

Supertasks

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

Wave Interference:
 $v = \lambda f$
 $\Delta x = \lambda \Delta n$
 $\Delta x = \frac{\lambda}{2} \Delta n$
 $\Delta x = \frac{\lambda}{4} \Delta n$

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

Optics:
 $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$
 $M = \frac{h_i}{h_o} = \frac{d_i}{d_o}$

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

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

Relativity:
 $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$
 $L = L_0 \gamma$
 $t = \gamma t_0$

Other Equations:
 $F = ma$
 $E = mc^2$
 $\rho = \frac{m}{V}$

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Outline

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

Let's cook!

(Background content: A dense page of handwritten physics notes and diagrams.)

Optics: $v(\lambda) = \frac{1}{2} k \lambda^2$, $E_{in} = 2U + K$, $I = I_0 \cos^2 \theta$, $n_1 \sin \theta_1 = n_2 \sin \theta_2$, $\theta_c = \sin^{-1} \frac{n_2}{n_1}$, $\theta_g = \tan^{-1} \frac{n_2}{n_1}$, $\Delta x = d \sin \theta$, $2d \sin \theta = m \lambda$ (maxima), $2d \sin \theta = (m + \frac{1}{2}) \lambda$ (minima), $\Delta L = \frac{2d \cos \theta}{\lambda}$.

Thermodynamics: $Q = mc\Delta T$, $Q_{rad} = \sigma \epsilon A T^4$, $P_{rad} = \sigma \epsilon A T_{env}^4$, $P_{net} = \sigma \epsilon A (T^4 - T_{env}^4)$, $\Delta T = T_2 - T_1$, $R = \frac{1}{\lambda}$, $R = \frac{1}{f} + \frac{1}{i} = \frac{1}{f}$ (spherical mirror), $M = -\frac{i}{f}$.

Electromagnetism: $\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \hat{r}$, $\vec{B} = \frac{\mu_0}{4\pi} \frac{q \vec{v} \times \hat{r}}{r^2}$, $\vec{E} \times \vec{B}$, $\vec{E} \cdot \vec{B}$, $\vec{E} \cdot \vec{v}$, $\vec{B} \cdot \vec{v}$, $\vec{E} \cdot \vec{v} = \frac{1}{2} \frac{d}{dt} \frac{v^2}{c^2}$.

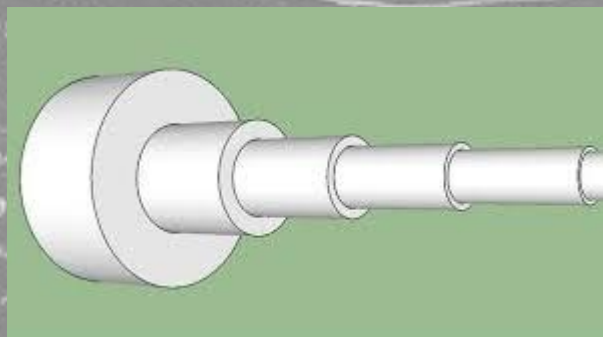
Diagrams: Ray diagrams for lenses and mirrors, showing focal points (F), optical centers (O), and image formation.

Medium	Refractive Index (n)	Speed of Light (v)	Wavelength (λ)	Frequency (f)
Vacuum	1	c	λ ₀	f ₀
Medium 1	n ₁	c/n ₁	λ ₁	f ₀
Medium 2	n ₂	c/n ₂	λ ₂	f ₀

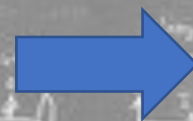
Equations: $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$, $M = \frac{v}{u}$, $\Delta L = \frac{2d \cos \theta}{\lambda}$, $\Delta \phi = \frac{2\pi \Delta L}{\lambda}$.

Introdacion.

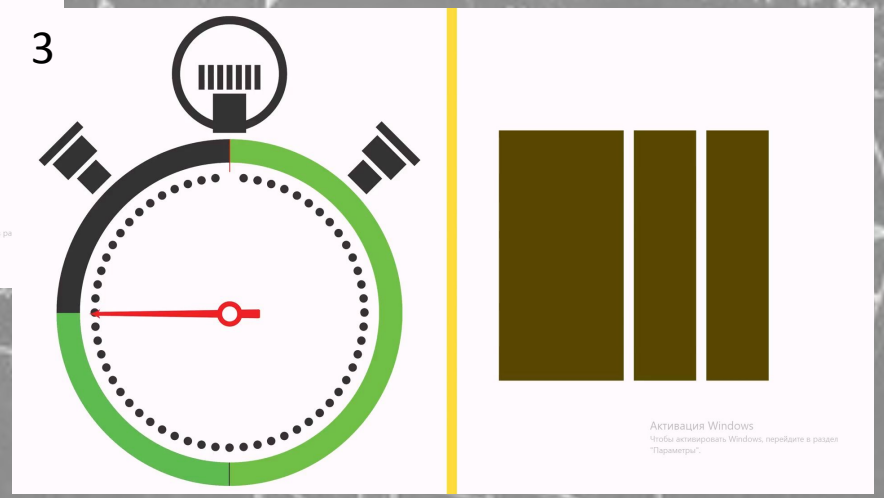
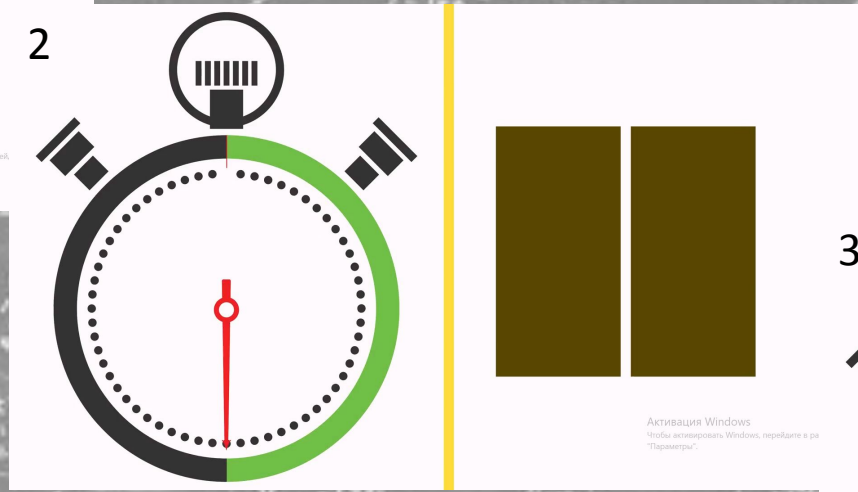
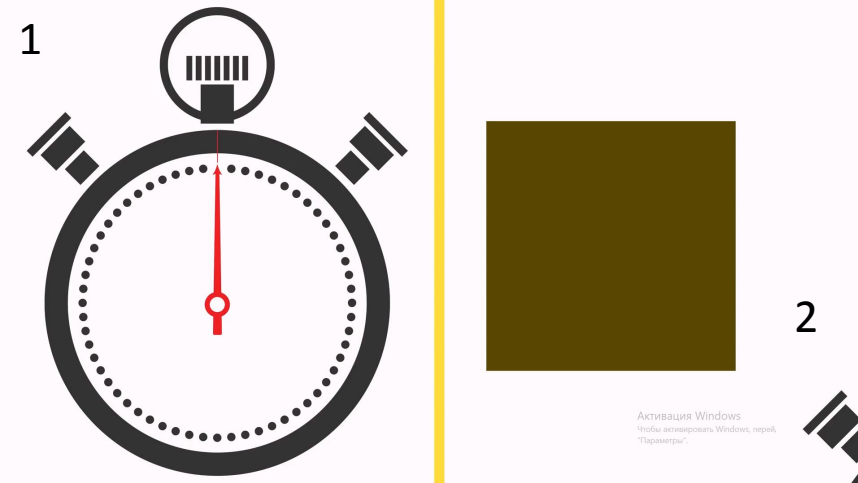
The Paradox of Gabriel's Horn.



What is a Gabriel's cake?



Gabriel's cake in two minutes



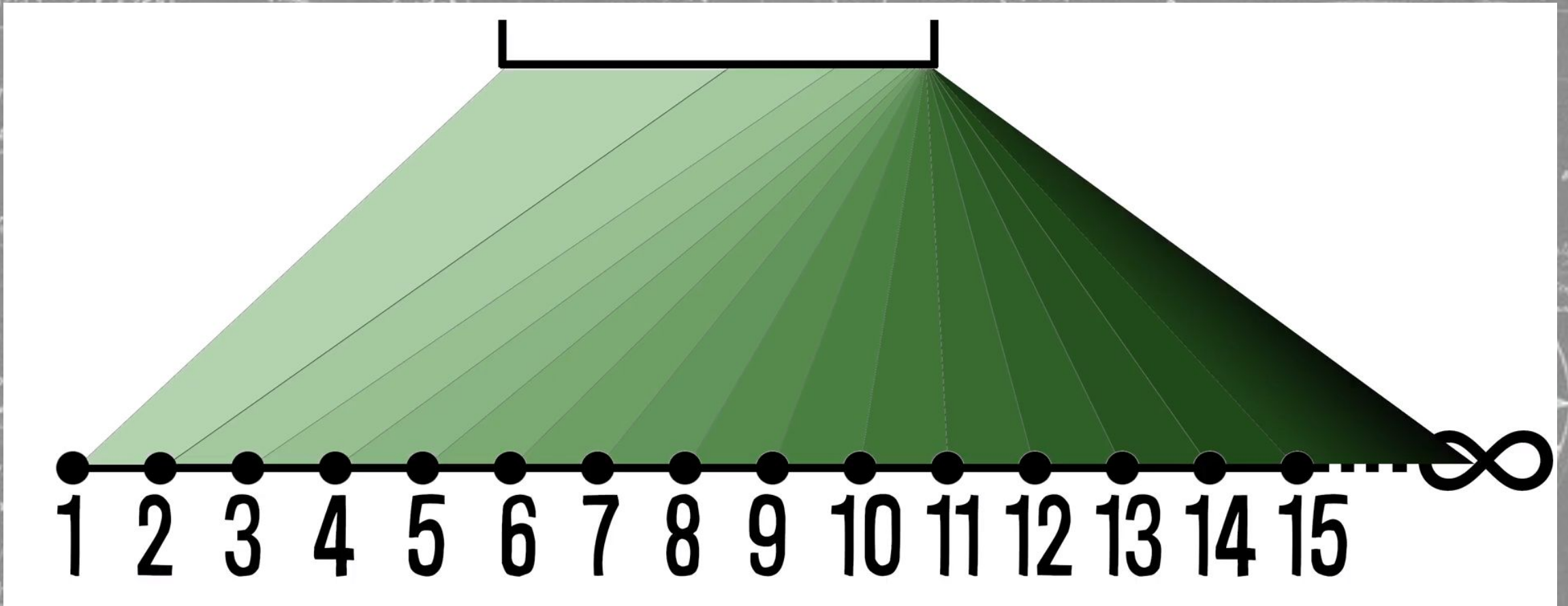
Активация Windows
Чтобы активировать Windows, перейдите в раздел "Параметры".

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Supertask

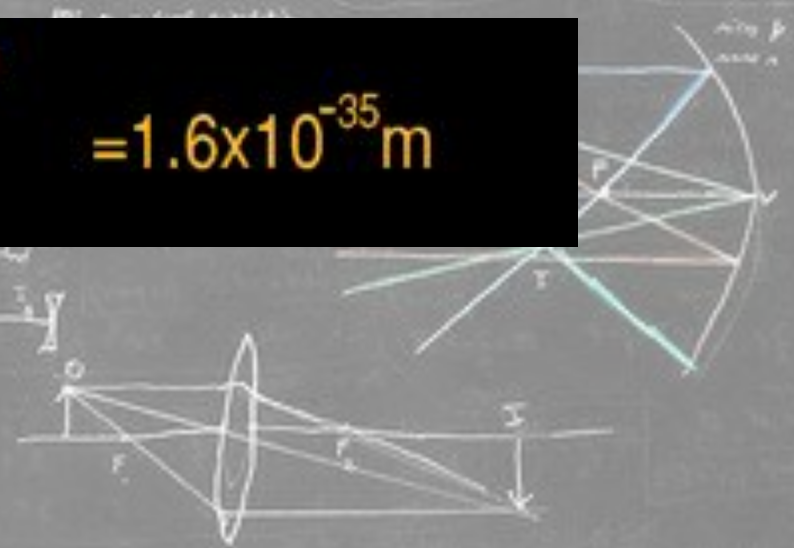
Infinitely actions in the limited period of time is a **SUPERTASK**.



Limitations of the real world

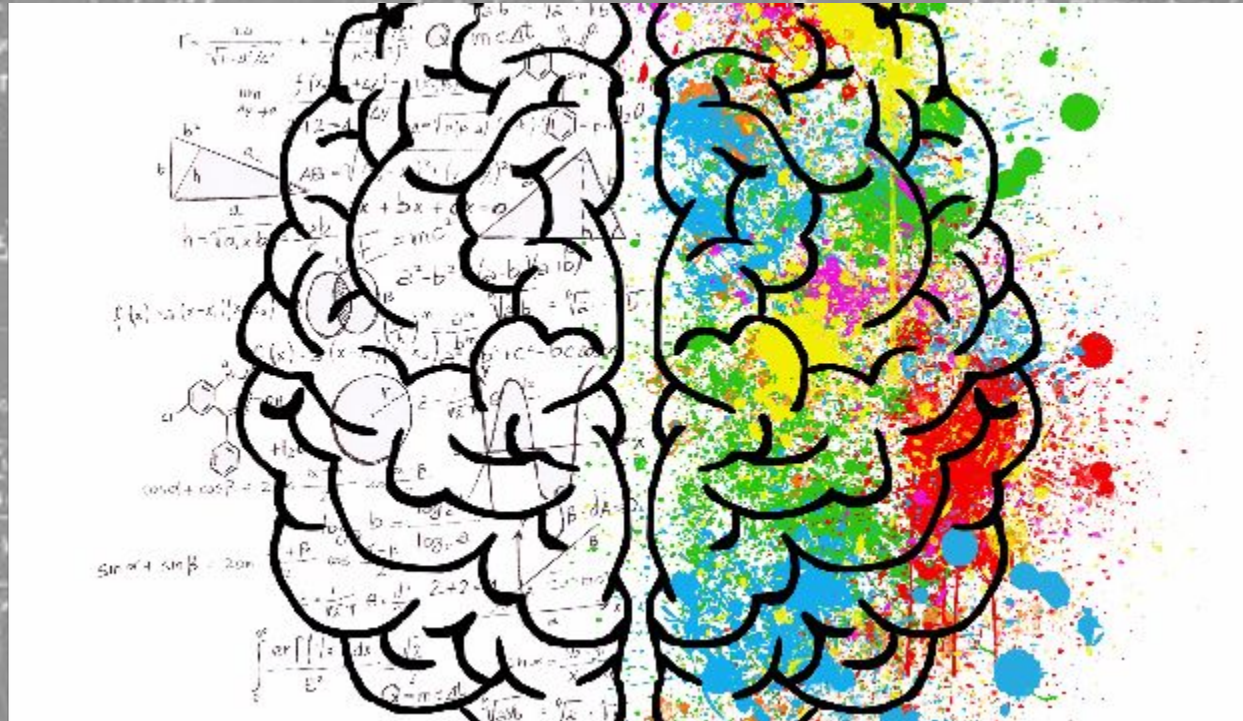
$$\text{Planck Time} = \sqrt{\frac{G\hbar}{c^5}} = 5.4 \times 10^{-44} \text{ s}$$

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



Conclusion

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



Thank for attention!

Wave Mechanics

Wave speed: $v = \frac{\omega}{k} = \frac{2\pi f}{2\pi/\lambda} = f\lambda$

Wave function: $y(x,t) = A \sin(kx - \omega t + \phi)$

Wave number: $k = \frac{2\pi}{\lambda}$

Angular frequency: $\omega = 2\pi f$

Phase difference: $\Delta\phi = k\Delta x - \omega\Delta t$

Interference

Path difference: $\Delta r = r_2 - r_1$

Condition for maxima: $\Delta r = n\lambda$

Condition for minima: $\Delta r = (n + \frac{1}{2})\lambda$

Thin Film Interference

Optical path difference: $\Delta O.P.D = 2nt \cos \theta$

Condition for constructive interference: $\Delta O.P.D = m\lambda$

Condition for destructive interference: $\Delta O.P.D = (m + \frac{1}{2})\lambda$

Diffraction

Single slit diffraction: $a \sin \theta = m\lambda$

Grating diffraction: $d \sin \theta = n\lambda$

Ray Optics

Refraction: $n_1 \sin \theta_1 = n_2 \sin \theta_2$

Total internal reflection: $\theta_i > \theta_c$

Thin lens formula: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

Magnification: $M = \frac{v}{u} = \frac{h'}{h}$

Geometrical Optics

Mirrors: $\frac{1}{f} = \frac{1}{R}$

Image formation: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

Thermodynamics

First law: $\Delta Q = \Delta U + \Delta W$

Work done: $W = \int P dV$

Heat capacity: $C_p = C_v + R$

Electromagnetism

Electric field: $E = \frac{F}{q}$

Potential: $V = \frac{W}{q}$

Gauss's law: $\oint \mathbf{E} \cdot d\mathbf{A} = \frac{Q_{enc}}{\epsilon_0}$

Ampere's law: $\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I_{enc}$

Modern Physics

Photoelectric effect: $E_k = h\nu - \phi$

Compton effect: $\lambda' - \lambda = \frac{h}{m_0 c} (1 - \cos \theta)$

De Broglie wavelength: $\lambda = \frac{h}{p}$

Atomic Structure

Bohr model: $r_n = n^2 a_0$

Rydberg formula: $\frac{1}{\lambda} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$

Relativity

Time dilation: $\Delta t = \gamma \Delta t_0$

Length contraction: $L = \frac{L_0}{\gamma}$

Mathematical Tools

Binomial expansion: $(1+x)^n = 1 + nx + \frac{n(n-1)}{2}x^2 + \dots$

Differentiation: $\frac{d}{dx} x^n = nx^{n-1}$

Integration: $\int x^n dx = \frac{x^{n+1}}{n+1}$

Diagrams

The page contains several diagrams:

- Interference:** Shows two slits and the resulting interference pattern with maxima and minima.
- Thin Film Interference:** Shows light reflecting off the top and bottom surfaces of a thin film, with path differences.
- Diffraction:** Shows light passing through a single slit and a grating, with angles of diffraction.
- Ray Optics:** Shows a convex lens forming a real inverted image, a concave lens forming a virtual upright image, and a spherical mirror focusing light.
- Atomic Models:** Shows the Bohr model of an atom with discrete energy levels and the Rutherford model.
- Relativity:** Shows a train moving relative to a platform, illustrating time dilation and length contraction.