motion) http://bilimland.kz/en/content/structure/229-physics#lesson=3292 
8	Solving problems at the blackboard after some solved examples by teacher (Appendix D)	Working individually and asking for clarification on unclear aspects	Checking results of solved problems by pupils at the blackboard	White board, workbook, teacher's PPP
6	Solving more interactive problems in order to learn the difference between angular and tangential speeds (Appendix E)	Watching and taking notes, solving examples	Q&A	Projector, smart board, PPP from Bilimland.kz (Physics course – Mechanics – Kinematics – Angular velocity. Angular acceleration) http://bilimland.kz/en/content/structure/783-mechanics#lesson=5891
2	Demonstration of circular motion by rotating a bucket filled with water in it in order to explain centripetal force	Watching and discussing in pairs	Q&A	Bucket, water, rope

Time	Content and teacher activity	Learner activity	Formative assessment (On-going assessment)	Learning materials and resources
5	Finally solving Schumacher's problem of finding optimum speed to pass the turn safely (Appendix F)	Working in pairs and trying to find optimum speed by taking necessary information from teacher's PPP	Q&A, observation	Projector, smart board, PPP with information of car and road properties (coefficient of friction, radius of turn, mass of the car, gravity)
2	Giving homework: problems from their workbook, find and show one exclusive, extraordinary example from real life of circular motion (Appendix G)	Taking notes, listening	Checking homework (next week)	Projector, smart board, workbook
Break time	Feedbacks	Giving feedbacks to the teacher by writing their comments on stickers and stick them on a board	Receiving feedback stickers	Stickers, board

APPENDIX A



QUESTIONS

1. How do we call change of the position from initial to final position?
2. What is the vector quantity of the speed?
3. $E_p = mgX$, what is X in formula?
4. $V_{avg} = dX/dM$, what is M in formula?
5. The ratio of the change in velocity to the time interval
6. A group of quantities that has only magnitude
7. Acceleration is _____ quantity
8. How do we call maximum distance that is covered by the object by a projectile?

APPENDIX B

TERMINOLOGY

#	WORD	TRANSLATION
1	Period	Период
2	Frequency	Частота
3	Tangential speed (linear speed)	Тангенциальная скорость (линейная скорость)
4	Angular speed	Угловая скорость
5	Centripetal force	Центростремительная сила
6	Revolution	Оборот
7	Centripetal acceleration	Центростремительное ускорение
8	Circumference	Длина окружности
9	Uniform circular motion	Равномерное круговое движение

APPENDIX C

Circular motion 2/9

Period and frequency

As a body is moving around a circle it will return to the original point every so often. If the body is moving in uniform motion, the return time is constant.

Complete the table with correct values. What is the relationship between the period of revolution and the frequency? Form the formula.

Number of revolutions	Period of revolution [s]
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abc period

Circular motion 3/9

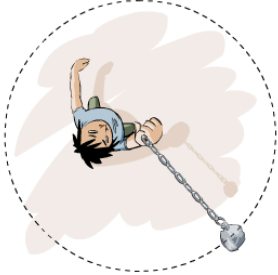
Speed of circular motion

How does one calculate the speed with which an object moves around a circle? Within one period, a body

Circular motion 5/9

Centripetal acceleration

Acceleration



Centripetal acceleration results from the change in the direction of the velocity vector in circular motion.

Centripetal acceleration is the acceleration of a body moving around a circle. It affects the direction of the movement of the body but it does not change the magnitude of its velocity. The formula for the magnitude of acceleration is:

$$a_{cp} = \frac{v^2}{R}$$

Tangential acceleration and centripetal acceleration

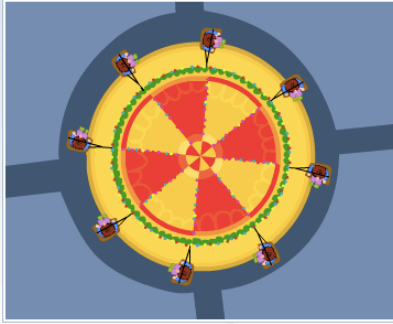
00:00 | 00:53

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Circular motion 7/9

Angular speed

Rectilinear motion and circular motion



The angular speed determines the number of revolutions or rotations around a circle performed by a body in a specific time. The symbol of angular speed is ω , and the basic unit is the reciprocal of a second – $[\omega] = 1 \text{ s}^{-1}$. The basic formula is:

$$\omega = \frac{\alpha}{t}$$

00:00 | 00:40

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APPENDIX D

Example:

The drum of a washing machine rotates 1200 times in 1 minute.

- What is the period and frequency of the drum?
- What is the angular speed of the drum?
- If the diameter of the drum is 40cm, what is the tangential speed of a point on the drum? (take $\pi=3$)

Example

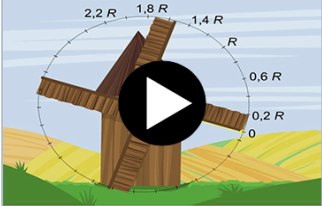
A 4 kg toy car is following a circular path with a constant speed of $v=3 \text{ m/s}$ and a period of 2 s. If the $r=1 \text{ m}$, find the centripetal acceleration and force.




APPENDIX E

Activity 1

Watch the animations and calculate the missing values.



The vane of the windmill has travelled through an angle of rad.



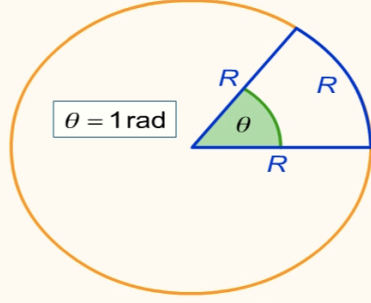
The end of the vane has travelled a distance of m.

0%

← 1 2 3 4 5 6 7 8 9 →

$\theta = \frac{s}{R}$

Radian



$\theta = 1 \text{ rad}$


00:00 | -00:16

APPENDIX F

- Normally, we consider the tire friction with a dry road being 0.8
- Most F1 cars weigh around 1,300 pounds with the driver

A hard disc

- Radius of curvature is 25 meters
- Gravity take as $9,8 \text{ m/s}^2$



Inside a computer, a hard disc can revolve at a frequency of 7200 rev/min that is 120 revs. Its angular velocity is then equal to about 750 rad/s.

Angular velocity versus linear velocity


The relationship between the linear velocity v and the angular velocity ω of the points on a rotating body which are located at a distance R from the axis of rotation is expressed by the

Activity 1

Complete the t

f [Hz]
<input type="text"/>
<input type="text"/>
6,28

79.



$R=200 \text{ m}$
 90 km/h

While a car of total mass 1000 kg is passing the valley, along a road of radius of curvature 200 m, moves at a constant speed of 90 km/h.

APPENDIX G

