

Supertasks

[Handwritten notes on physics topics including wave interference, diffraction, and optics]

Wave Interference:
 $v = \lambda f$
 $\Delta x = \lambda \Delta n$
 $\Delta x = \frac{\lambda}{2} \Delta n$
 maxima: $\Delta x = m\lambda$
 minima: $\Delta x = (m + \frac{1}{2})\lambda$

Diffraction:
 $d \sin \theta = m\lambda$
 $d \sin \theta = (m + \frac{1}{2})\lambda$


Optics:
 $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$
 $M = \frac{h_i}{h_o} = \frac{d_i}{d_o}$
 $n_1 \sin \theta_1 = n_2 \sin \theta_2$

Thermodynamics:
 $Q = mc\Delta T$
 $P = \frac{Q}{t}$
 $\Delta T = \frac{Q}{mc}$

Electromagnetism:
 $E = \frac{F}{q}$
 $V = \frac{W}{q}$
 $I = \frac{Q}{t}$

Tables:

Material	Index of Refraction (n)	Speed of Light (v)
Vacuum	1	c
Air	1.0003	~c
Water	1.33	~0.75c
Glass	1.5	~0.67c
Diamond	2.42	~0.41c

Diagrams:


Voitsova Sophia
 ЗЛИСИ В1.2/2
 W3362

Outline

Today I'm telling you about supertask by example
Gabriel's cake.
Let's cook!

(Background contains handwritten physics notes on various topics including optics, thermodynamics, and mechanics.)

Optics:
 $v(\theta) = \frac{1}{2} k \theta^2$
 $E(\theta) = \frac{1}{2} k \omega^2$
 $I = I_0 \cos^2 \theta$
 $n_1 \sin \theta_1 = n_2 \sin \theta_2$
 $\theta_c = \sin^{-1} \frac{n_2}{n_1}$
 $\theta_2 = \tan^{-1} \frac{n_2}{n_1}$
 $\Delta = \frac{2d}{\lambda} \sin \theta$
 $2d \sin \theta = m \lambda$ (maxima)
 $2d \sin \theta = (m + \frac{1}{2}) \lambda$ (minima)

Thermodynamics:
 $Q = mc\Delta T$
 $Q = nC_v \Delta T$
 $Q = nC_p \Delta T$
 $Q_{rad} = \sigma \epsilon A T^4$
 $P_{rad} = \sigma \epsilon A T_{sur}^4$
 $P_{in} = \sigma \epsilon A T_{in}^4$
 $P_{out} = \sigma \epsilon A T_{out}^4$
 $T_{in}^4 = T_{out}^4$

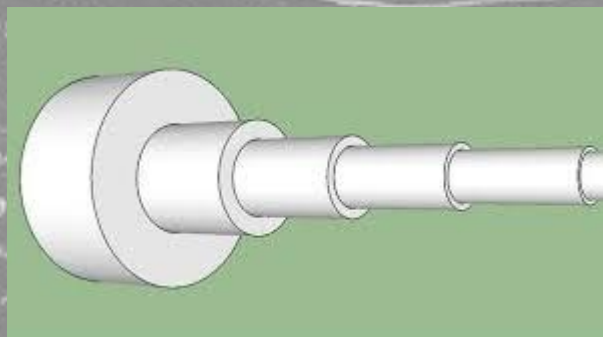
Mechanics:
 $R = \frac{1}{k}$
 $R = \frac{1}{k} \frac{A(T_2 - T_1)}{L}$
 $R = \frac{1}{k} \frac{A(T_2 - T_1)}{L}$

Diagrams:
1. Ray diagram showing light rays passing through a lens and converging at a point.
2. Ray diagram showing light rays reflecting off a curved surface.
3. Ray diagram showing light rays passing through a lens and diverging from a point.

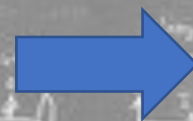
Material	Transmittance	Reflectance	Loss	Gain
Amorphous	0	0	0	0
Polycrystalline	0	0	0	0
Single crystal	0	0	0	0

Introdacion.

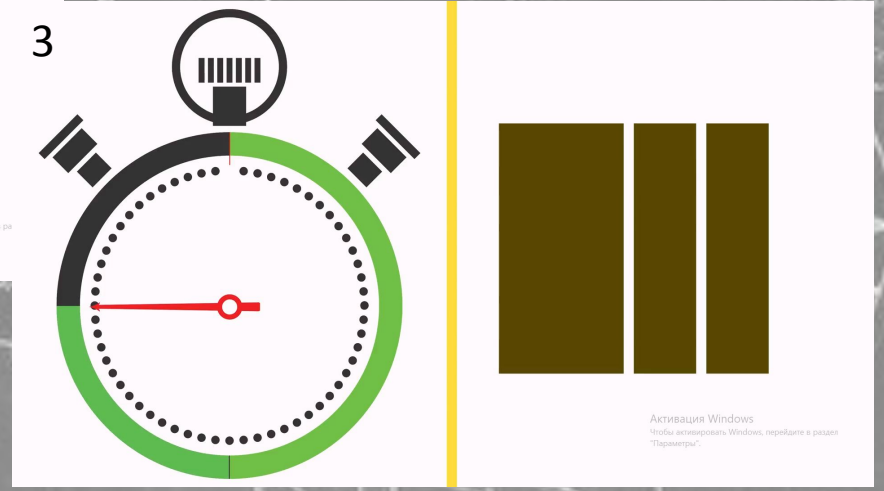
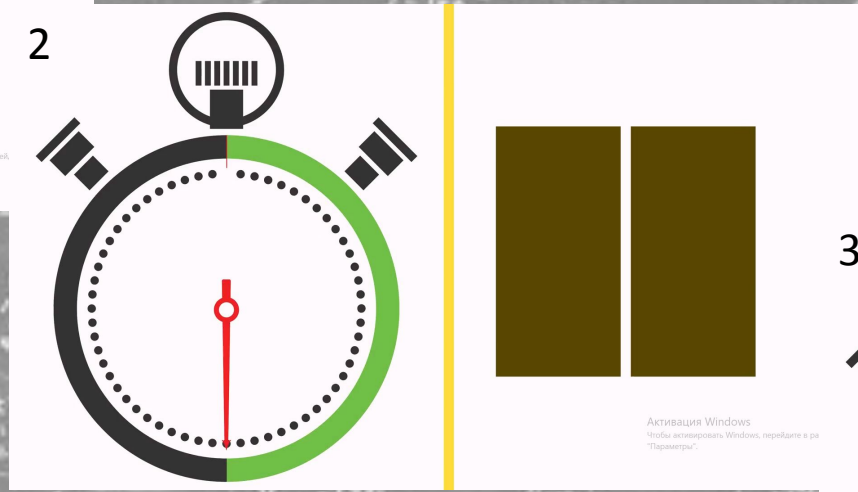
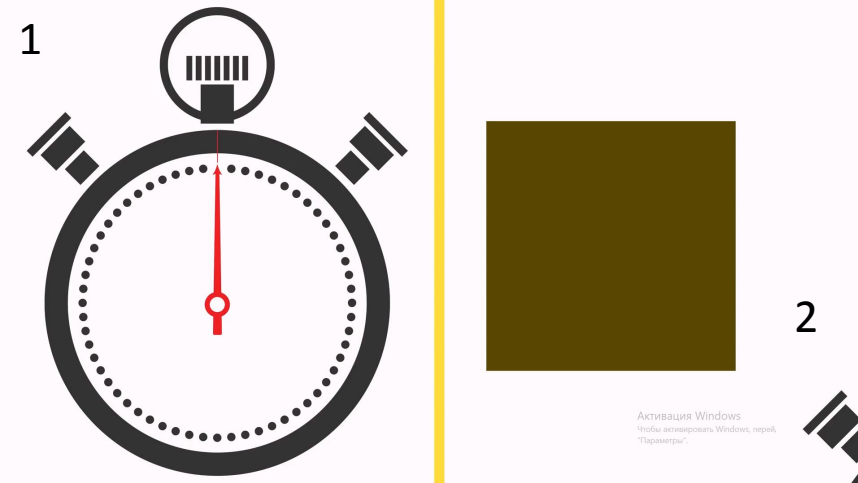
The Paradox of Gabriel's Horn.



What is a Gabriel's cake?



Gabriel's cake in two minutes



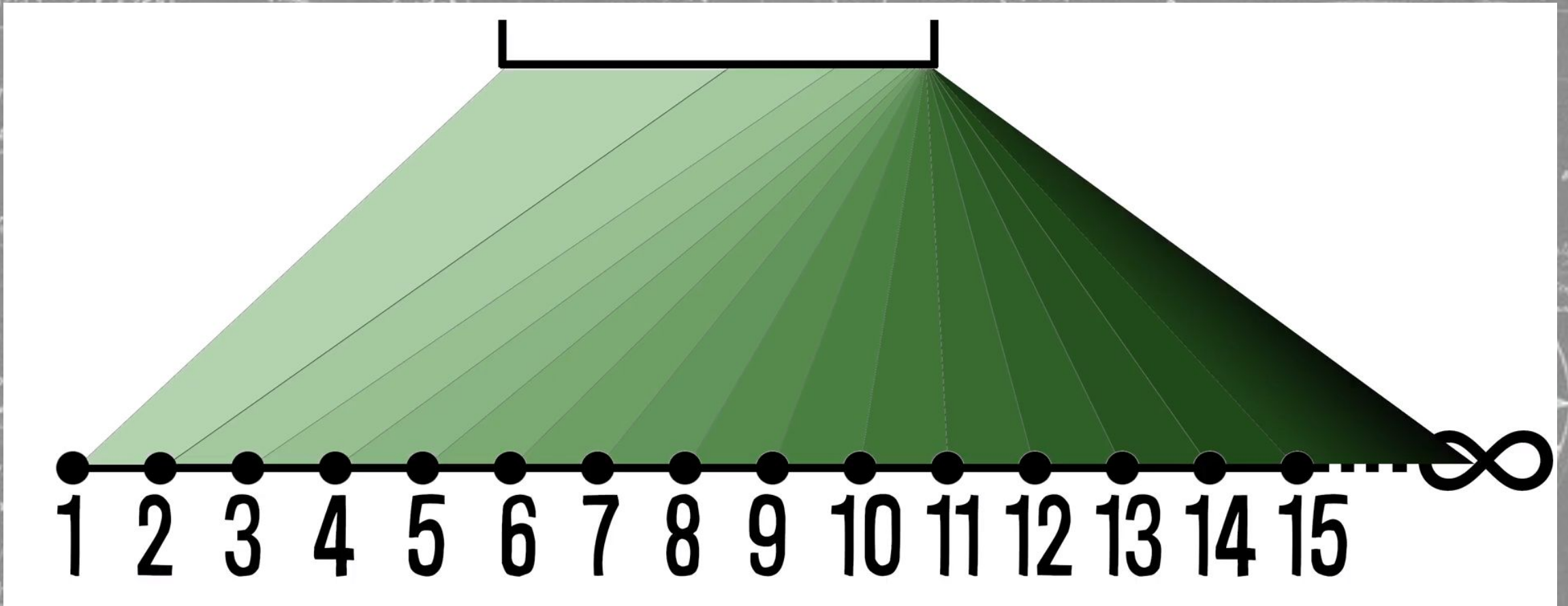
Активация Windows
Чтобы активировать Windows, перейдите в раздел "Параметры".

Активация Windows
Чтобы активировать Windows, перейдите в раздел "Параметры".

Активация Windows
Чтобы активировать Windows, перейдите в раздел "Параметры".

Supertask

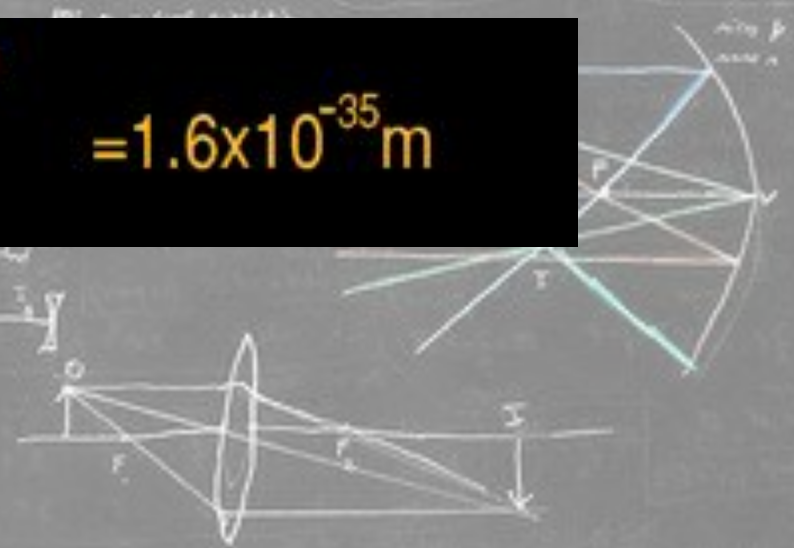
Infinitely actions in the limited period of time is a **SUPERTASK**.



Limitations of the real world

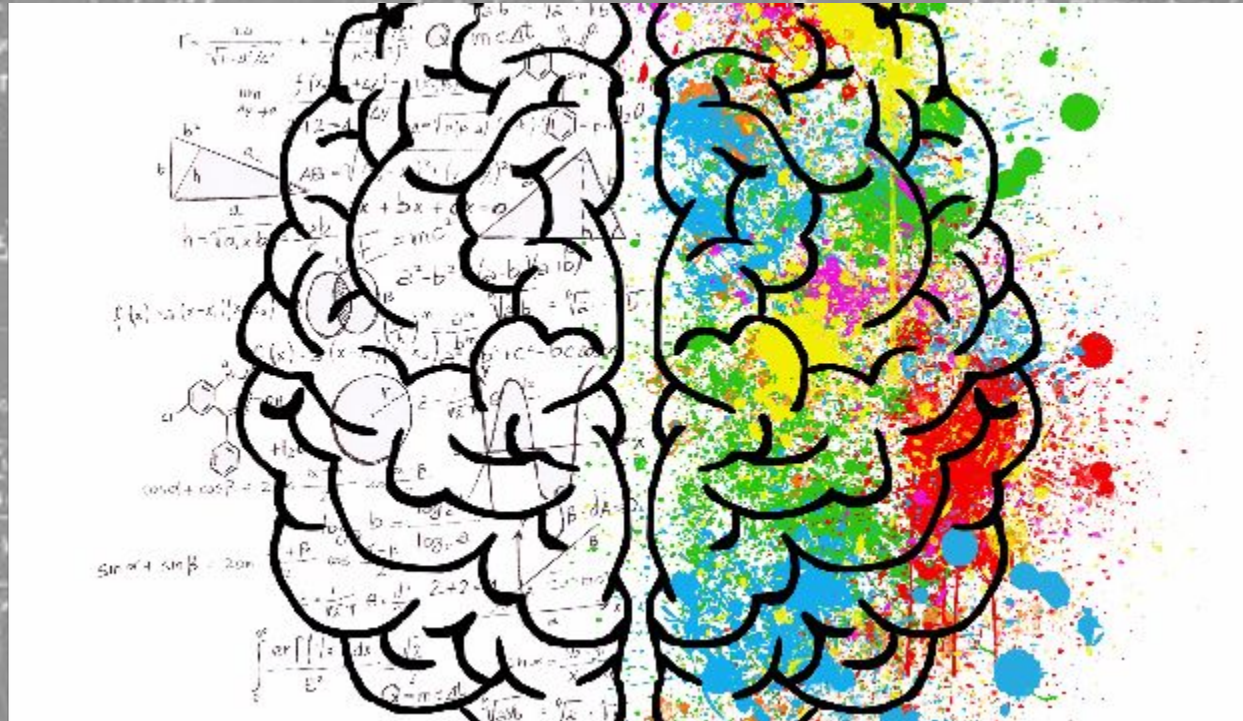
$$\text{Planck Time} = \sqrt{\frac{G\hbar}{c^5}} = 5.4 \times 10^{-44} \text{ s}$$

$$\text{Planck Length} = \sqrt{\frac{G\hbar}{c^3}} = 1.6 \times 10^{-35} \text{ m}$$



Conclusion

Logically an infinite number of individual actions can be carried out over a finite period of time. But only logically!



$v = \frac{\omega}{k}$ wave speed
 $\lambda = \frac{v}{f}$ wavelength
 $T = \frac{1}{f}$ period
 $\omega = 2\pi f$ angular frequency
 $k = \frac{2\pi}{\lambda}$ wave number
 $y(x,t) = A \sin(kx - \omega t + \phi)$ wave function
 $v = \frac{\omega}{k} = \frac{2\pi f}{\frac{2\pi}{\lambda}} = \lambda f$
 $\frac{\partial y}{\partial x} = -A k \cos(kx - \omega t + \phi)$ slope
 $\frac{\partial y}{\partial t} = -A \omega \cos(kx - \omega t + \phi)$ transverse velocity
 $\frac{\partial^2 y}{\partial x^2} = -A k^2 \sin(kx - \omega t + \phi)$ curvature
 $\frac{\partial^2 y}{\partial t^2} = -A \omega^2 \sin(kx - \omega t + \phi)$ transverse acceleration
 $\frac{\partial^2 y}{\partial x^2} = -\frac{\omega^2}{v^2} y$ wave equation

Thank for attention!

Interference
 $\Delta L = \frac{1}{2} \lambda$ path difference
 $\Delta \phi = \frac{2\pi}{\lambda} \Delta L$ phase difference
 $I = I_0 \cos^2 \frac{\Delta \phi}{2}$ intensity
 $\Delta L = m \lambda$ maxima
 $\Delta L = (m + \frac{1}{2}) \lambda$ minima
Thin film interference
 $2nt = m \lambda$ constructive
 $2nt = (m + \frac{1}{2}) \lambda$ destructive
Diffraction
 $\sin \theta = \frac{\lambda}{d}$ maxima
 $\sin \theta = \frac{\lambda}{d} (m + \frac{1}{2})$ minima
Rayleigh's criterion
 $\theta = 1.22 \frac{\lambda}{D}$ resolution
Optics
 $n = \frac{c}{v}$ refractive index
 $n_1 \sin \theta_1 = n_2 \sin \theta_2$ Snell's law
 $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ lens equation
 $M = \frac{h_i}{h_o} = \frac{d_i}{d_o}$ magnification
Thermodynamics
 $Q = mc\Delta T$ heat
 $W = PdV$ work
 $\Delta U = Q - W$ first law
 $P = \frac{1}{3} n \langle mv^2 \rangle$ pressure
 $\frac{1}{P} = \frac{1}{\gamma} \left(\frac{1}{P_0} + \frac{v^2}{c^2} \right)$ relativistic pressure
Electromagnetism
 $E = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$ electric field
 $B = \frac{\mu_0}{4\pi} \frac{qv \sin \theta}{r^2}$ magnetic field
 $\vec{E} \times \vec{B}$ direction of propagation
Relativity
 $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$ Lorentz factor
 $L = L_0 \gamma^{-1}$ length contraction
 $\Delta t = \gamma \Delta t_0$ time dilation
Atomic Physics
 $E_n = -\frac{13.6 \text{ eV}}{n^2}$ energy levels
 $\lambda = \frac{hc}{E}$ photon wavelength
Statistics
 $\langle x \rangle = \int x P(x) dx$ expectation value
 $\sigma^2 = \langle x^2 \rangle - \langle x \rangle^2$ variance

