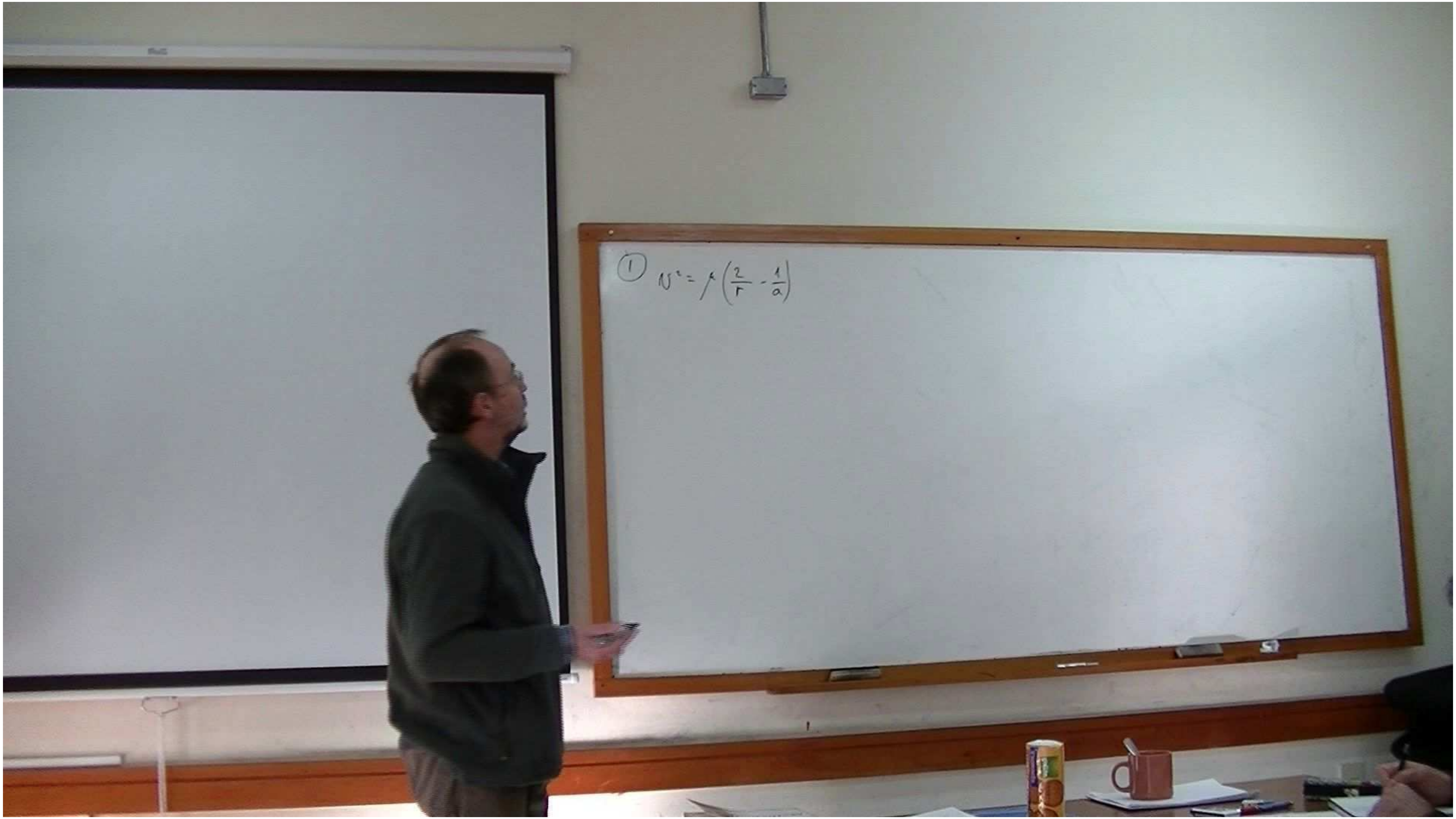
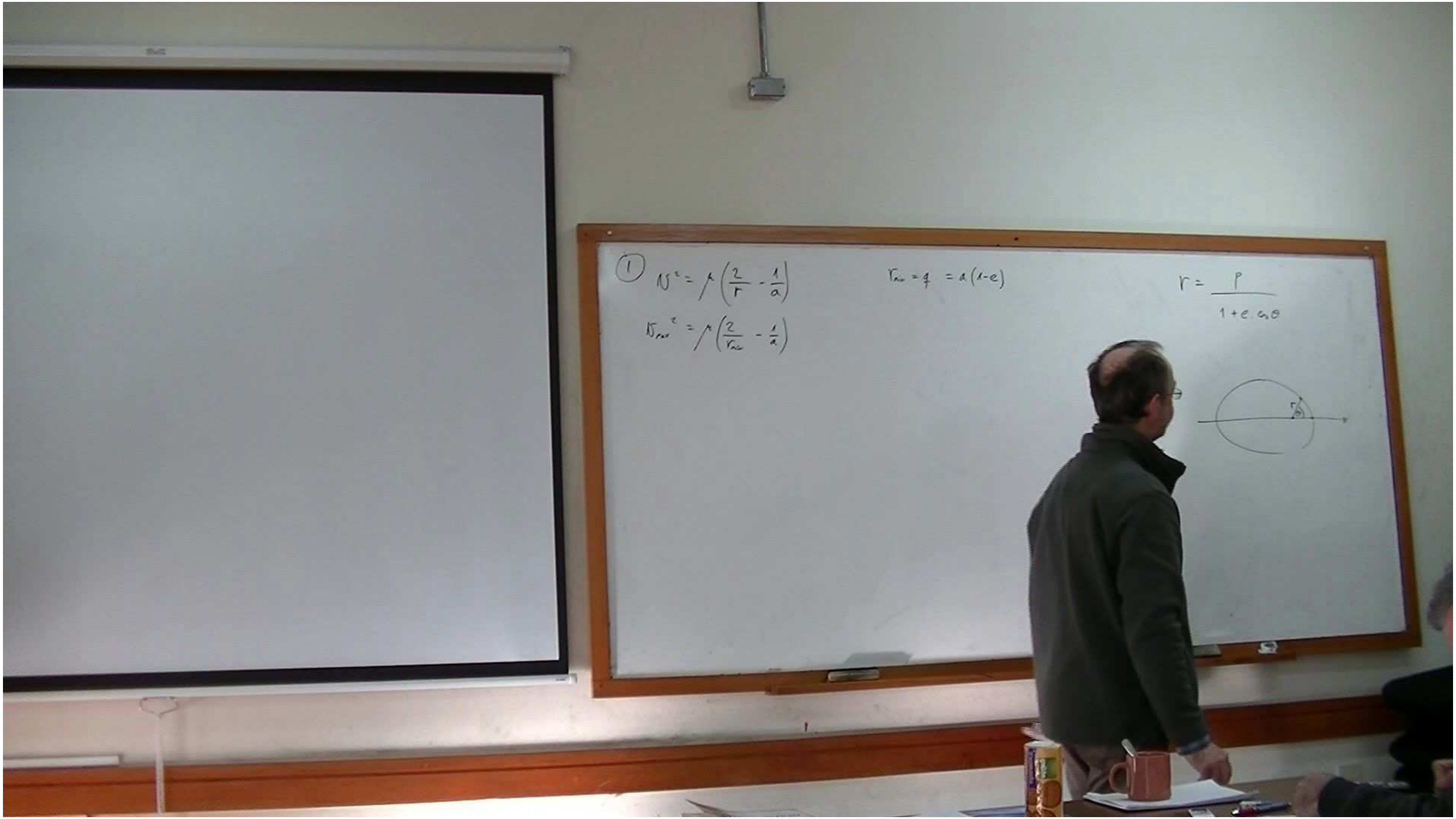
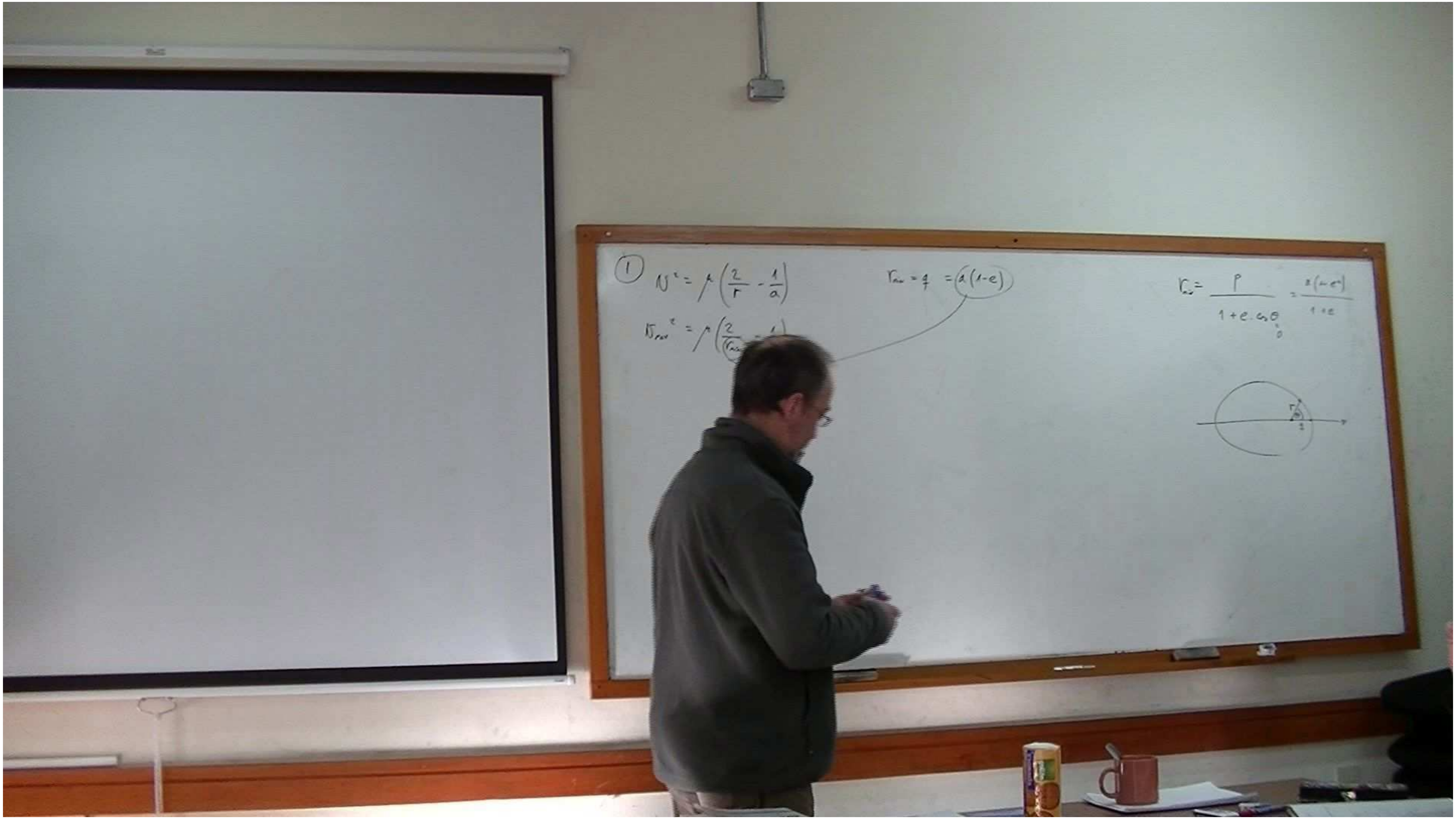
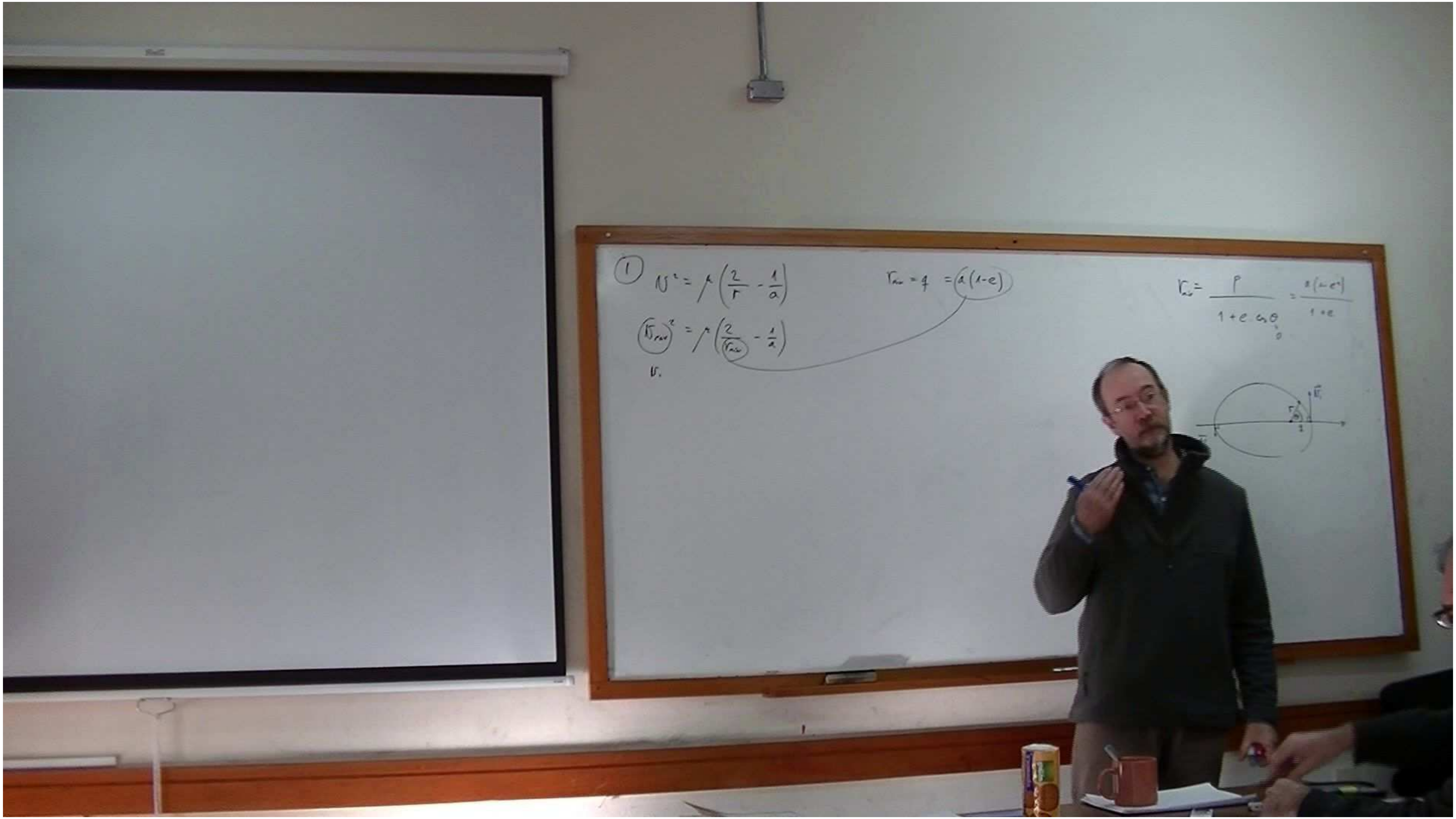
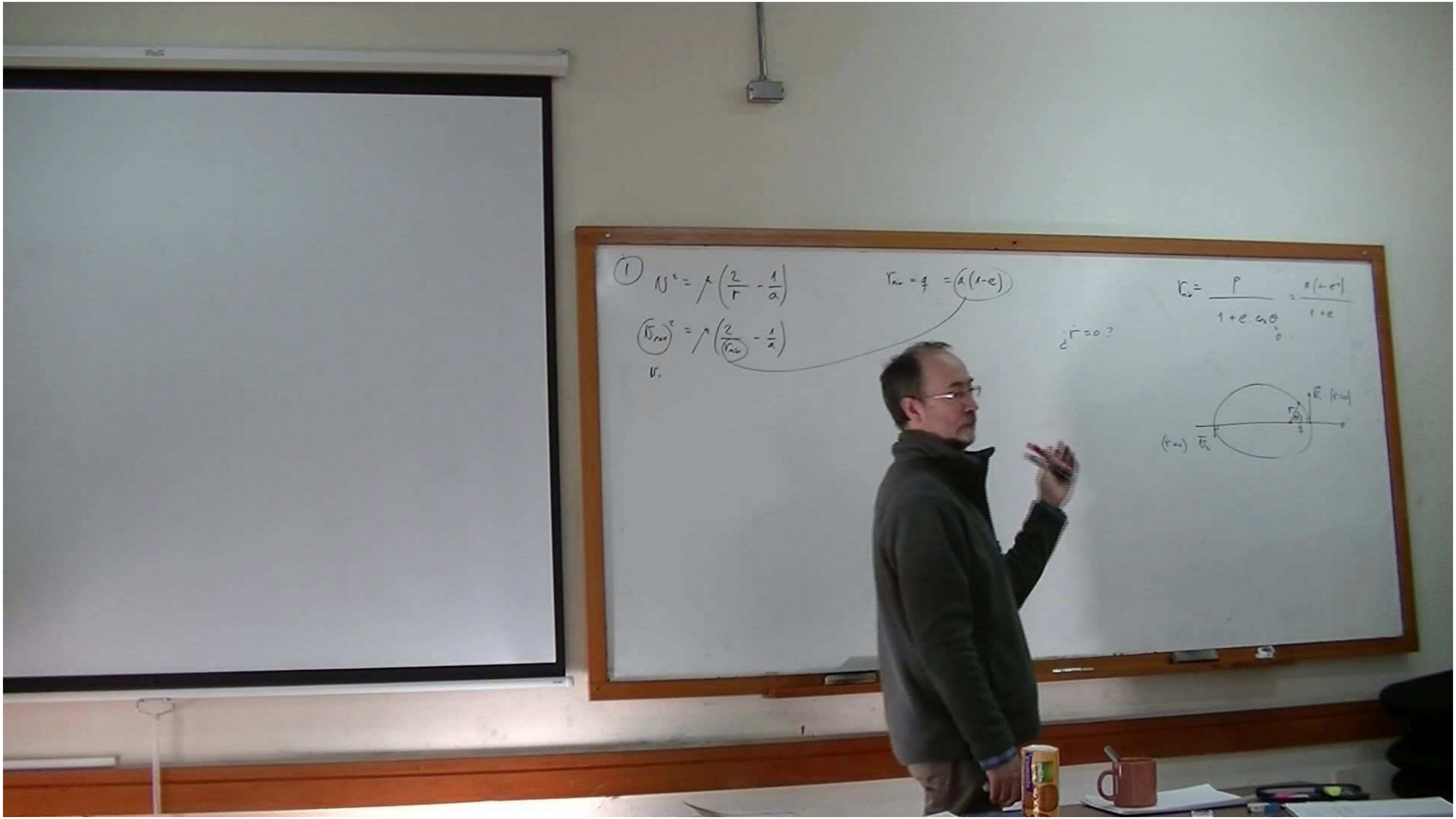


① $v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$


①
$v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$
$v_{min}^2 = \mu\left(\frac{2}{r_{min}} - \frac{1}{a}\right)$
$r_{min} = q = a(1-e)$
$r = \frac{p}{1 + e \cos\theta}$
r
θ


①
$v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$
$v_{\rm per}^2 = \mu\left(\frac{2}{r_{\rm per}} - \frac{1}{\ }\right)$
$r_{\rm per} = q = a(1-e)$
$r_{\rm per} = \frac{p}{1+e\cdot\cos\theta} = \frac{a(1-e^2)}{1+e}$
r
θ


①
$v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$
$(v_{per})^2 = \mu\left(\frac{2}{r_{per}} - \frac{1}{a}\right)$
$v.$
$r_{per} = q = a(1-e)$
$r_{per} = \frac{p}{1+e\cos\theta} = \frac{a(1-e^2)}{1+e}$
r
θ
$\vec{v}$



① $v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$

$(v_{min})^2 = \mu\left(\frac{2}{r_{min}} - \frac{1}{a}\right)$

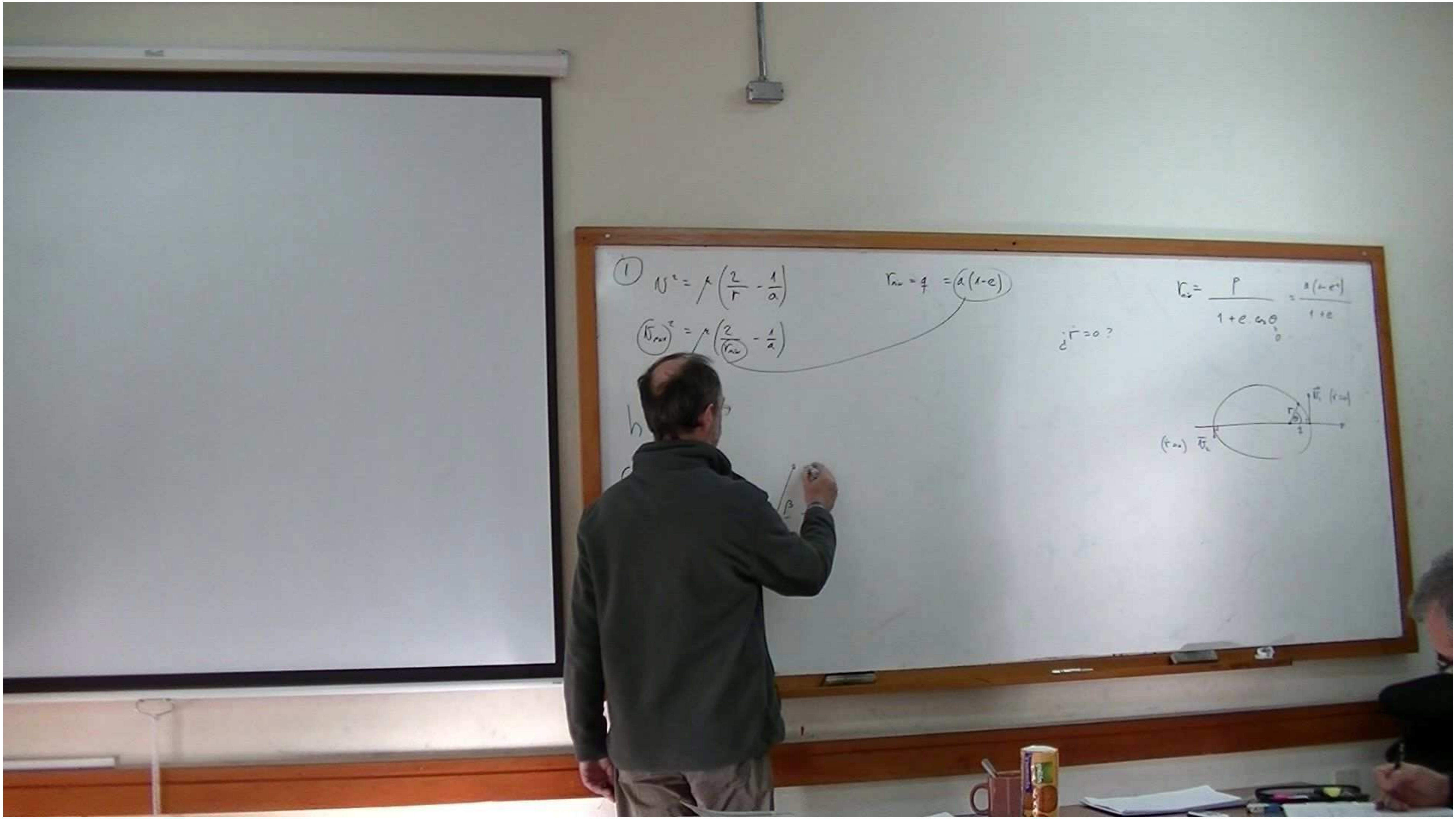
v_1

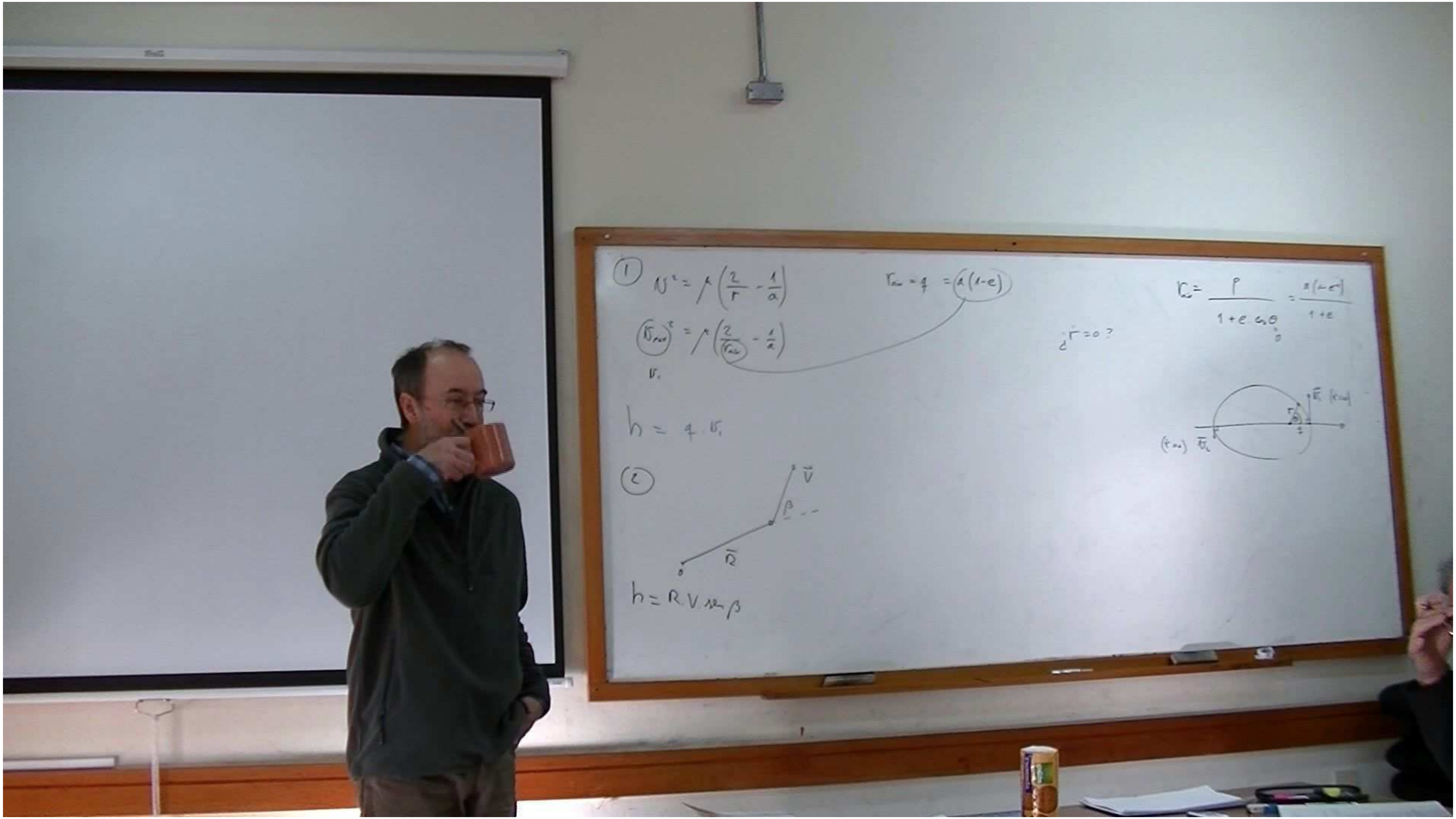
$r_{min} = q = a(1-e)$

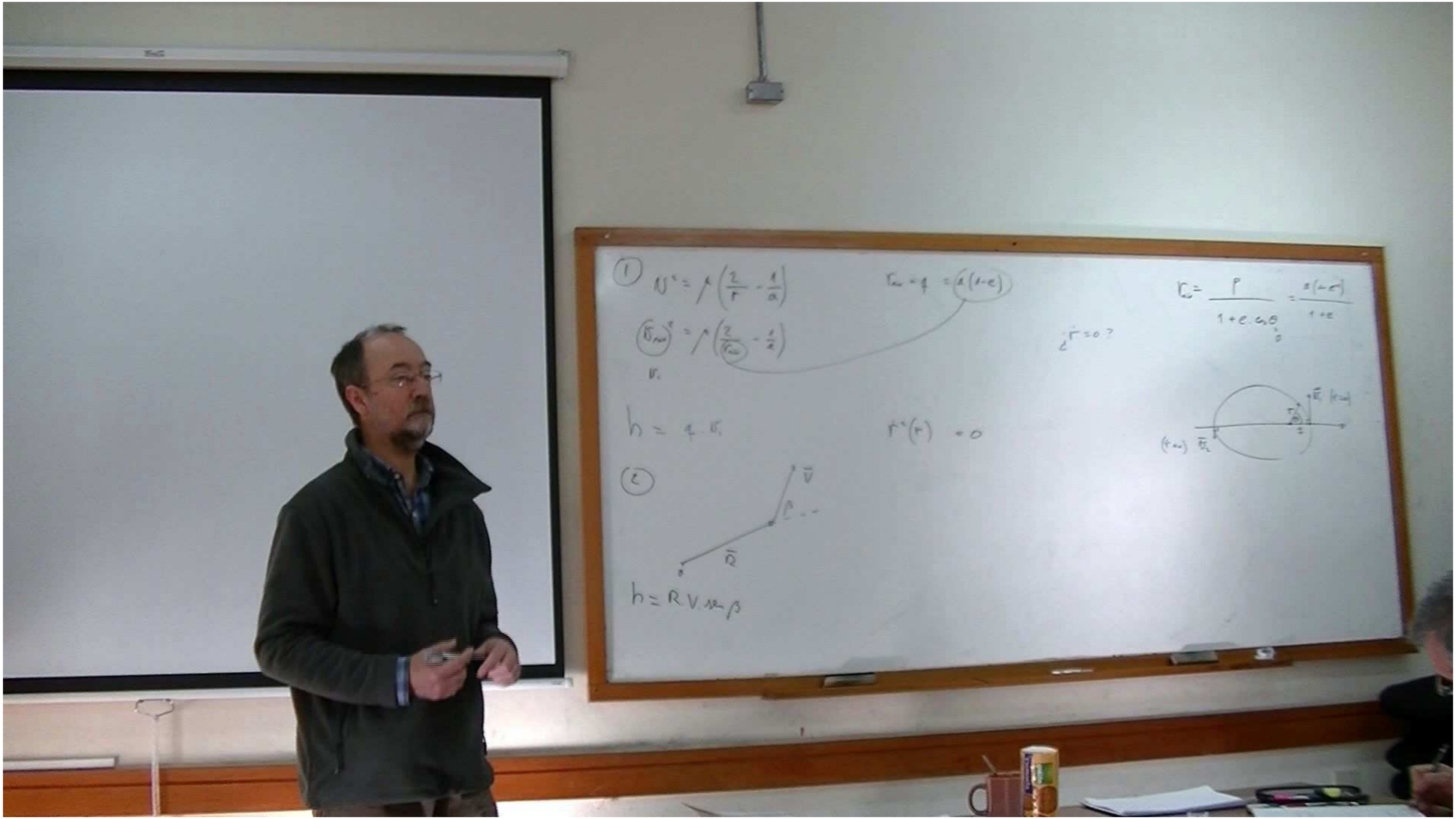
$r_{min} = \frac{p}{1 + e\cos\theta} = \frac{a(1-e^2)}{1+e}$

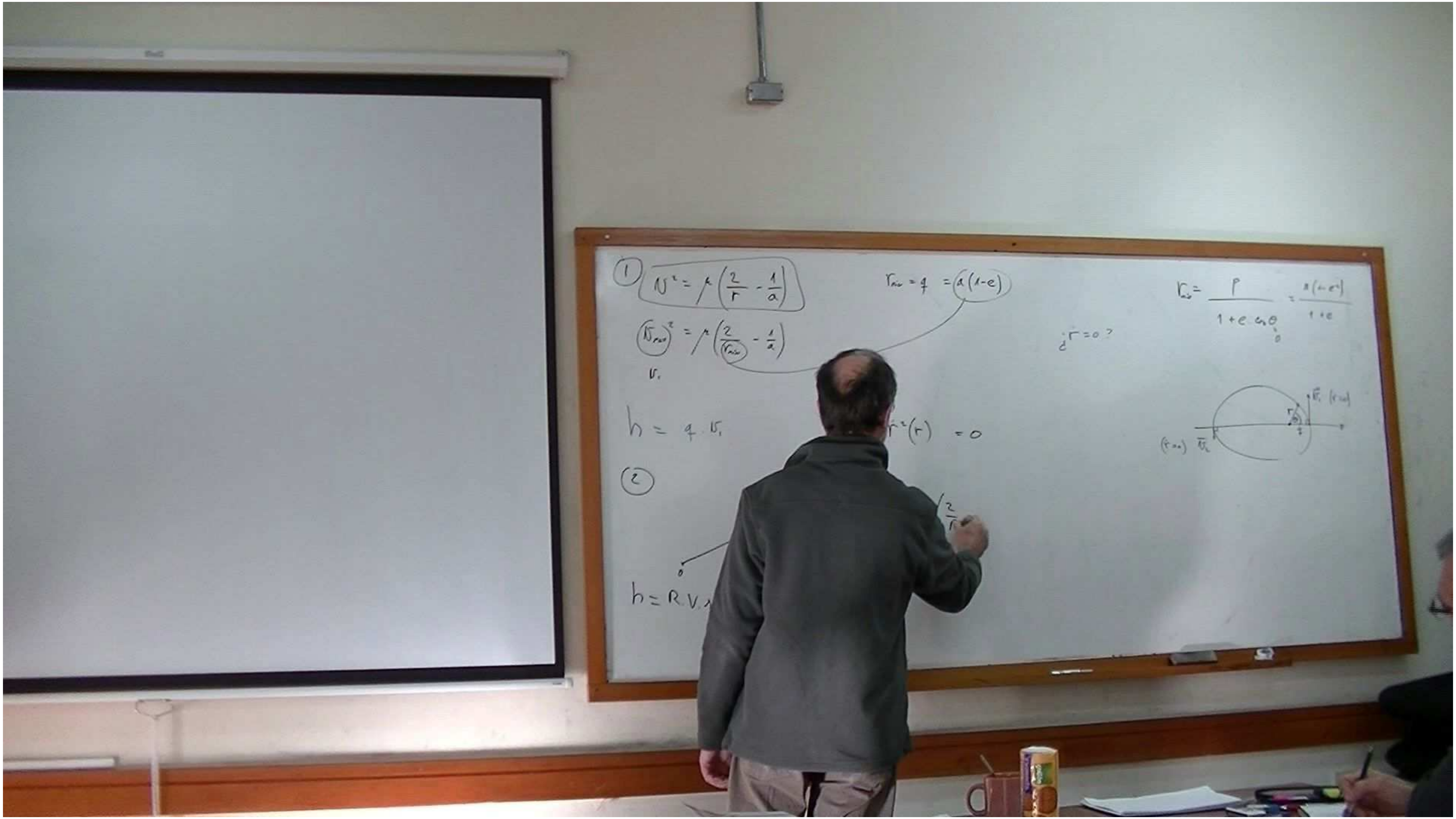
$\theta = 0$

¿$\dot{r} = 0$?


①
$v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$
$(v_{per})^2 = \mu\left(\frac{2}{r_{per}} - \frac{1}{a}\right)$
$r_{per} = q = a(1-e)$
$r_{per} = \frac{p}{1+e\cos\theta} = \frac{a(1-e^2)}{1+e}$
¿$\dot{r} = 0$?
$\vec{v}_1$ $(r=a)$
(r_{ma}) $\vec{v}_2$
r
θ
q
h
β


①
v² = μ(2/r − 1/a)
(v_max)² = μ(2/r_min − 1/a)
v₁
r_min = q = a(1−e)
¿ṙ = 0 ?
r_min = p / (1 + e cos θ) = a(1−e²) / (1 + e)
0
h = q · v₁
(r_min) v̄₁
v̄ (r_max)
r
β
0
②
V̄
β
R̄
0
h = R V sen β


①
v² = μ (2/r − 1/a)
(v_per)² = μ (2/r_per − 1/a)
v₁
r_per = q = a(1−e)
h = q . v₁
r² (r) = 0
¿ṙ = 0 ?
r_per = p / (1 + e cos θ) = a(1−e²) / (1+e)
(r_per) v̄₁
v̄ (r = a)
②
v̄
β
R̄
h = R V sen β



①
$$\boxed{v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)}$$

$$(v_{min})^2 = \mu\left(\frac{2}{r_{min}} - \frac{1}{a}\right)$$

v_1

$r_{min} = q = a(1-e)$

$h = q \cdot v_1$

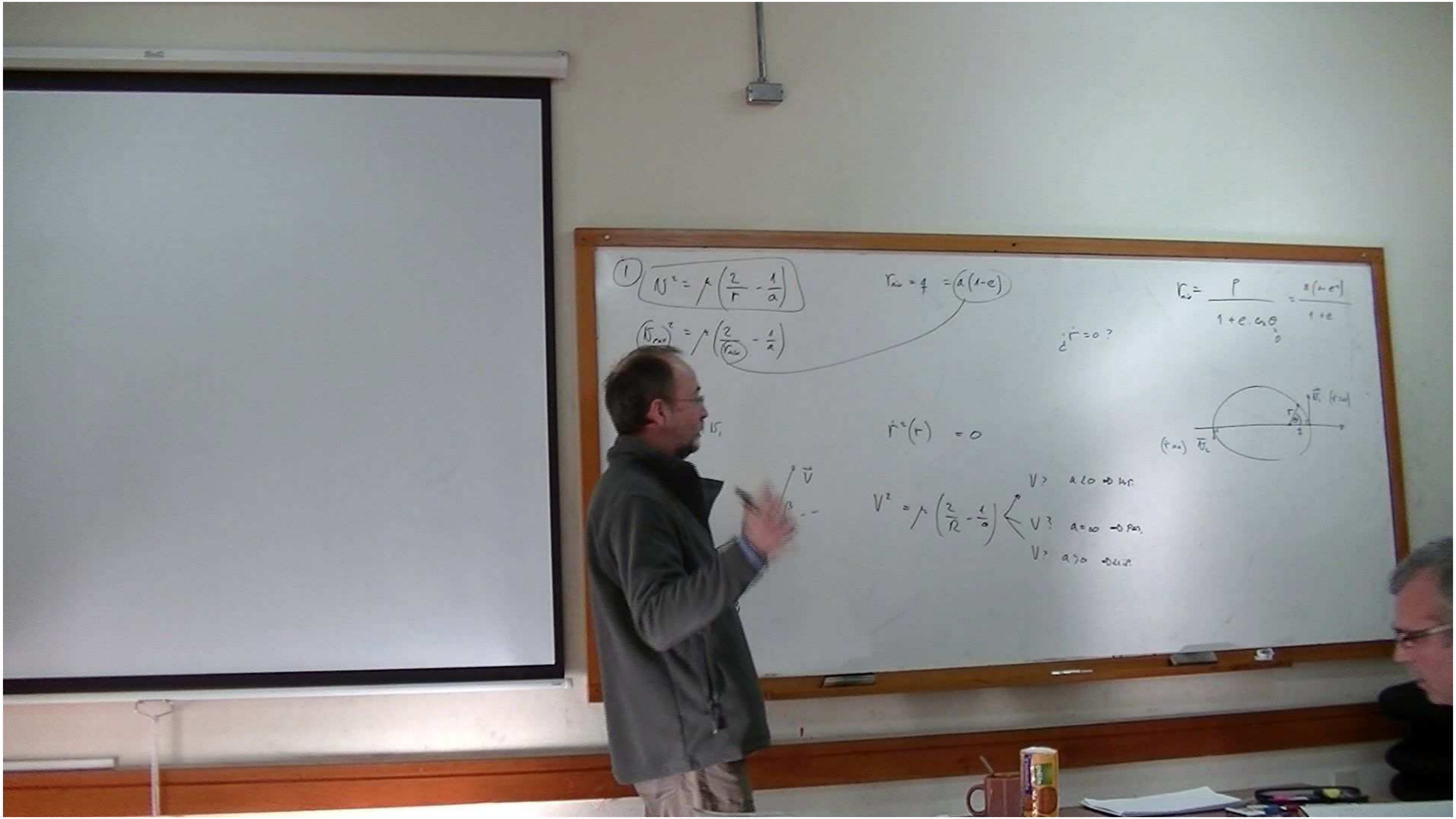
¿$\dot{r} = 0$?

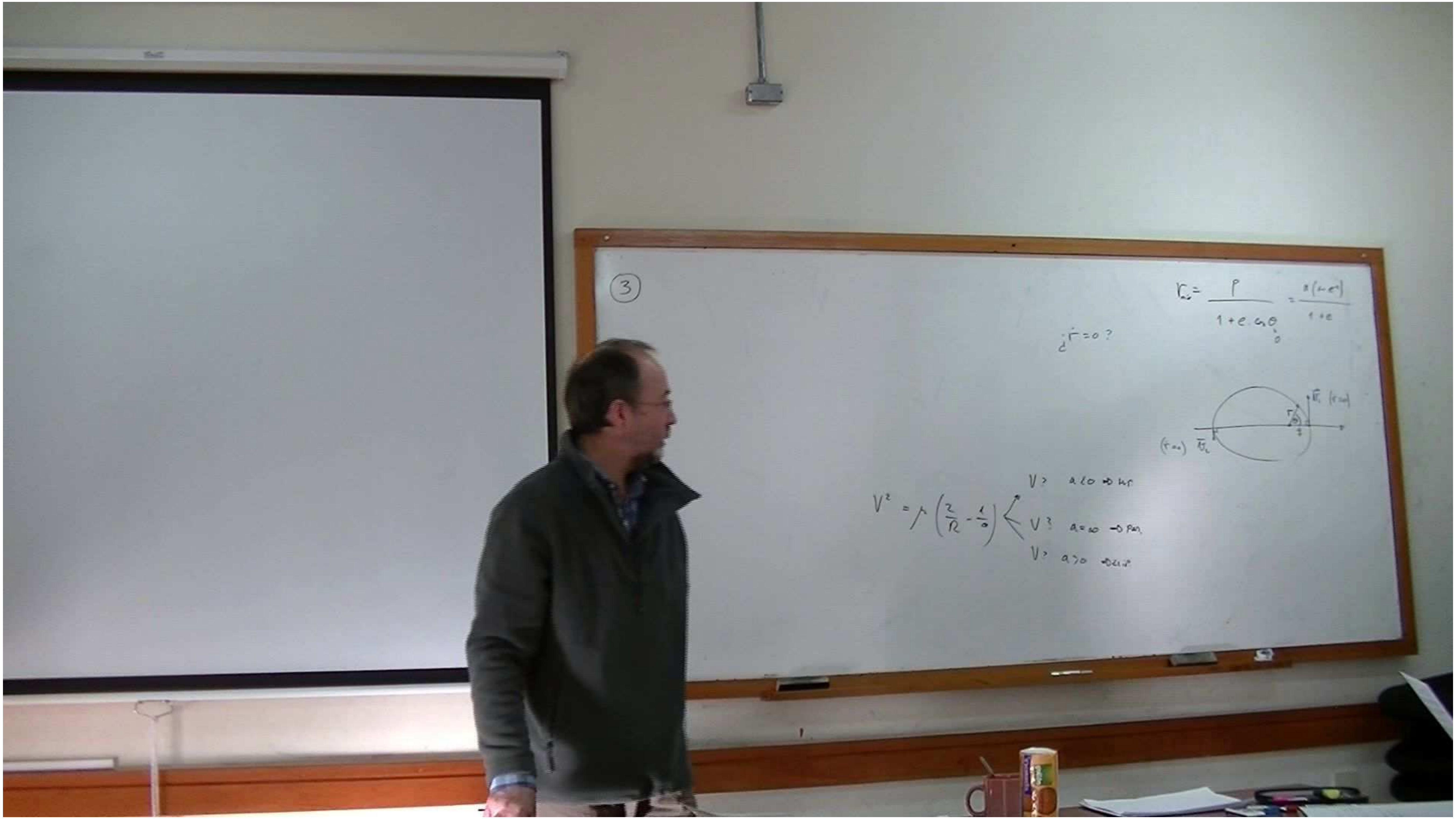
$r^2(r) \quad = 0$

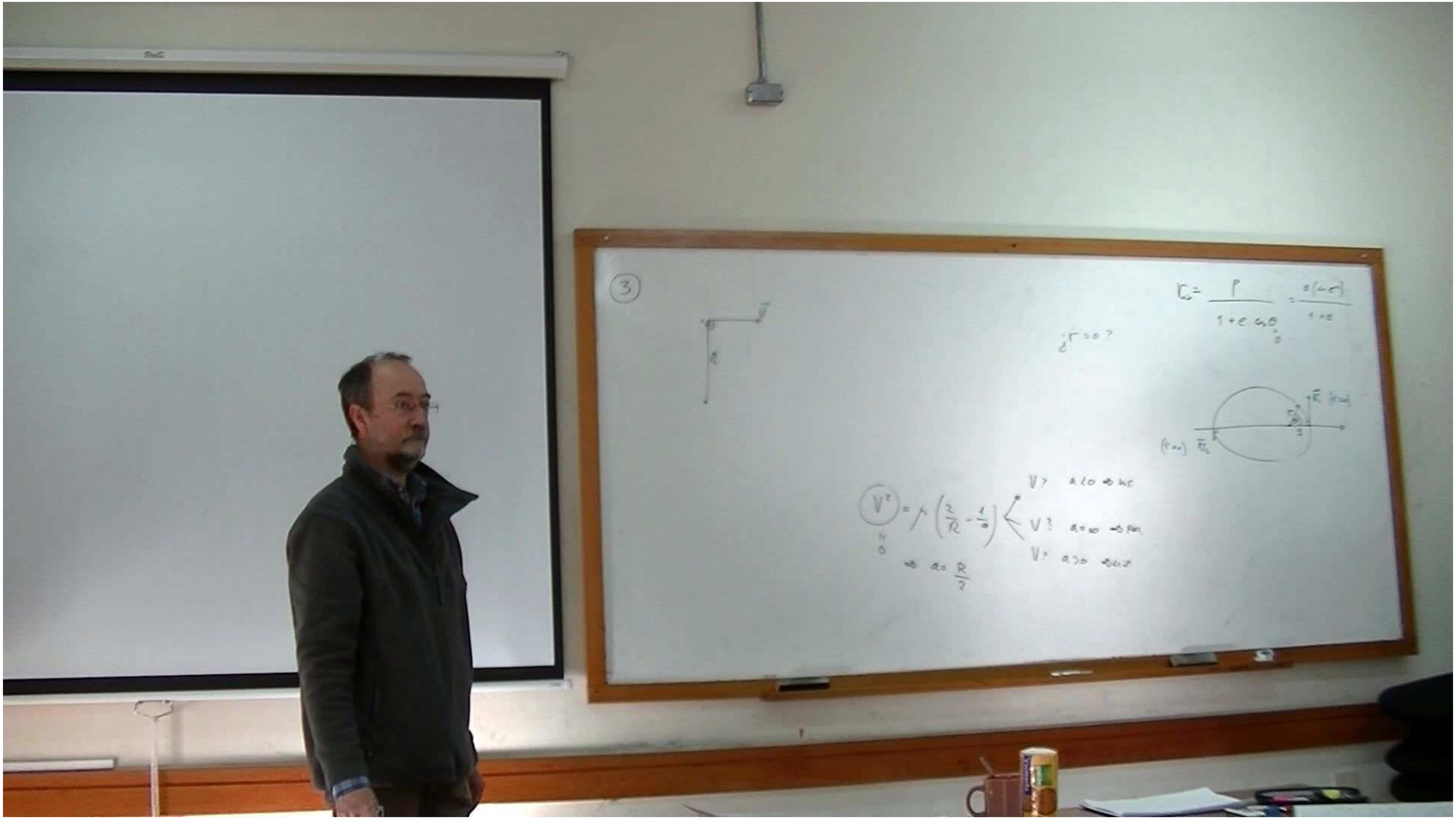
$$r_{min} = \frac{p}{1 + e \cos\underset{0}{\theta}} = \frac{a(1-e^2)}{1+e}$$

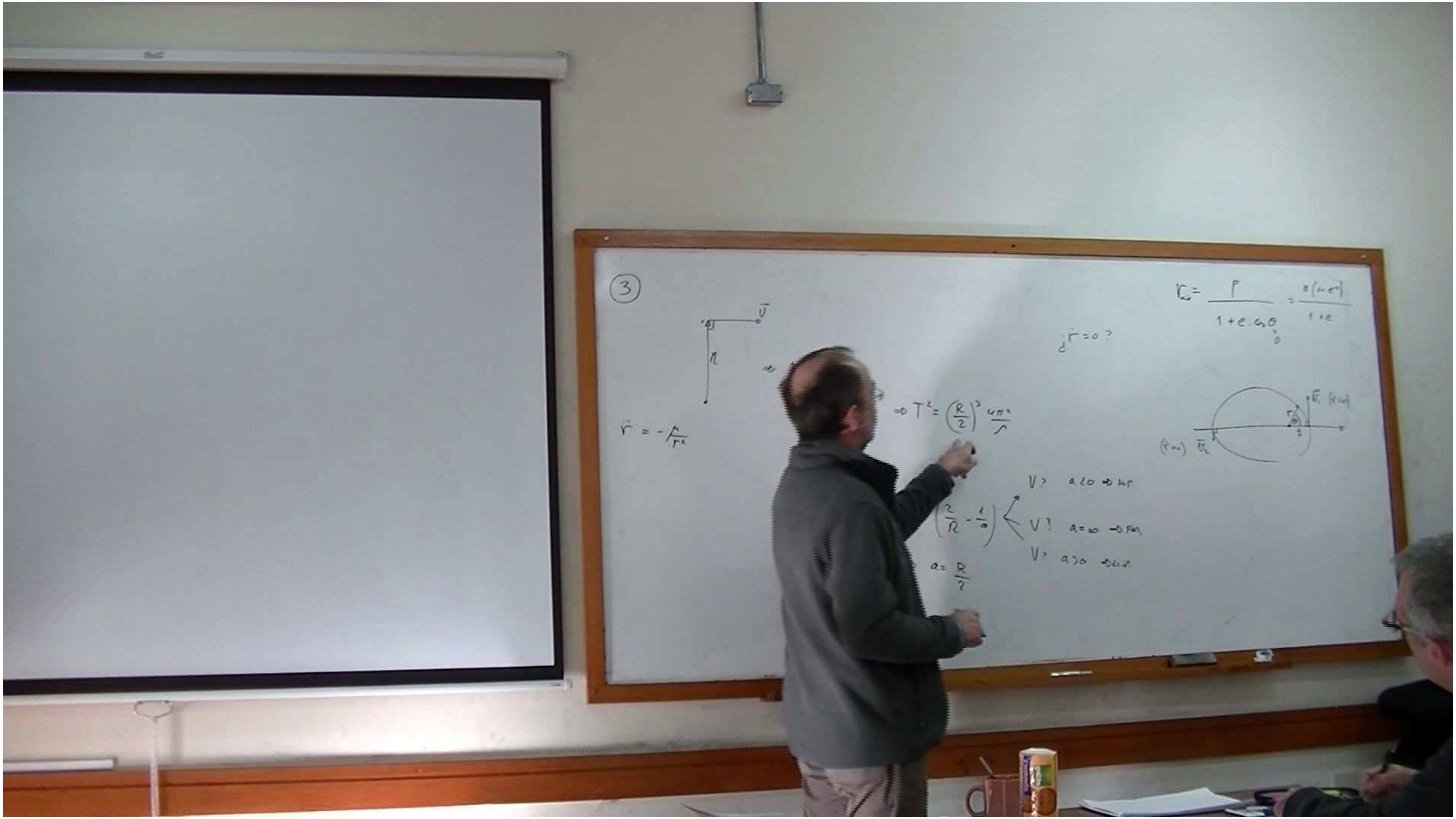
②

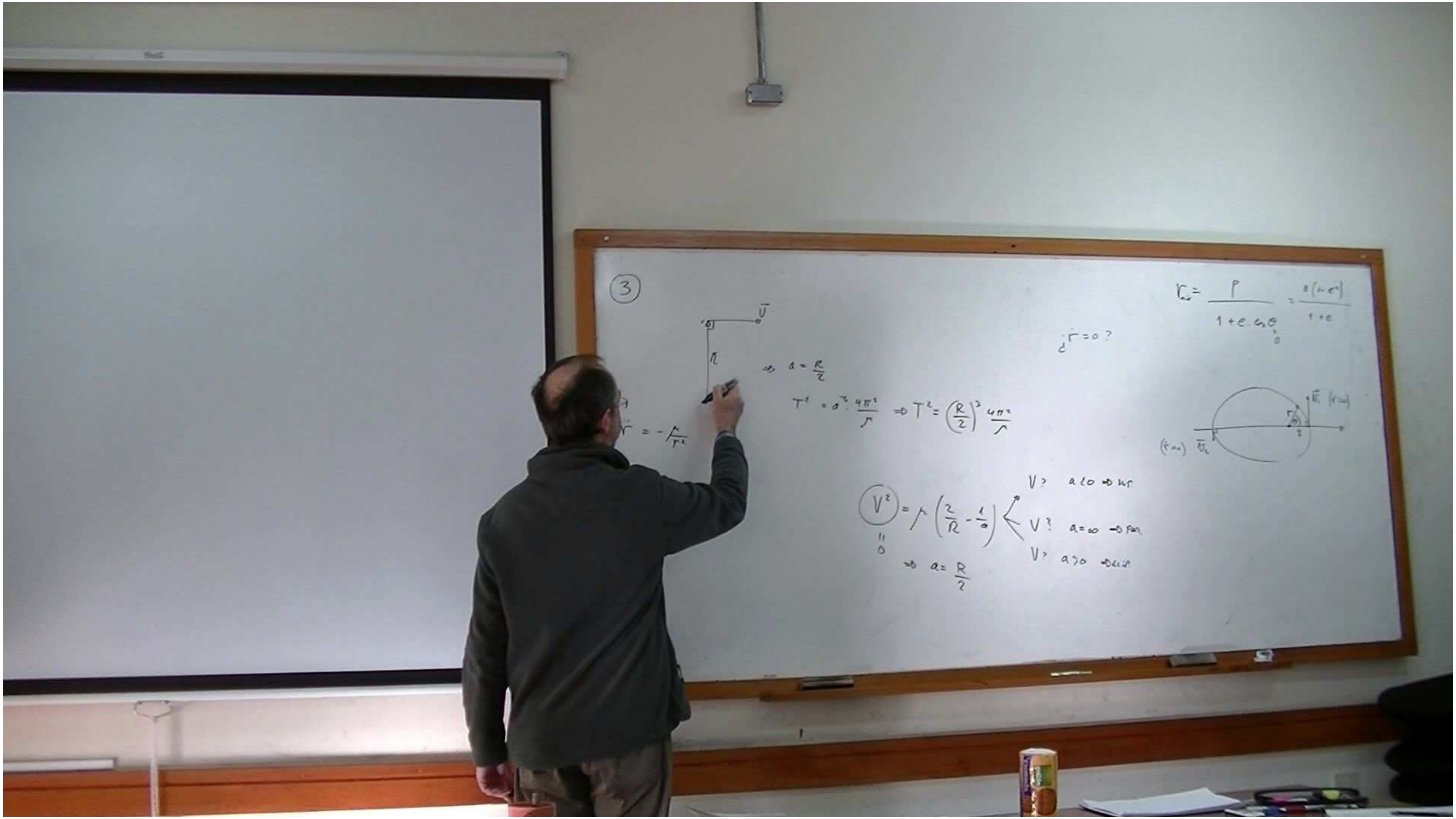
$h = R.V.$

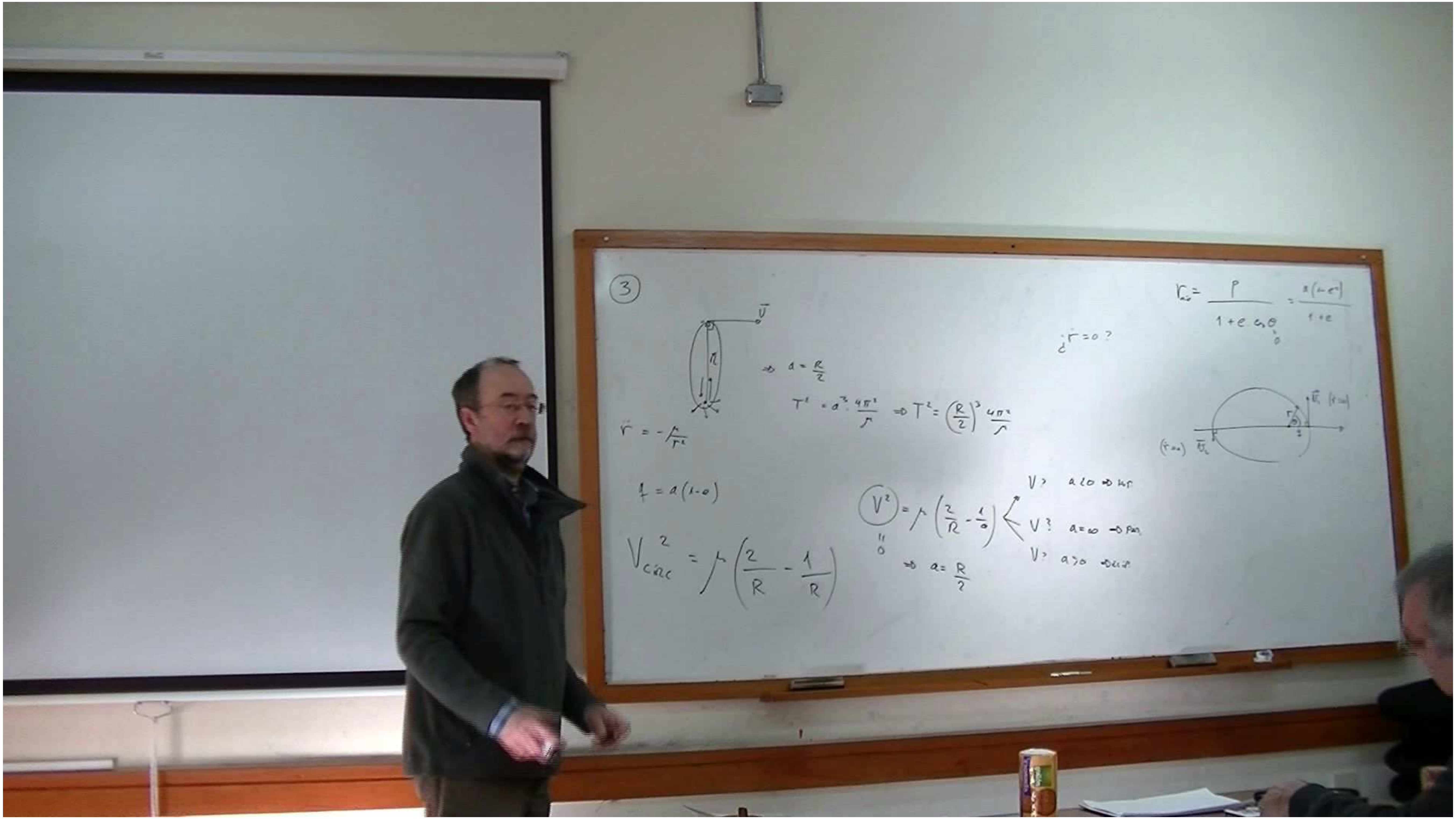

①
$v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$
$(v_{per})^2 = \mu\left(\frac{2}{r_{per}} - \frac{1}{a}\right)$
$r_{per} = q = a(1-e)$
$r_{per} = \frac{p}{1 + e\cos\theta} = \frac{a(1-e^2)}{1+e}$
¿$\dot{r} = 0$?
$\dot{r}^2(r) = 0$
$\vec{V}$
$V^2 = \mu\left(\frac{2}{R} - \frac{1}{a}\right)$
V > a < 0 → hip.
V ? a = ∞ → par.
V > a > 0 → elip.


③
¿ṙ = 0 ?
$r = \frac{p}{1 + e \cos\theta} = \frac{a(1-e^2)}{1+e}$
$V^2 = \mu\left(\frac{2}{R} - \frac{1}{a}\right)$
V? a<0 → hr
V? a=∞ → Par
V? a>0 → elip


3
¿r = 0?
$r_0 = \frac{p}{1+e\cos\theta}$
$V^2 = \mu\left(\frac{2}{R} - \frac{1}{a}\right)$
⇒ $a = \frac{R}{2}$
V? a<0 ⇒ hip.
V? a=∞ ⇒ par.
V? a>0 ⇒ elip.


③
$\vec{v}$
R
$\ddot{r} = -\mu/r^2$
$\Rightarrow T^2 = \left(\frac{R}{2}\right)^3 \frac{4\pi^2}{\mu}$
¿$\dot{r}=0$?
$r_? = \frac{p}{1+e\cos\theta} = \frac{a(1-e^2)}{1+e}$
$\left(\frac{2}{R} - \frac{1}{a}\right)$
V> a<0 ⇒ hip
V? a=∞ ⇒ par
V> a>0 ⇒ elip
$a = \frac{R}{2}$


3
V
R
⇒ a = R/2
r̈ = −μ/r²
T² = a³ · 4π²/μ ⇒ T² = (R/2)³ 4π²/μ
V² = μ (2/R − 1/a)
0
⇒ a = R/2
V> a<0 ⇒ hip
V? a=∞ → Par.
V> a>0 ⇒ elip
¿ṙ = 0 ?
r = p / (1 + e cos θ) = a(1−e²)/(1+e)
0
r
θ
V₁
(ṙ=0)
(ṙ=0)
V₂



③

$\vec{v}$

R

$\Rightarrow a = \frac{R}{2}$

$T^2 = a^3 \cdot \frac{4\pi^2}{\mu} \Rightarrow T^2 = \left(\frac{R}{2}\right)^3 \frac{4\pi^2}{\mu}$

$\ddot{r} = -\frac{\mu}{r^2}$

$q = a(1-e)$

$V^2_{circ} = \mu\left(\frac{2}{R} - \frac{1}{R}\right)$

$\boxed{V^2} = \mu\left(\frac{2}{R} - \frac{1}{a}\right)$

$\overset{\shortparallel}{0}$

$\Rightarrow a = \frac{R}{2}$

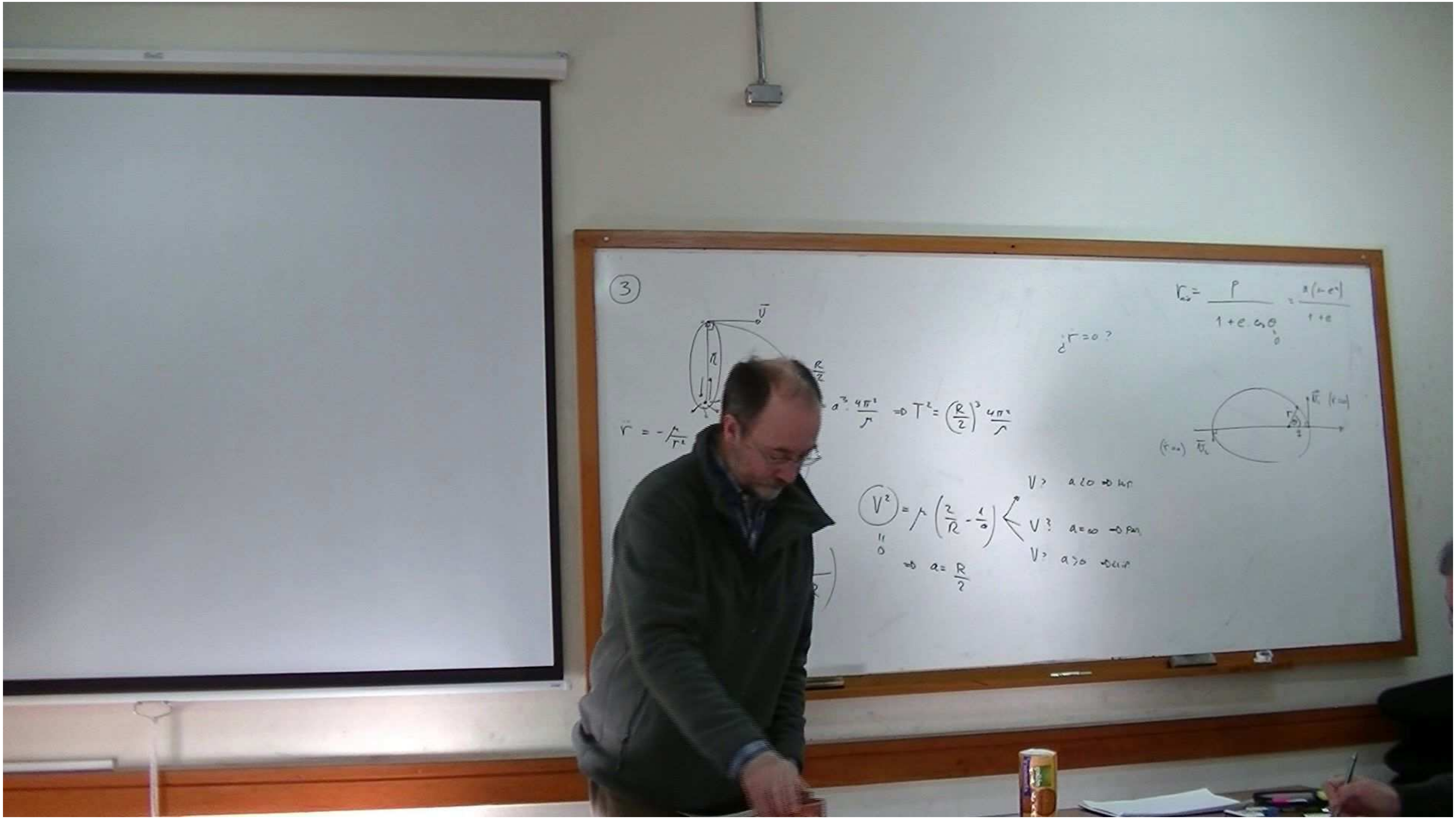
$V >$ $a < 0 \Rightarrow$ hip

$V ?$ $a = \infty \rightarrow$ par

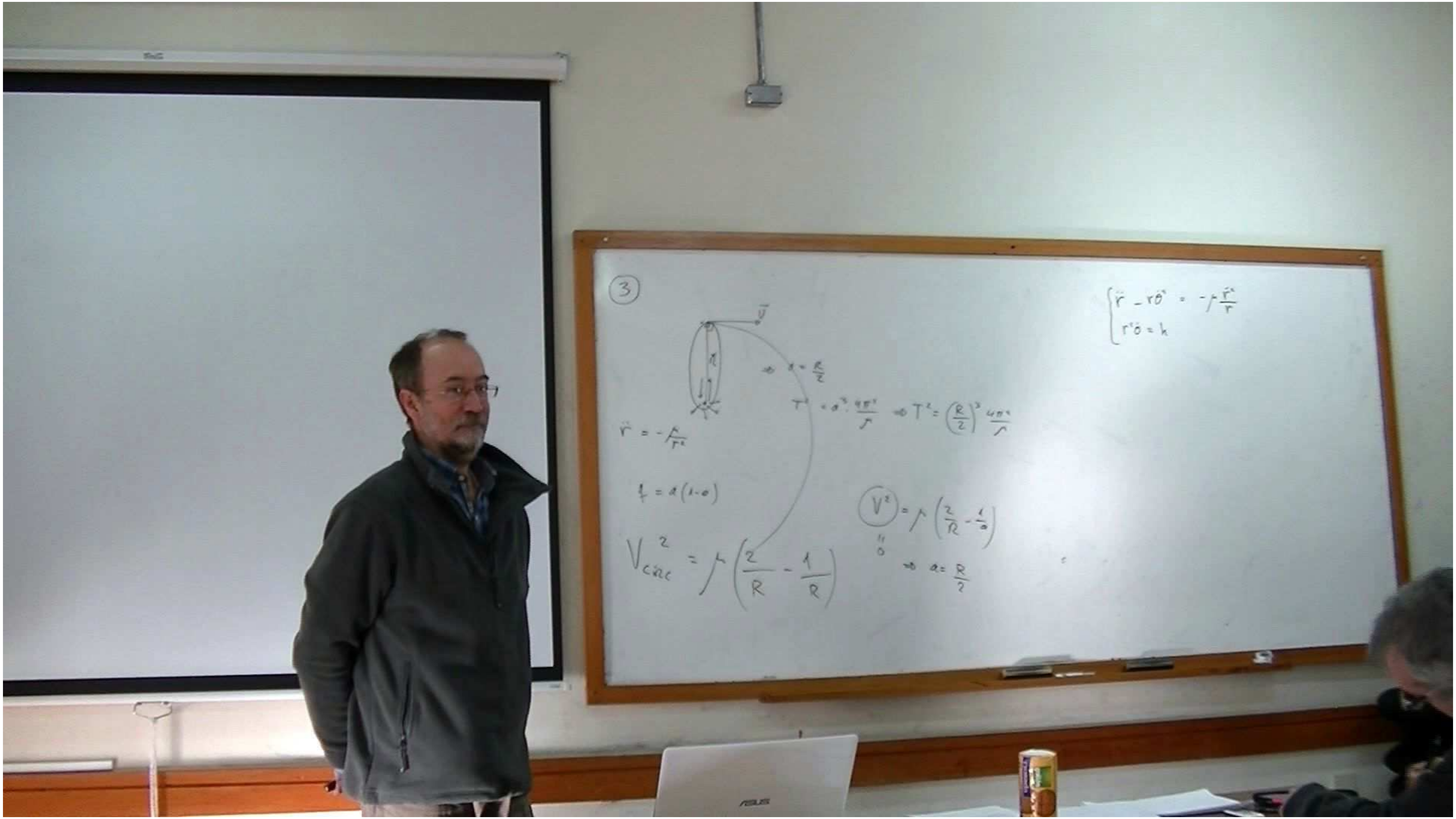
$V >$ $a > 0 \Rightarrow$ elip

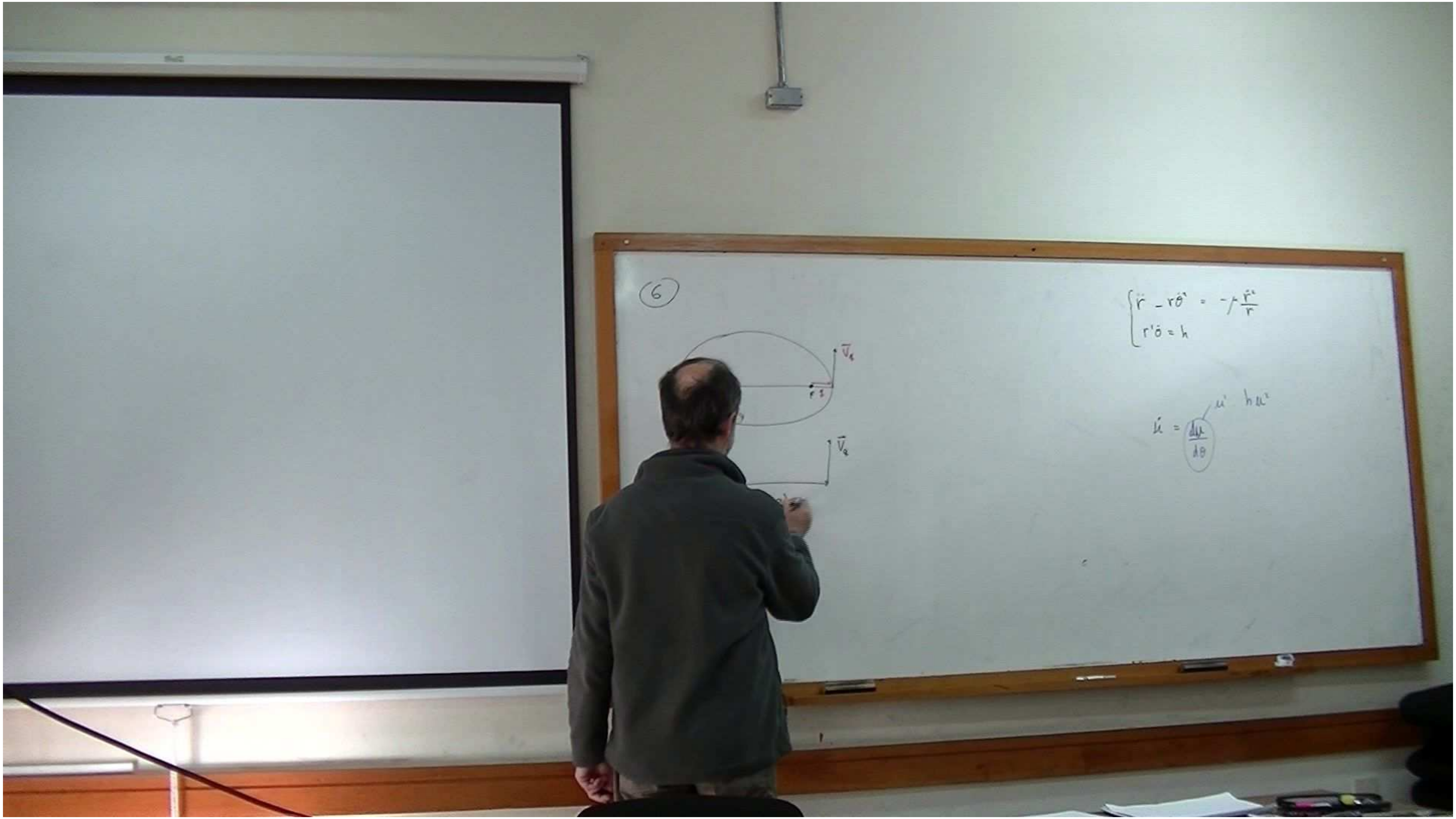
¿$\dot{r} = 0$?

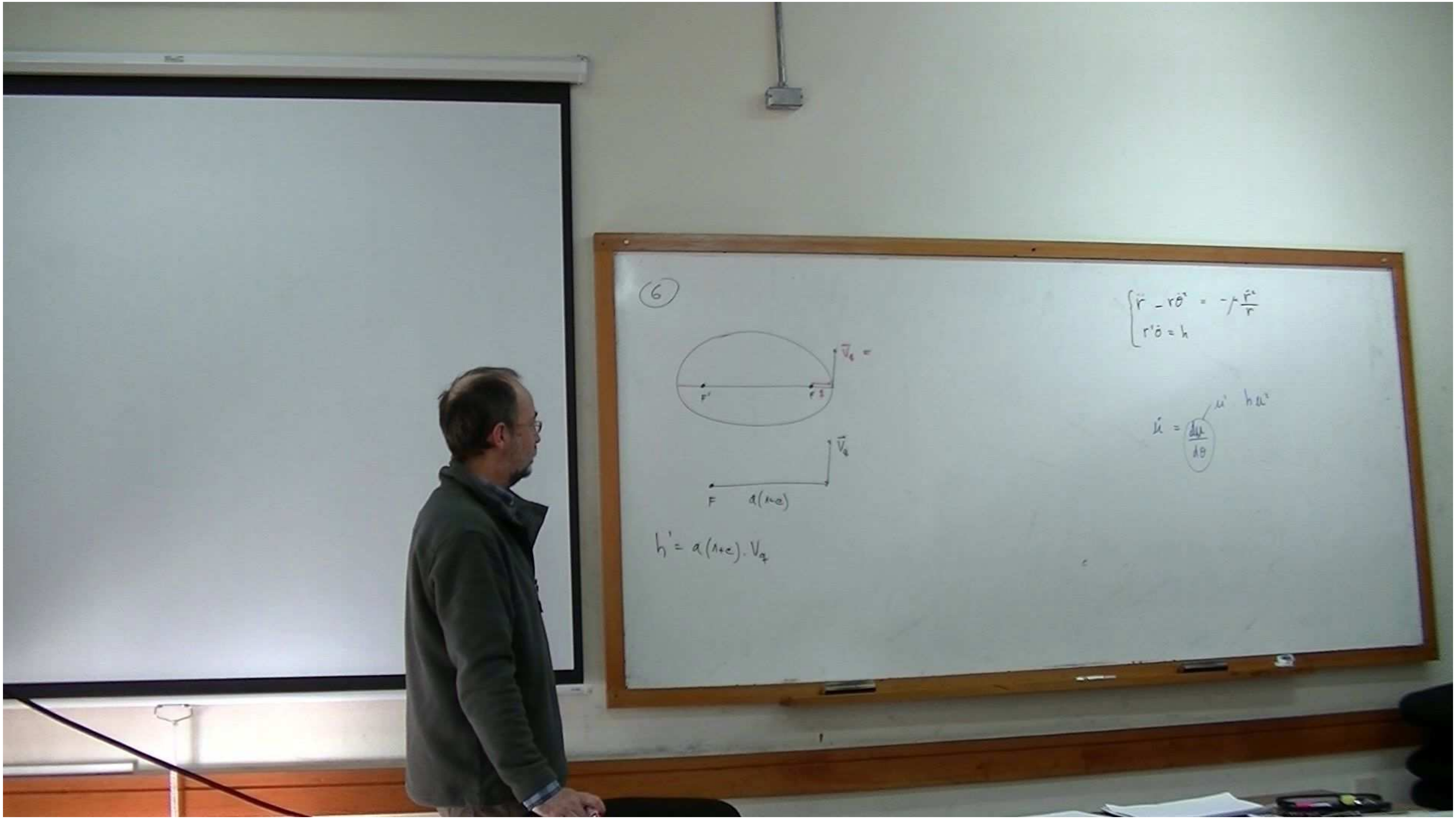
$r_{\min} = \frac{p}{1 + e\cos\theta} = \frac{a(1-e^2)}{1+e}$


③
$\vec{v}$
R
$\frac{R}{2}$
$\ddot{r} = -\frac{\mu}{r^2}$
$a^3 \frac{4\pi^2}{\mu} \Rightarrow T^2 = \left(\frac{R}{2}\right)^3 \frac{4\pi^2}{\mu}$
¿$\dot{r} = 0$?
$r_{\min} = \frac{p}{1 + e \cos\theta} = \frac{a(1-e^2)}{1+e}$
$\vec{v}_1$ $(\dot{r}=0)$
$(\dot{r}=0)$ $\vec{v}_2$
r
θ
$V^2 = \mu\left(\frac{2}{R} - \frac{1}{a}\right)$
0
$\Rightarrow a = \frac{R}{2}$
V? a<0 ⇒ hip
V? a=∞ ⇒ par
V? a>0 ⇒ elip


③
v⃗
R
⇒ a = R/2
T² = a³ · 4π
(R/2)³ 4π²/μ
r̈ = − μ/r²
q = a(1−e)
V²circ = μ(2/R
r̈ − 2ṙθ̇


③
$\vec{v}$
R
$\Rightarrow a = \frac{R}{2}$
$T^2 = a^3 \cdot \frac{4\pi^2}{\mu} \Rightarrow T^2 = \left(\frac{R}{2}\right)^3 \frac{4\pi^2}{\mu}$
$\ddot{r} = -\frac{\mu}{r^2}$
$q = a(1-e)$
$V^2_{circ} = \mu\left(\frac{2}{R} - \frac{1}{R}\right)$
$V^2 = \mu\left(\frac{2}{R} - \frac{1}{a}\right)$
$\| \, 0$
$\Rightarrow a = \frac{R}{2}$
$\begin{cases} \ddot{r} - r\dot{\theta}^2 = -\mu\frac{\vec{r}}{r} \\ r^2\dot{\theta} = k \end{cases}$


6
$\vec{V}_1$
$\vec{V}_2$
$\ddot{r} - r\dot{\theta}^2 = -\mu \frac{\hat{r}}{r}$
$r^2\dot{\theta} = h$
u'
hu^2
$\dot{u} = \frac{du}{d\theta}$

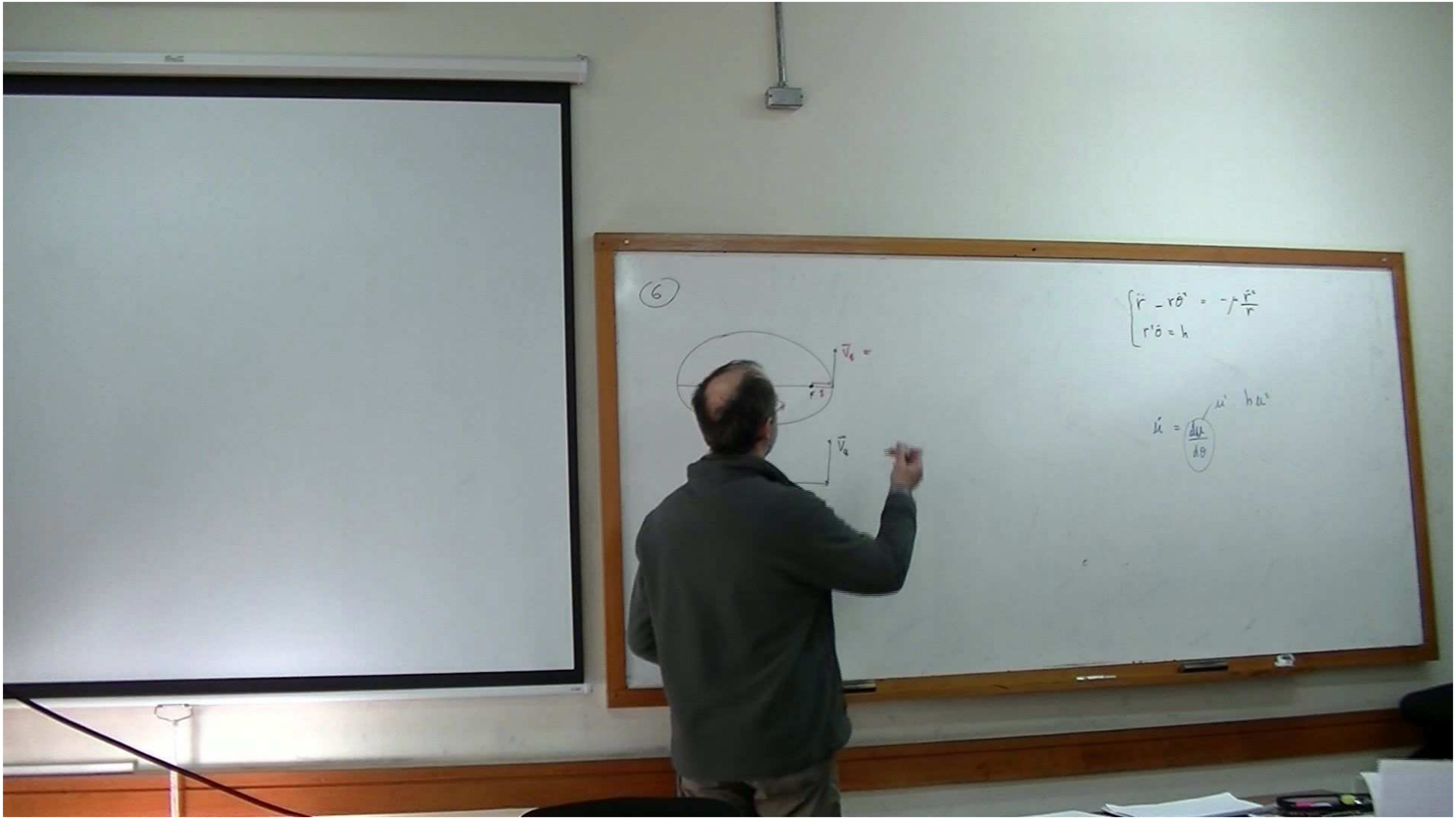


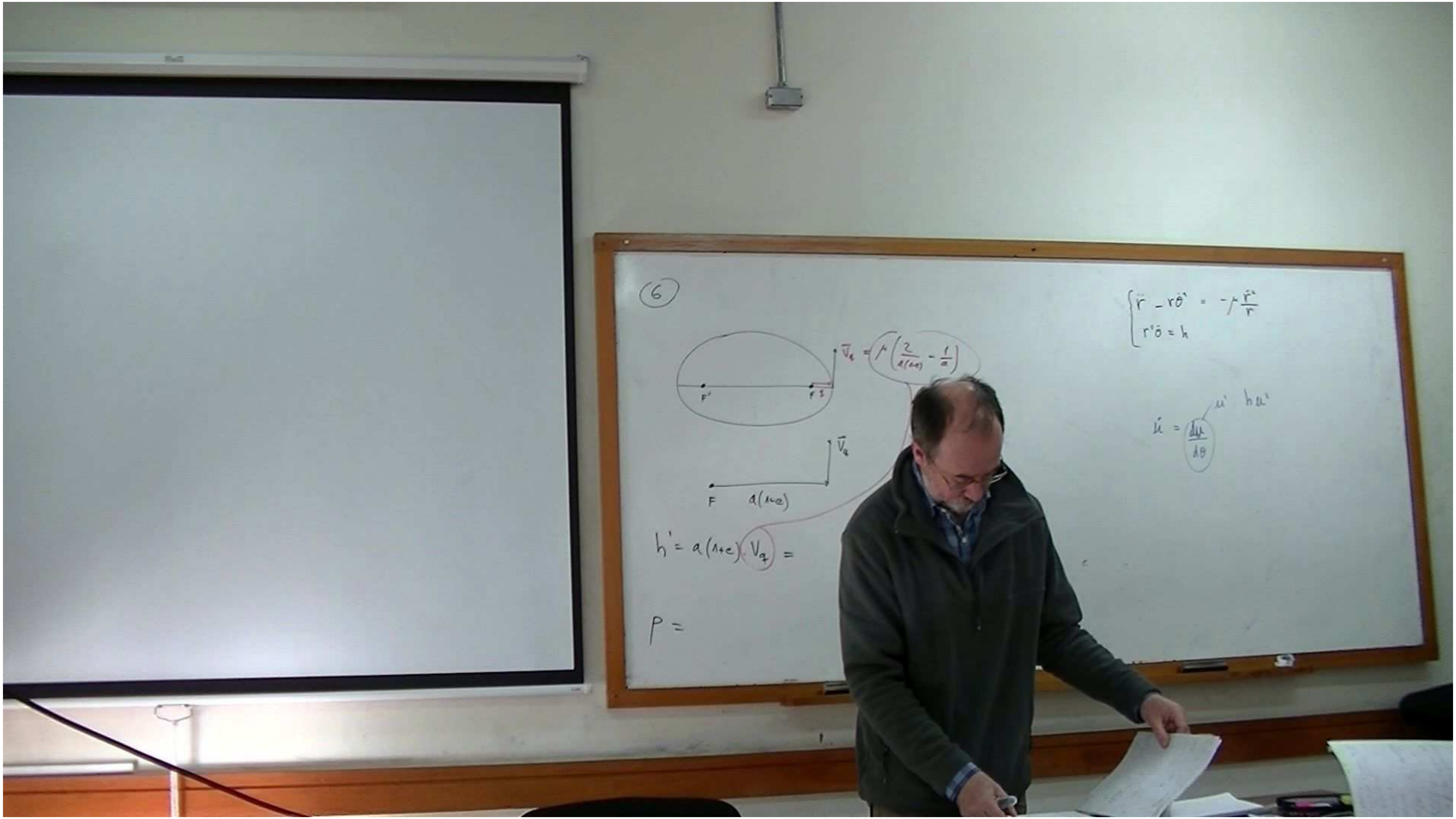
$h' = a(1+e).V_q$

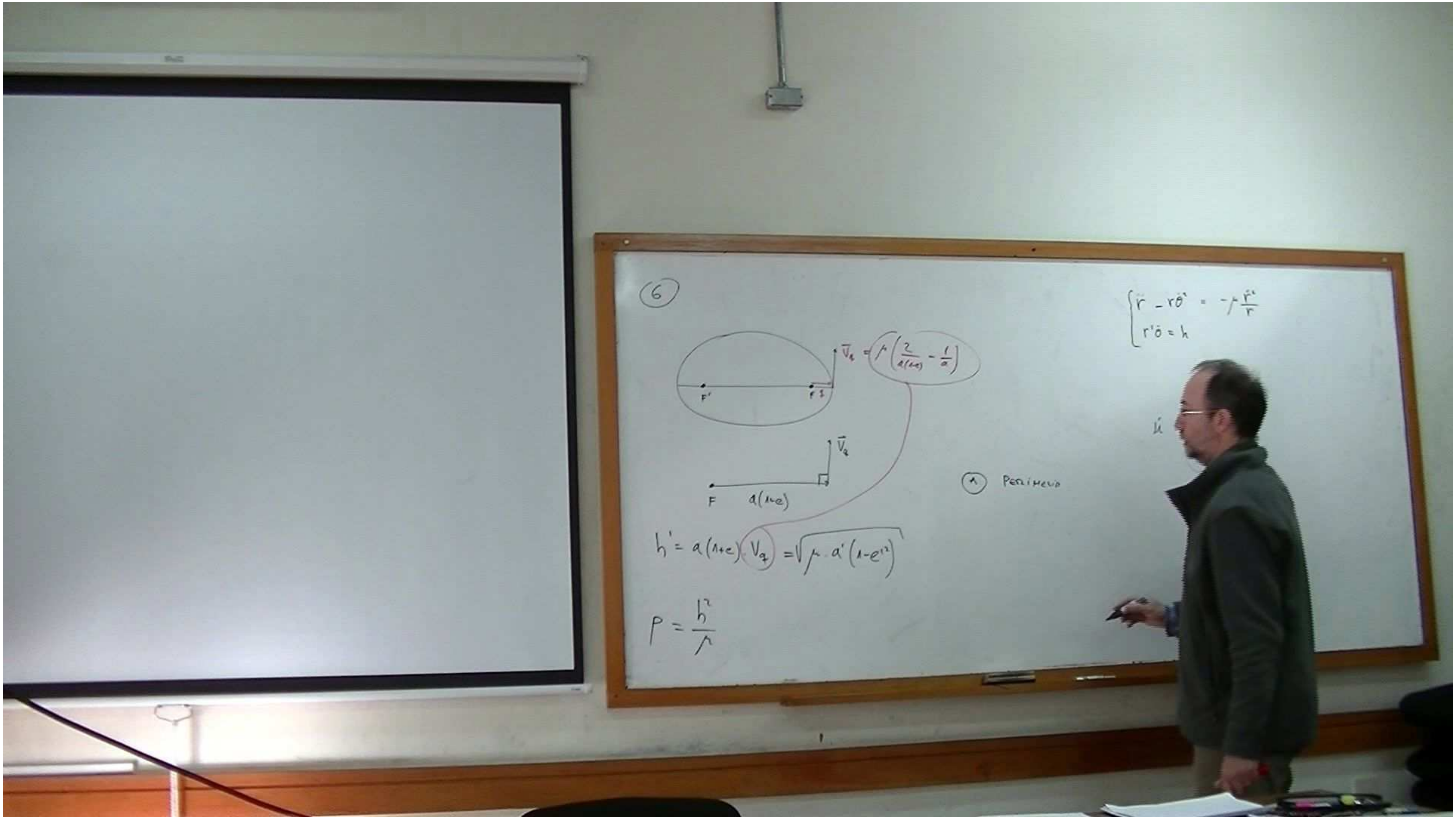
$$\begin{cases} \ddot{r} - r\dot{\theta}^2 = -\mu\frac{\vec{r}^2}{r} \\ r^2\dot{\theta} = h \end{cases}$$

$u' = \frac{du}{d\theta}$

u^2 hu^2


6
$\vec{V}_q =$
$\vec{V}_q$
$\ddot{r} - r\dot{\theta}^2 = -\mu \frac{\vec{r}}{r}$
$r^2\dot{\theta} = h$
$\dot{u} = \frac{du}{d\theta}$
u'
hu^2


6
F'
F
$\vec{V}_q = \mu\left(\frac{2}{a(1+e)} - \frac{1}{a}\right)$
$\vec{V}_q$
F
a(1+e)
$h' = a(1+e) \cdot V_q =$
$p =$
$\ddot{r} - r\dot{\theta}^2 = -\mu \frac{\hat{r}}{r}$
$r^2\dot{\theta} = h$
$u' = \frac{du}{d\theta}$
u' hu^2



⑥

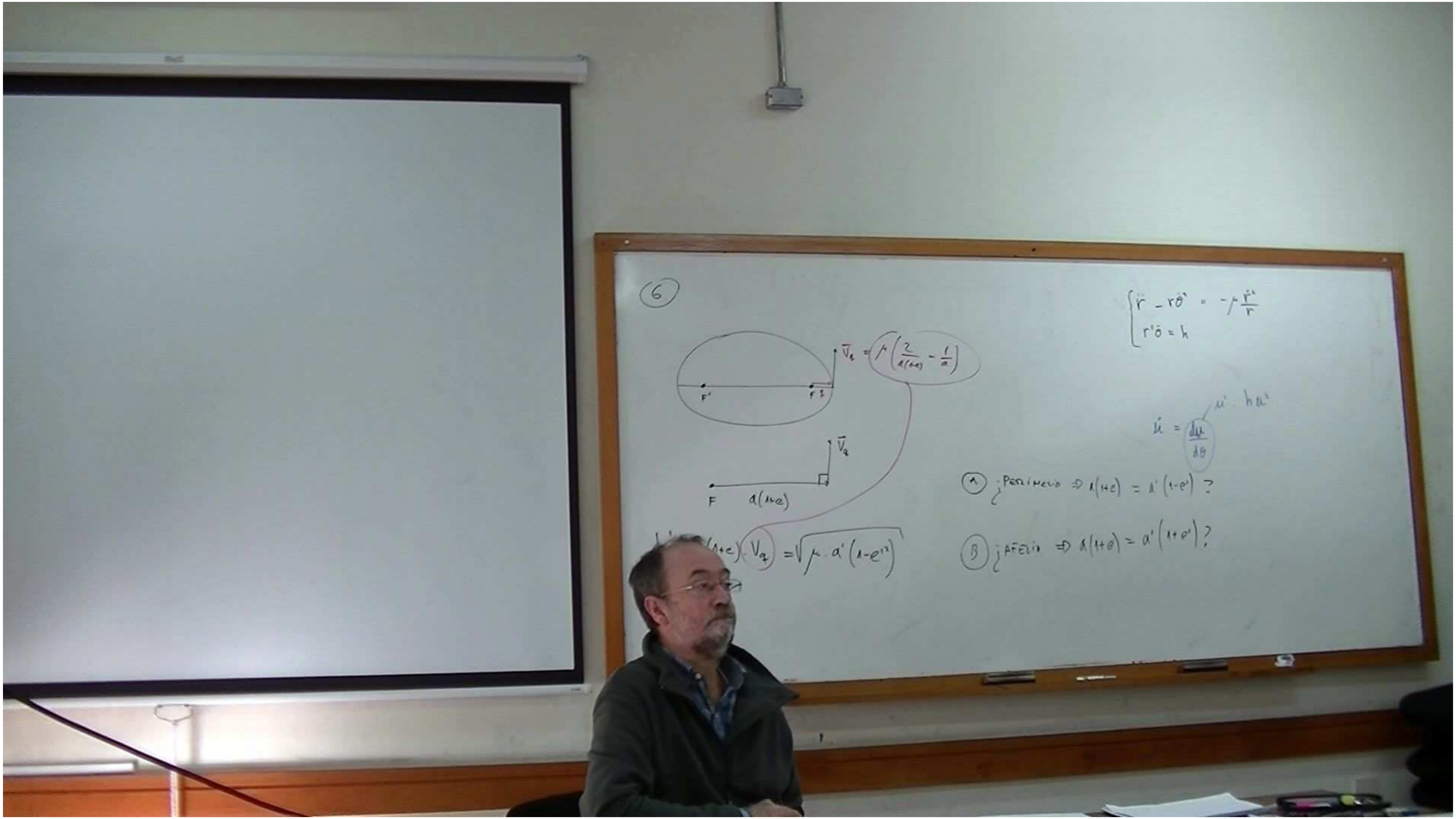
$$\vec{V}_q = \mu\left(\frac{2}{a(1+e)} - \frac{1}{a}\right)$$

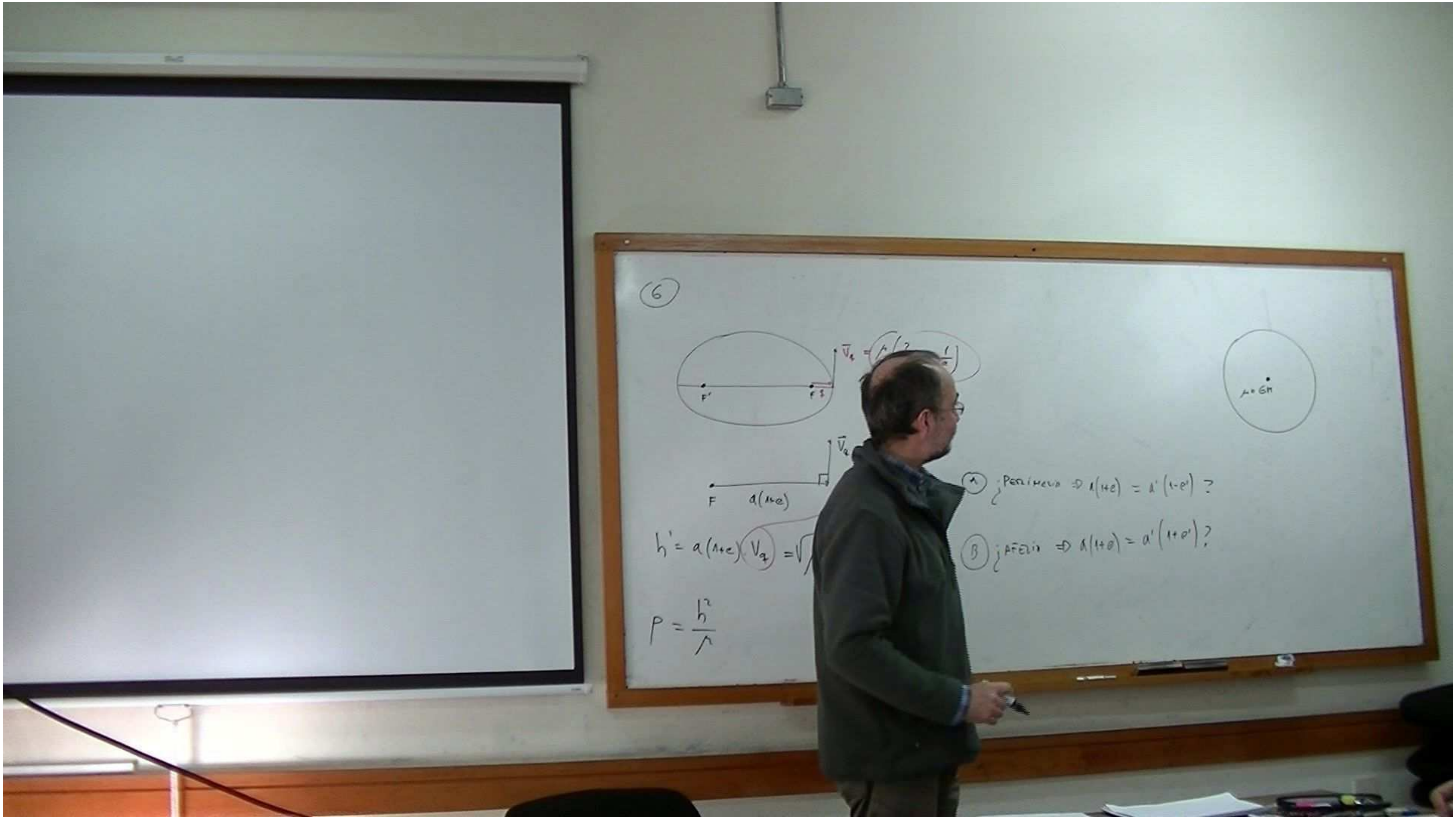
$$h' = a(1+e)\,V_q = \sqrt{\mu\, a'(1-e'^2)}$$

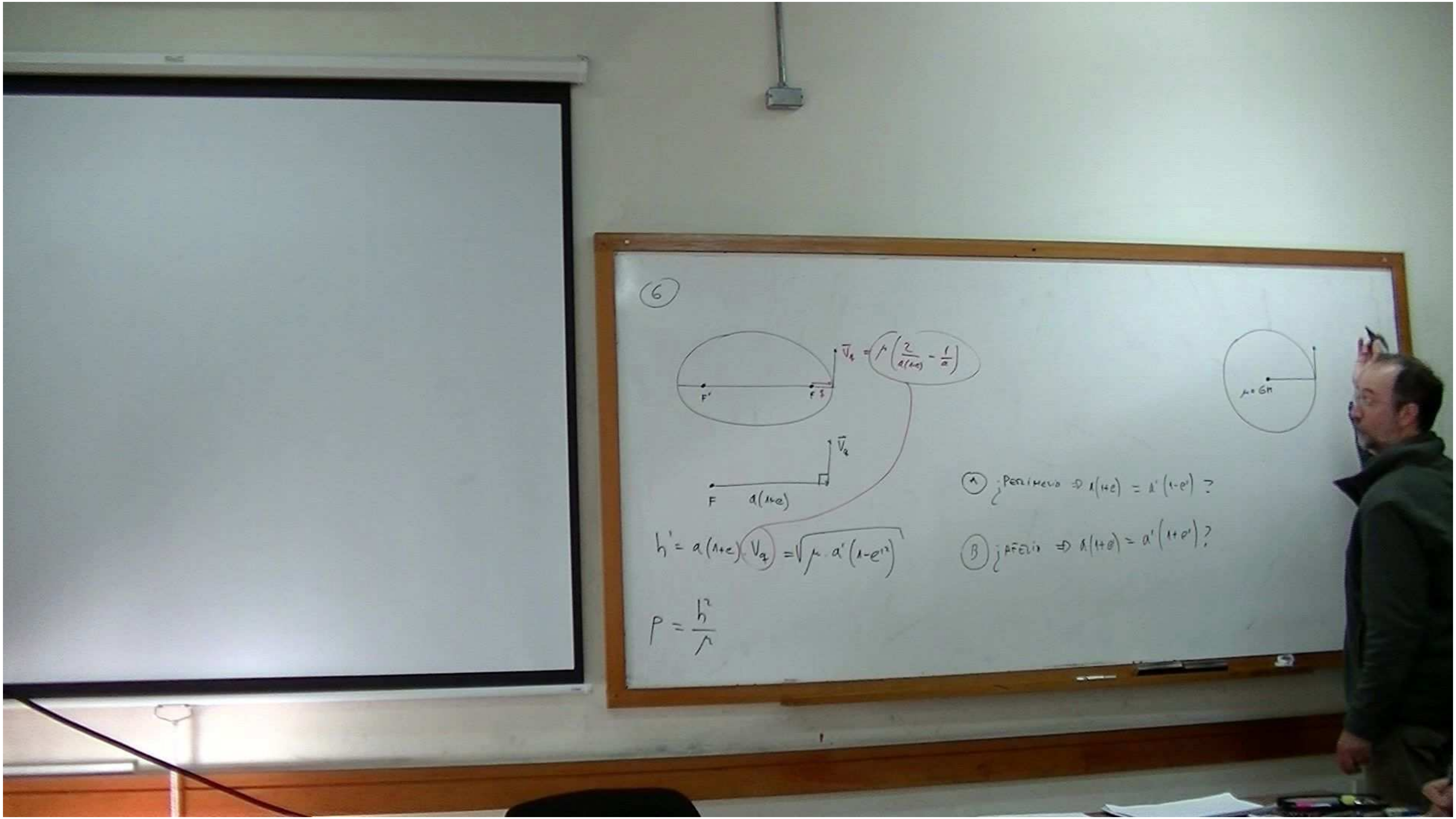
$$p = \frac{h^2}{\mu}$$

$$\begin{cases} \ddot{r} - r\dot{\theta}^2 = -\mu\frac{\vec{r}}{r} \\ r^2\dot{\theta} = h \end{cases}$$

① Perihelio


6
F'
F
a(1+e)
V_2 = μ(2/a(1+e) − 1/a)
V_2
(1+e) V_2 = √(μ · a'(1−e'²))
r̈ − rθ̇² = −μ ṙ²/r
r²θ̇ = h
u' = du/dθ
u' . hu²
A ¿Perihelio ⇒ a(1+e) = a'(1−e') ?
B ¿Afelio ⇒ a(1+e) = a'(1+e') ?


⑥
F'
F
$\vec{V}_q = \sqrt{\mu\left(\frac{2}{\ }-\frac{1}{a}\right)}$
$\mu = GM$
$\vec{V}_q$
F
$a(1+e)$
A ¿Perihelio ⇒ $a(1+e) = a'(1-e')$?
B ¿Afelio ⇒ $a(1+e) = a'(1+e')$?
$h' = a(1+e)\,V_q = \sqrt{\mu}$
$p = \frac{h^2}{\mu}$



⑥

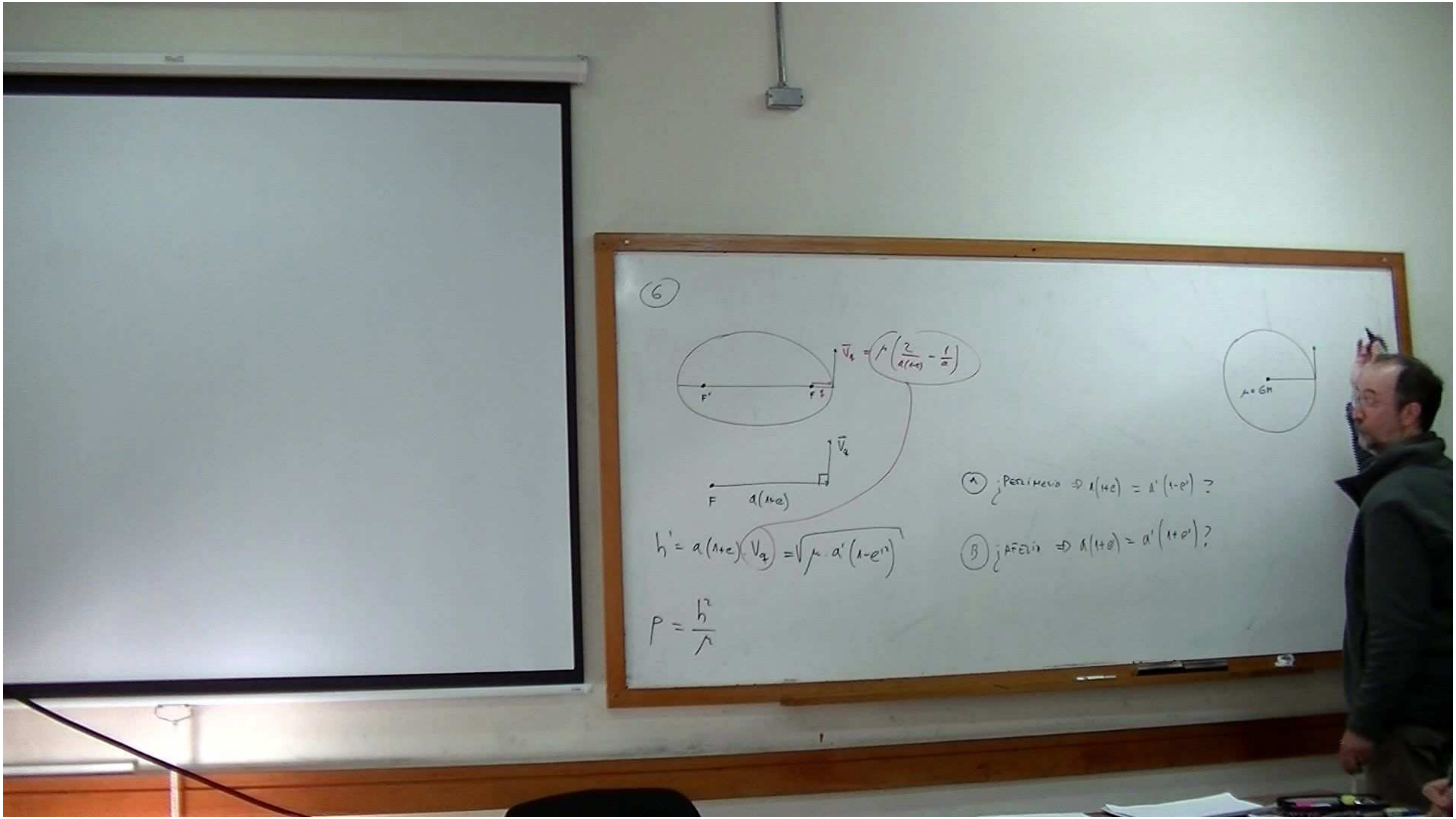
$$\vec{V}_q = \mu\left(\frac{2}{a(1+e)} - \frac{1}{a}\right)$$

$$h' = a(1+e)\,V_q = \sqrt{\mu\, a'(1-e'^2)}$$

$$p = \frac{h^2}{\mu}$$

① ¿Perihelio ⇒ $a(1+e) = a'(1-e')$?

Ⓑ ¿Afelio ⇒ $a(1+e) = a'(1+e')$?



⑥

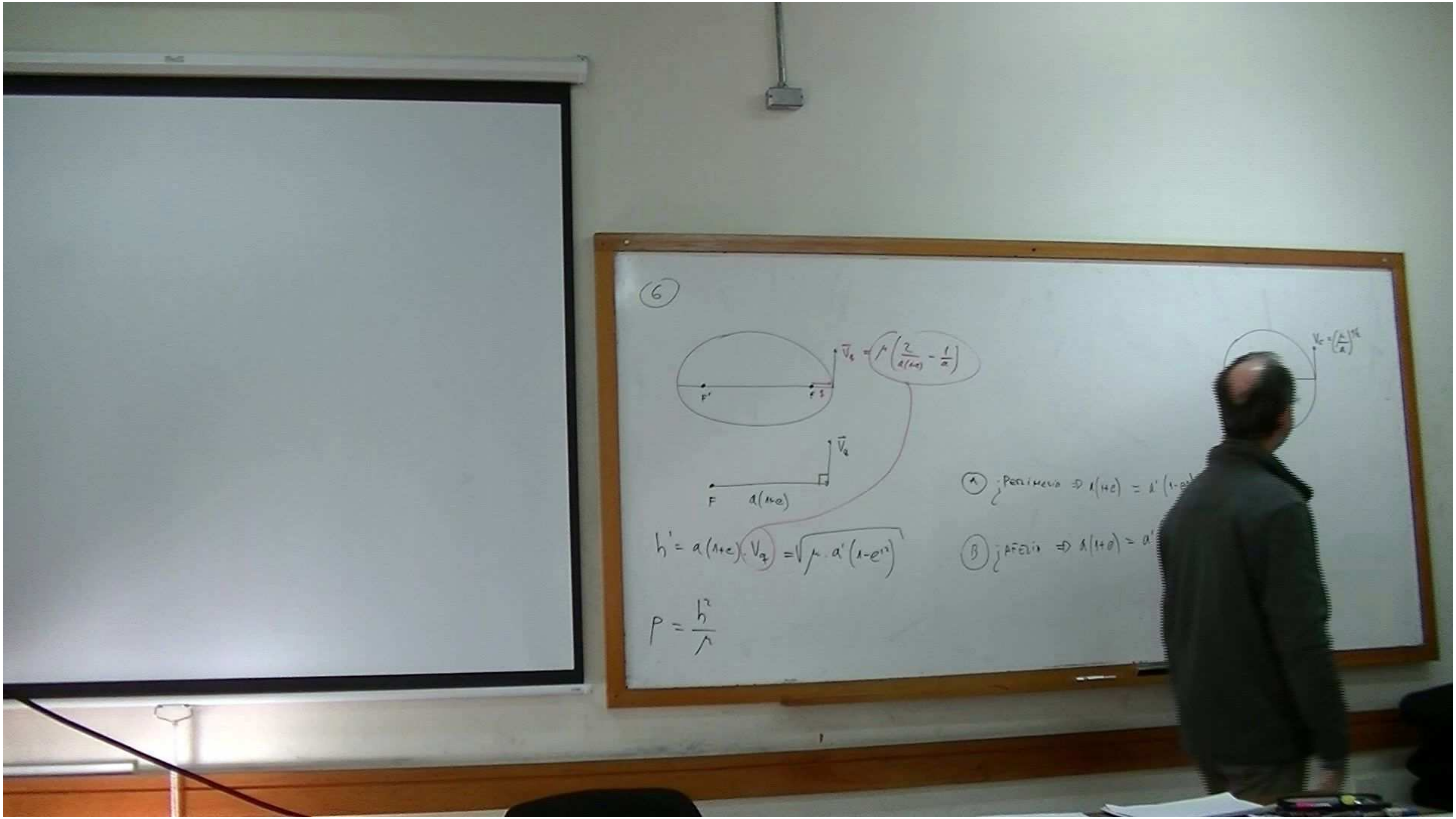
$$\vec{V}_q = \mu\left(\frac{2}{a(1+e)} - \frac{1}{a}\right)$$

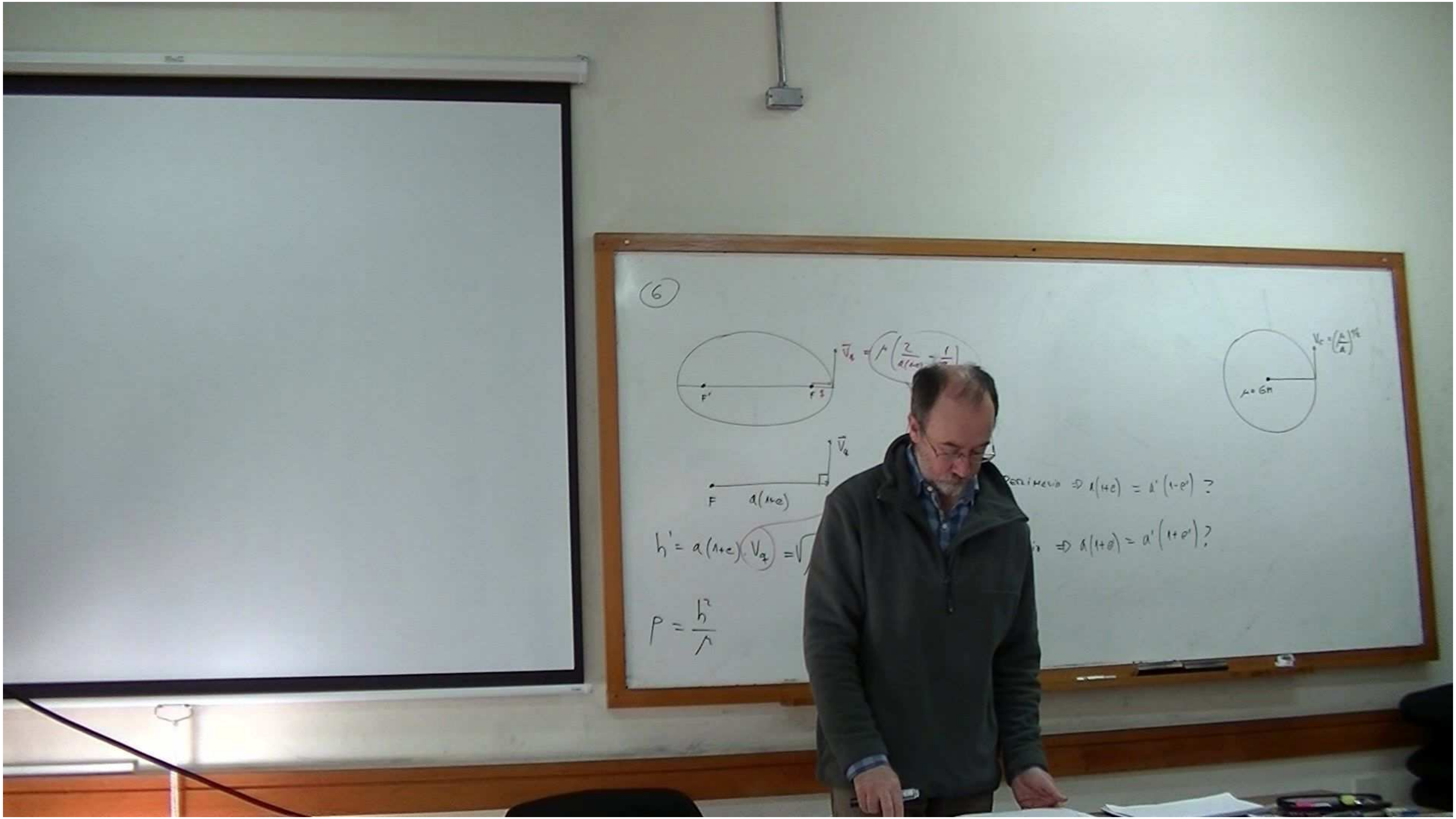
$$h' = a(1+e)\,V_q = \sqrt{\mu \cdot a'(1-e'^2)}$$

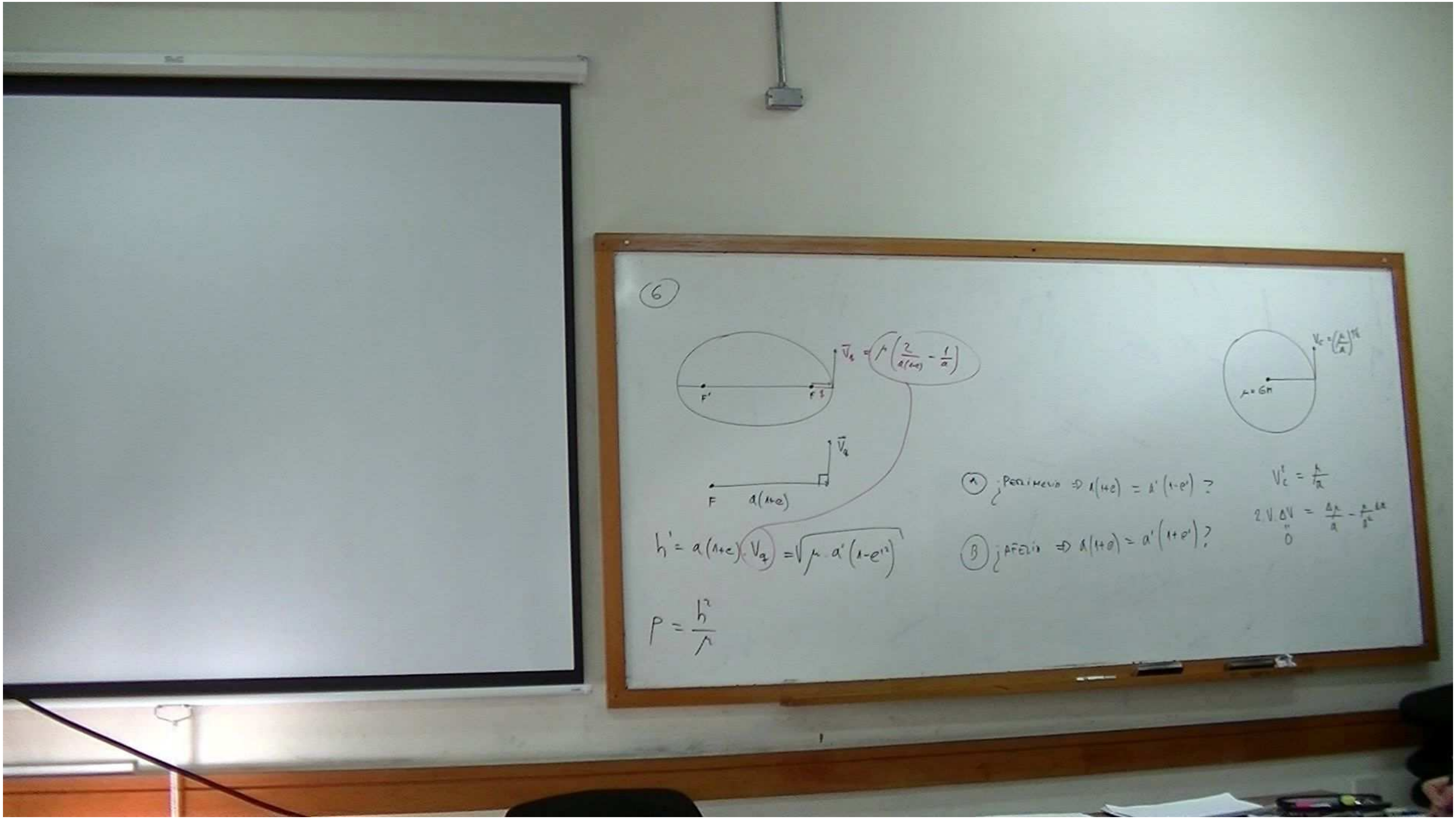
$$p = \frac{h^2}{\mu}$$

① ¿Perihelio ⇒ $a(1+e) = a'(1-e')$?

(β) ¿Afelio ⇒ $a(1+e) = a'(1+e')$?


6
F'
F S
$\vec{V}_q = \mu\left(\frac{2}{a(1+e)} - \frac{1}{a}\right)$
$\vec{V}_q$
F
a(1+e)
$h' = a(1+e) \cdot V_q = \sqrt{\mu \cdot a'(1-e'^2)}$
$p = \frac{h^2}{\mu}$
$V_c = \left(\frac{\mu}{a}\right)^{1/2}$
α ¿Perihelio ⇒ a(1+e) = a'(1-e'
β ¿Afelio ⇒ a(1+e) = a'


6
F'
F
$\vec{V}_q = \sqrt{\mu\left(\frac{2}{a(1+e)} - \frac{1}{a}\right)}$
$\vec{V}_q$
F
a(1+e)
$h' = a(1+e) \cdot V_q = \sqrt{}$
$p = \frac{h^2}{\mu}$
Perihelio ⇒ a(1+e) = a'(1-e') ?
⇒ a(1+e) = a'(1+e') ?
$V_c = \left(\frac{\mu}{a}\right)^{1/2}$
μ = GM



⑥

$$\vec{V}_q = \sqrt{\mu\left(\frac{2}{a(1+e)} - \frac{1}{a}\right)}$$

$$h' = a(1+e)\cdot V_q = \sqrt{\mu \cdot a'(1-e'^2)}$$

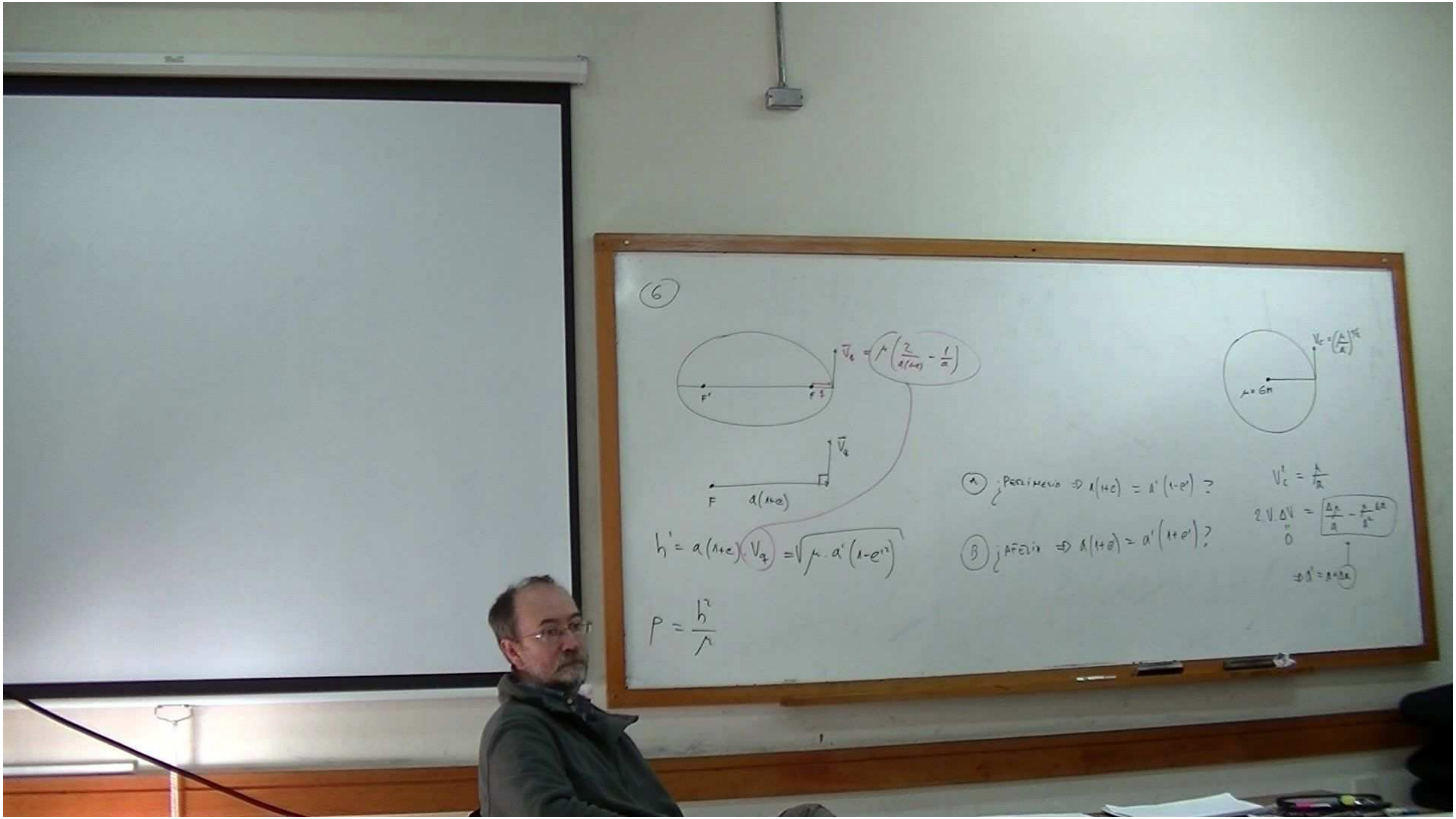
$$p = \frac{h^2}{\mu}$$

ⓐ ¿Perihelio ⇒ $a(1+e) = a'(1-e')$?

Ⓑ ¿Afelio ⇒ $a(1+e) = a'(1+e')$?

$$V_c^2 = \frac{\mu}{R}$$

$$2\,V\,\underset{0}{\underset{\shortparallel}{\Delta V}} = \frac{\Delta\mu}{R} - \frac{\mu}{R^2}\Delta R$$



⑥

$\vec{V}_q = \mu\left(\frac{2}{a(1+e)} - \frac{1}{a}\right)$

$h' = a(1+e) \cdot V_q = \sqrt{\mu \cdot a'(1-e'^2)}$

$p = \frac{h^2}{\mu}$

$V_c = \left(\frac{\mu}{R}\right)^{1/2}$

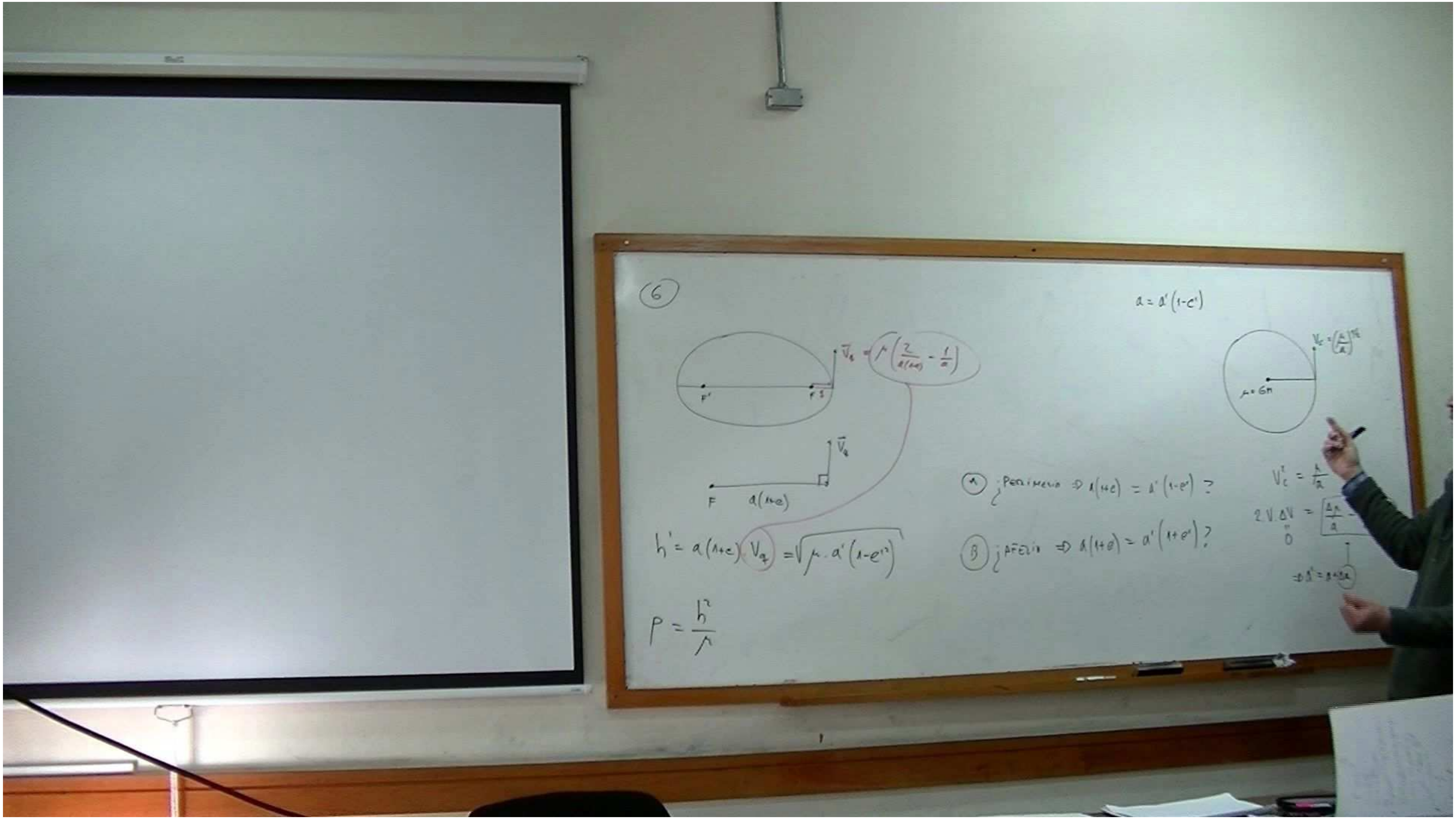
(α) ¿Perihelio ⇒ $a(1+e) = a'(1-e')$?

(β) ¿Afelio ⇒ $a(1+e) = a'(1+e')$?

$V_c^2 = \frac{\mu}{R}$

$2V\underset{0}{\underset{\shortparallel}{\Delta V}} = \boxed{\frac{\Delta\mu}{R} - \frac{\mu}{R^2}\Delta R}$

$\Rightarrow R' = R + \Delta R$



⑥

$a = a'(1-e')$

$\vec{V}_q = \mu\left(\frac{2}{a(1+e)} - \frac{1}{a}\right)$

$V_c = \left(\frac{\mu}{a}\right)^{1/2}$

$h' = a(1+e)\,V_q = \sqrt{\mu \cdot a'(1-e'^2)}$

$P = \frac{h^2}{\mu}$

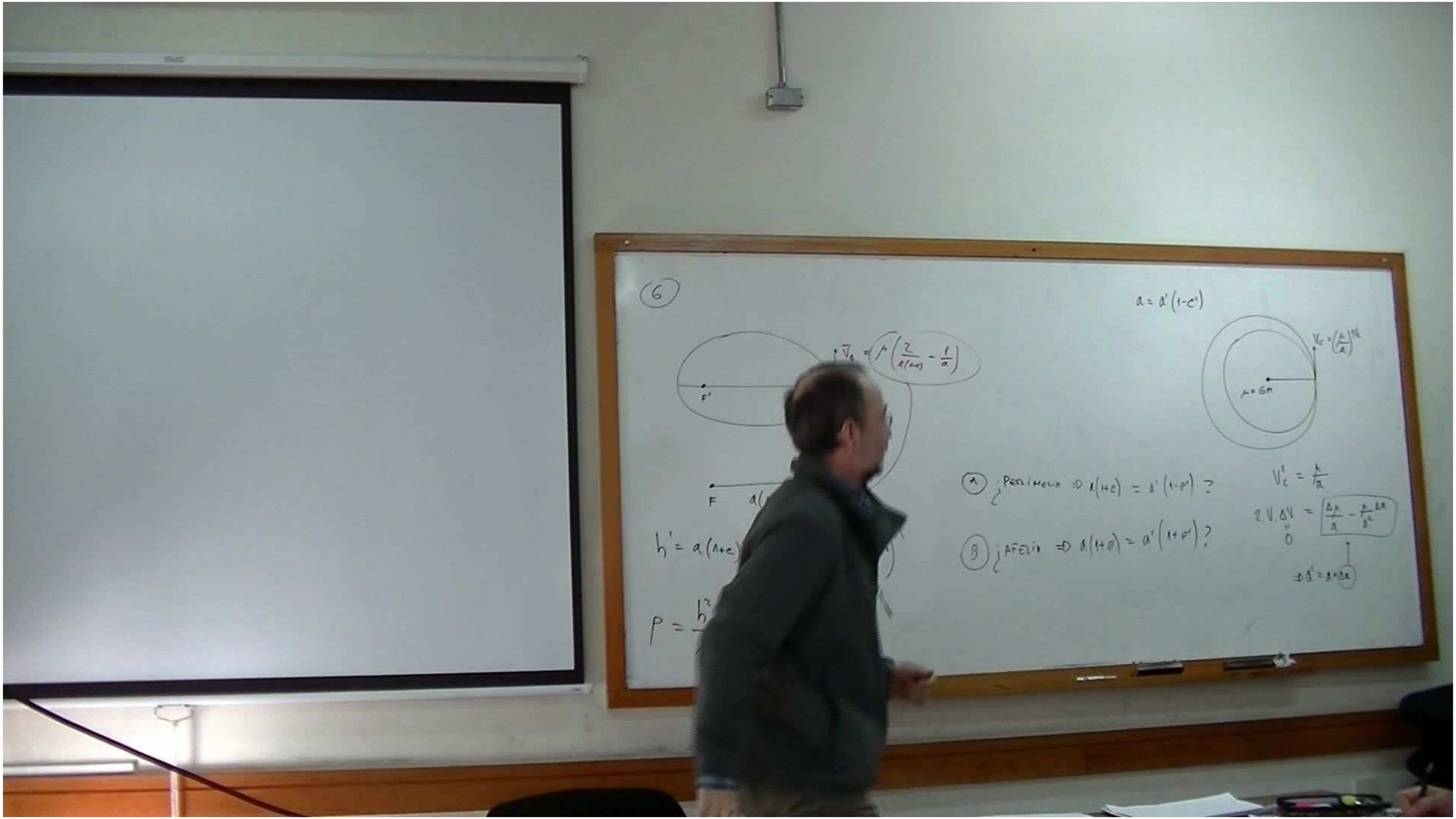
Ⓐ ¿Perihelio ⇒ $a(1+e) = a'(1-e')$?

Ⓑ ¿Afelio ⇒ $a(1+e) = a'(1+e')$?

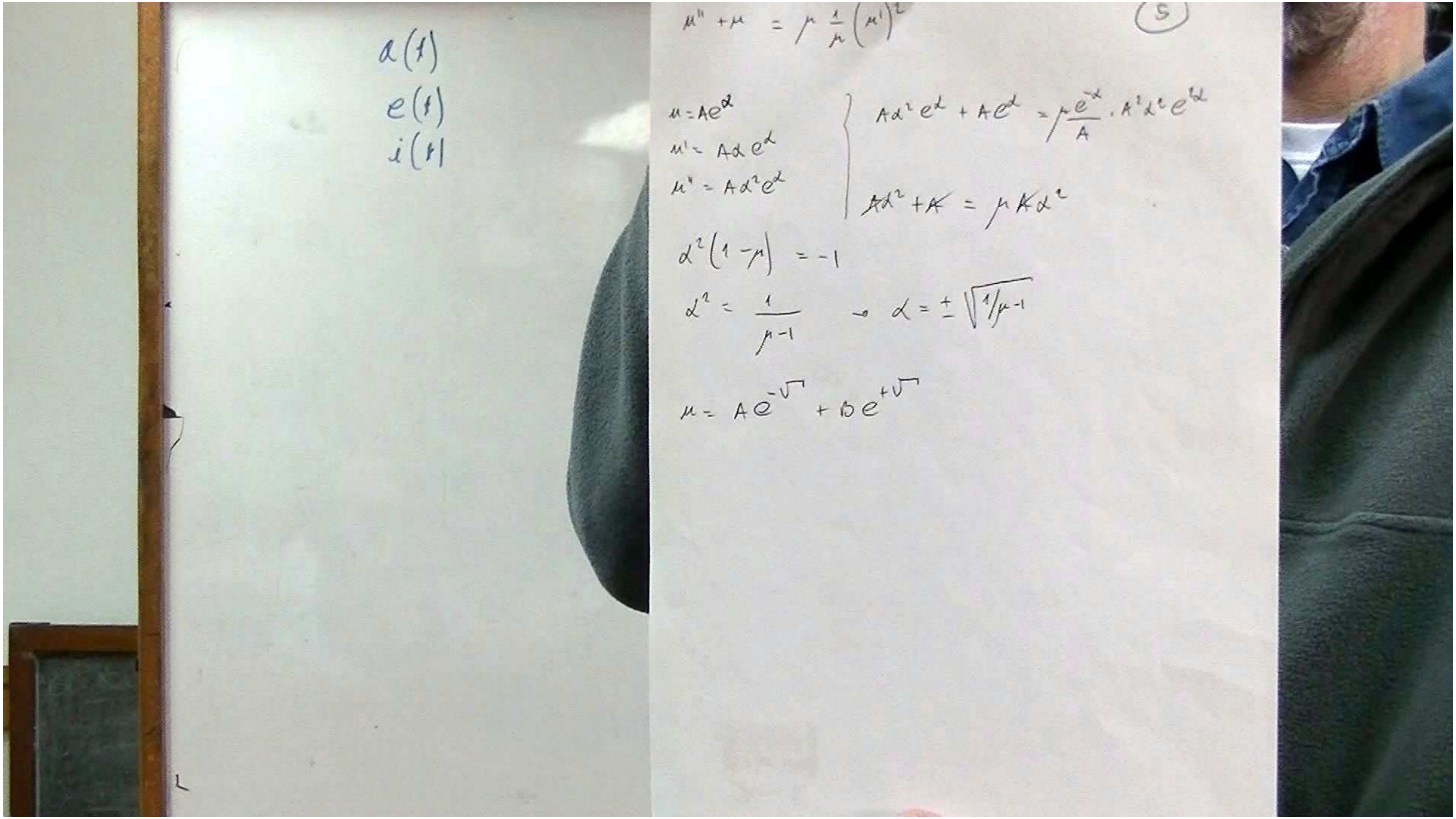
$V_c^2 = \frac{\mu}{a}$

$2V.\underset{0}{\underset{\parallel}{\Delta V}} = \boxed{\frac{\Delta\mu}{a}}$

$\Rightarrow a' = a + \Delta a$


6
F'
F
h' = a(1+e)
P = h²
a = a'(1-e')
V_c = (μ/a)^½
μ = GM
α ¿Perihelio ⇒ a(1+e) = a'(1-e') ?
β ¿Afelio ⇒ a(1+e) = a'(1+e') ?
V_c² = μ/a
2 V ΔV = Δμ/a - μ/a² Δa
0
⇒ a' = a + Δa


6
F'
F
F
h' = a(1+
P = h²/μ
2/(a(1+e)) - 1/a
a = a'(1-e')
V'
V
F
Vc = (μ/a)^1/2
μ = GM
A ¿Perihelio ⇒ a(1+e) = a'(1-e') ?
B ¿Afelio ⇒ a(1+e) = a'(1+e') ?
Vc² = μ/a
2 V ΔV = Δμ/a - μ/a² Δa
0
⇒ a' = a + Δa



$a(t)$

$e(t)$

$i(t)$

⑤

$$\mu'' + \mu = \mu \frac{1}{\mu}(\mu')^2$$

$u = Ae^{\alpha}$

$u' = A\alpha e^{\alpha}$

$\mu'' = A\alpha^2 e^{\alpha}$

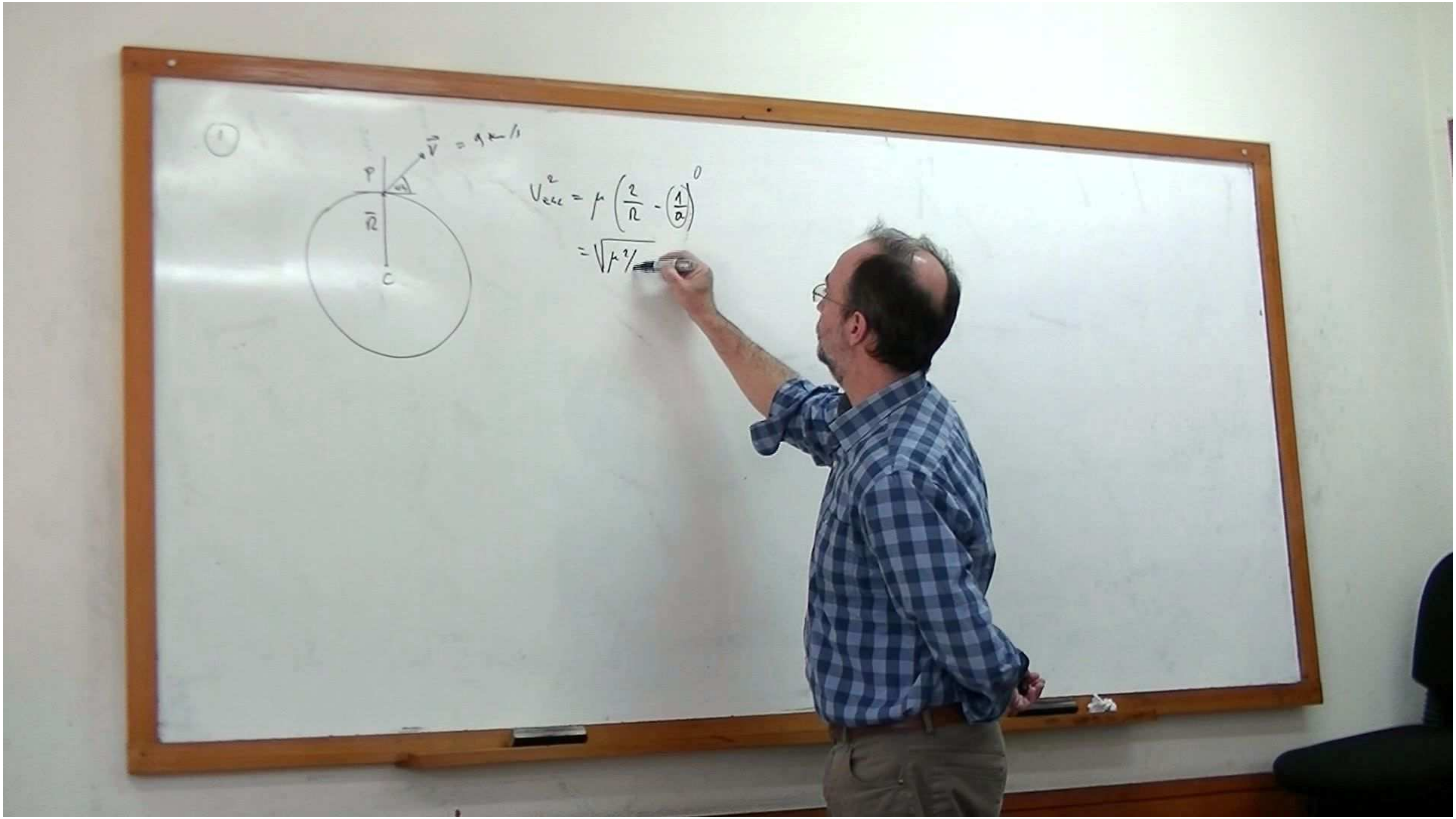
$$A\alpha^2 e^{\alpha} + Ae^{\alpha} = \mu \frac{e^{-\alpha}}{A} \cdot A^2\alpha^2 e^{2\alpha}$$

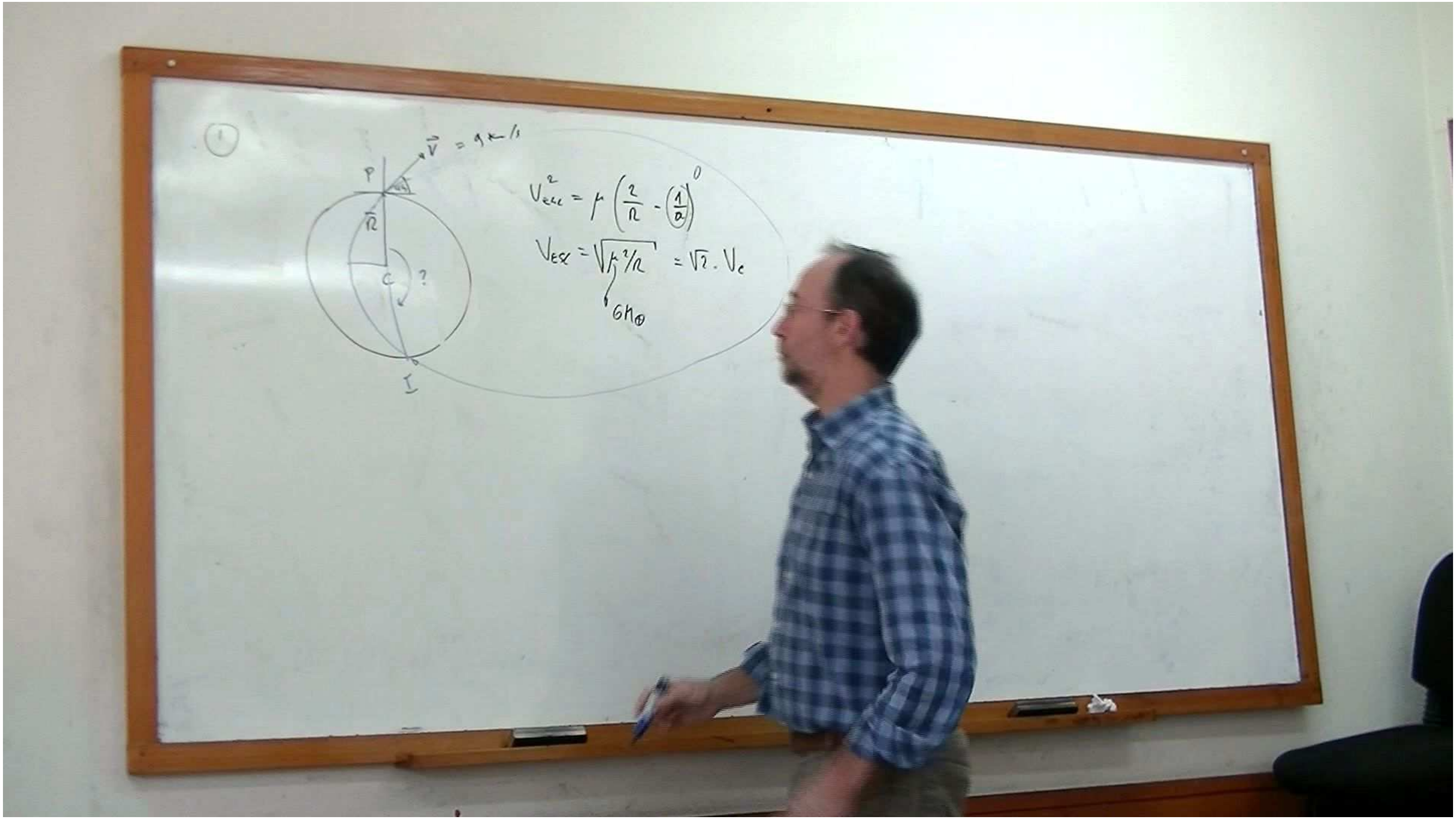
$$\cancel{A}\alpha^2 + \cancel{A} = \mu \cancel{A}\alpha^2$$

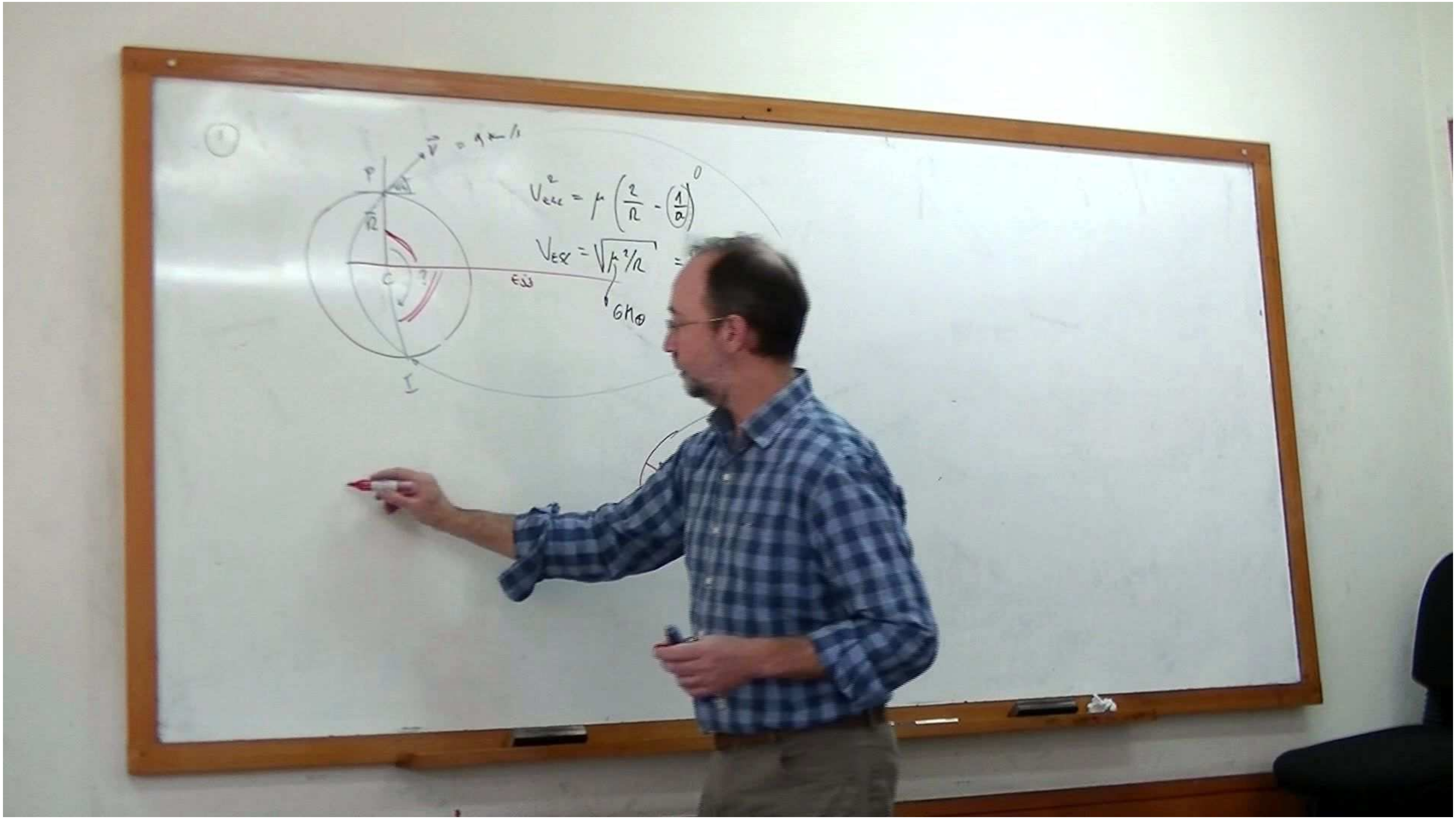
$$\alpha^2(1-\mu) = -1$$

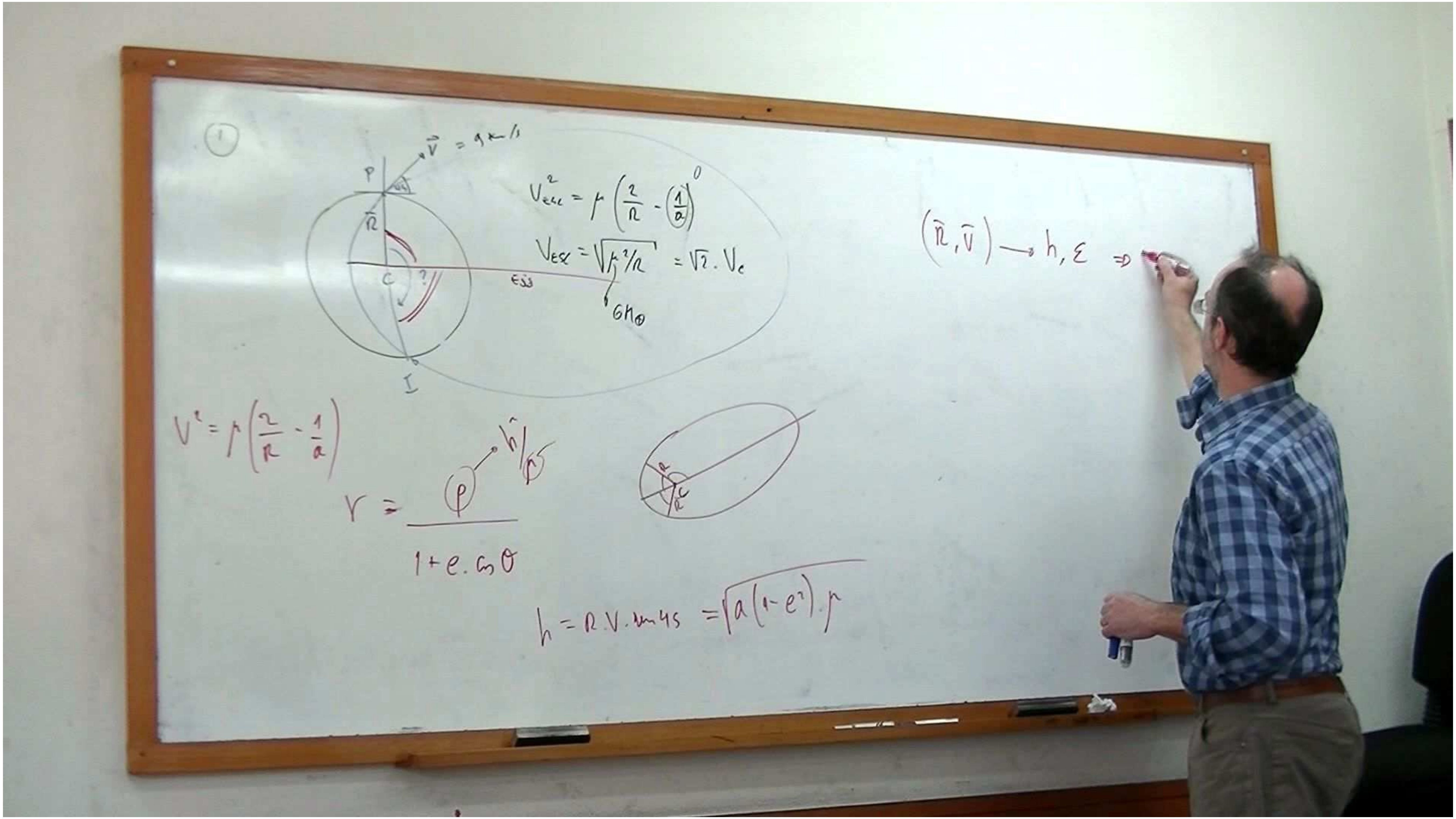
$$\alpha^2 = \frac{1}{\mu - 1} \rightarrow \alpha = \pm\sqrt{1/\mu-1}$$

$$\mu = Ae^{-\sqrt{\ }} + Be^{+\sqrt{\ }}$$


①
$\vec{V}$ = 9 km/s
P
α
$\bar{R}$
C
$V_{esc}^2 = \mu \left(\frac{2}{R} - \frac{1}{a} \right)$
0
$= \sqrt{\mu 2/}$


①
P
$\vec{V} = 9$ km/s
$\vec{R}$
C
?
I
$V_{esc}^2 = \mu\left(\frac{2}{R} - \frac{1}{a}\right)^0$
$V_{Esc} = \sqrt{\mu\, 2/R} = \sqrt{2}\cdot V_c$
$GM_\oplus$


①
$\vec{V}$ = 9 km/s
P
$\vec{R}$
C
?
Eje
I
$V_{esc}^2 = \mu \left(\frac{2}{R} - \left(\frac{1}{a}\right)^0\right)$
$V_{esc} = \sqrt{\mu\, 2/R}$ =
$GM_\odot$



$$V_{esc}^2 = \mu\left(\frac{2}{R} - \left(\frac{1}{a}\right)^0\right)$$

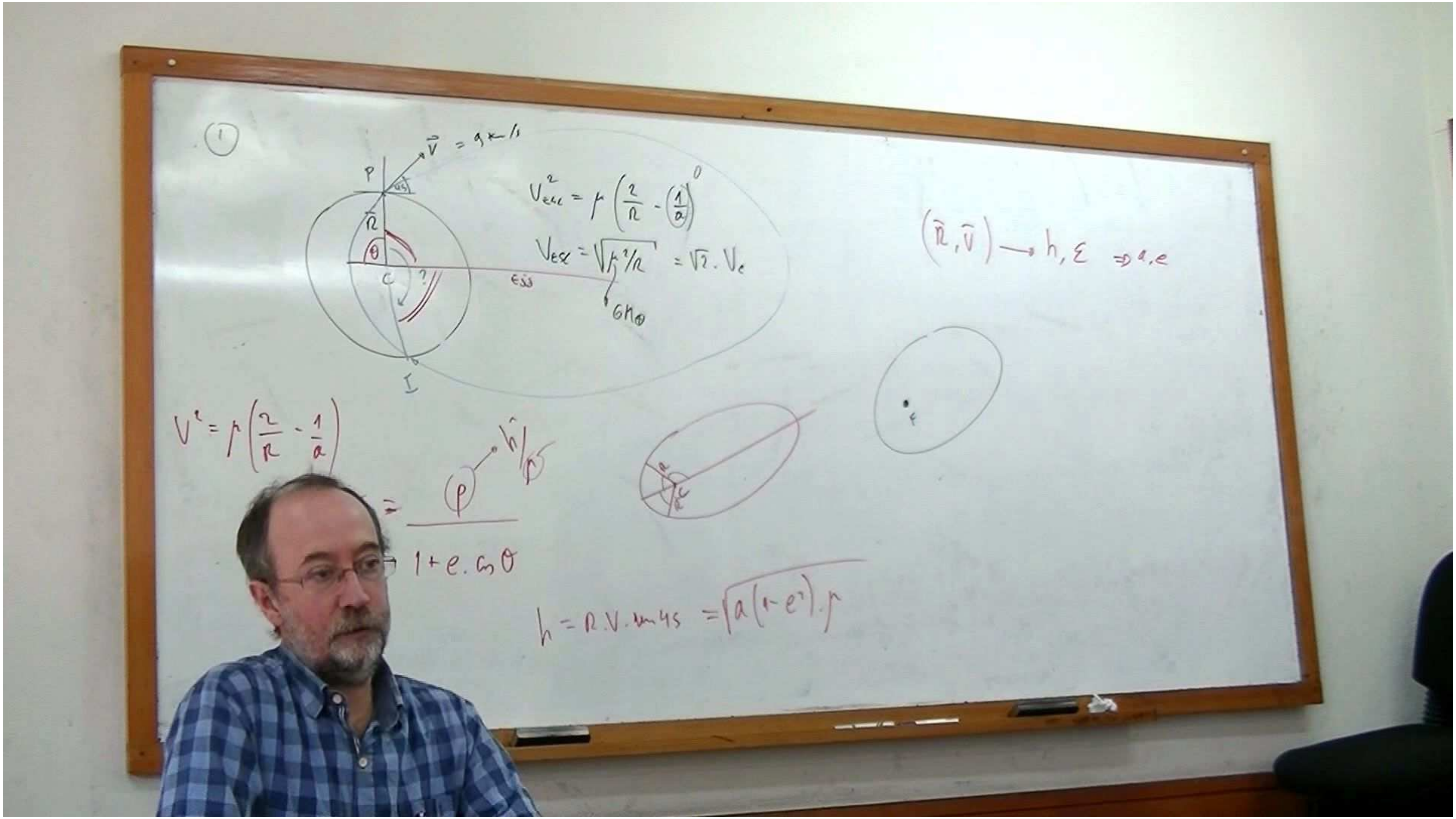
$$V_{esc} = \sqrt{\mu\,2/R} = \sqrt{2}\cdot V_c$$

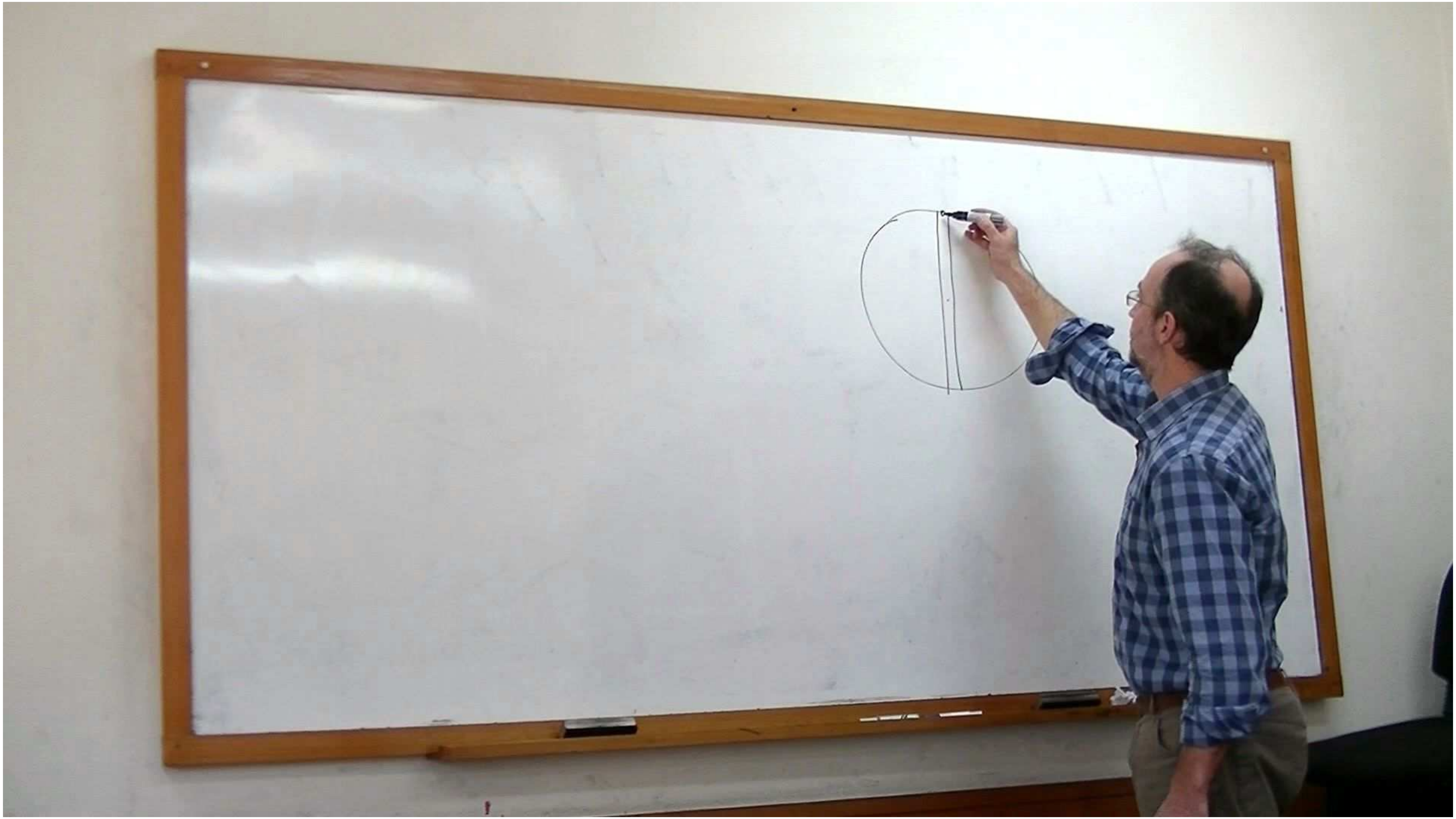
$$(\bar{R}, \bar{V}) \longrightarrow h, \varepsilon \Rightarrow$$

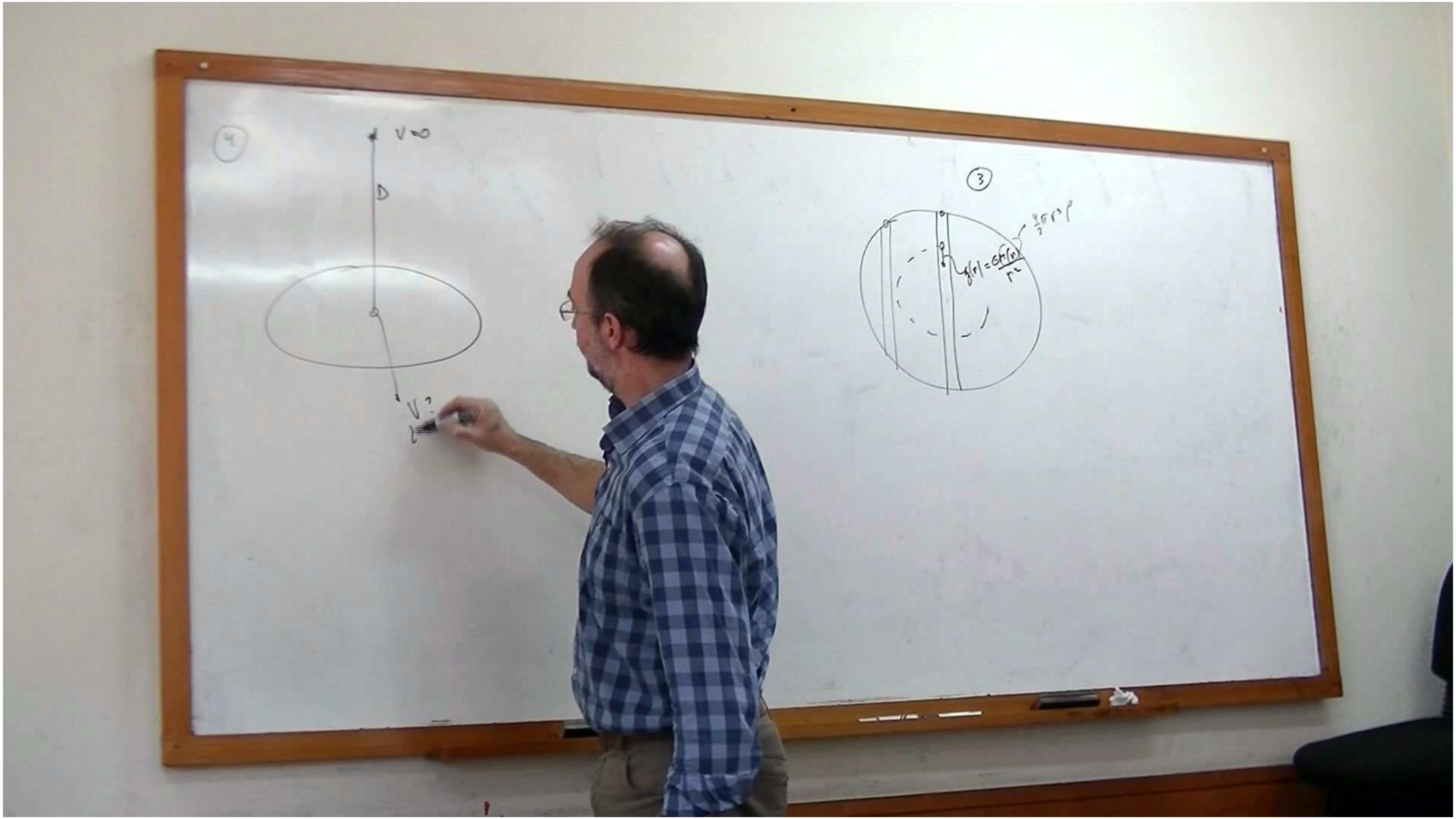
$$V^2 = \mu\left(\frac{2}{R} - \frac{1}{a}\right)$$

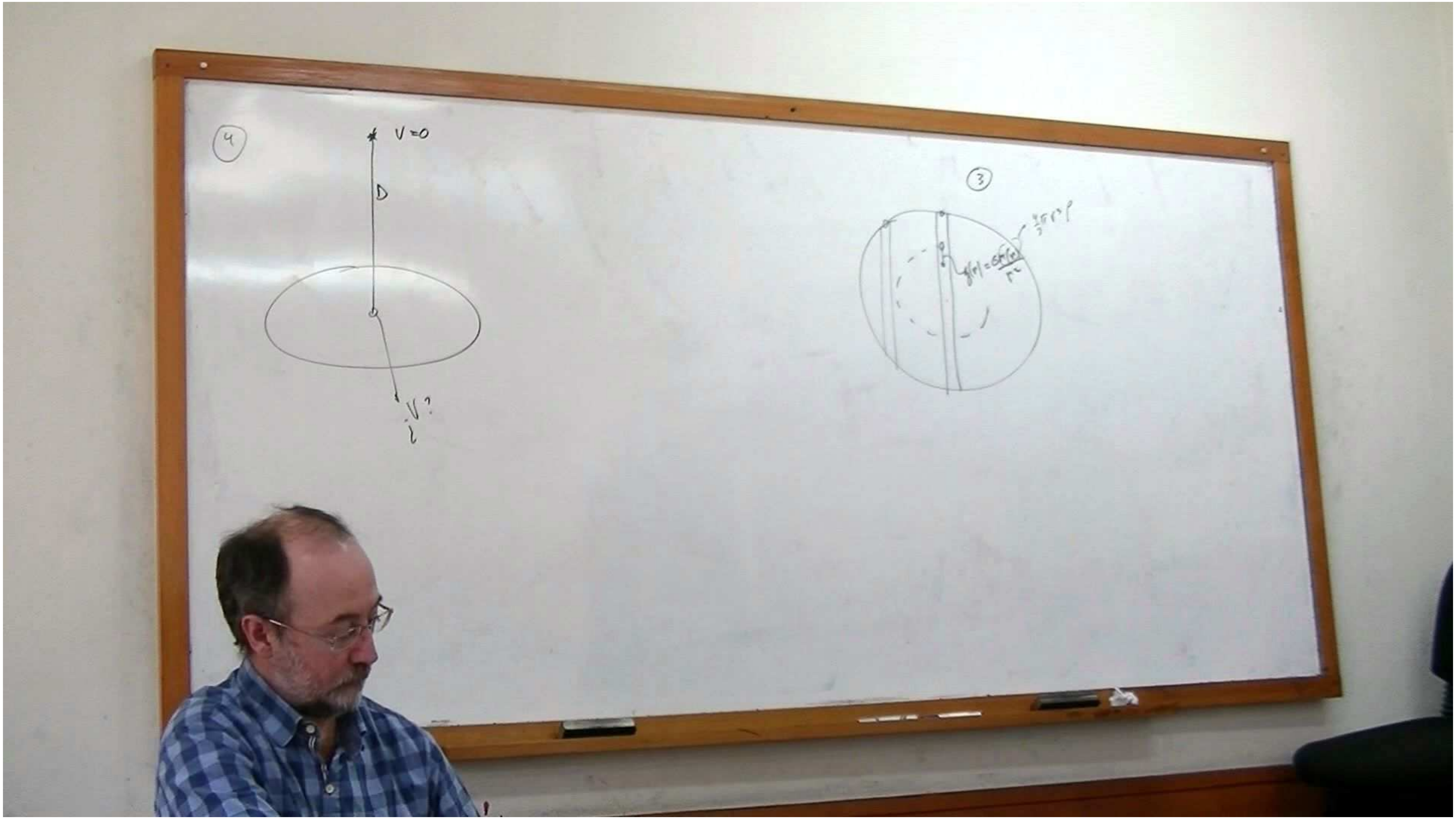
$$r = \frac{\overset{h^2/\mu}{p}}{1+e\cdot\cos\theta}$$

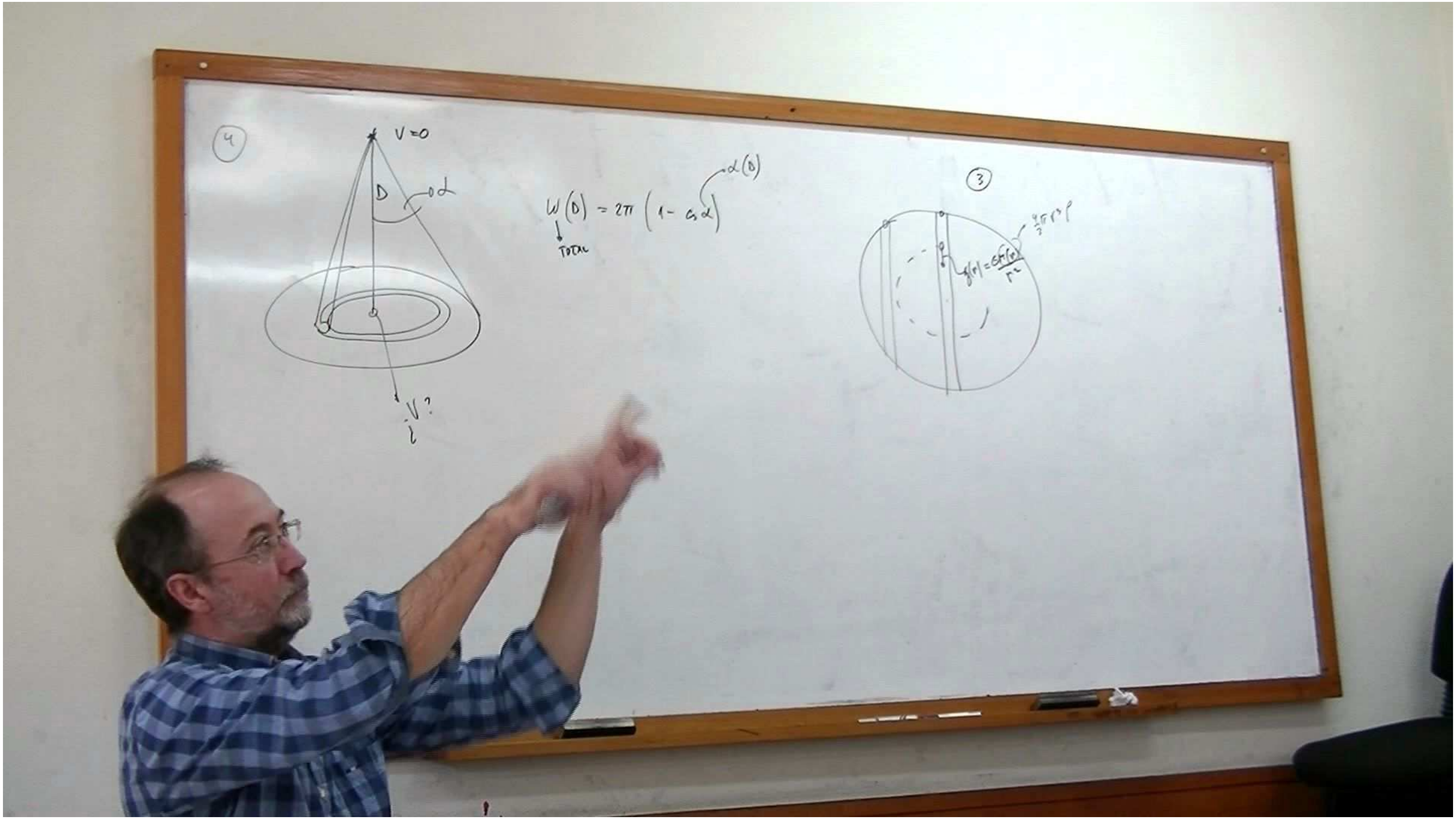
$$h = R.V.\sin 45 = \sqrt{a(1-e^2)\,\mu}$$

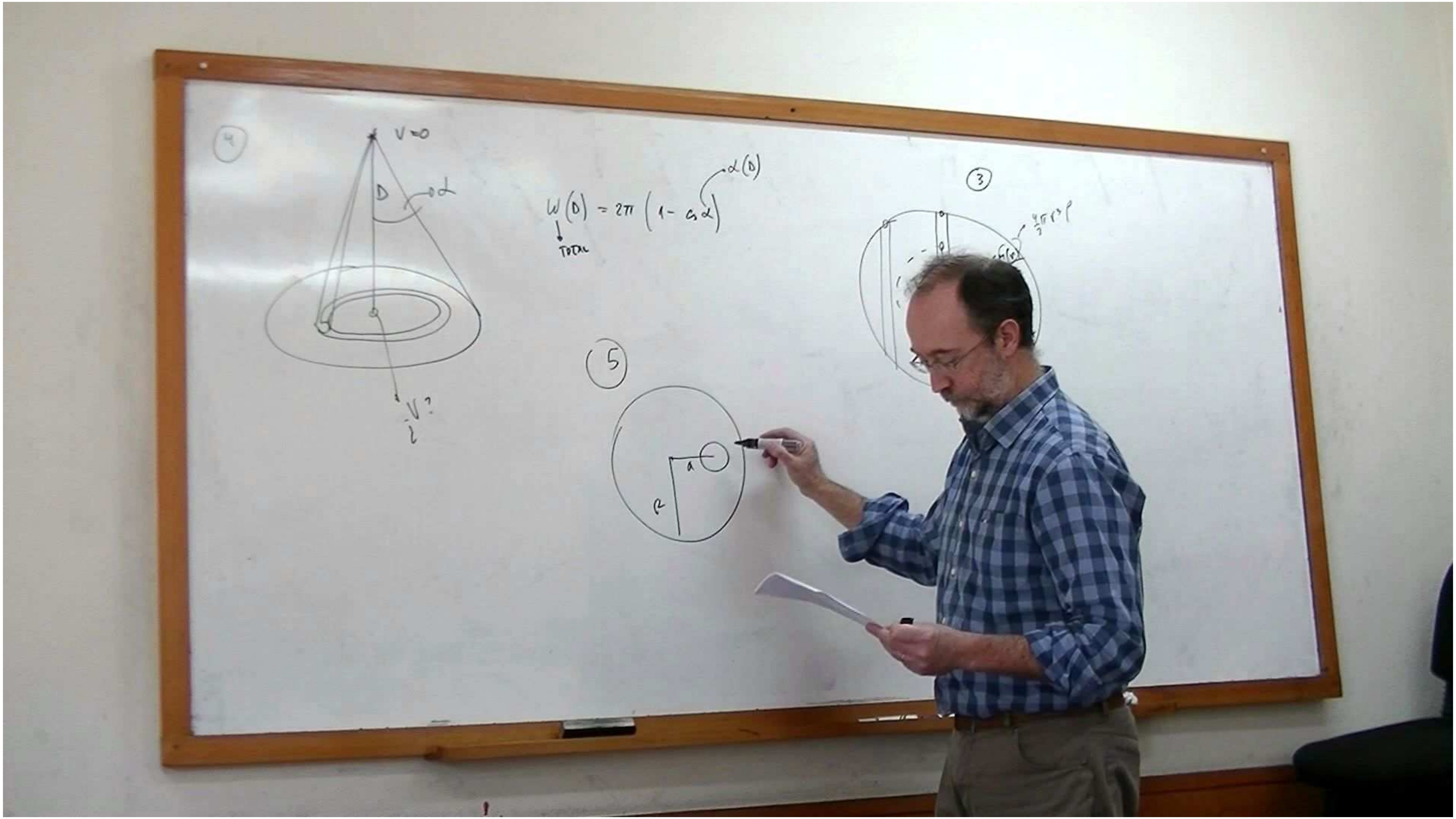

①
$\vec{V} = 9$ km/s
P
45
$\bar{R}$
θ
C
?
E⊙
I
$V_{esc}^2 = \mu\left(\frac{2}{R} - \frac{1}{a}\right)^0$
$V_{esc} = \sqrt{\mu 2/R} = \sqrt{2}\cdot V_c$
GM⊙
$(\bar{R},\bar{V}) \to h, \varepsilon \Rightarrow a, e$
F
$V^2 = \mu\left(\frac{2}{R} - \frac{1}{a}\right)$
$= \frac{p}{1+e\cos\theta}$
$\hat{h}/\mu$
a
c
$h = R.V.\sin 45 = \sqrt{a(1-e^2).\mu}$

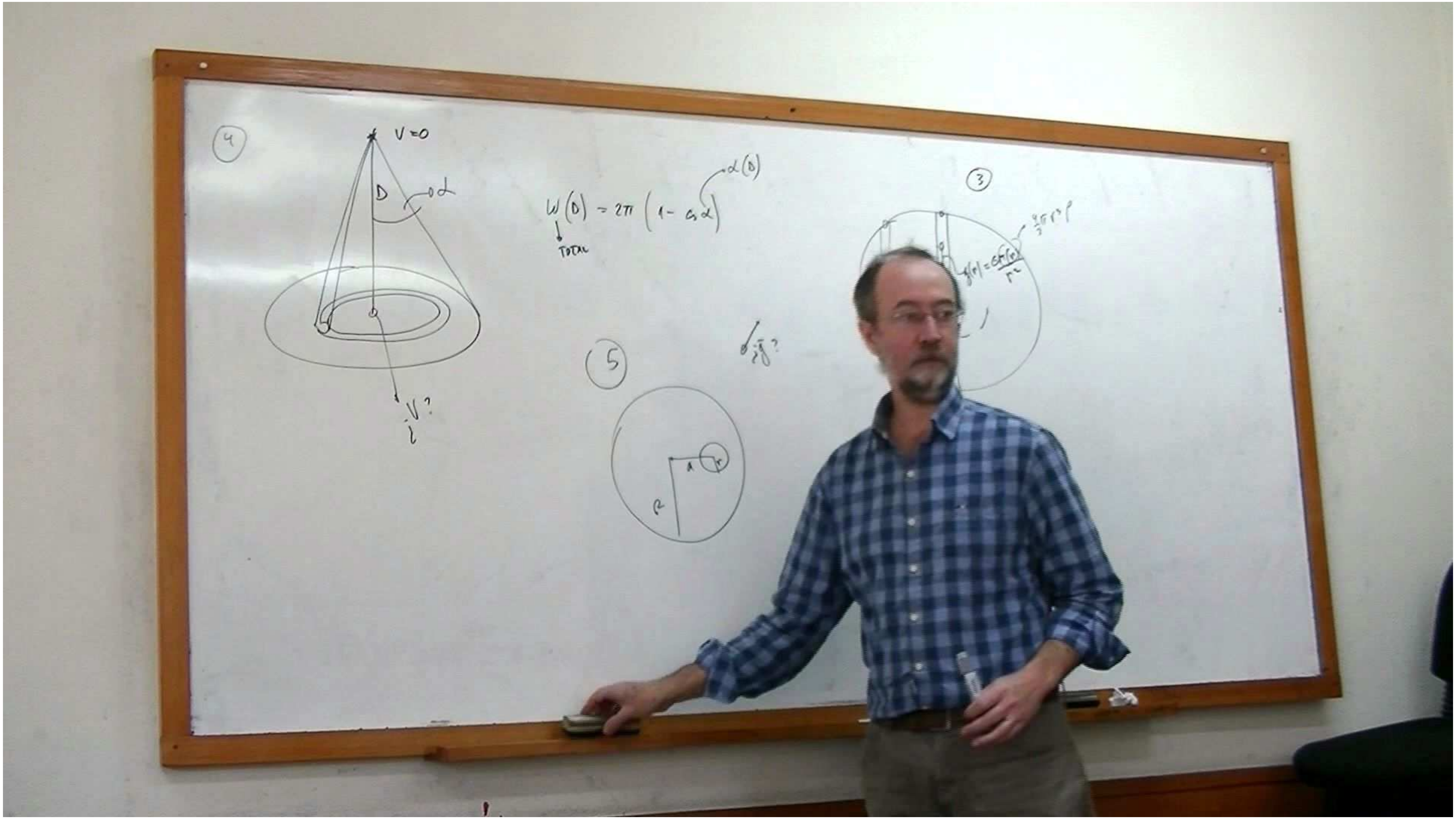


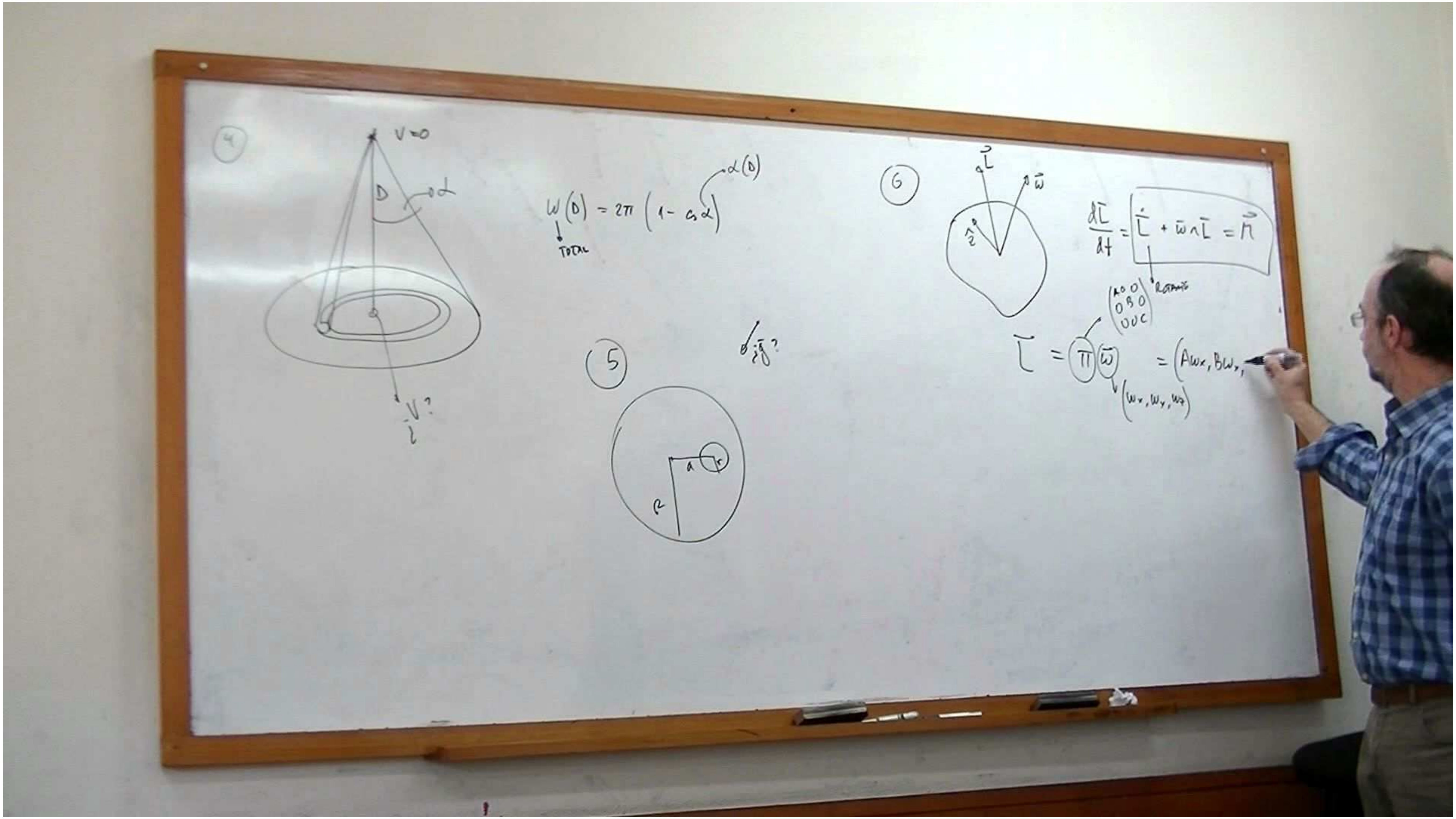

4
V=0
D
V ?
3
g(r) = GM(r)/r²
4/3 π r³ ρ

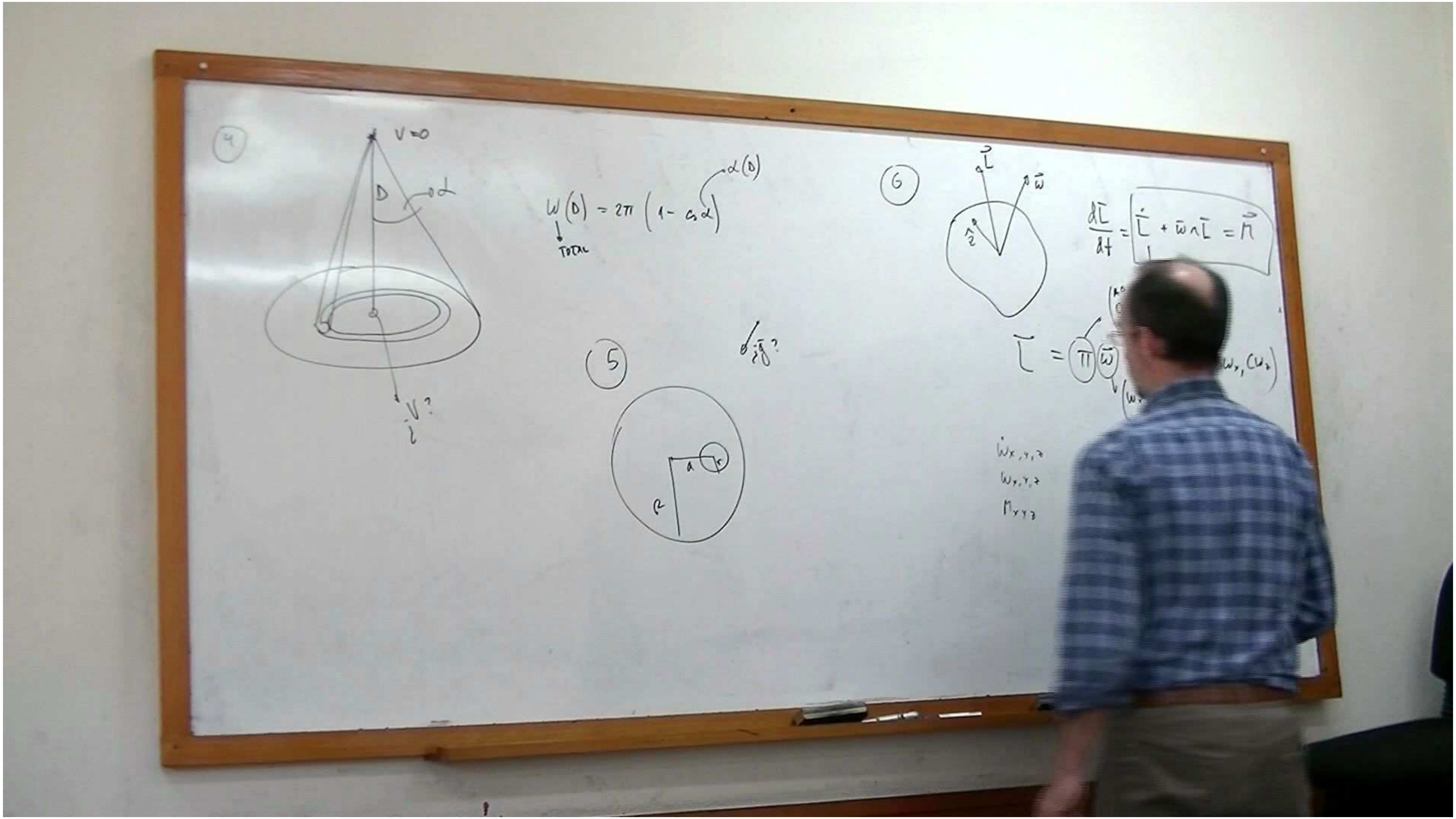

④
V=0
D
V?
i
③
g(r) = GM(r)/r²
4/3 π r³ ρ

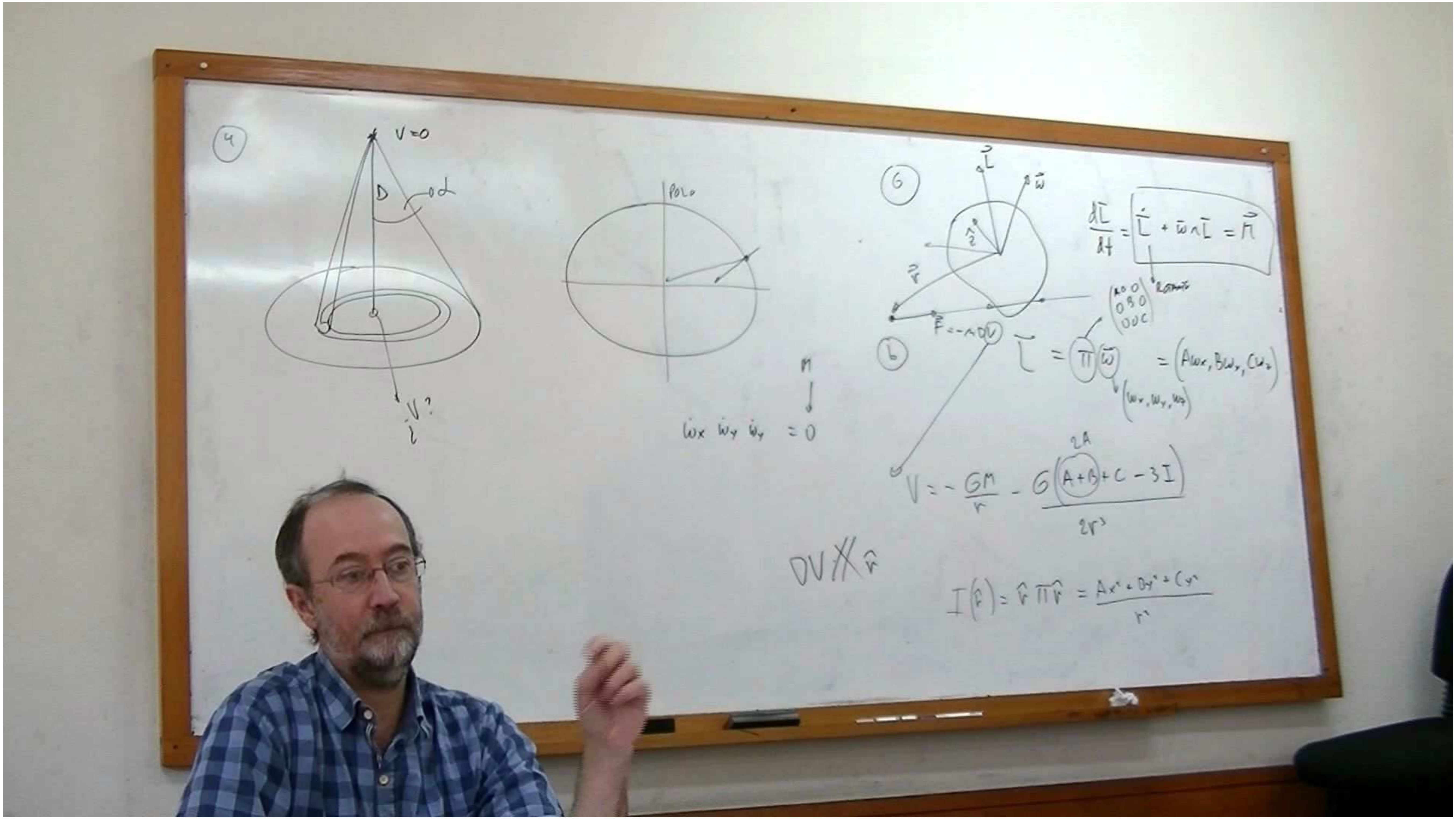

④
V=0
D
α
¿V?
W(D) = 2π (1 - cos α)
α(D)
TOTAL
③
g(r) = GM(r)/r²
4/3 π r³ ρ

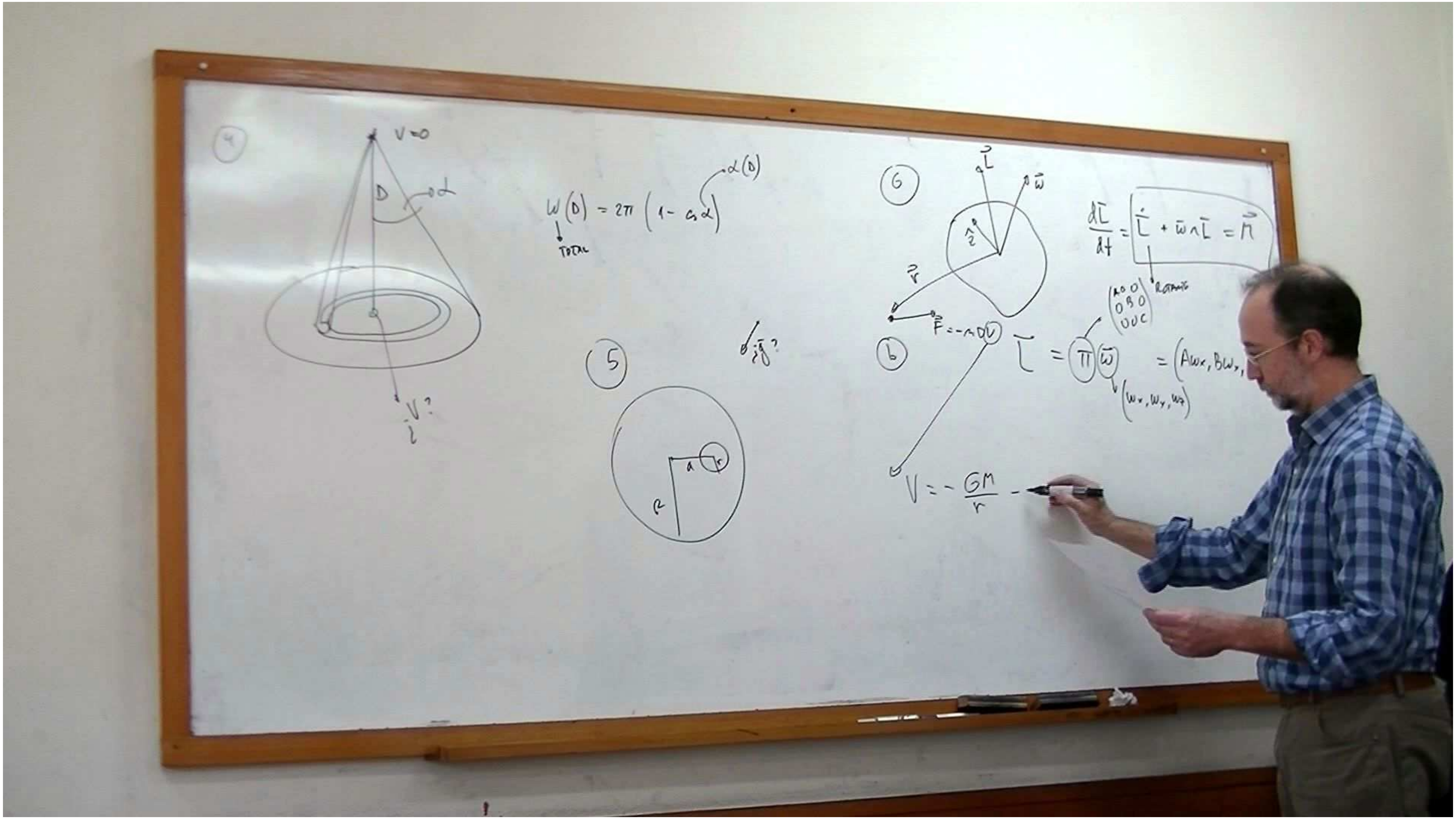

4
V=0
D
α
V?
W(D) = 2π (1 - cos α)
α(D)
TOTAL
3
4/3 π r³ ρ
5
a
R

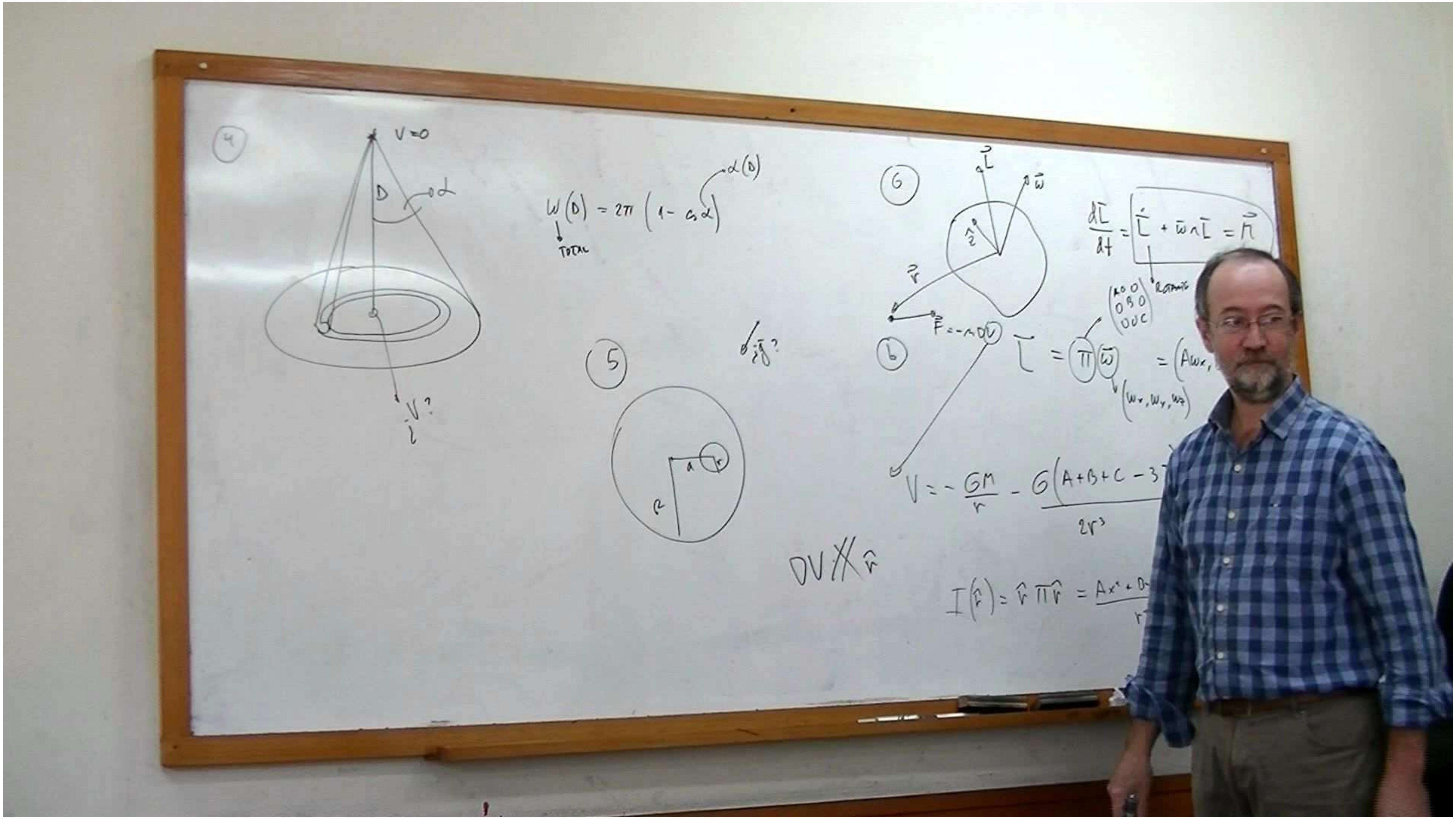

4
V=0
D
α
α(D)
W(D) = 2π (1 - cos α)
TOTAL
¿V?
5
¿g?
a
r
R
3
4/3 π r³ ρ
g(r) = GM(r)/r²

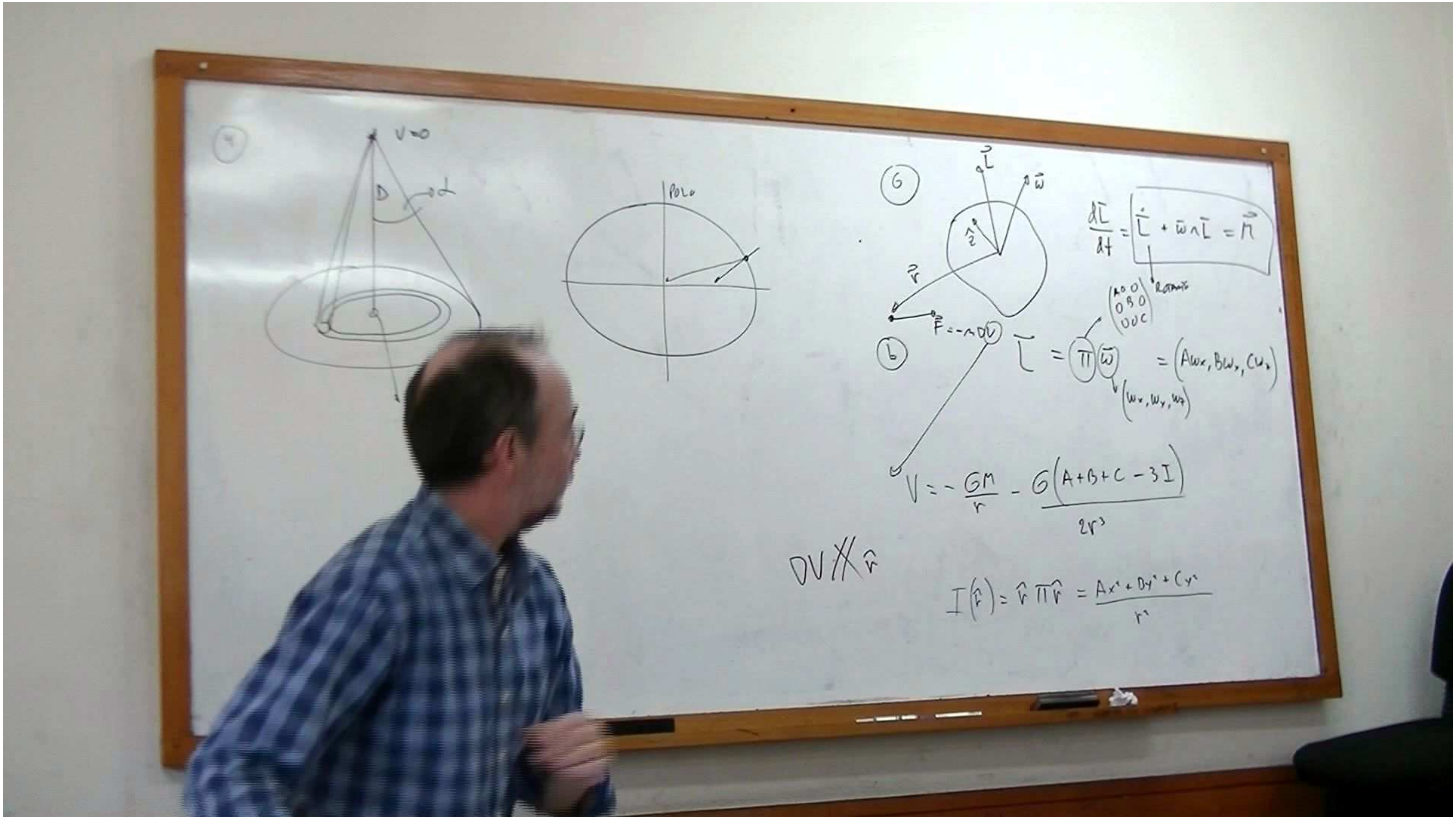

4
V=0
D
α
W(D) = 2π (1 - cos α)
α(D)
TOTAL
¿V?
5
¿g?
a
r
R
6
L
ω
ẑ
dL/dt = L̇ + ω∧L = M
ROTANTE
A 0 0
0 B 0
0 0 C
L = Π ω = (Aωx, Bωy,
(ωx, ωy, ωz)

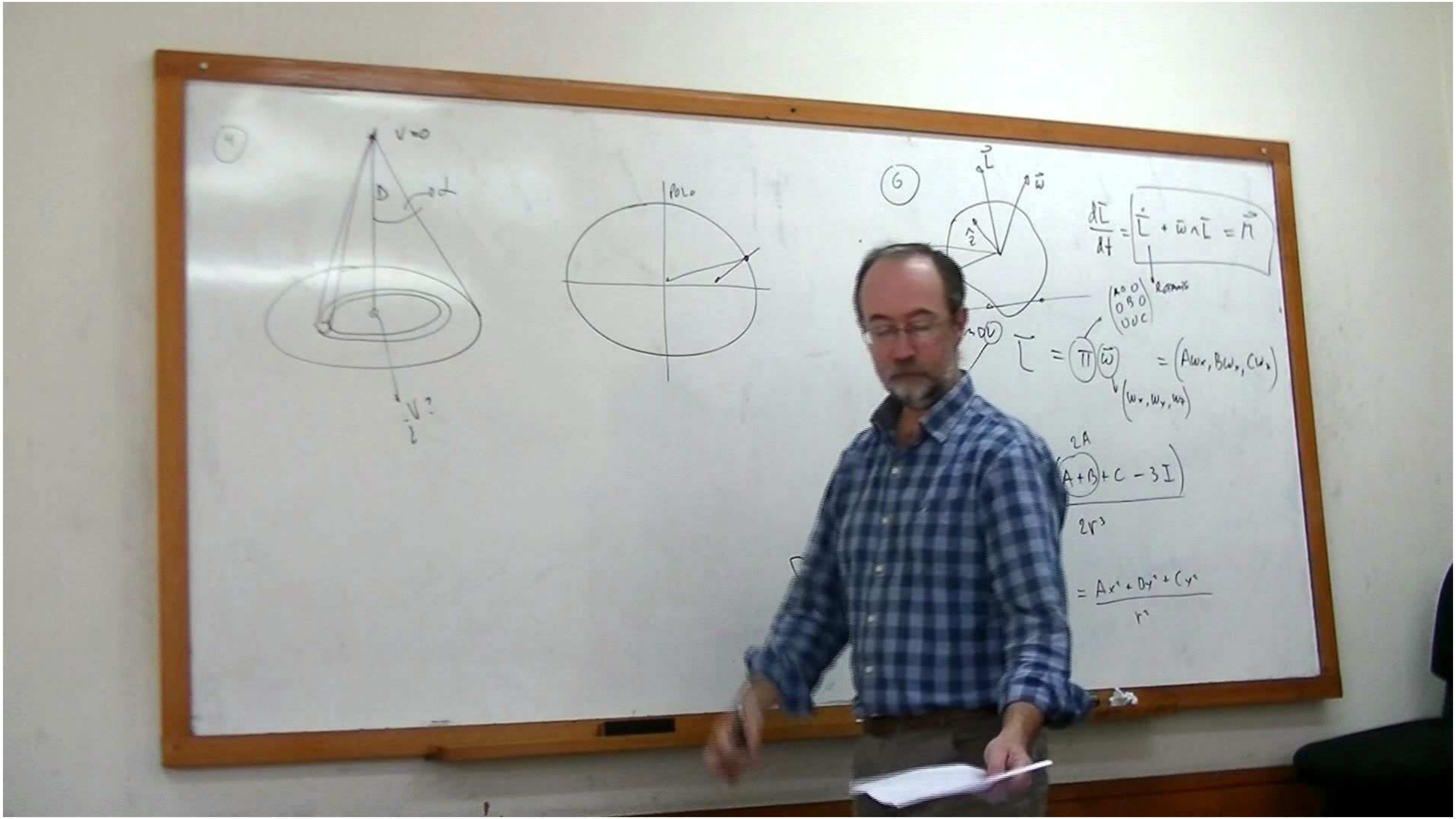

4
V=0
D
α
$W(D) = 2\pi(1 - \cos\alpha)$
TOTAL
α(D)
¿V?
5
¿g?
a
r
R
6
$\vec{L}$
$\vec{\omega}$
$\hat{z}$
$\frac{d\vec{L}}{dt} = \dot{\vec{L}} + \vec{\omega}\wedge\vec{L} = \vec{M}$
$\vec{L} = I\,\vec{\omega}$
$\dot{\omega}_{x,y,z}$
$\omega_{x,y,z}$
M_{xyz}

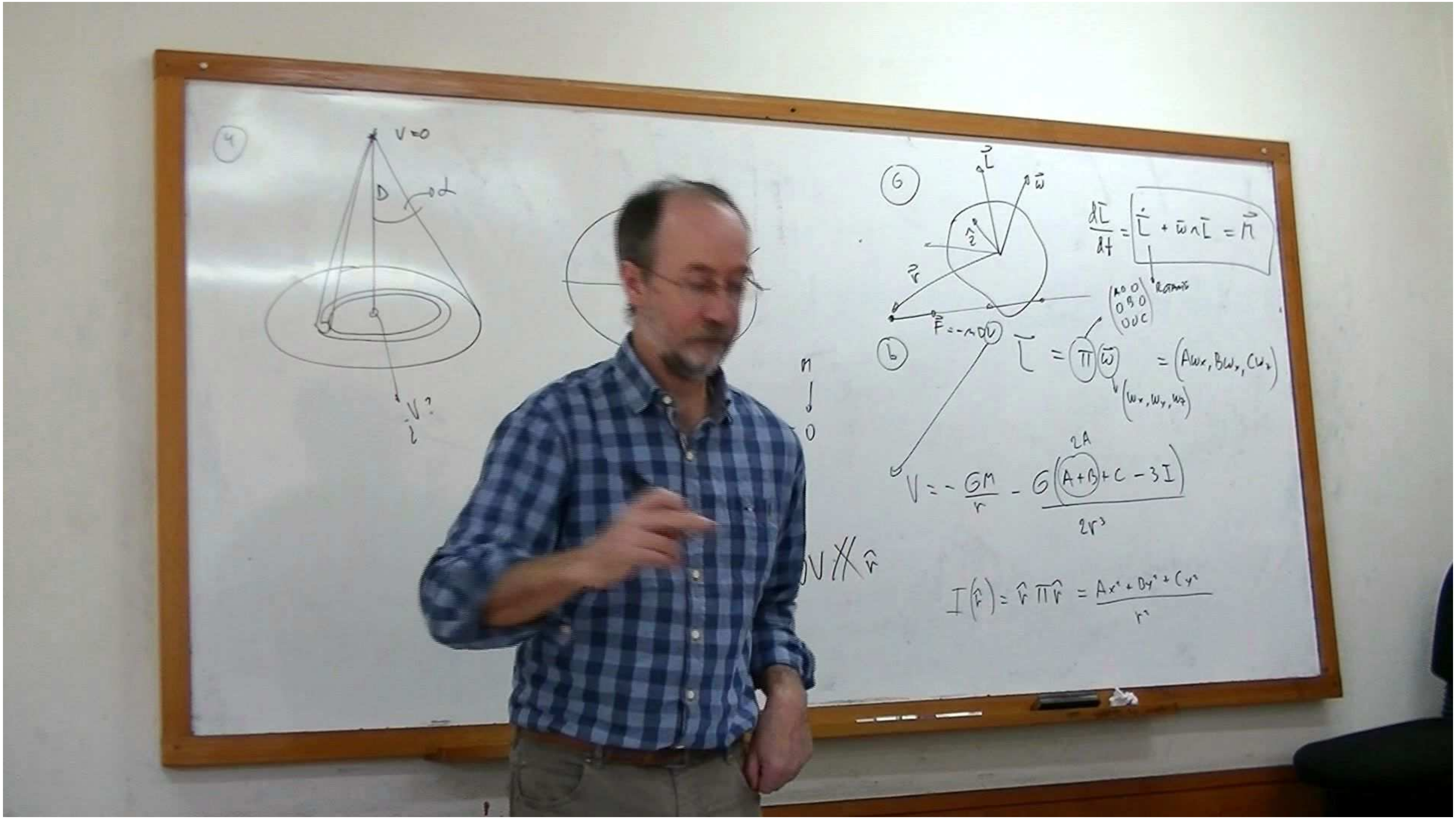

4
V=0
D
α
V?
i
POLO
ω̇x ω̇y ω̇y = 0
M
6
L
ω
ẑ
r
F = -m∇V
b
dL/dt = L̇ + ω ∧ L = M
ROTANTE
(A 0 0; 0 B 0; 0 0 C)
L = Π ω = (Aωx, Bωy, Cωz)
(ωx, ωy, ωz)
V = - GM/r - G(A+B+C-3I)/2r³
2A
∇V ∦ r̂
I(r̂) = r̂ Π r̂ = (Ax² + By² + Cy²)/r²

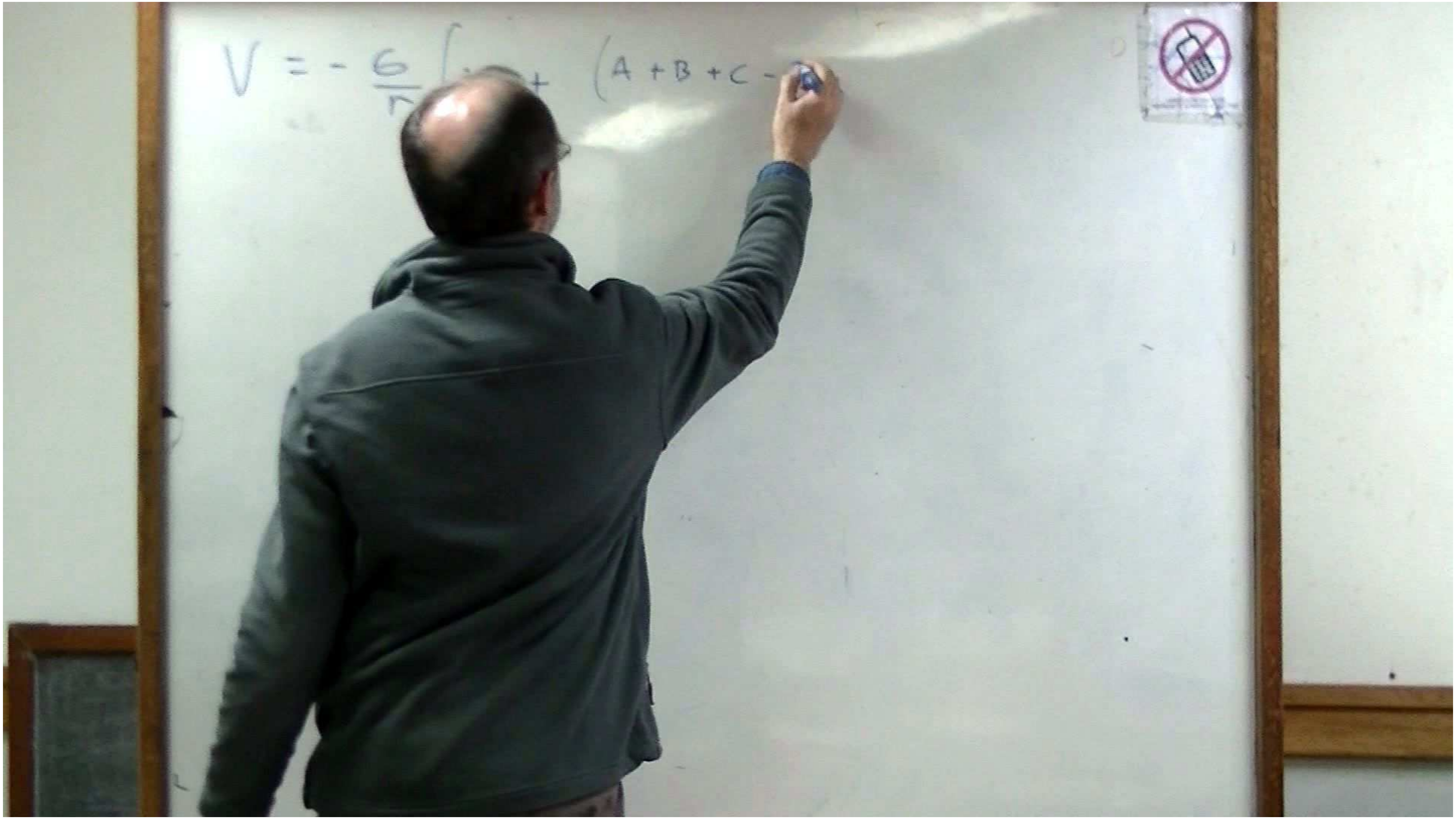

4
V=0
D
α
¿V?
W(D) = 2π (1 - cos α)
α(D)
TOTAL
5
¿g?
a
r
R
6
L
ω
ẑ
r
F = -m∇V
dL/dt = L̇ + ω∧L = M
ROTANTE
A 0 0
0 B 0
0 0 C
b
L = I ω = (Aωx, Bωy,
(ωx, ωy, ωz)
V = - GM/r - -

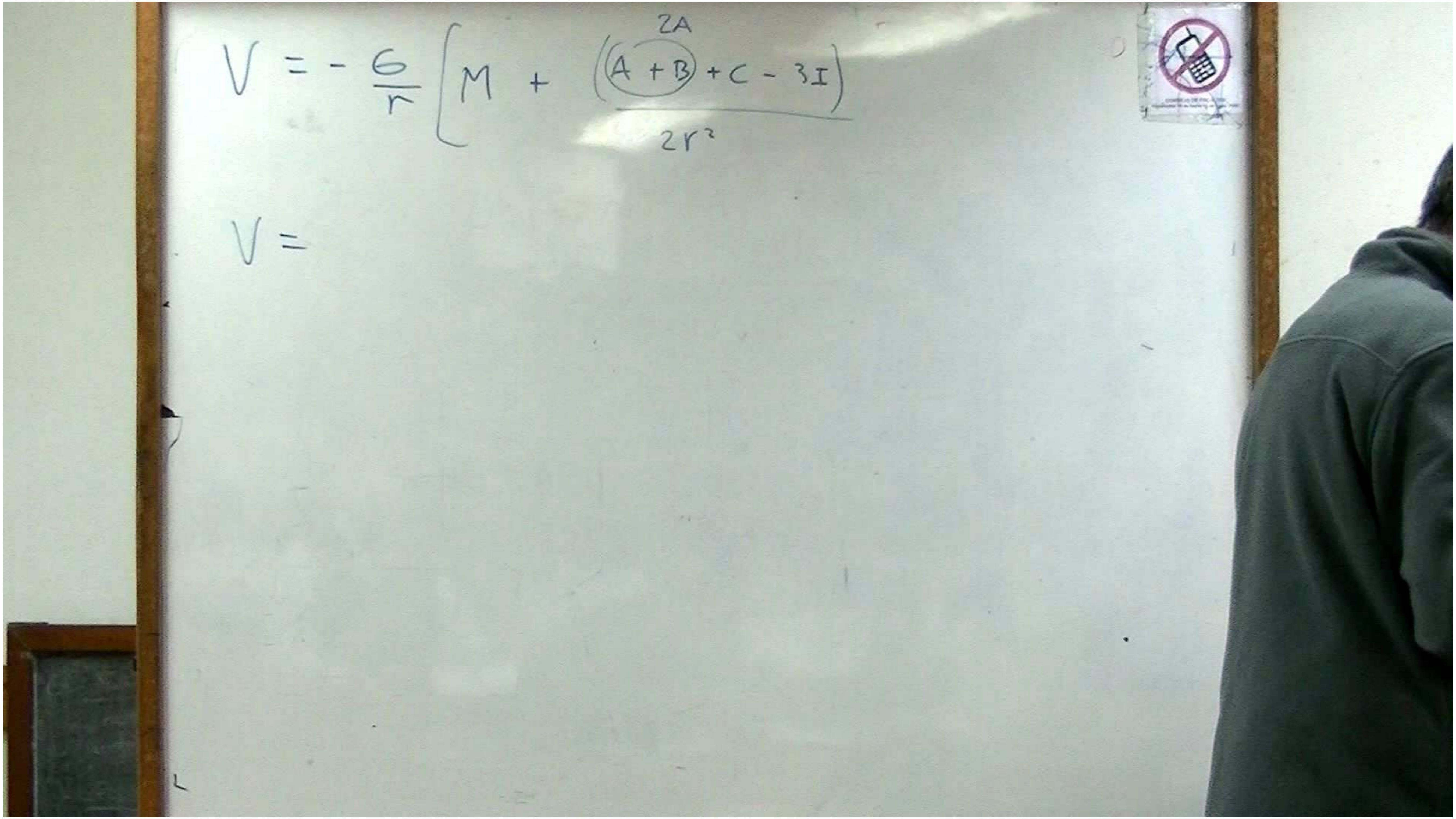

4
V=0
D
α
¿V?
W(D) = 2π (1 − cos α)
α(D)
TOTAL
5
¿g?
a
r
R
6
L
ω
ẑ
r
F = −∇V
dL/dt = L̇ + ω∧L = M
ROTANTE
b
L = Π ω = (Aωx,
(A 0 0 / 0 B 0 / 0 0 C)
(ωx, ωy, ωz)
V = − GM/r − G(A+B+C − 3…)/2r³
∇V ∦ r̂
I(r̂) = r̂ Π r̂ = (Ax² + B…)/r²


④
V=0
D
α
POLO
⑥
$\vec{L}$
$\vec{\omega}$
$\hat{z}$
$\vec{r}$
$\frac{d\vec{L}}{dt} = \dot{\vec{L}} + \vec{\omega} \wedge \vec{L} = \vec{M}$
ROTANTE
$\begin{pmatrix} A&0&0 \\ 0&B&0 \\ 0&0&C \end{pmatrix}$
$\vec{F} = -m\nabla V$
ⓑ
$\vec{L} = \Pi \, \vec{\omega} = (A\omega_x, B\omega_y, C\omega_z)$
$(\omega_x, \omega_y, \omega_z)$
$V = -\frac{GM}{r} - \frac{G(A+B+C-3I)}{2r^3}$
$\nabla V \not\parallel \hat{r}$
$I(\hat{r}) = \hat{r}\,\Pi\,\hat{r} = \frac{Ax^2 + By^2 + Cz^2}{r^2}$


4
V=0
D
α
V?
POLO
6
L
ω
ẑ
dL/dt = L̇ + ω∧L = M
Rotante
A 0 0 / 0 B 0 / 0 0 C
L = Π ω = (Aωx, Bωy, Cωz)
(ωx, ωy, ωz)
2A
(A+B+C − 3I)
2r³
= Ax² + By² + Cy² / r²

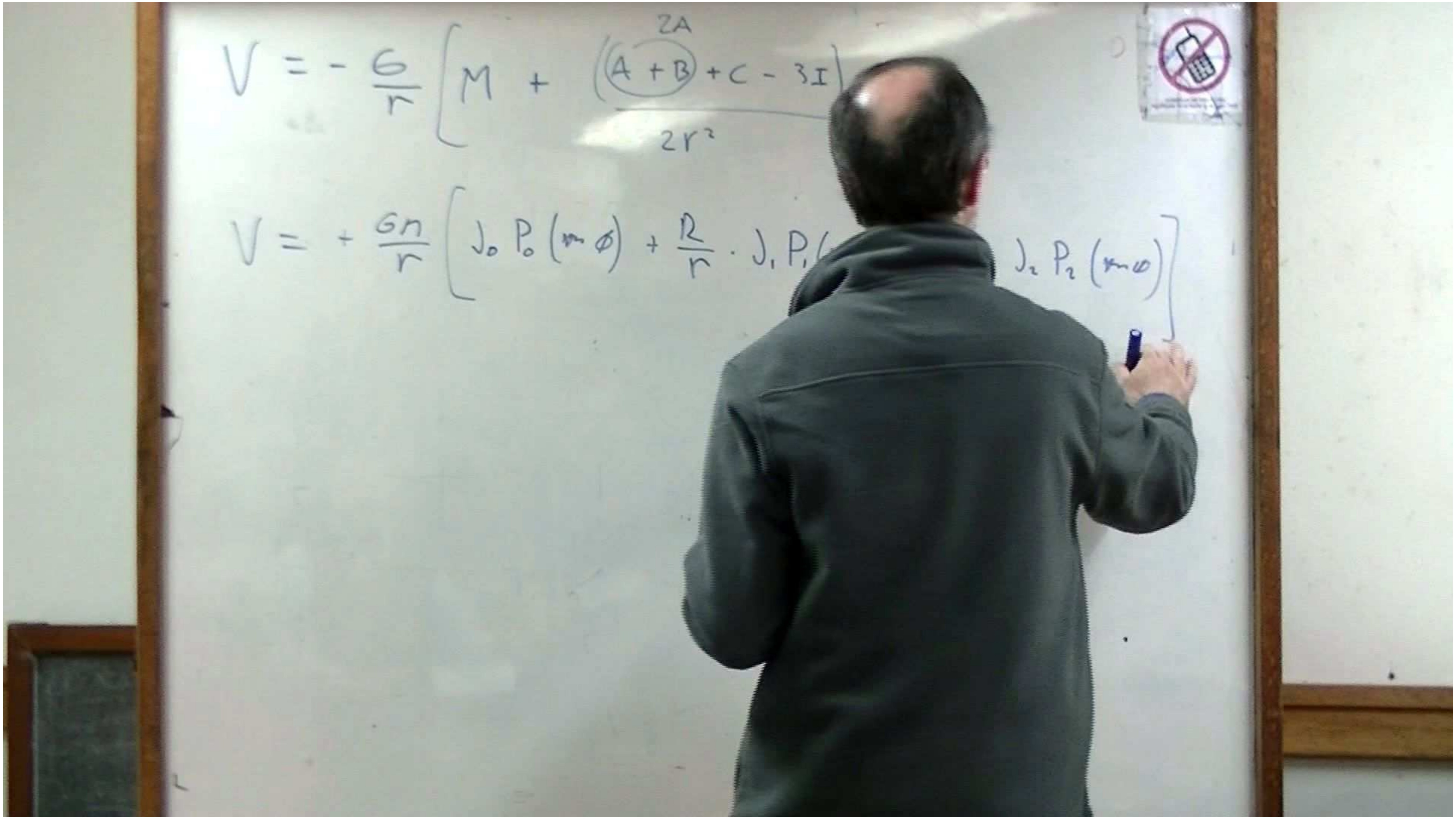

4
V=0
D
α
V?
l
6
L
ω
ẑ
r
F = -m∇V
dL/dt = L̇ + ω∧L = M
Rotante
A 0 0 / 0 B 0 / 0 0 C
b
L = Π ω = (Aωx, Bωy, Cωz)
(ωx, ωy, ωz)
2A
V = -GM/r - G(A+B+C-3I)/2r³
m
0
∇V ∦ r̂
I(r̂) = r̂ Π r̂ = (Ax² + By² + Cz²)/r²


V = - G/r ∫
(A + B + C -



$$V = -\frac{G}{r}\left[M + \frac{\left(\overset{2A}{\boxed{A+B}} + C - 3I\right)}{2r^2} \right.$$

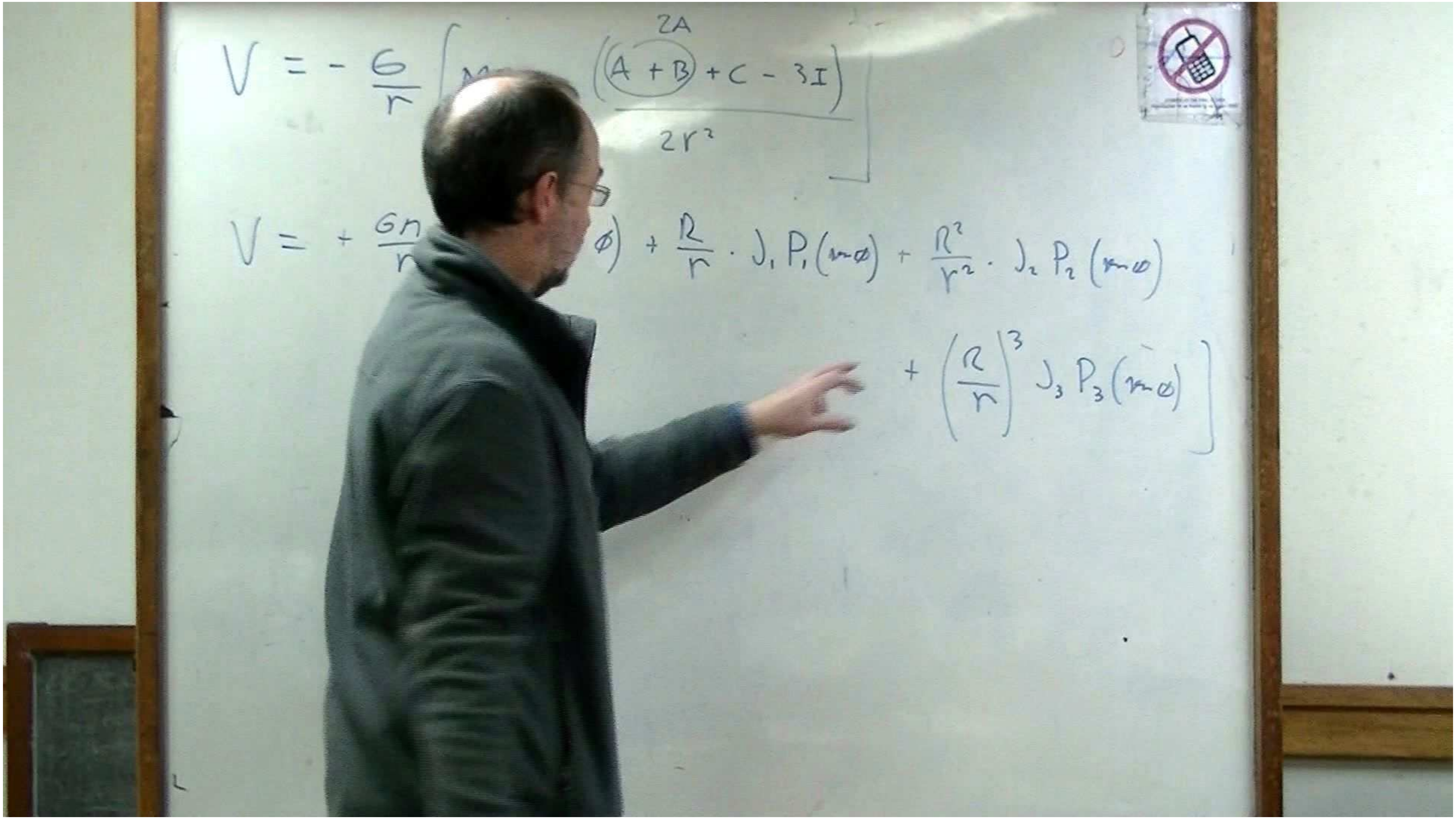
$$V =$$



$$V = -\frac{G}{r}\left[M + \frac{(\overset{2A}{(A+B)} + C - 3I)}{2r^2}\right.$$

$$V = +\frac{Gm}{r}\left[J_0 P_0(\text{sen}\,\phi) + \frac{R}{r} \cdot J_1 P_1(\right.$$

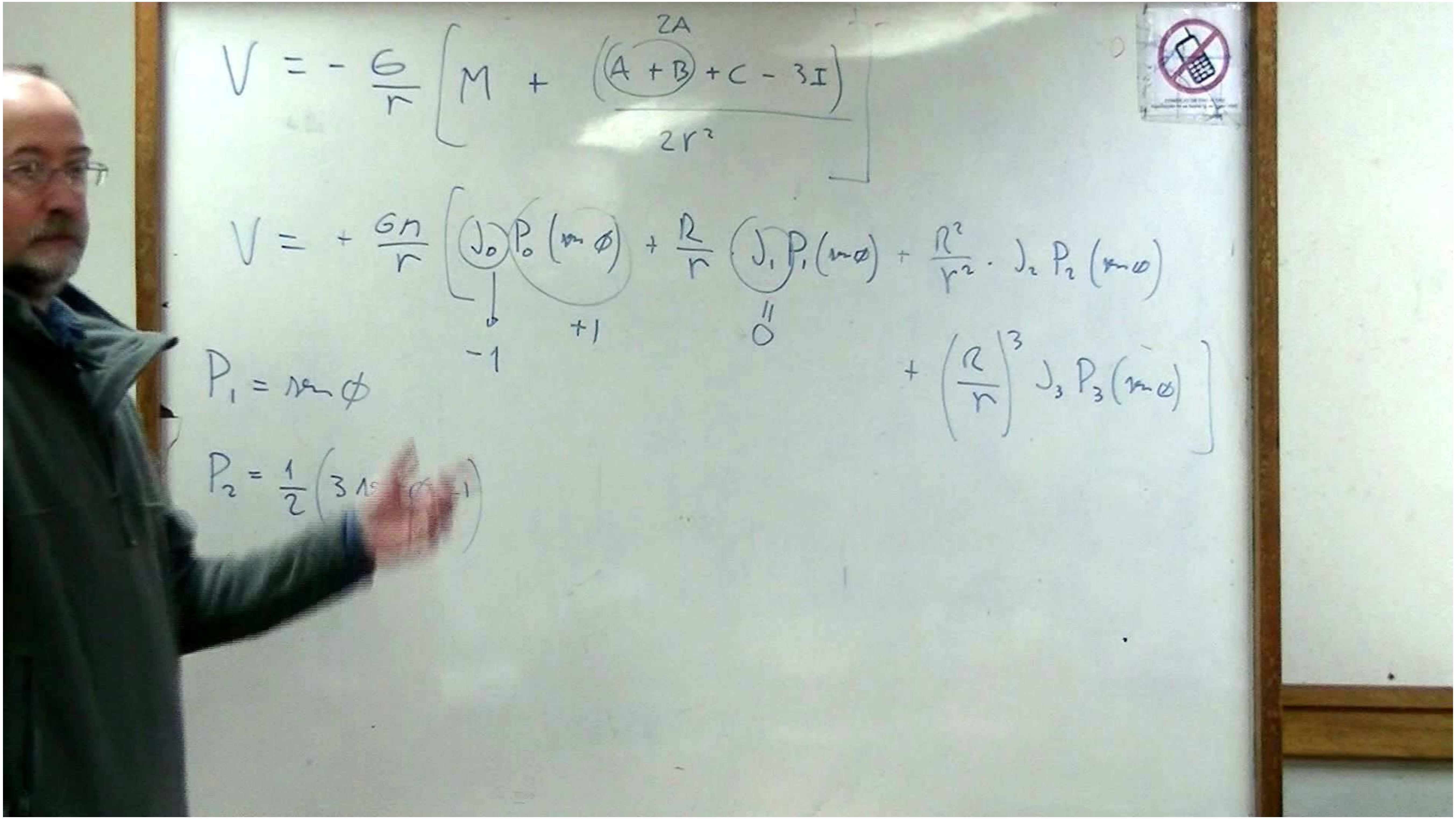
$$\left. J_2 P_2(\text{sen}\,\phi)\right]$$



$$V = -\frac{G}{r}\left[M \qquad \frac{\left(\overset{2A}{\boxed{A+B}} + C - 3I\right)}{2r^2}\right]$$

$$V = +\frac{Gm}{r} \qquad \phi) + \frac{R}{r}\cdot J_1 P_1(\operatorname{sen}\phi) + \frac{R^2}{r^2}\cdot J_2 P_2(\operatorname{sen}\phi)$$

$$+\left(\frac{R}{r}\right)^3 J_3 P_3(\operatorname{sen}\phi)\Big]$$

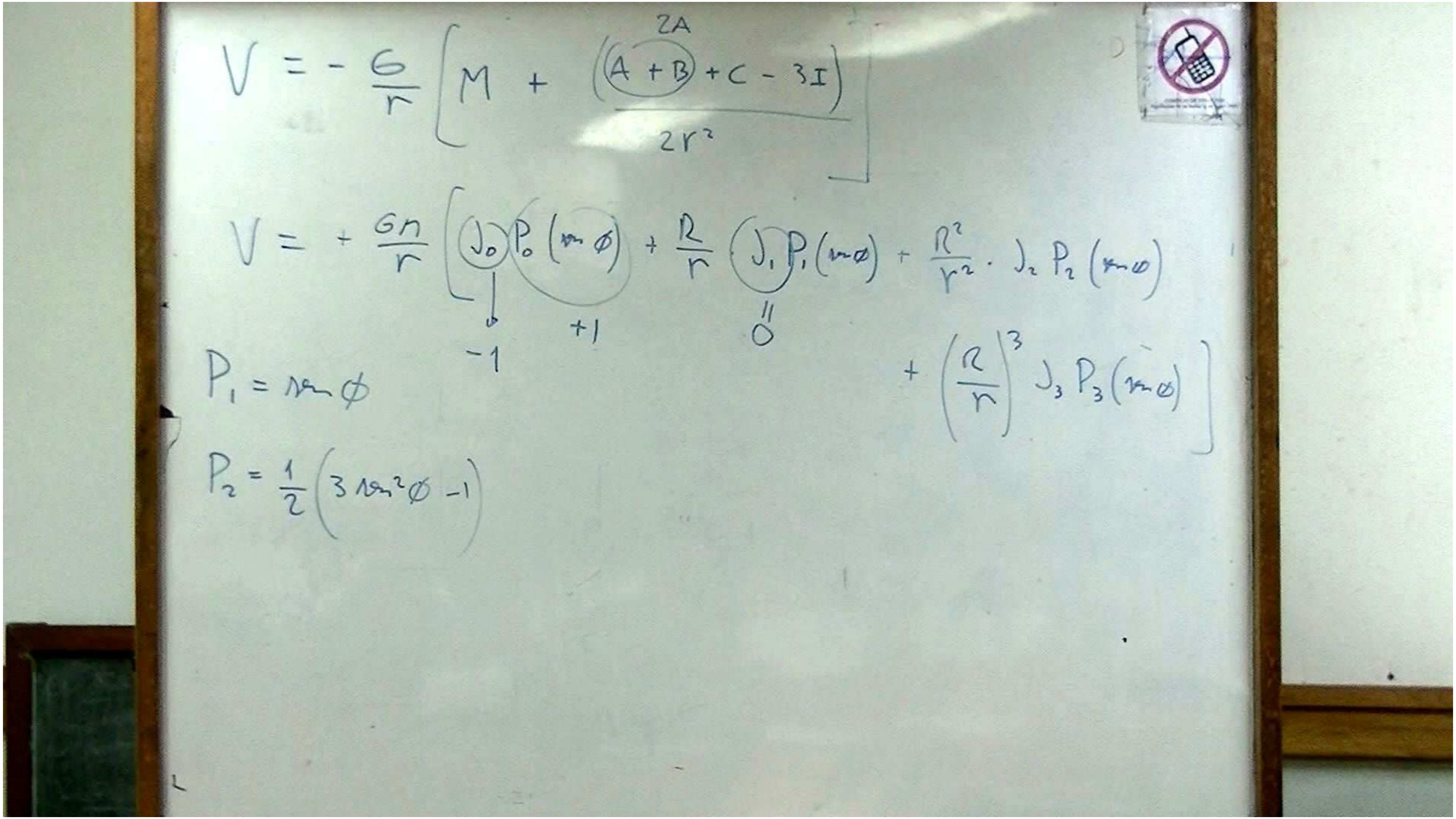


$$V = -\frac{G}{r}\left[M + \frac{\left(\overset{2A}{(A+B)} + C - 3I\right)}{2r^2}\right]$$

$$V = +\frac{Gm}{r}\left[\underset{-1}{J_0}\,\underset{+1}{P_0(\sin\phi)} + \frac{R}{r}\,\underset{0}{\underset{\|}{J_1}}\,P_1(\sin\phi) + \frac{R^2}{r^2}\cdot J_2\,P_2(\sin\phi) + \left(\frac{R}{r}\right)^3 J_3\,P_3(\sin\phi)\right]$$

$$P_1 = \sin\phi$$

$$P_2 = \frac{1}{2}\left(3\sin^2\phi - 1\right)$$

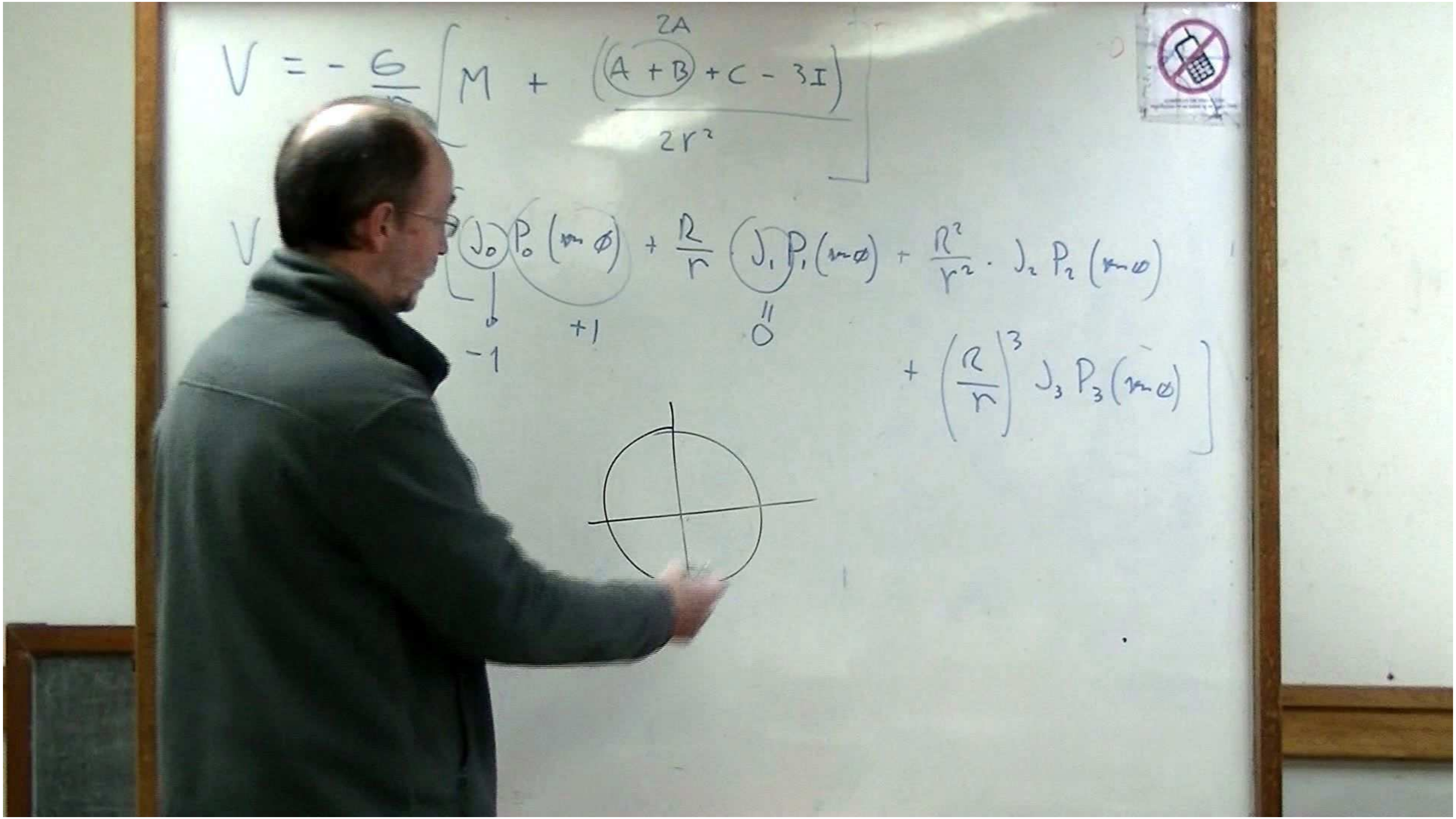


$$V = -\frac{G}{r}\left[M + \frac{(\overset{2A}{A+B} + C - 3I)}{2r^2}\right]$$

$$V = +\frac{Gm}{r}\left[\underset{-1}{\underset{\downarrow}{J_0}}\,\underset{+1}{P_0(\text{sen}\,\phi)} + \frac{R}{r}\,\underset{0}{\underset{\|}{J_1}}\,P_1(\text{sen}\,\phi) + \frac{R^2}{r^2}\cdot J_2\,P_2(\text{sen}\,\phi) + \left(\frac{R}{r}\right)^3 J_3\,P_3(\text{sen}\,\phi)\right]$$

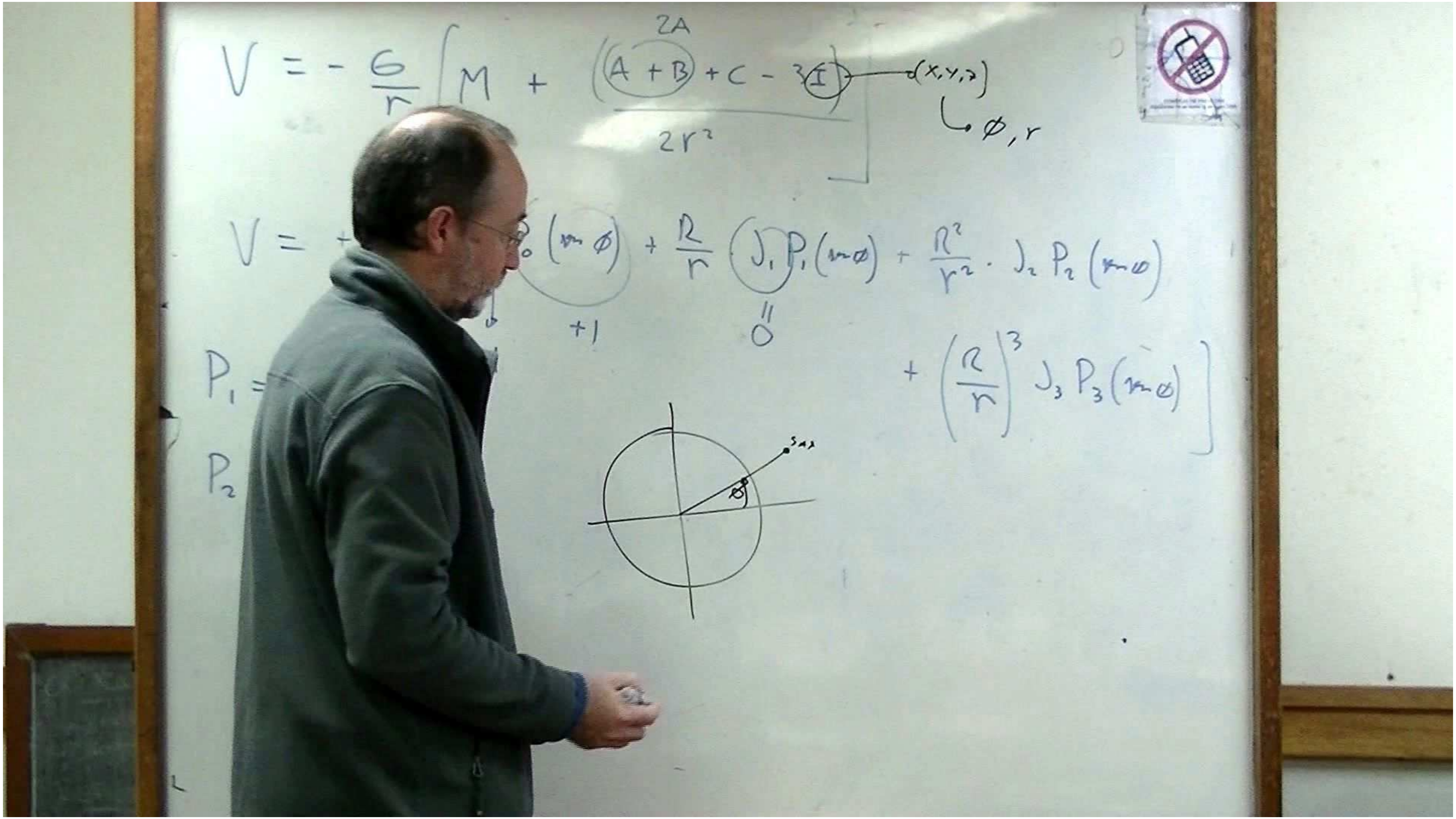
$$P_1 = \text{sen}\,\phi$$

$$P_2 = \frac{1}{2}\left(3\,\text{sen}^2\phi - 1\right)$$



$$V = -\frac{G}{r}\left[M + \frac{(\overset{2A}{\boxed{A+B}} + C - 3I)}{2r^2}\right]$$

$$V \left[\underset{\downarrow \; -1}{J_0}\,\underset{+1}{\boxed{P_0(\sin\phi)}} + \frac{R}{r}\,\underset{\overset{\parallel}{0}}{J_1}\,P_1(\sin\phi) + \frac{R^2}{r^2}\cdot J_2\,P_2(\sin\phi) + \left(\frac{R}{r}\right)^3 J_3\,P_3(\sin\phi)\right]$$



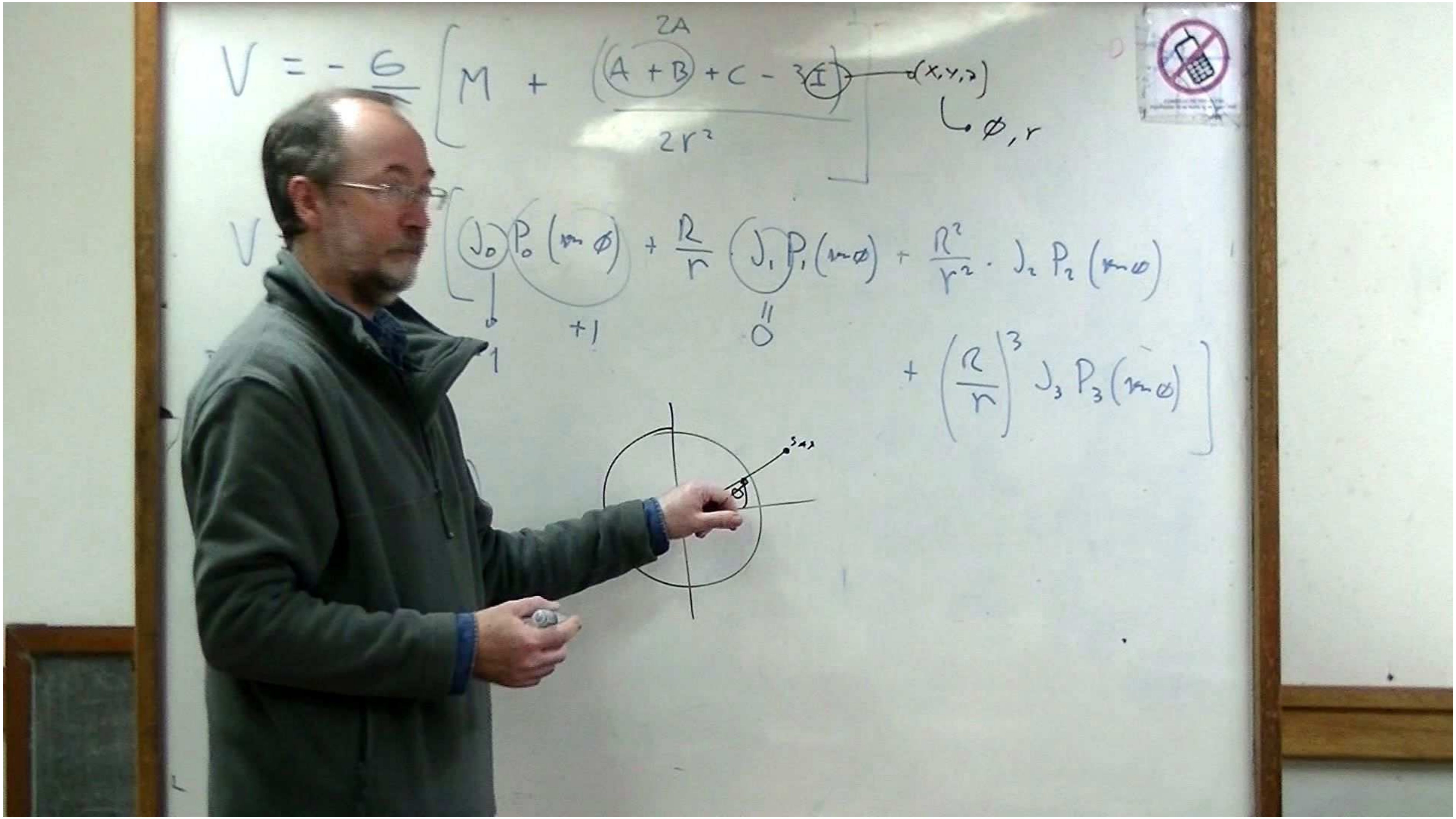
$$V = -\frac{G}{r}\left[M + \frac{\left(\overset{2A}{(A+B)} + C - 3I\right)}{2r^2}\right]$$

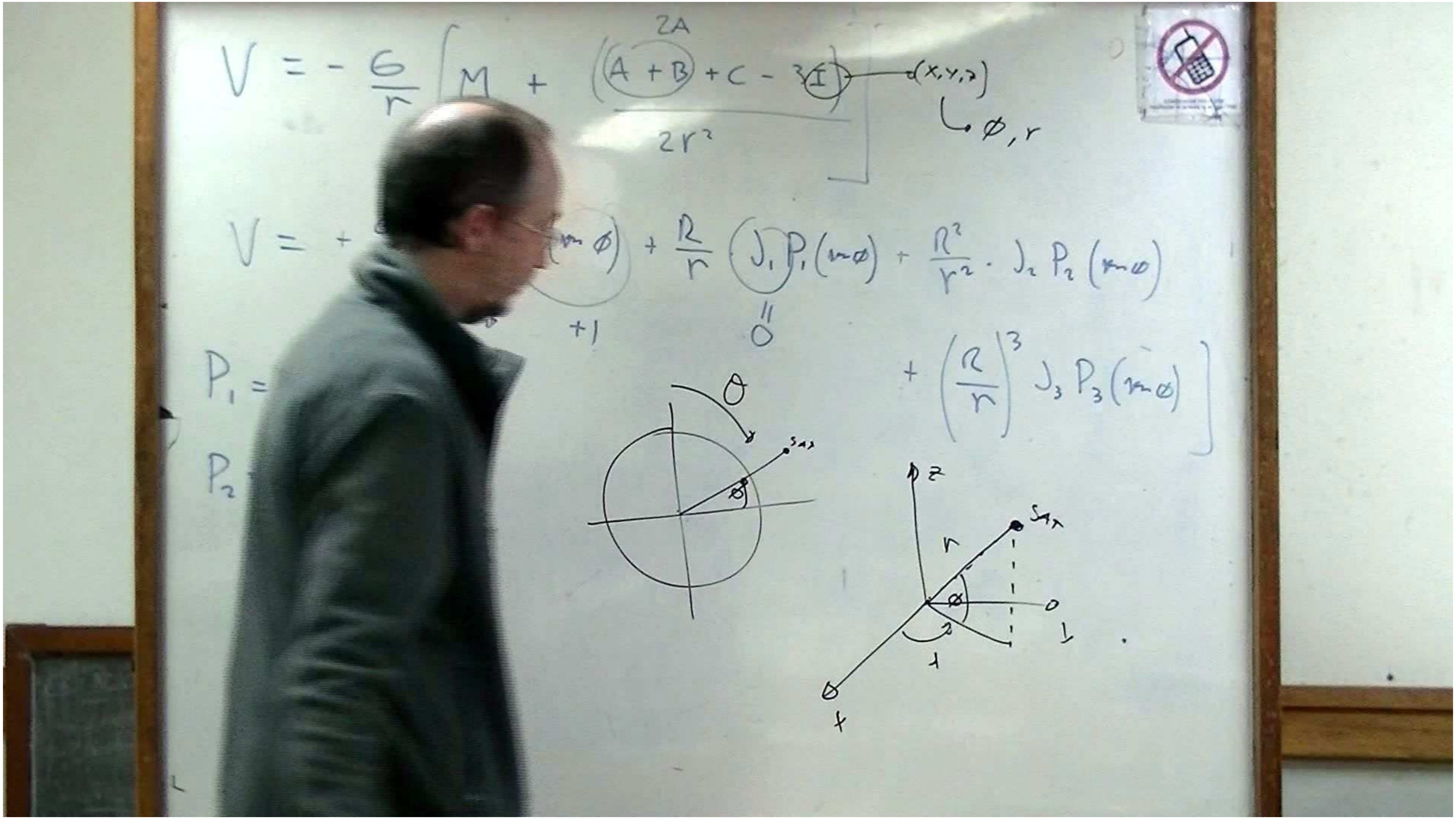
$I \rightarrow (x,y,z) \rightarrow \phi, r$

$$V = + \underset{+1}{P_0(\sin\phi)} + \frac{R}{r}\underset{\overset{\|}{0}}{J_1} P_1(\sin\phi) + \frac{R^2}{r^2}\cdot J_2 P_2(\sin\phi) + \left(\frac{R}{r}\right)^3 J_3 P_3(\sin\phi)\Big]$$

$P_1 =$

P_2


V = - G [M + ((A + B) + C - 3I) / 2r²
2A
(x,y,z)
φ, r
V [J₀ P₀ (sin φ) + R/r J₁ P₁ (sin φ) + R²/r² · J₂ P₂ (sin φ)
+ (R/r)³ J₃ P₃ (sin φ)]
1
+1
0
sat
φ

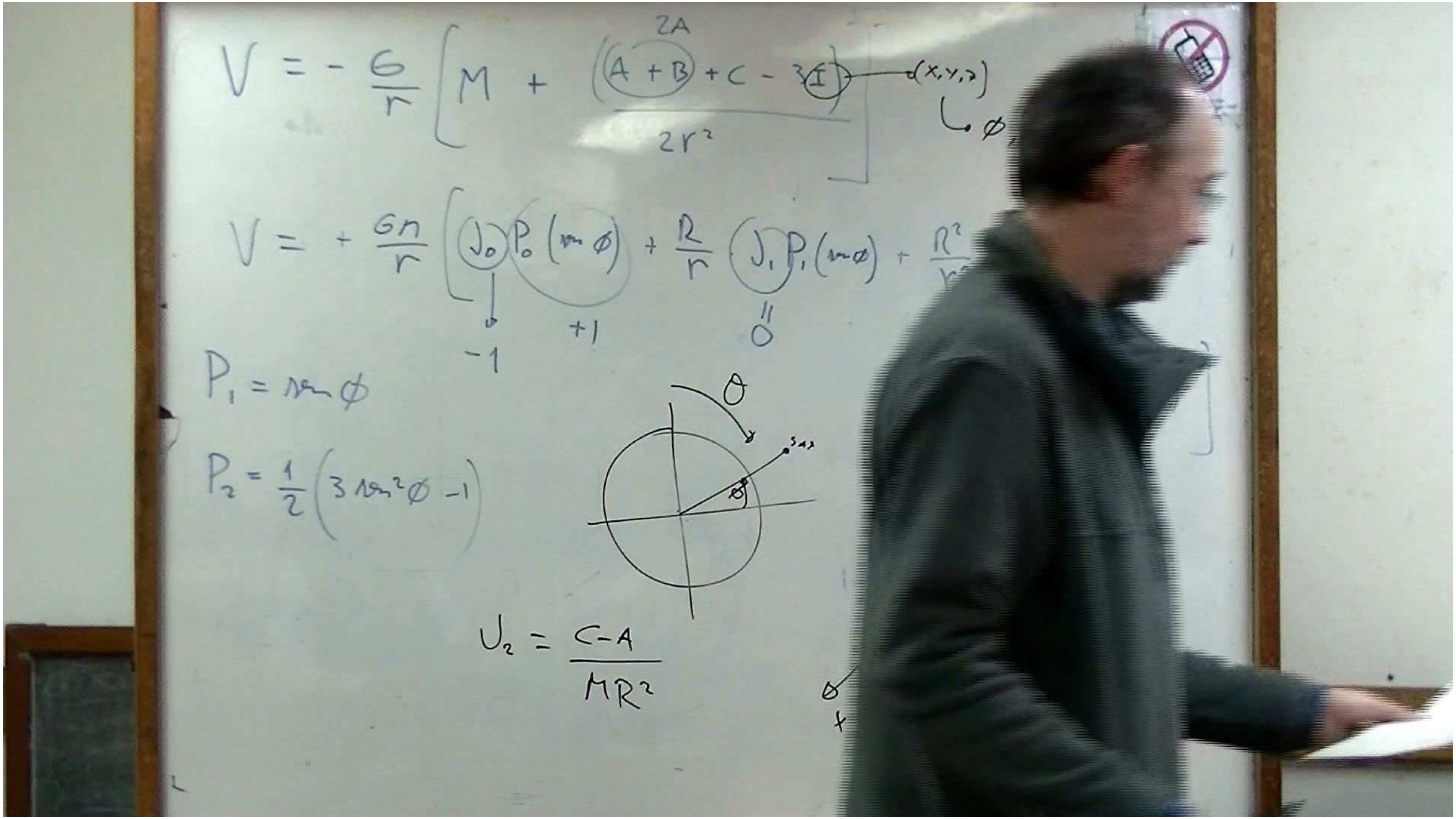


$$V = -\frac{G}{r}\left[M + \frac{(\overset{2A}{A+B} + C - 3I)}{2r^2}\right] \qquad I \rightarrow (x,y,z) \hookrightarrow \phi, r$$

$$V = + \ldots \underset{+1}{(\sin\phi)} + \frac{R}{r}\underset{\overset{\shortparallel}{0}}{J_1} P_1(\sin\phi) + \frac{R^2}{r^2}\cdot J_2 P_2(\sin\phi) + \left(\frac{R}{r}\right)^3 J_3 P_3(\sin\phi)\Big]$$

$P_1 =$

P_2



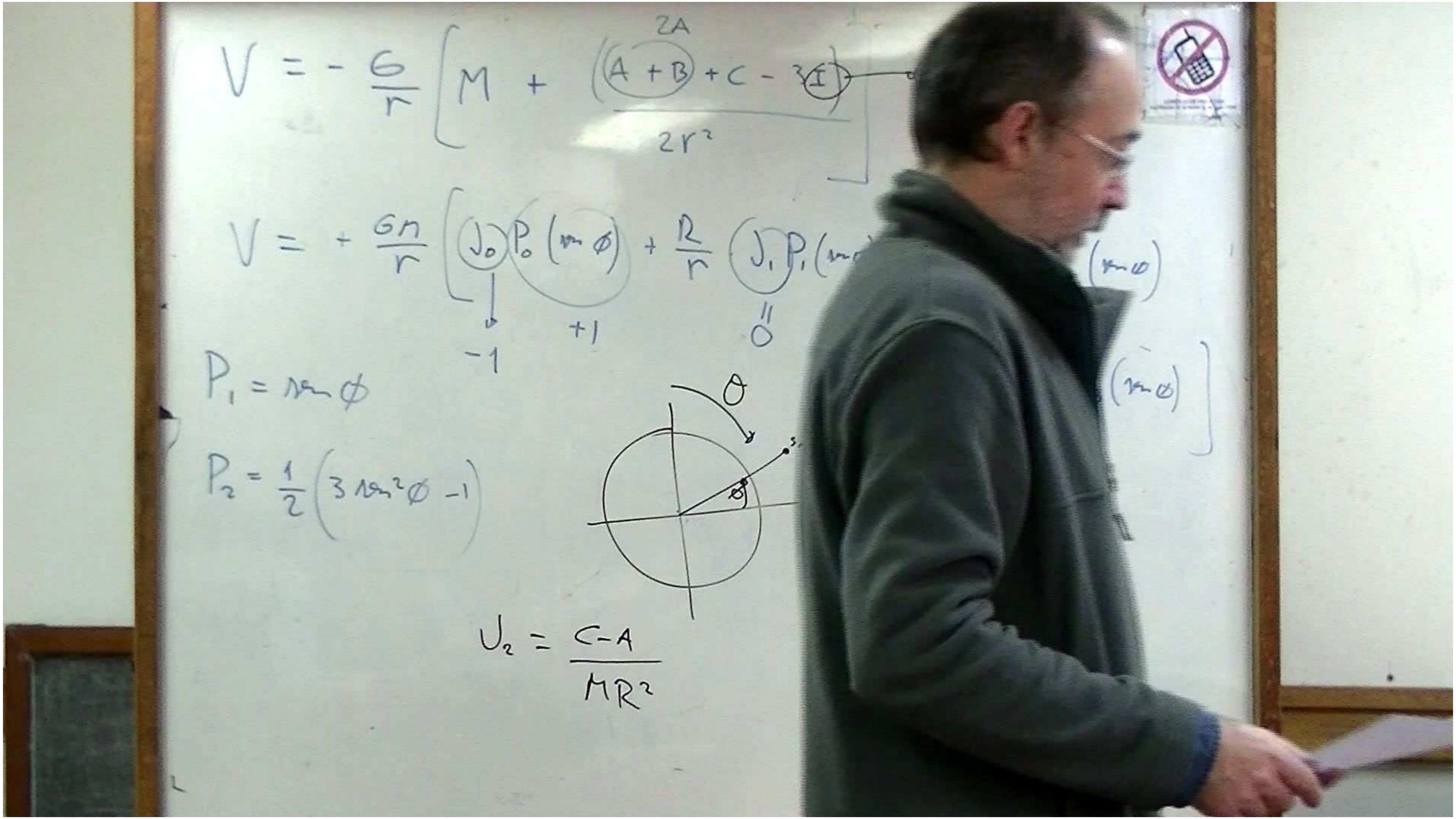
$$V = -\frac{G}{r}\left[M + \frac{(\underbrace{A+B}_{2A} + C - 3I)}{2r^2}\right] \rightarrow (x,y,z) \hookrightarrow \phi,$$

$$V = +\frac{Gm}{r}\left[\underbrace{J_0}_{-1}\underbrace{P_0(\mathrm{sen}\,\phi)}_{+1} + \frac{R}{r}\underbrace{J_1}_{0} P_1(\mathrm{sen}\,\phi) + \frac{R^2}{r^2}\right.$$

$$P_1 = \mathrm{sen}\,\phi$$

$$P_2 = \frac{1}{2}\left(3\,\mathrm{sen}^2\phi - 1\right)$$

$$U_2 = \frac{C-A}{MR^2}$$



$$V = -\frac{G}{r}\left[M + \frac{(\underbrace{A+B}^{2A} + C - 3I)}{2r^2}\right]$$

$$V = +\frac{Gm}{r}\left[\underset{-1}{J_0}\,\underset{+1}{P_0(\sin\phi)} + \frac{R}{r}\,\underset{0}{J_1}\,P_1(\sin$$

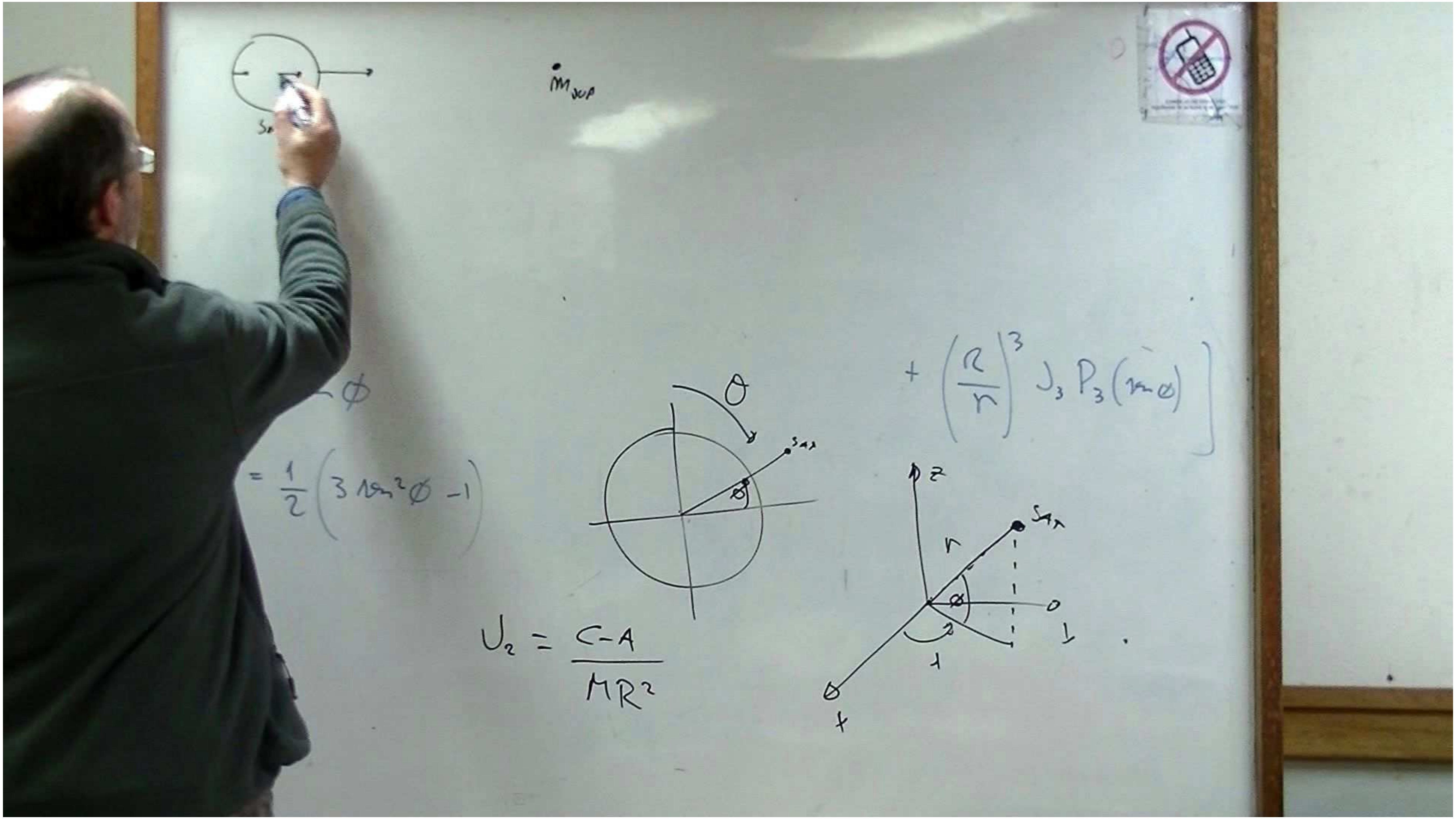
$$(\sin\phi)$$

$$(\sin\phi)\Big]$$

$$P_1 = \sin\phi$$

$$P_2 = \frac{1}{2}\left(3\sin^2\phi - 1\right)$$

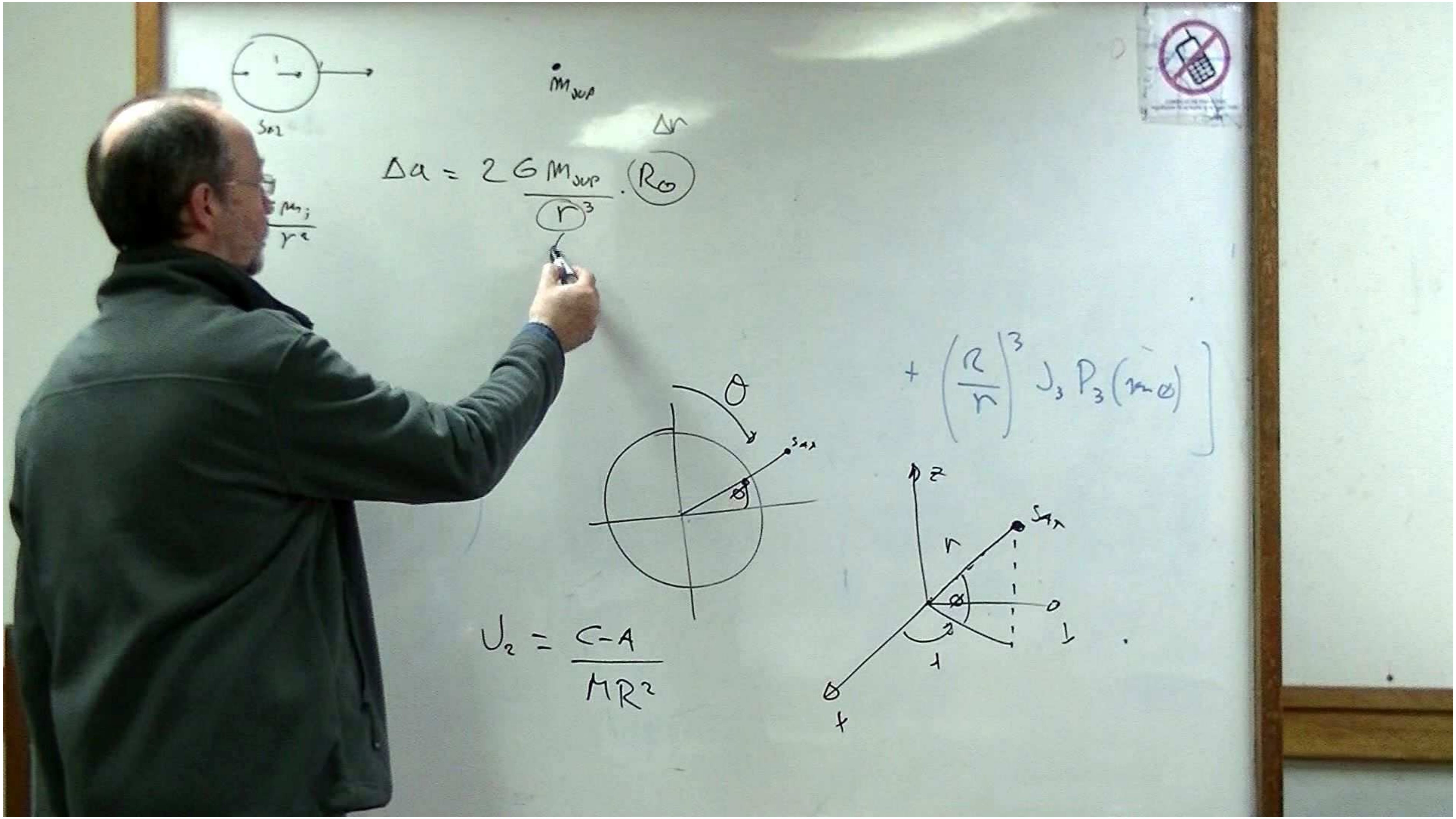
$$J_2 = \frac{C-A}{MR^2}$$



$$+ \left(\frac{R}{r}\right)^3 J_3 P_3(\sin\phi) \Big]$$

$$= \frac{1}{2}\left(3\sin^2\phi - 1\right)$$

$$U_2 = \frac{C-A}{MR^2}$$


SAT
m JUP
Δr
Δa = 2 G M JUP / r^3 · R⊙
m_j / r^2
+ (R/r)^3 J_3 P_3(sin φ)]
θ
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SAT
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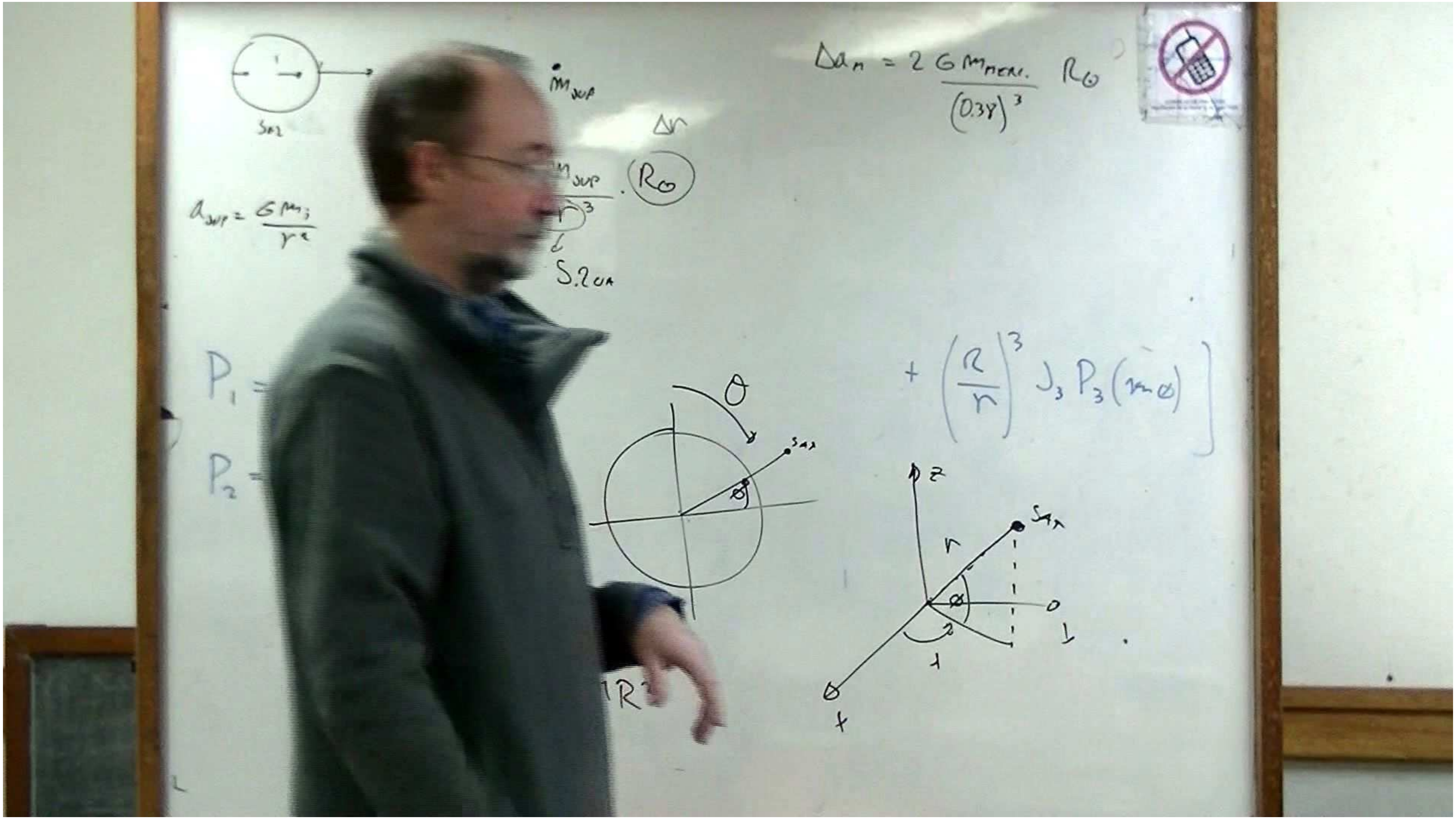
U_2 = (C-A) / (MR^2)


Sat
m sup
Δr
m sup / r^3 · R⊙
a sup = G m_i / r^2
5.2 ua
Δa_n = 2 G m merc. / (0.38)^3 R⊙
P_1 =
P_2 =
+ (R/r)^3 J_3 P_3 (sin φ)]
θ
φ
Sat
z
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φ
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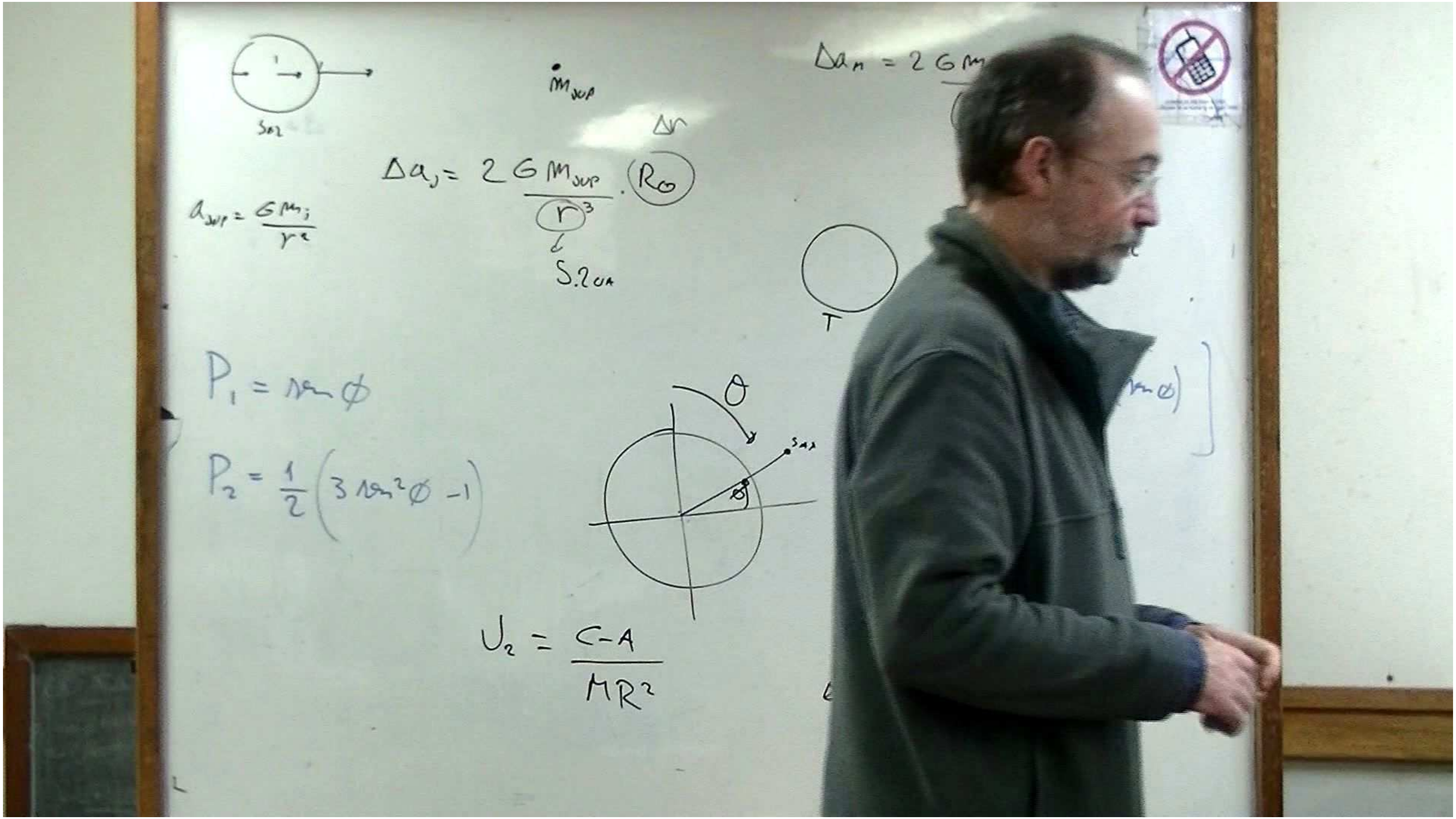
y
Sat



$\dot{m}_{Jup}$

Δr

$$\Delta a_J = \frac{2 G M_{Jup}}{\boxed{r}^3} \cdot \boxed{R_\odot}$$

5.2 UA

$$a_{Jup} = \frac{G M_J}{r^2}$$

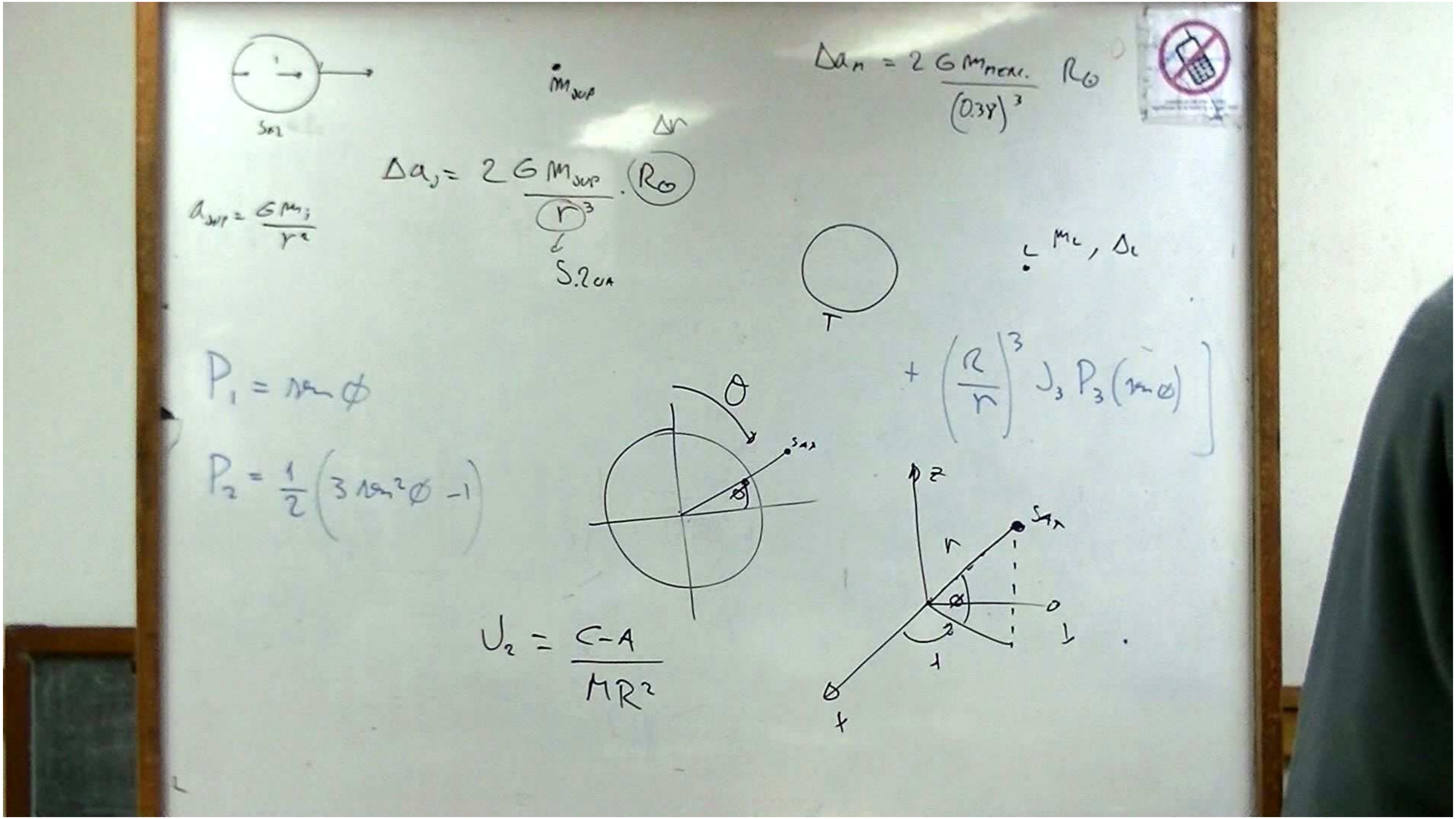
$\Delta a_M = 2 G M$

$P_1 = \sin\phi$

$P_2 = \frac{1}{2}\left(3 \sin^2\phi - 1\right)$

$\sin\phi)$

$$U_2 = \frac{C-A}{MR^2}$$



$$\Delta a_M = 2\frac{G m_{merc}}{(0.39)^3} R_\odot$$

$$\Delta a_J = 2\frac{G m_{Jup}}{r^3}\cdot R_\odot$$

$r \to 5.2\,\mathrm{UA}$

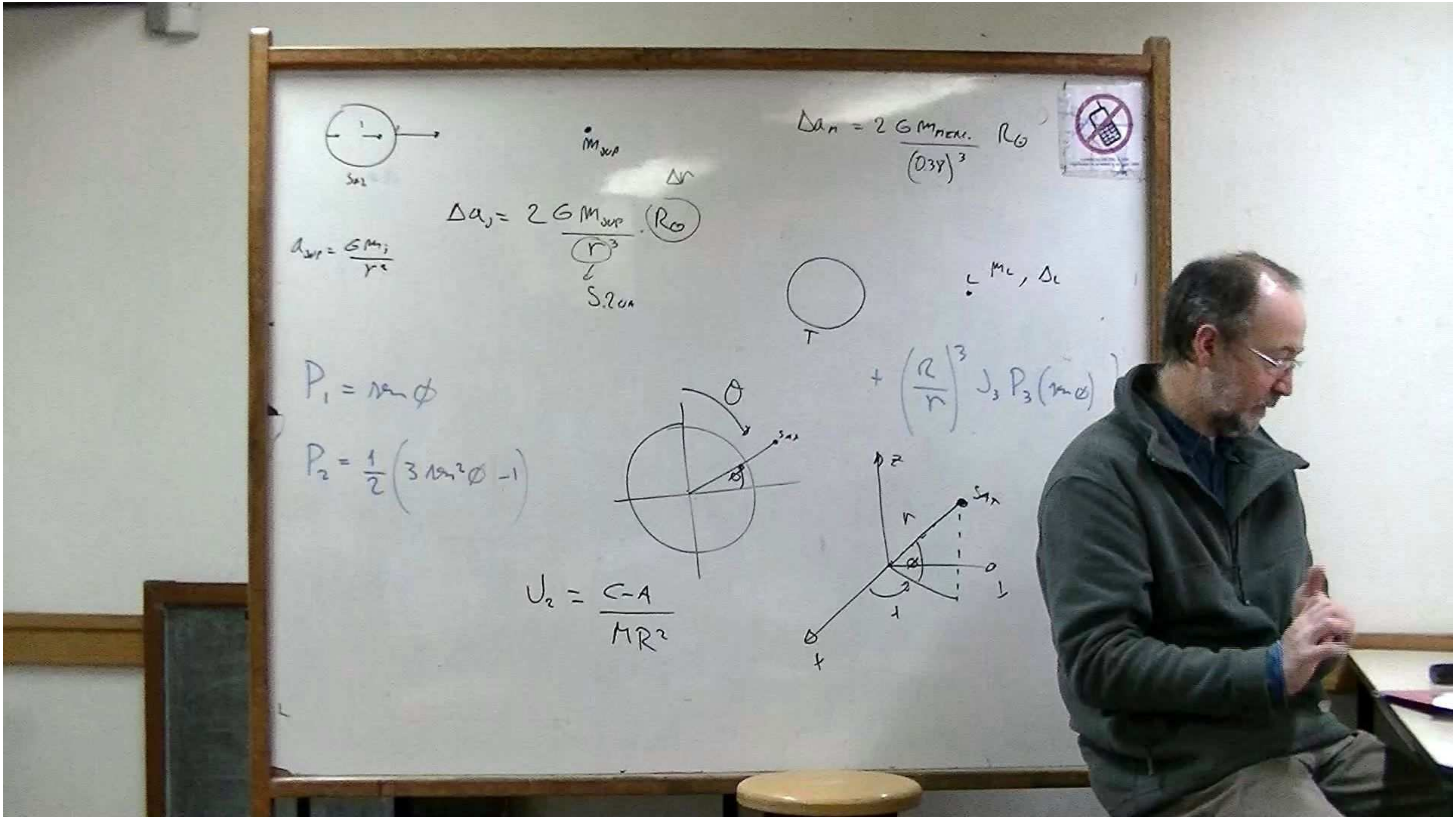
$$a_{Jup} = \frac{G m_J}{r^2}$$

$$P_1 = \sin\phi$$

$$P_2 = \frac{1}{2}\left(3\sin^2\phi - 1\right)$$

$$+ \left(\frac{R}{r}\right)^3 J_3 P_3(\sin\phi) \Big]$$

$$U_2 = \frac{C-A}{MR^2}$$



$a_{Jup} = \frac{G m_J}{r^2}$

$\Delta a_J = 2 \frac{G m_{Jup}}{r^3} \cdot R_\oplus$

r = 5.2 UA

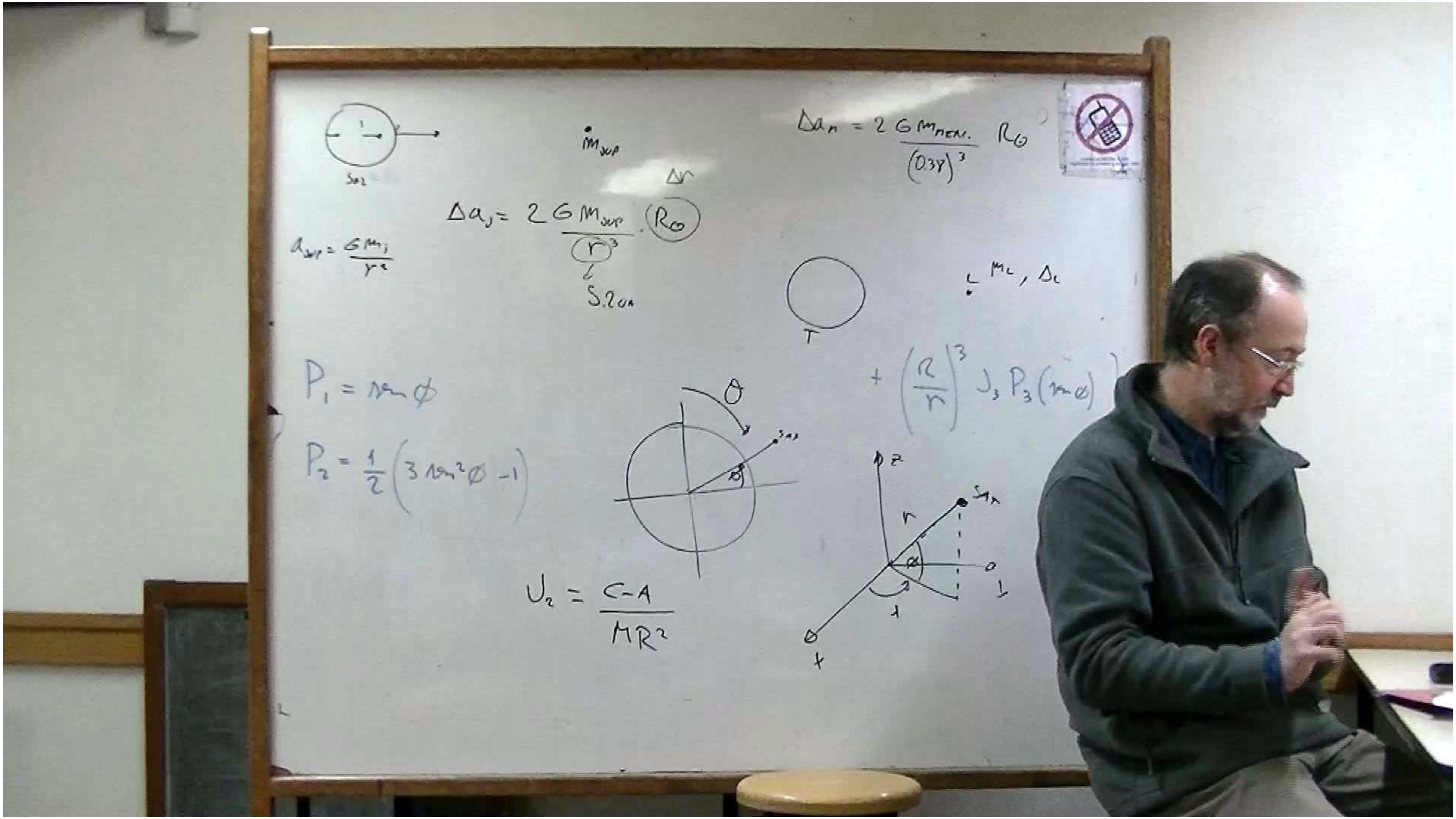
$\Delta a_M = 2 \frac{G m_{Merc.}}{(0.39)^3} R_\oplus$

$P_1 = \sin \phi$

$P_2 = \frac{1}{2}\left(3 \sin^2 \phi - 1\right)$

$+ \left(\frac{R}{r}\right)^3 J_3 P_3(\sin \phi)$

$U_2 = \frac{C-A}{MR^2}$



$$a_{Jup} = \frac{G M_J}{r^2}$$

$$\Delta a_J = 2 \frac{G M_{Jup}}{(r)^3} \cdot R_\oplus$$

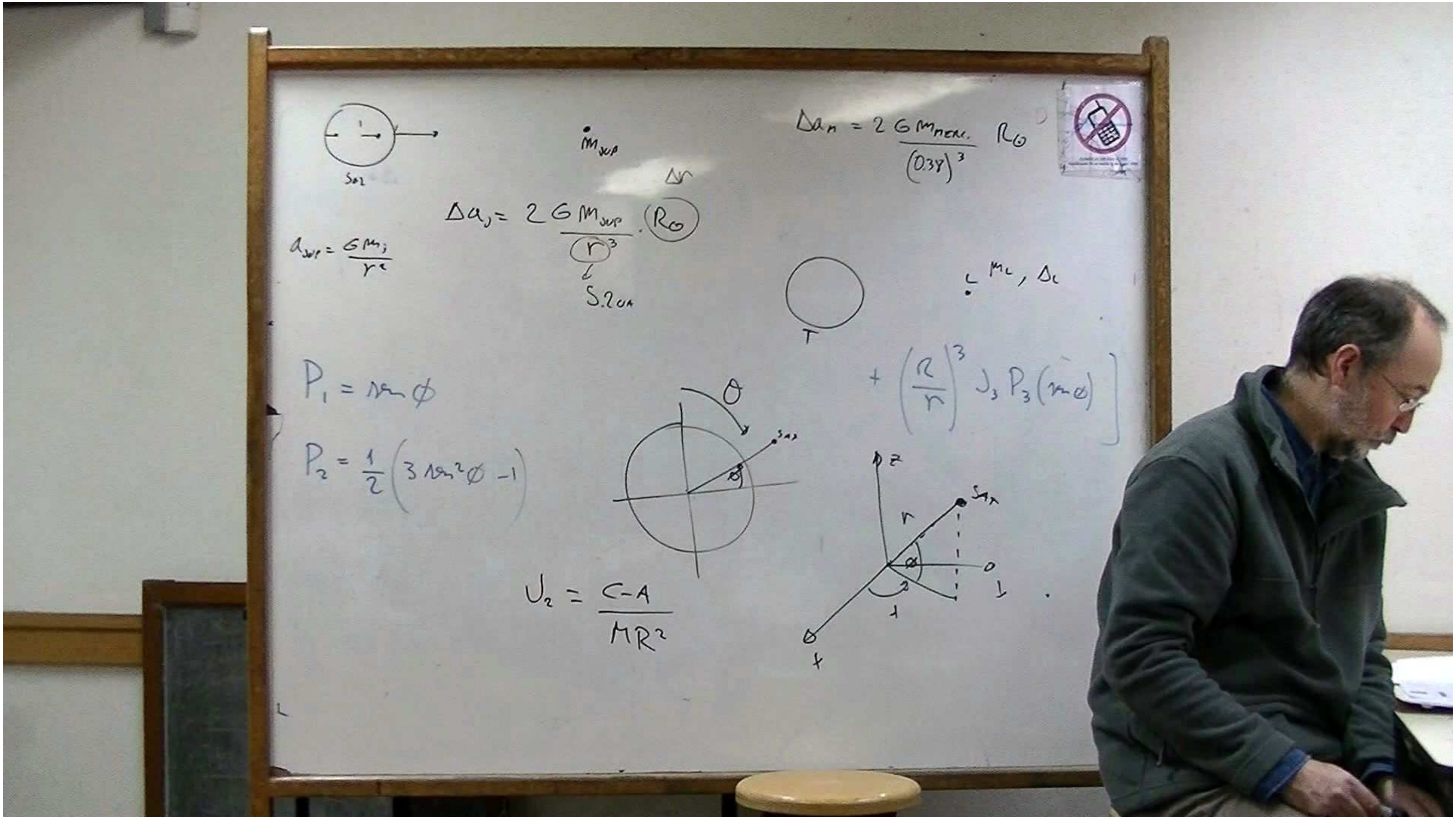
$$\Delta a_M = 2 \frac{G M_{merc.}}{(0.38)^3} R_\oplus$$

$$P_1 = \operatorname{sen} \phi$$

$$P_2 = \frac{1}{2}\left(3 \operatorname{sen}^2 \phi - 1\right)$$

$$+ \left(\frac{R}{r}\right)^3 J_3 P_3(\operatorname{sen} \phi)$$

$$U_2 = \frac{C-A}{MR^2}$$



$a_{Jup} = \frac{G m_J}{r^2}$

$\Delta a_J = 2\, \frac{G\, m_{Jup}}{r^3} \cdot R_\odot$

$r \rightarrow 5.2\,ua$

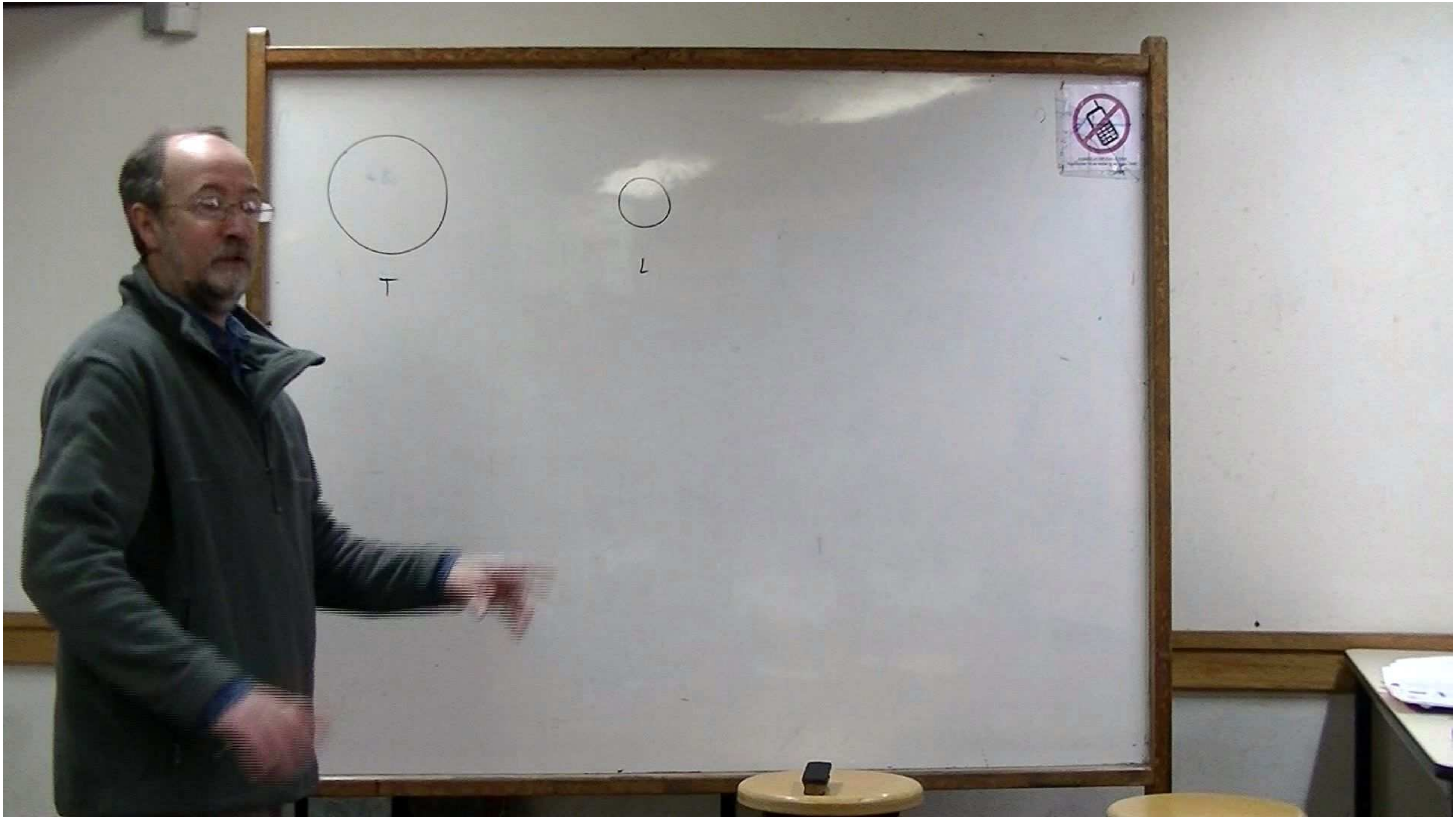
$\Delta a_n = 2\, \frac{G\, m_{merc.}}{(0.38)^3}\, R_\odot$

$P_1 = \sin\phi$

$P_2 = \frac{1}{2}\left(3 \sin^2\phi - 1\right)$

$+ \left(\frac{R}{r}\right)^3 J_3\, P_3(\sin\phi) \Big]$

$U_2 = \frac{C-A}{MR^2}$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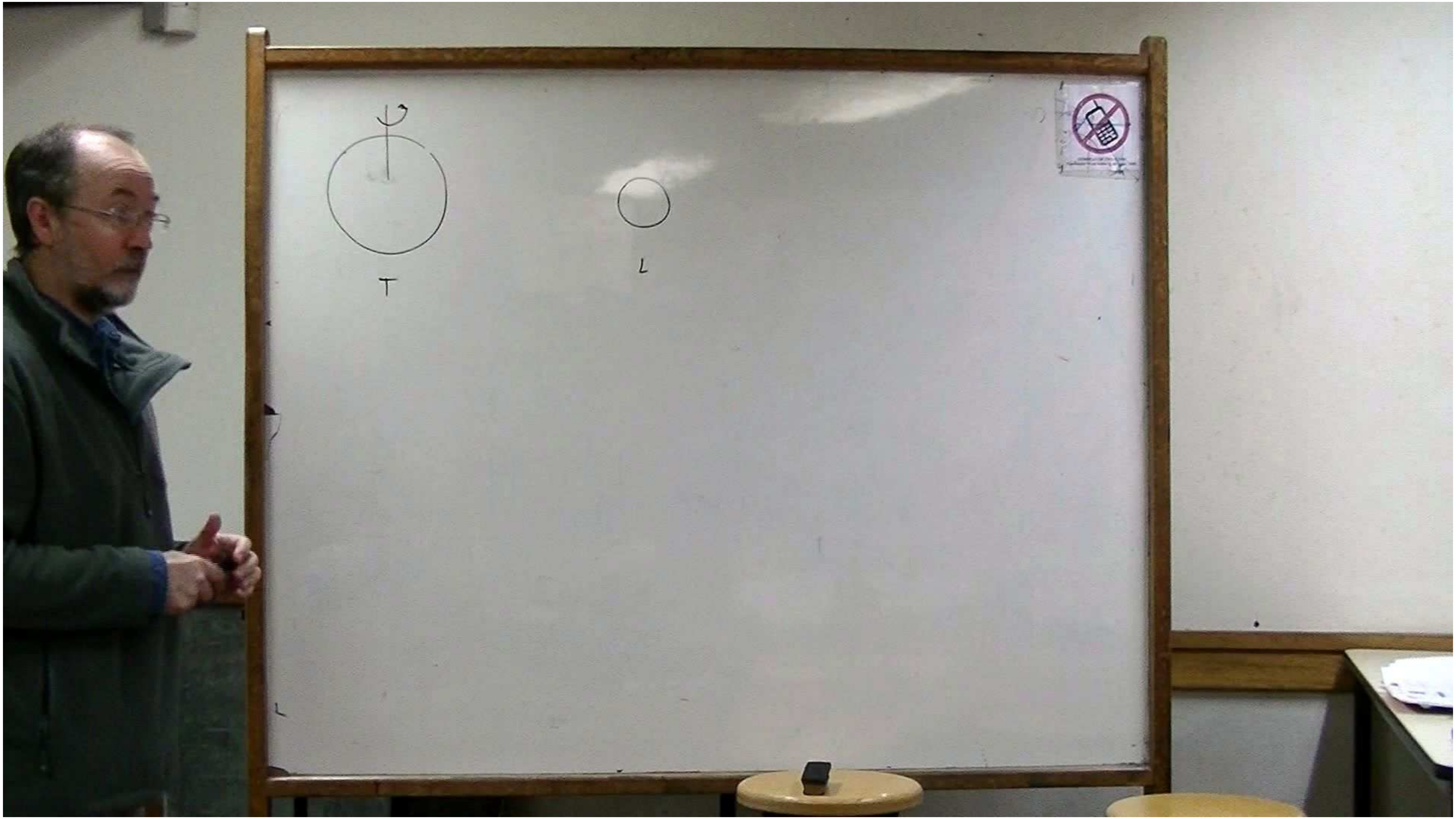
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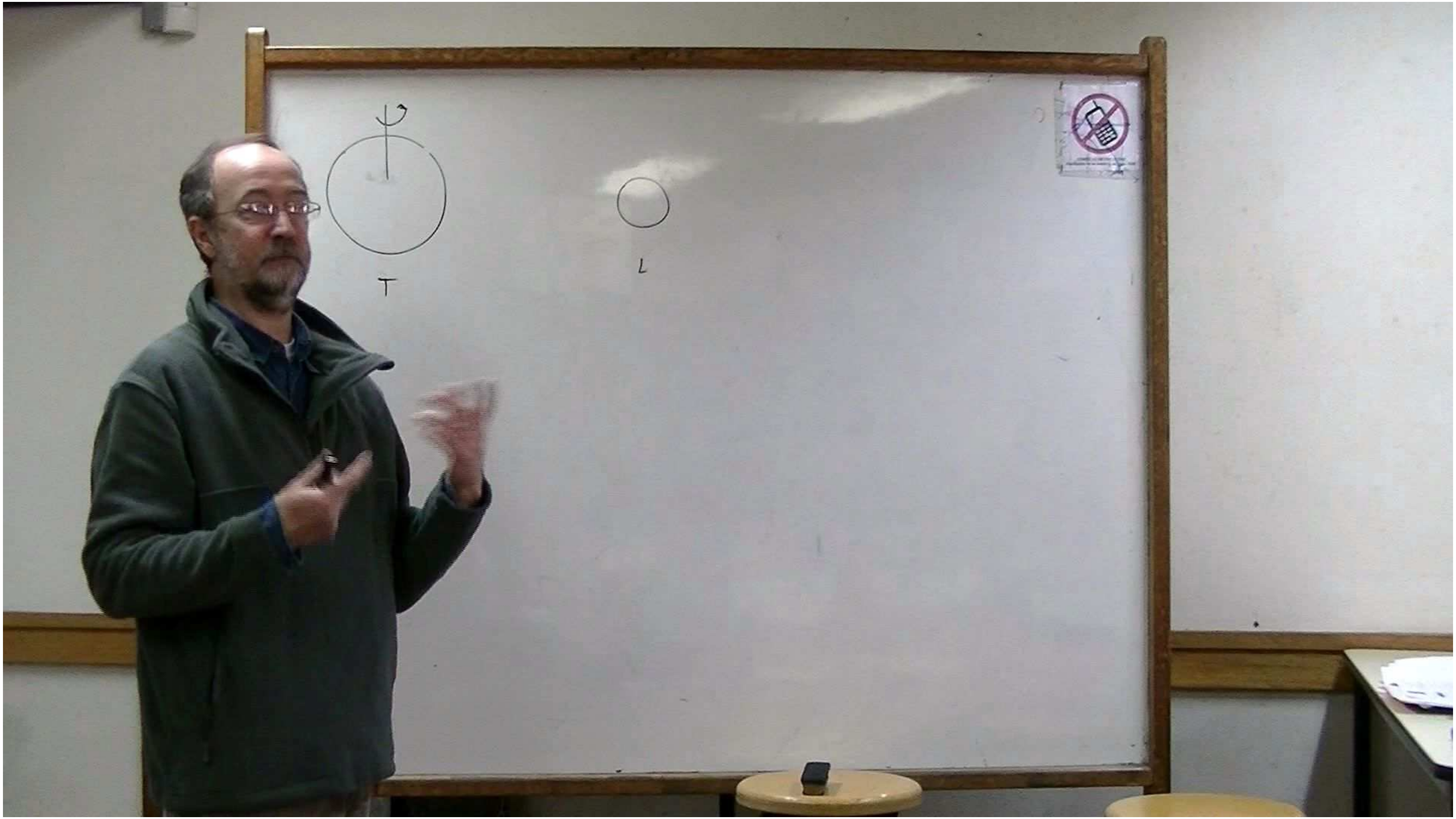
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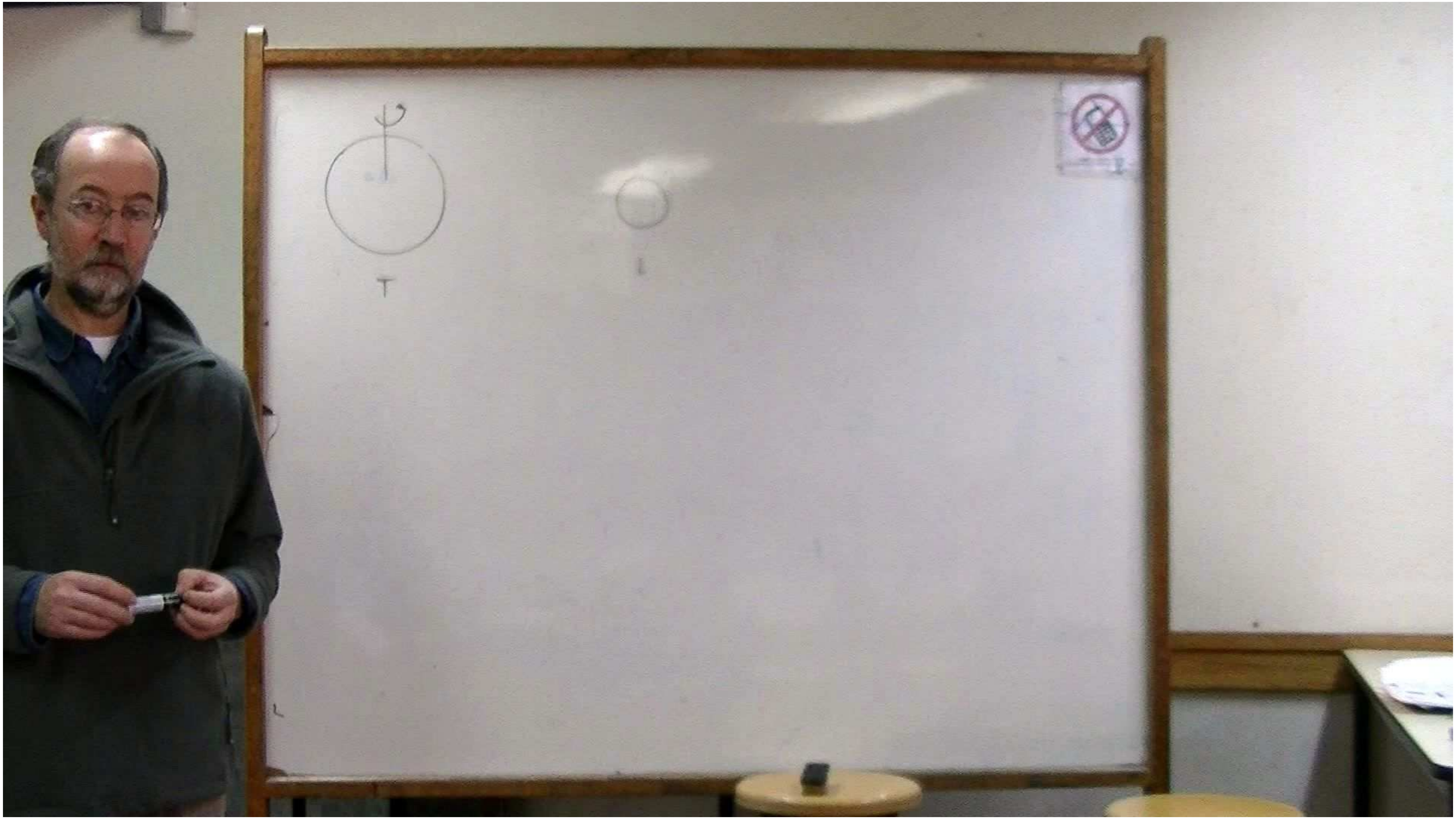
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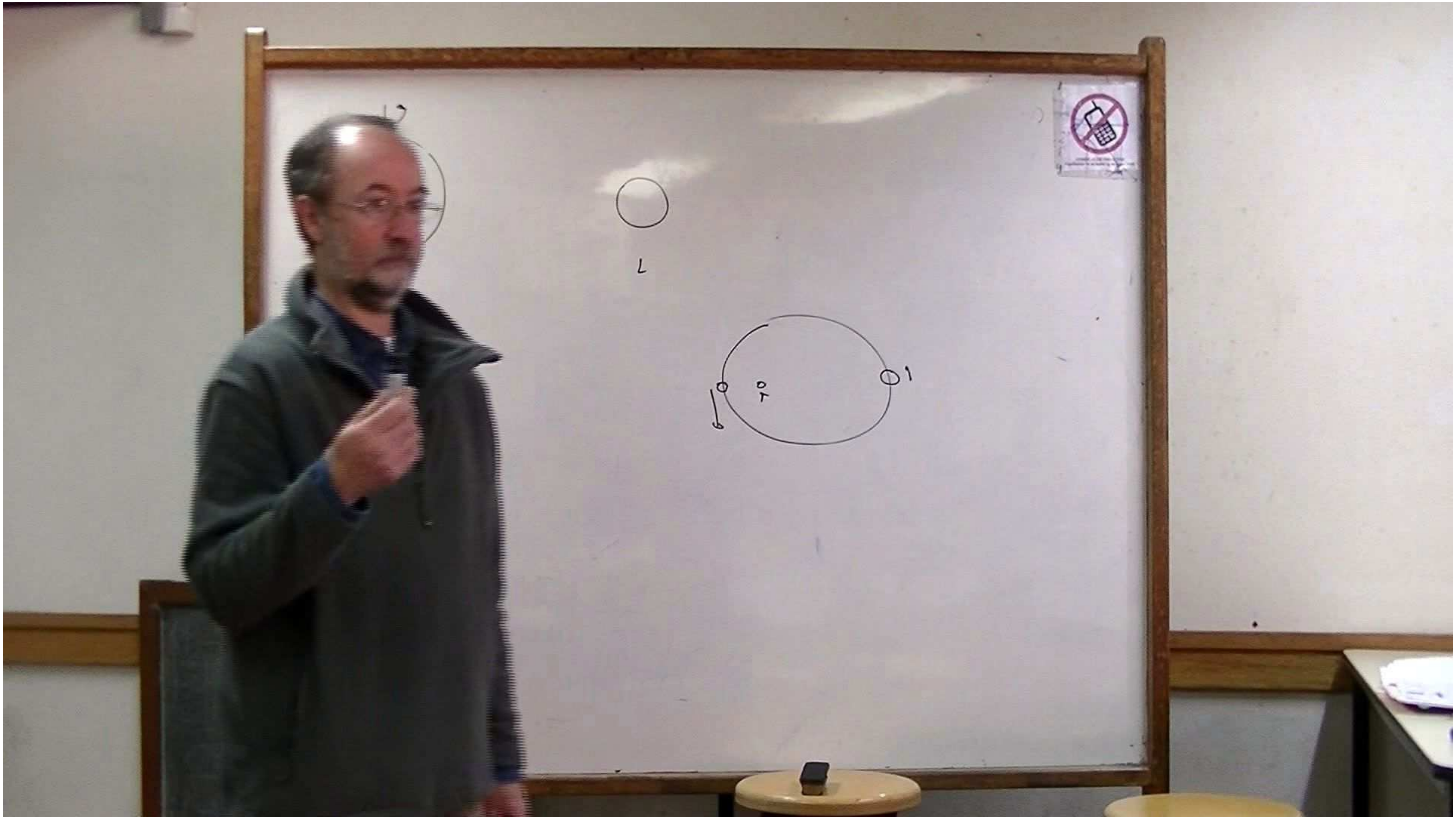
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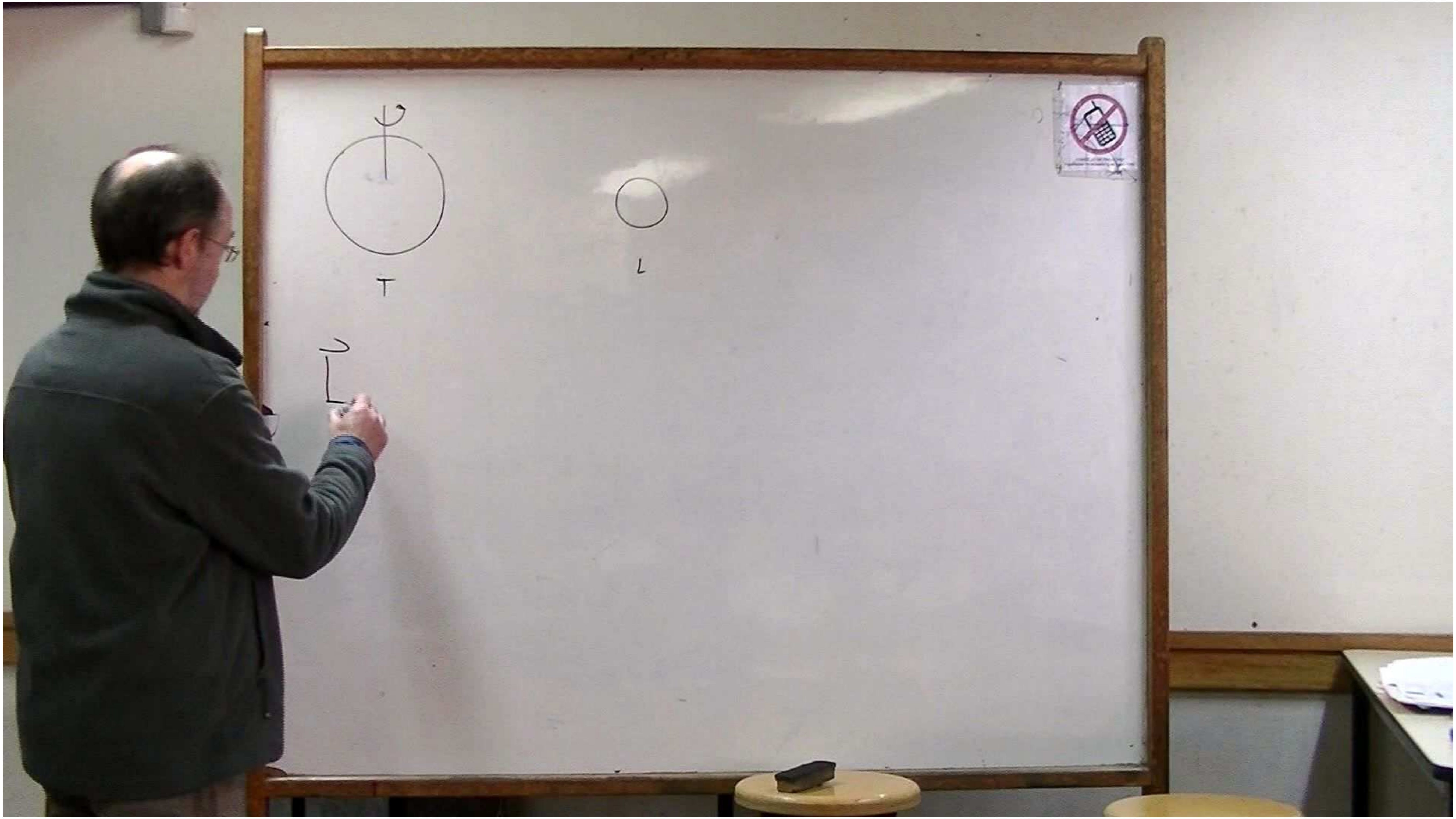
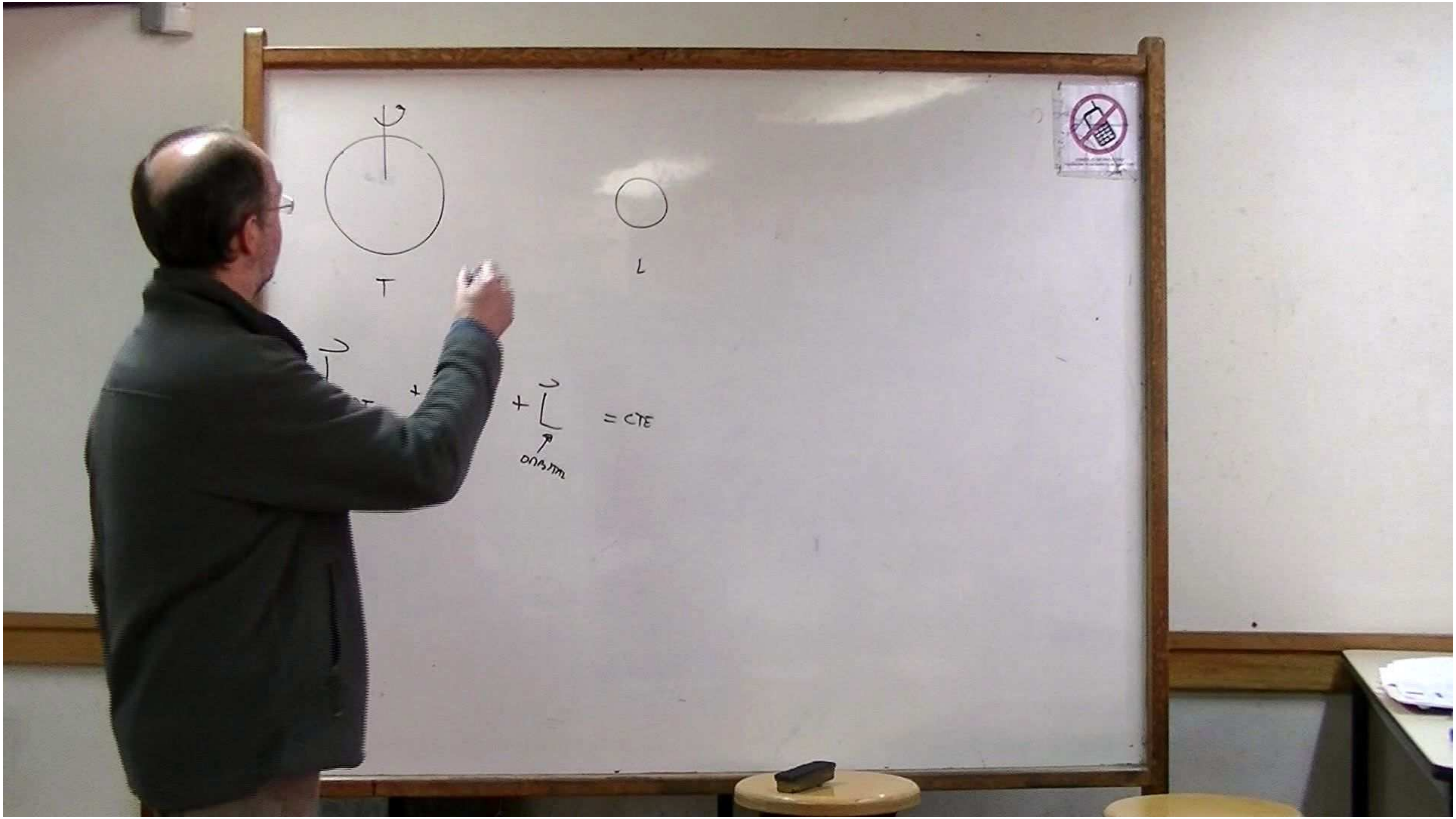
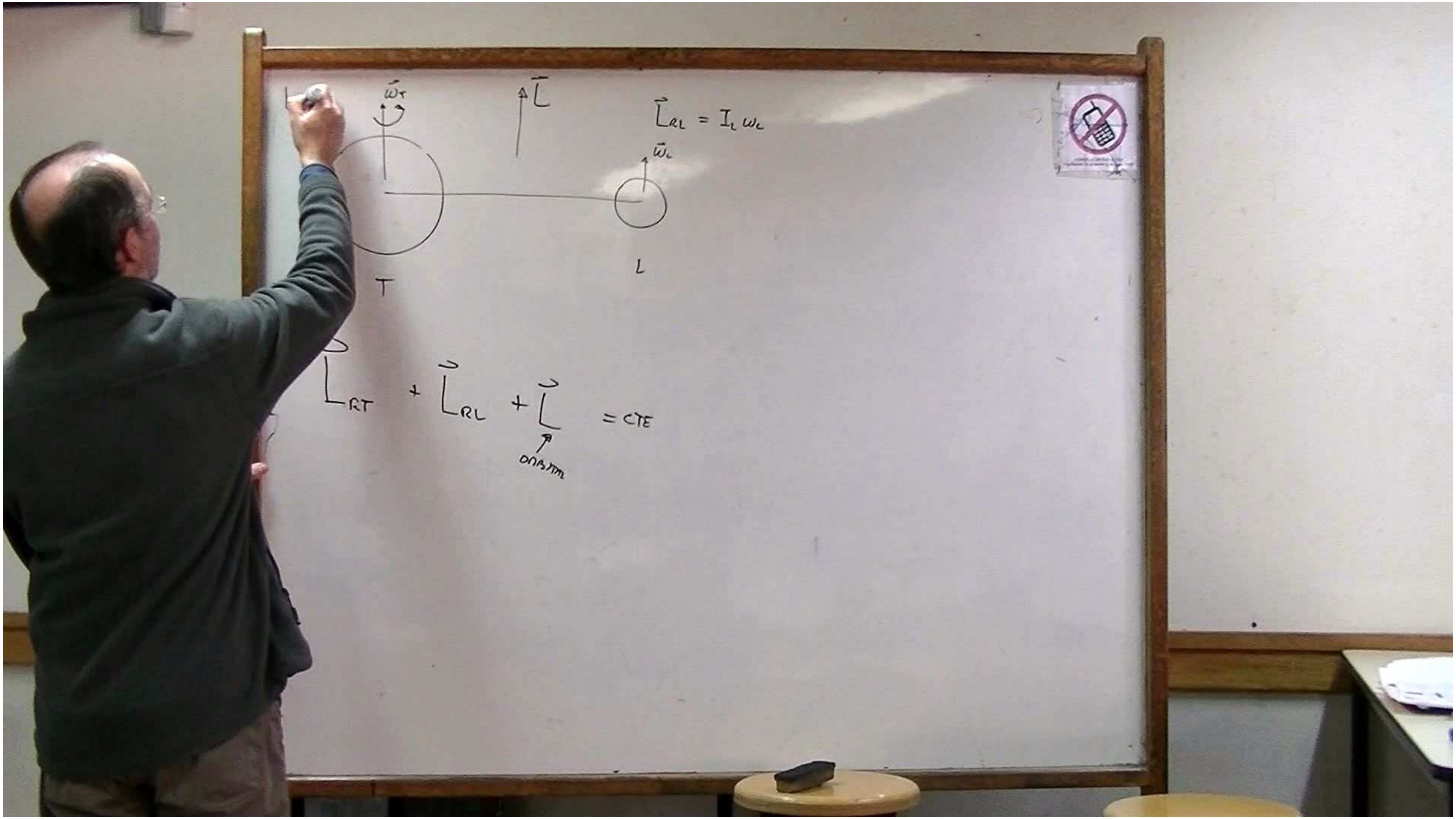
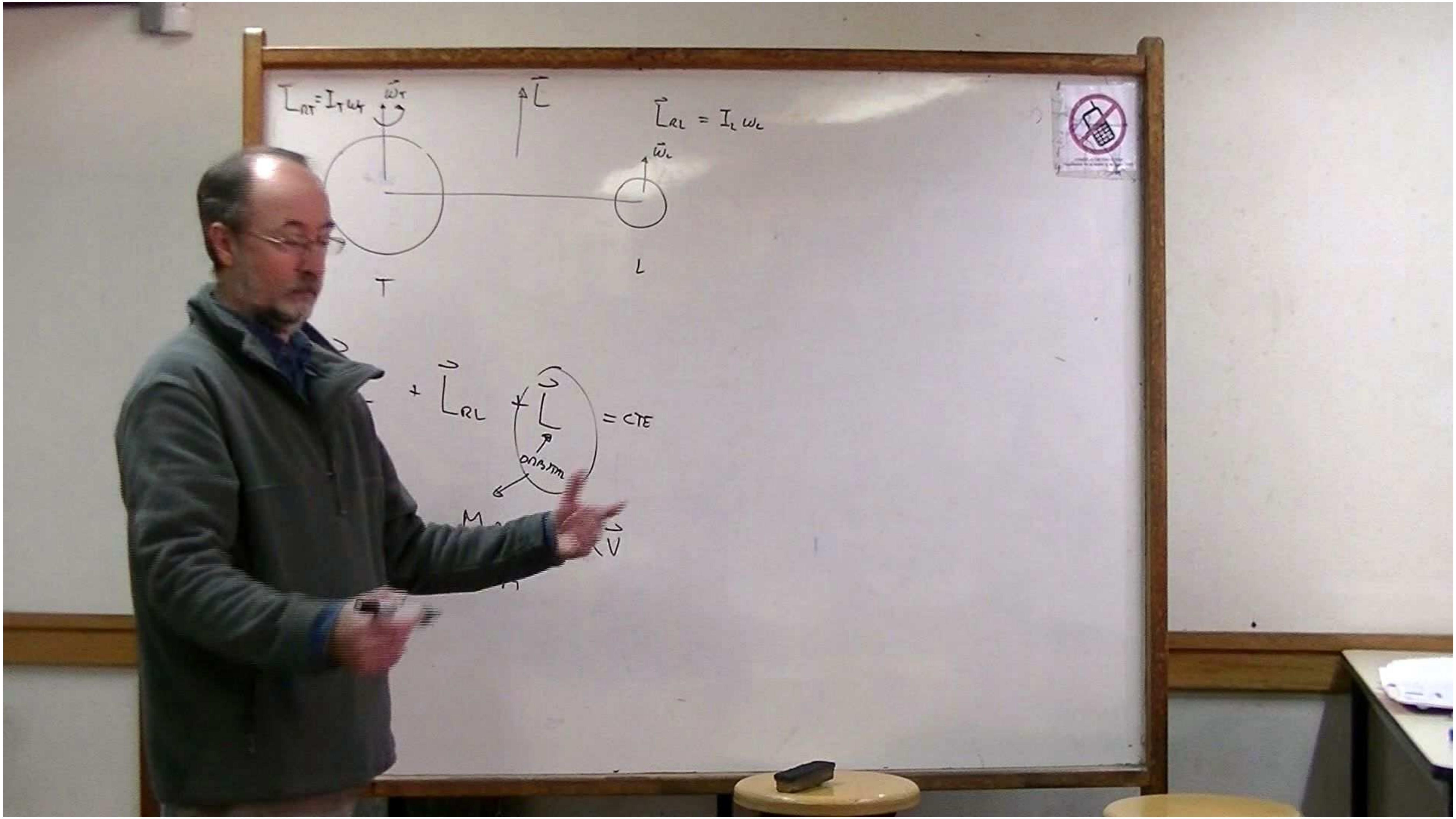

T
L
L

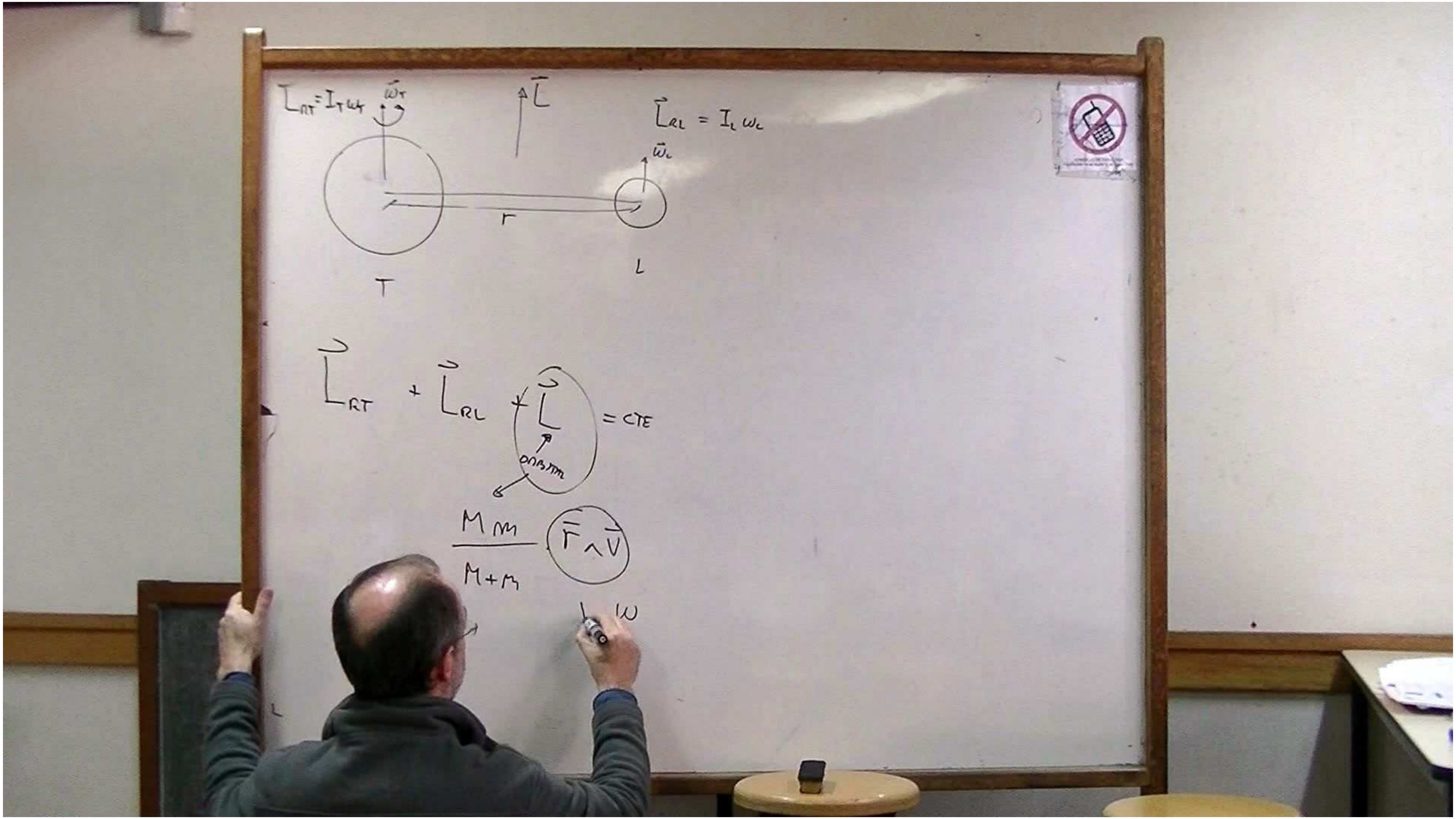

T
L
+
+ L = CTE
orbital



$\vec{L}_{RL} = I_L \omega_L$

$\vec{L}_{RT} + \vec{L}_{RL} + \vec{L} = CTE$


$\vec{L}_{RT} = I_T \omega_T$
$\vec{\omega}_T$
$\vec{L}$
$\vec{L}_{RL} = I_L \omega_L$
$\vec{\omega}_L$
T
L
$+ \vec{L}_{RL} + \vec{L} = CTE$
ORBITAL
M
$\times \vec{V}$



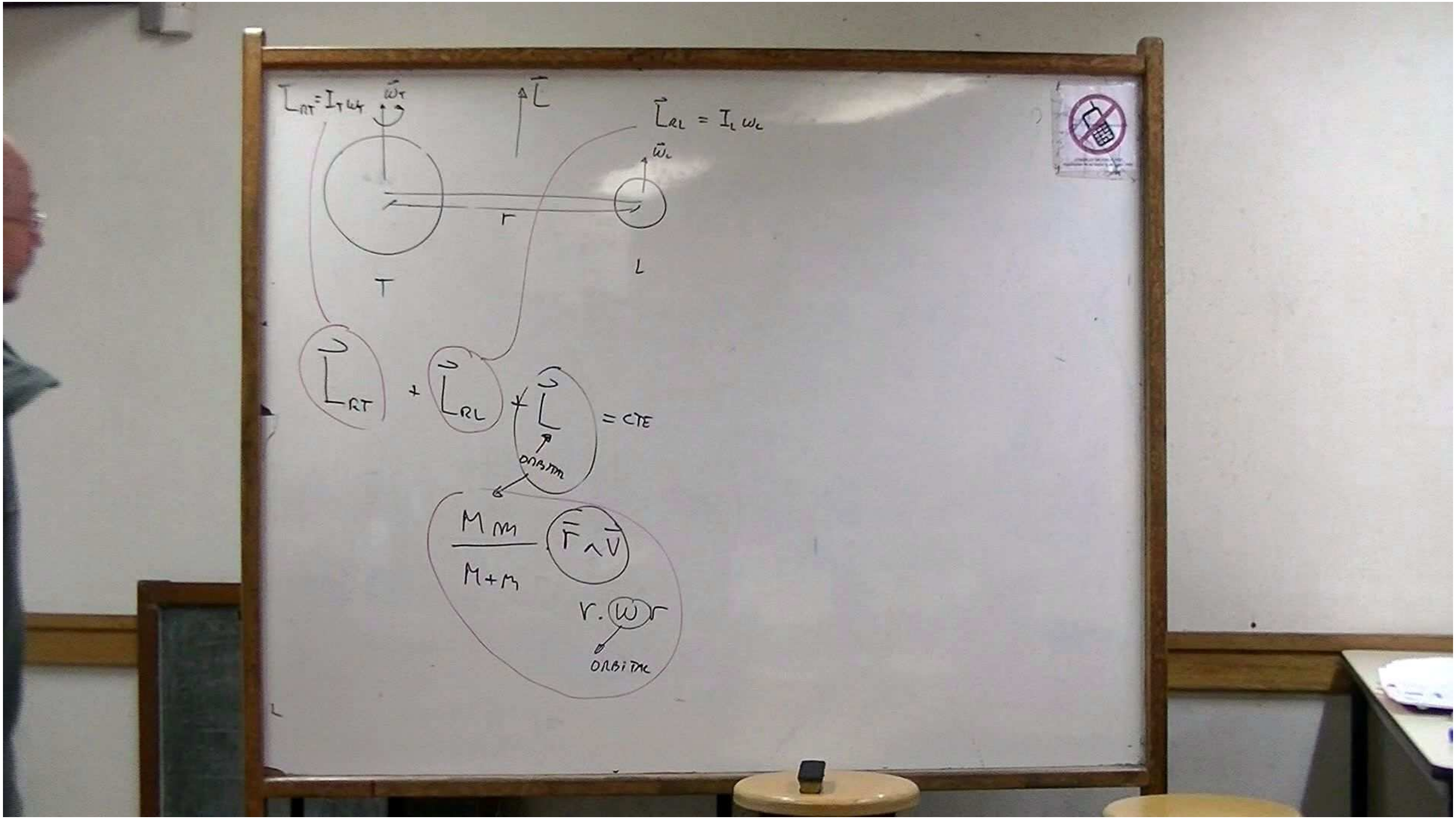
$\vec{L}_{RT} = I_T \omega_T$

$\vec{L}_{RL} = I_L \omega_L$

$$\vec{L}_{RT} + \vec{L}_{RL} + \vec{L} = CTE$$

$$\frac{Mm}{M+m} \, \vec{r} \wedge \vec{v}$$

L ω



$\vec{L}_{RT} = I_T \omega_T$

$\vec{L}_{RL} = I_L \omega_L$

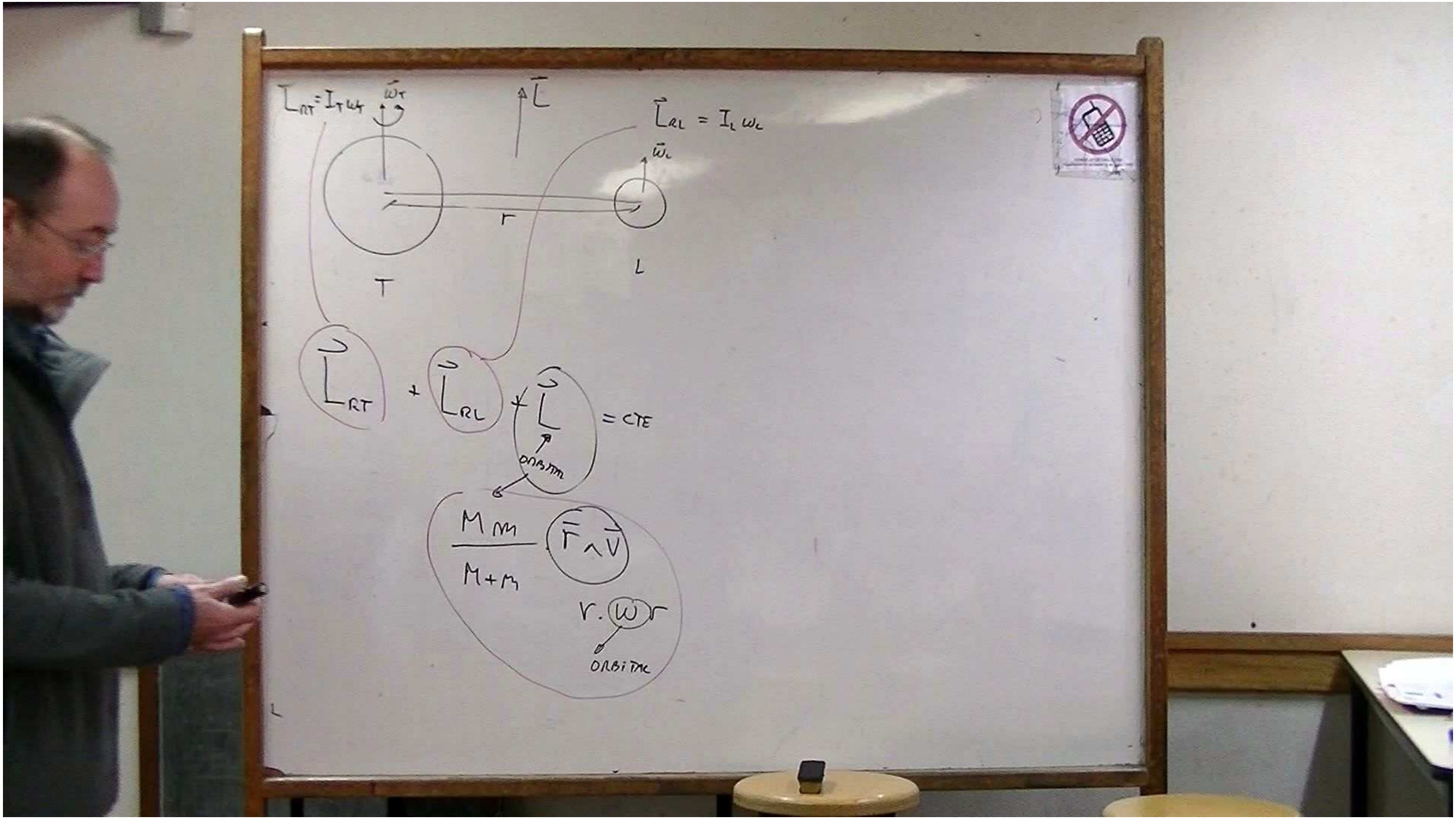
$$\vec{L}_{RT} + \vec{L}_{RL} + \vec{L} = CTE$$

ORBITAL

$$\frac{Mm}{M+m} \, \vec{r} \wedge \vec{V}$$

$r \cdot \omega r$

ORBITAL



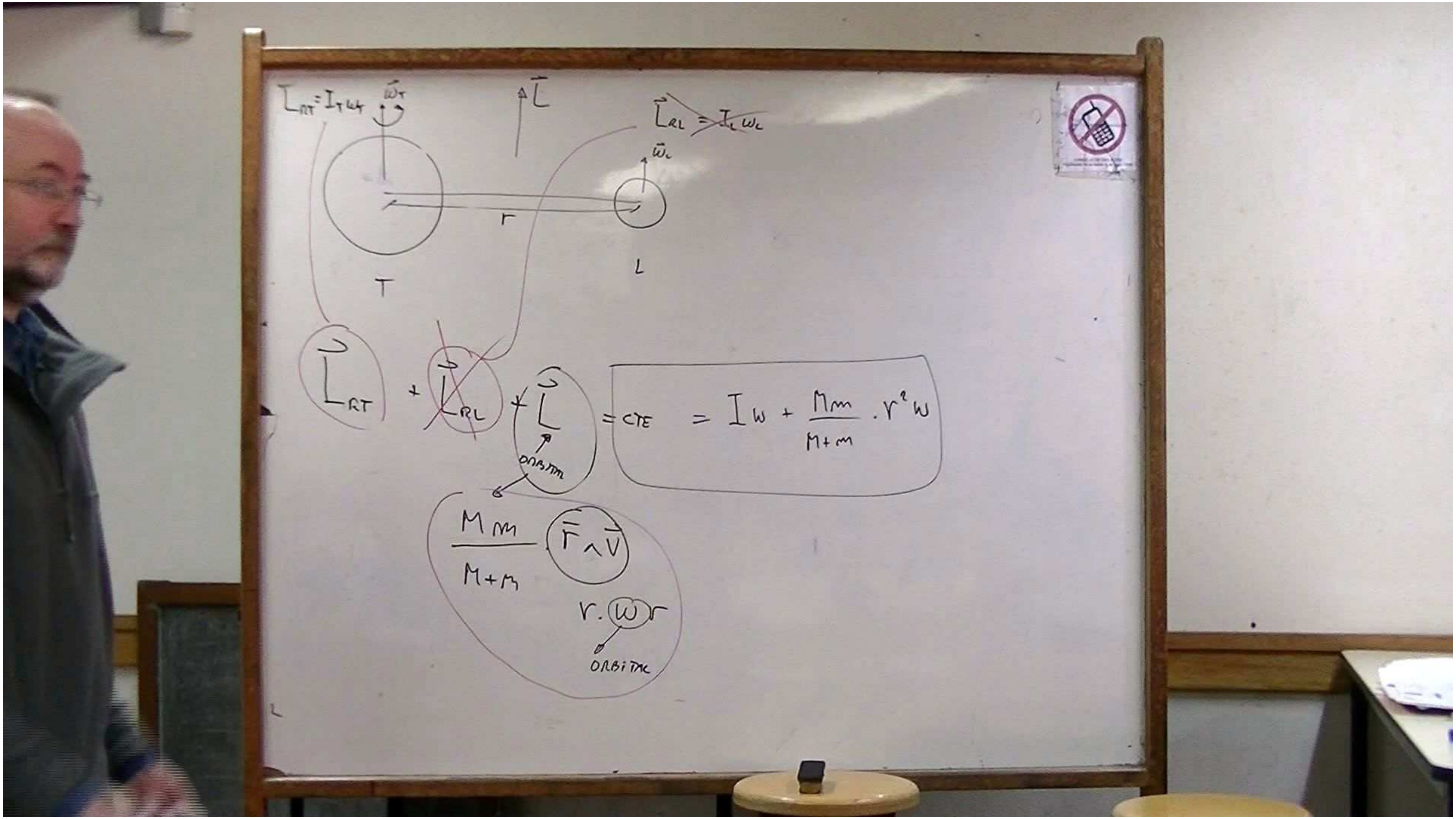
$$L_{RT} = I_T \omega_T$$

$$\vec{L}_{RL} = I_L \omega_L$$

$$\vec{L}_{RT} + \vec{L}_{RL} + \vec{L} = CTE$$

$$\frac{Mm}{M+m} \left(\vec{r} \wedge \vec{v} \right)$$

$$r . \omega r$$



$\vec{L}_{RT} = I_T \omega_T$

$\vec{L}_{RL}$ ~~$= I_L \omega_L$~~

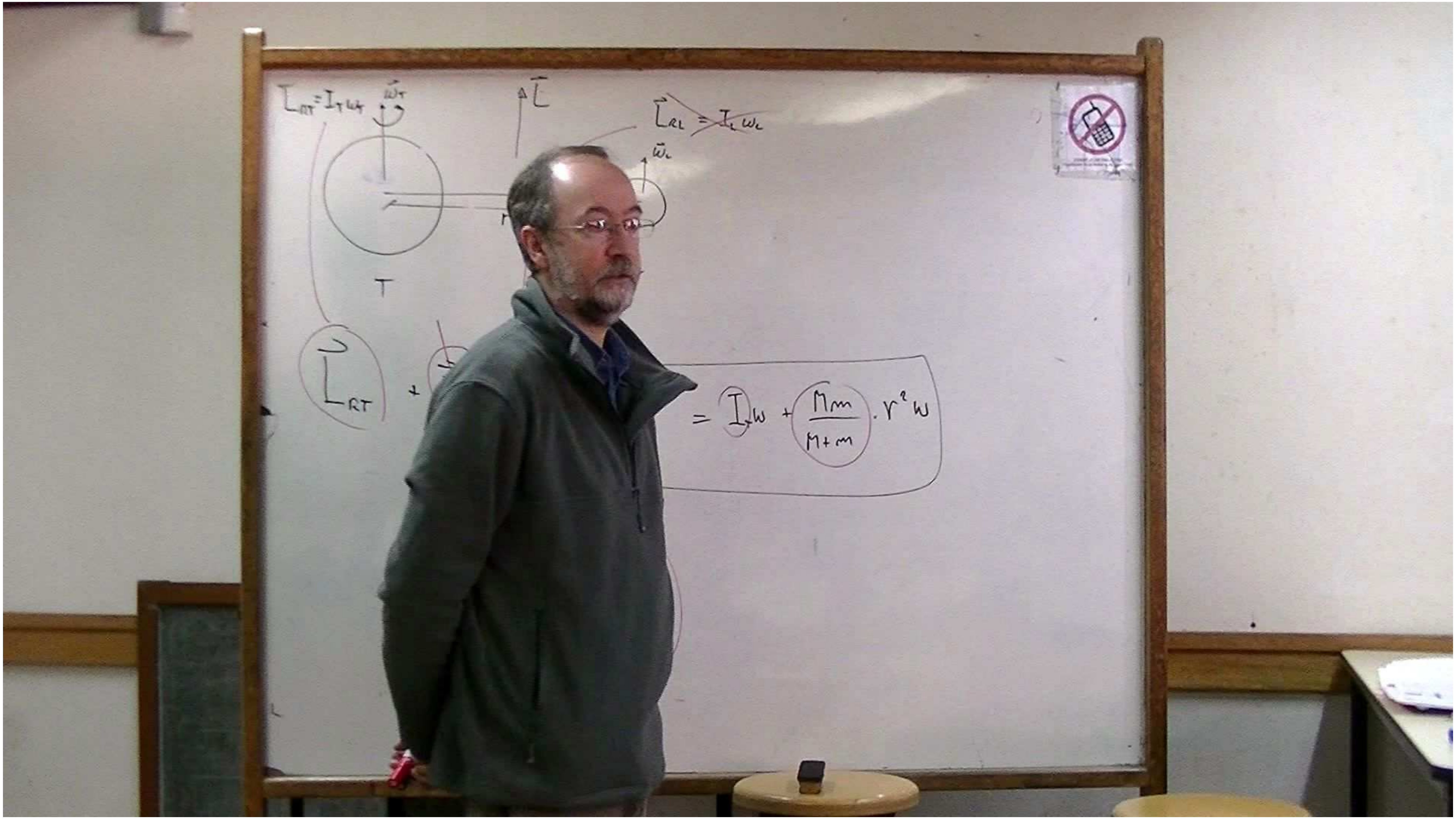
$$\vec{L}_{RT} + \cancel{\vec{L}_{RL}} + \vec{L} = CTE = I\omega + \frac{Mm}{M+m} \cdot r^2 \omega$$

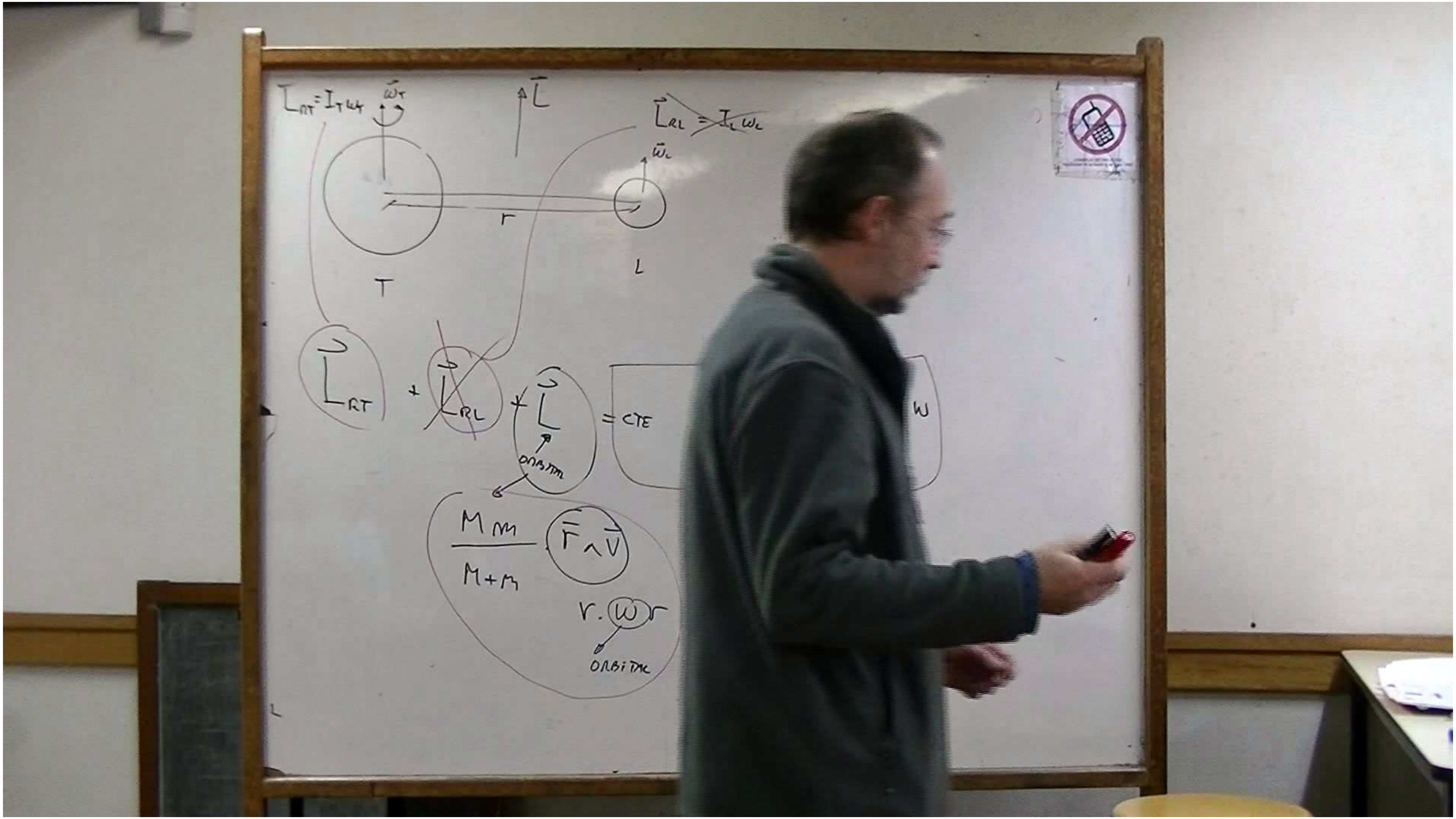
ORBITAL

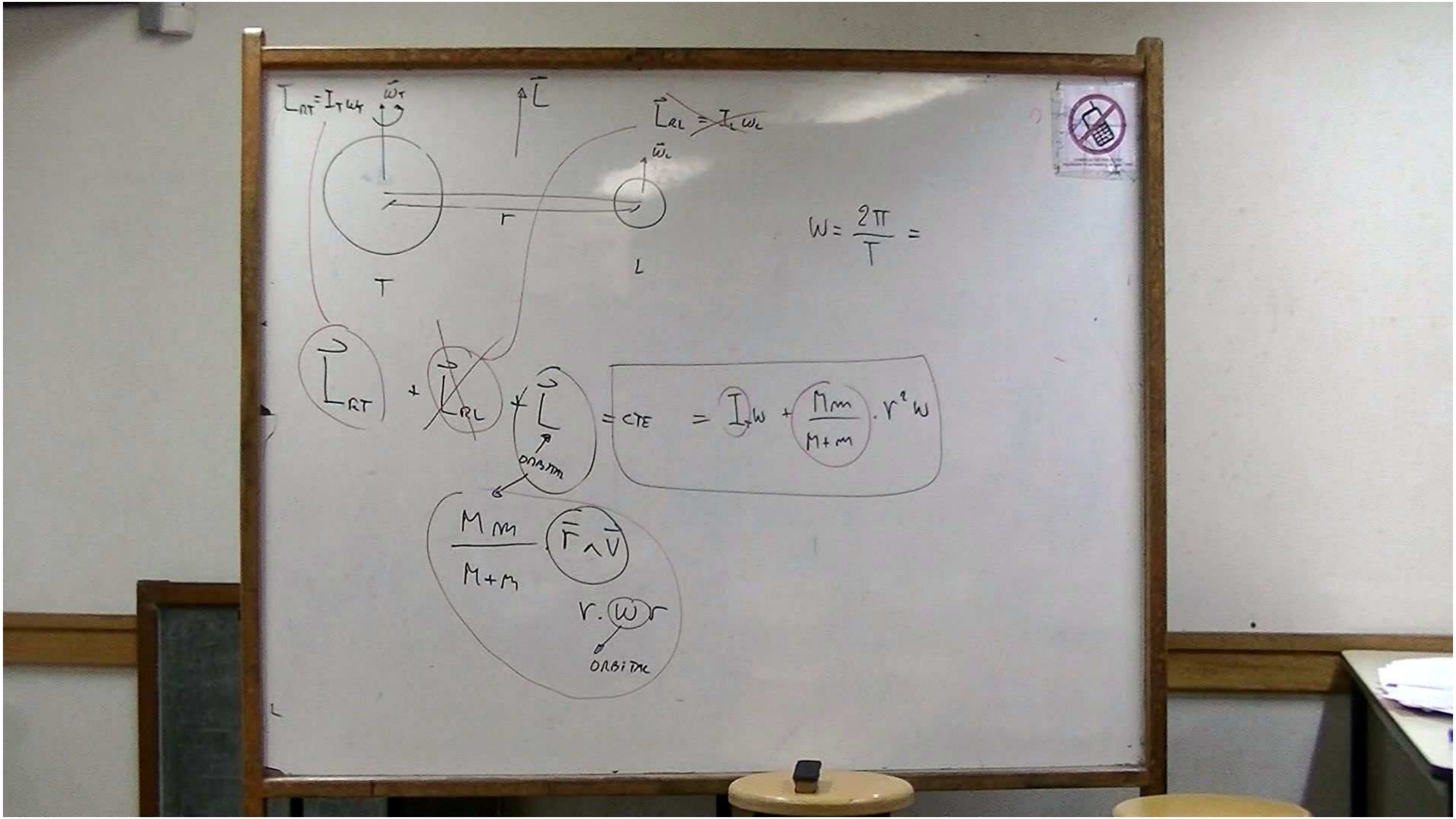
$$\frac{Mm}{M+m} \vec{r} \wedge \vec{V}$$

$$r \cdot \omega r$$

ORBITAL


$L_{RT} = I_T \omega_T$
$\vec{\omega}_T$
$\vec{L}$
$\vec{L}_{RL} = \cancel{I_L \omega_L}$
$\vec{\omega}_L$
r
T
$\vec{L}_{RT}$
+
$= I_T \omega + \frac{Mm}{M+m} \cdot r^2 \omega$


L_RT = I_T ω_T
ω_T
L
L_RL = I_L ω_L
ω_L
r
T
L
L_RT + L_RL + L = CTE
ORBITAL
Mm / M+m r ∧ V
r . ω r
ORBITAL
ω



$$\vec{L}_{RT} = I_T \omega_T$$

$$\vec{L}_{RL} \cancel{= I_L \omega_L}$$

$$W = \frac{2\pi}{T} =$$

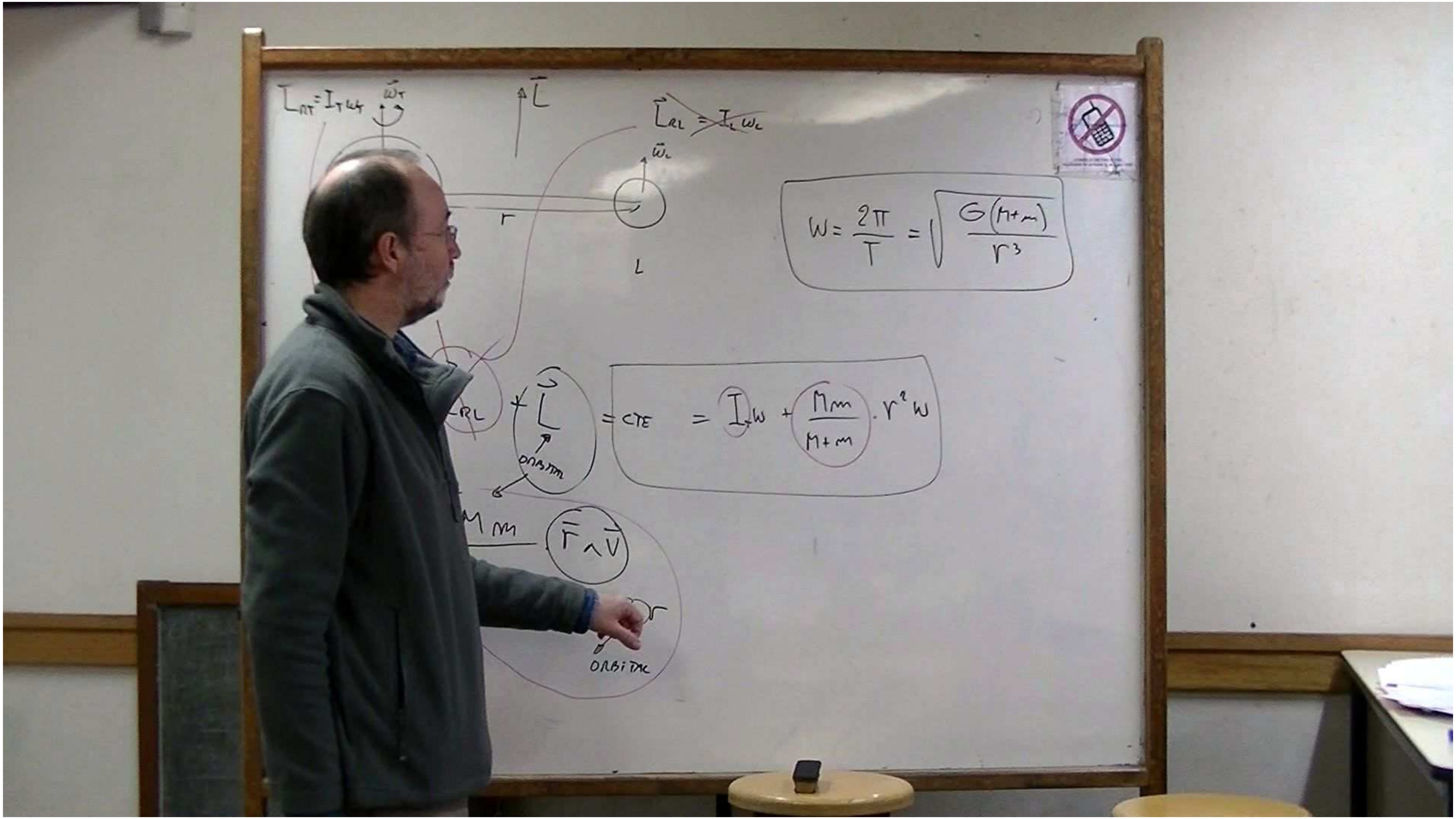
$$\vec{L}_{RT} + \cancel{\vec{L}_{RL}} + \vec{L} = CTE = I_T w + \frac{Mm}{M+m} \cdot r^2 w$$

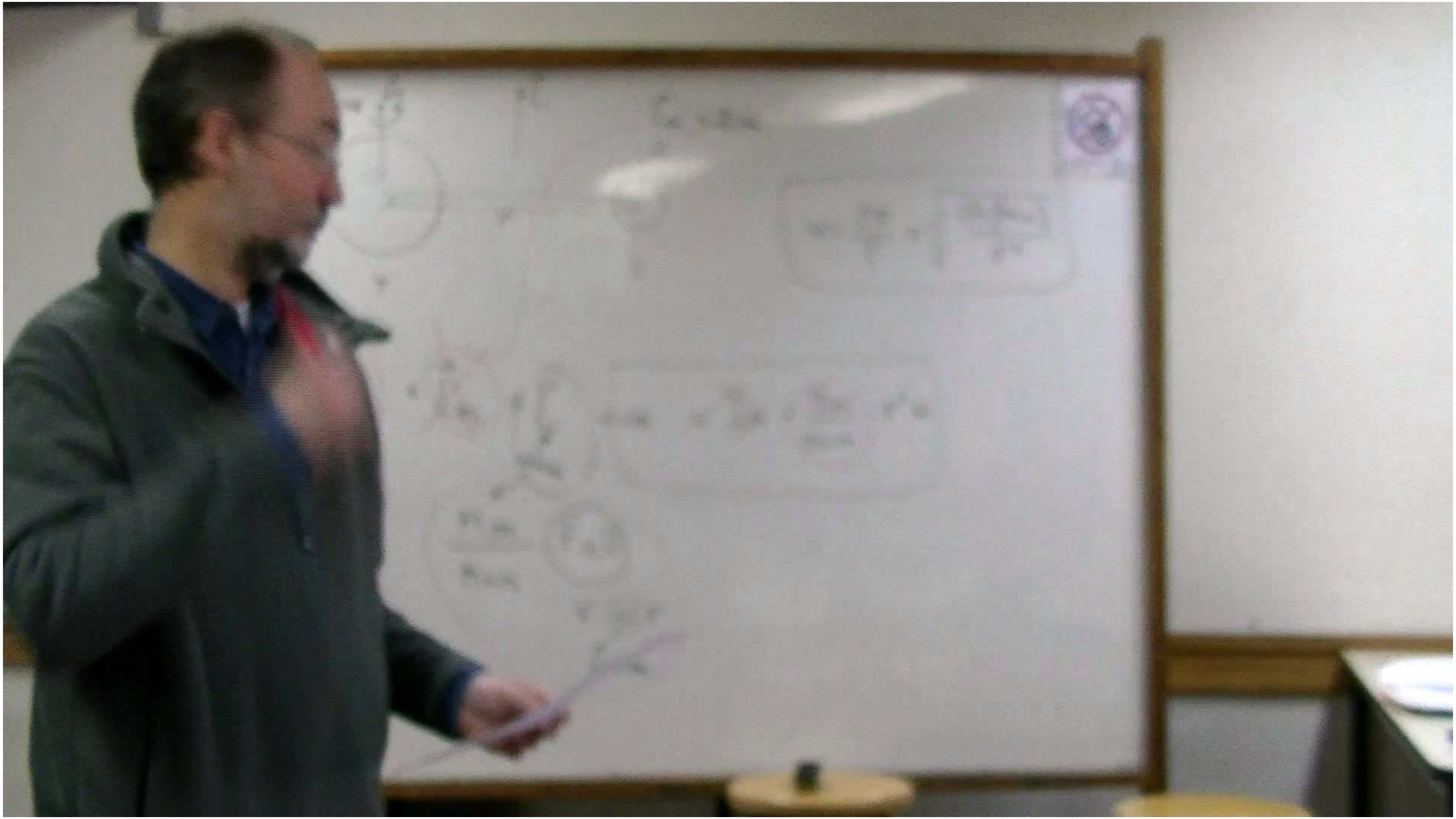
ORBITAL

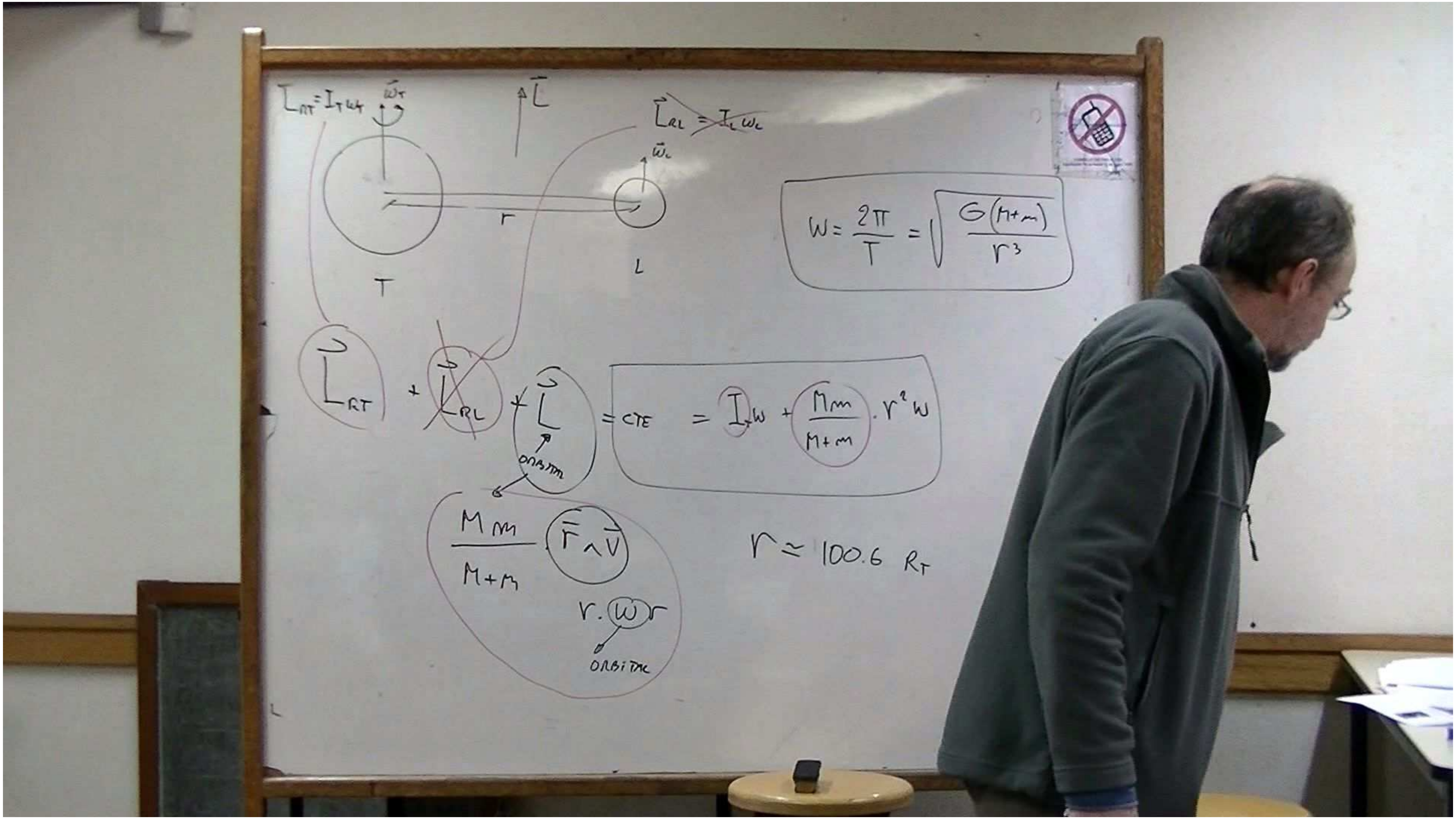
$$\frac{Mm}{M+m} \bar{r} \wedge \bar{V}$$

$$r \cdot \omega r$$

ORBITAL


$\vec{L}_{RT} = I_T \omega_T$
$\vec{\omega}_T$
$\vec{L}$
$\vec{L}_{RL} \cancel{= I_L \omega_L}$
$\vec{\omega}_L$
r
L
$W = \frac{2\pi}{T} = \sqrt{\frac{G(M+m)}{r^3}}$
$\vec{L}_{RL} + \vec{L} = CTE = I_T \omega + \frac{Mm}{M+m} \cdot r^2 \omega$
ORBITAL
Mm
$\vec{r} \wedge \vec{v}$
ORBITAL





$L_{RT} = I_T \omega_T$

$\vec{L}_{RL} \cancel{= I_L \omega_L}$

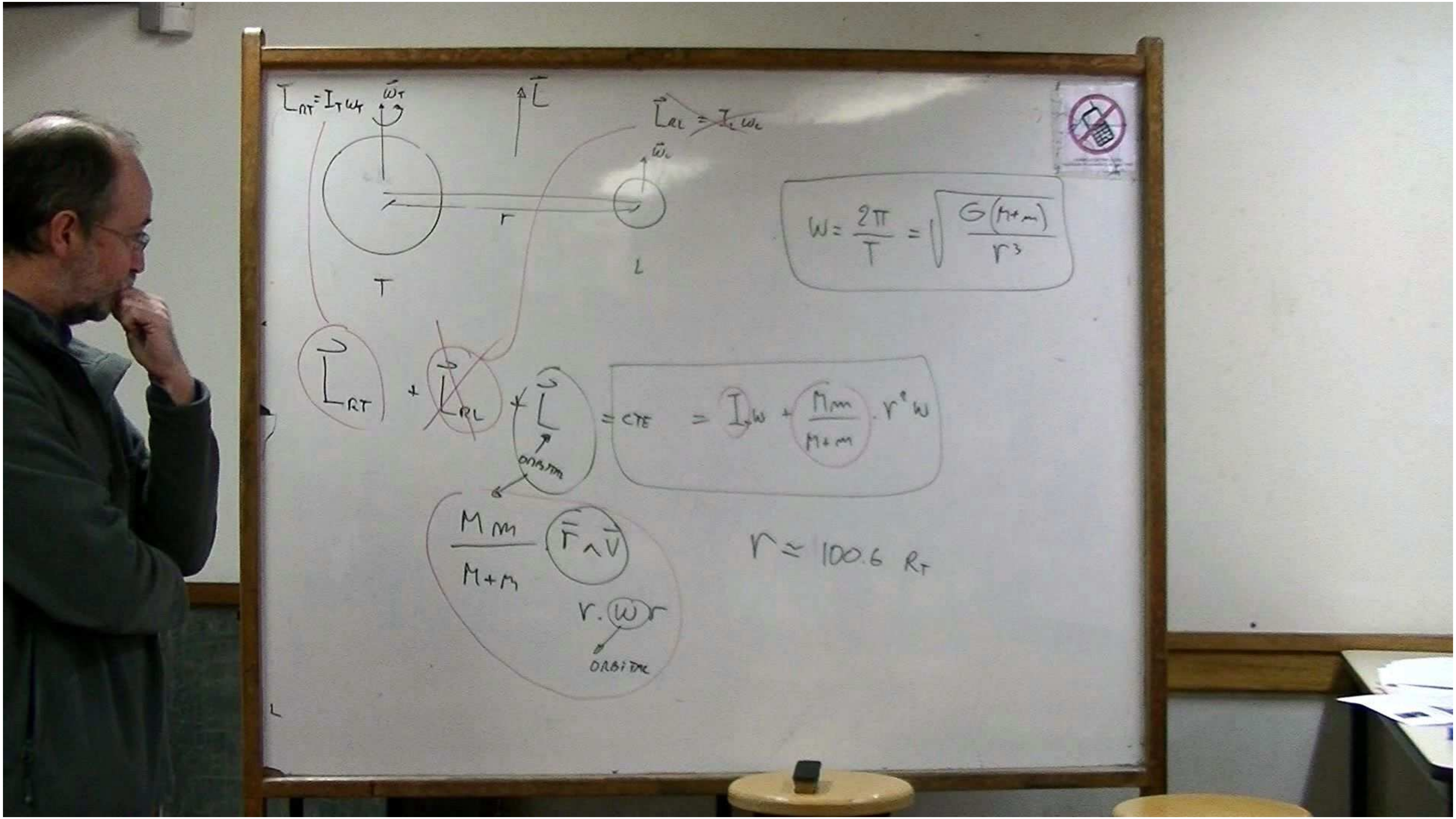
$$\boxed{W = \frac{2\pi}{T} = \sqrt{\frac{G(M+m)}{r^3}}}$$

$$\vec{L}_{RT} + \cancel{\vec{L}_{RL}} + \vec{L} = CTE \boxed{= I_T W + \frac{Mm}{M+m} \cdot r^2 W}$$

$$\frac{Mm}{M+m} \bar{r} \wedge \bar{V}$$

$$r \cdot \omega r$$

$$r \simeq 100.6 \; R_T$$



$L_{RT} = I_T \omega_T$ $\quad \vec{\omega}_T$

$\vec{L}$

~~$\vec{L}_{RL} = I_L \omega_L$~~ $\quad \vec{\omega}_L$

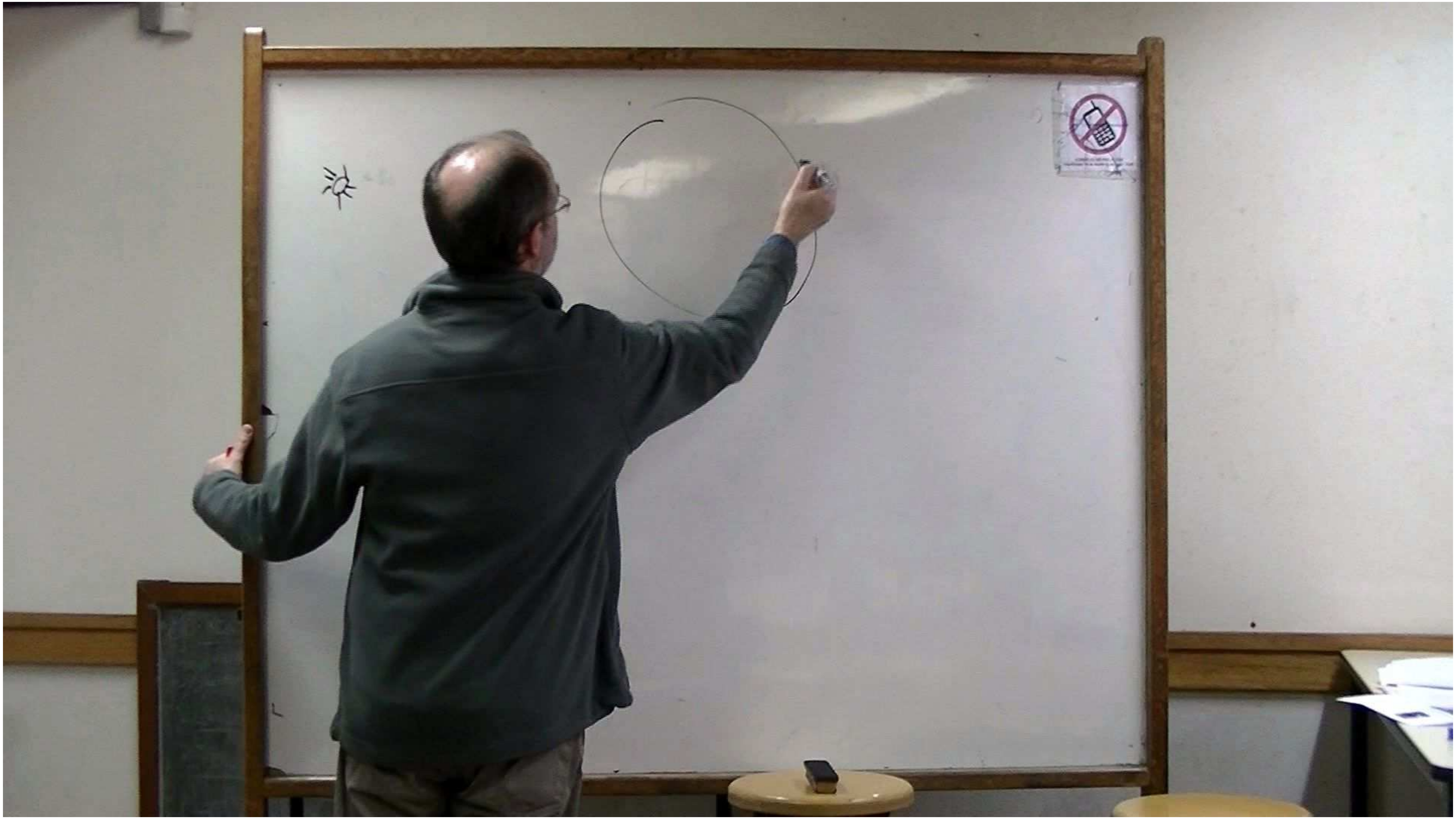
$$\boxed{\omega = \frac{2\pi}{T} = \sqrt{\frac{G(M+m)}{r^3}}}$$

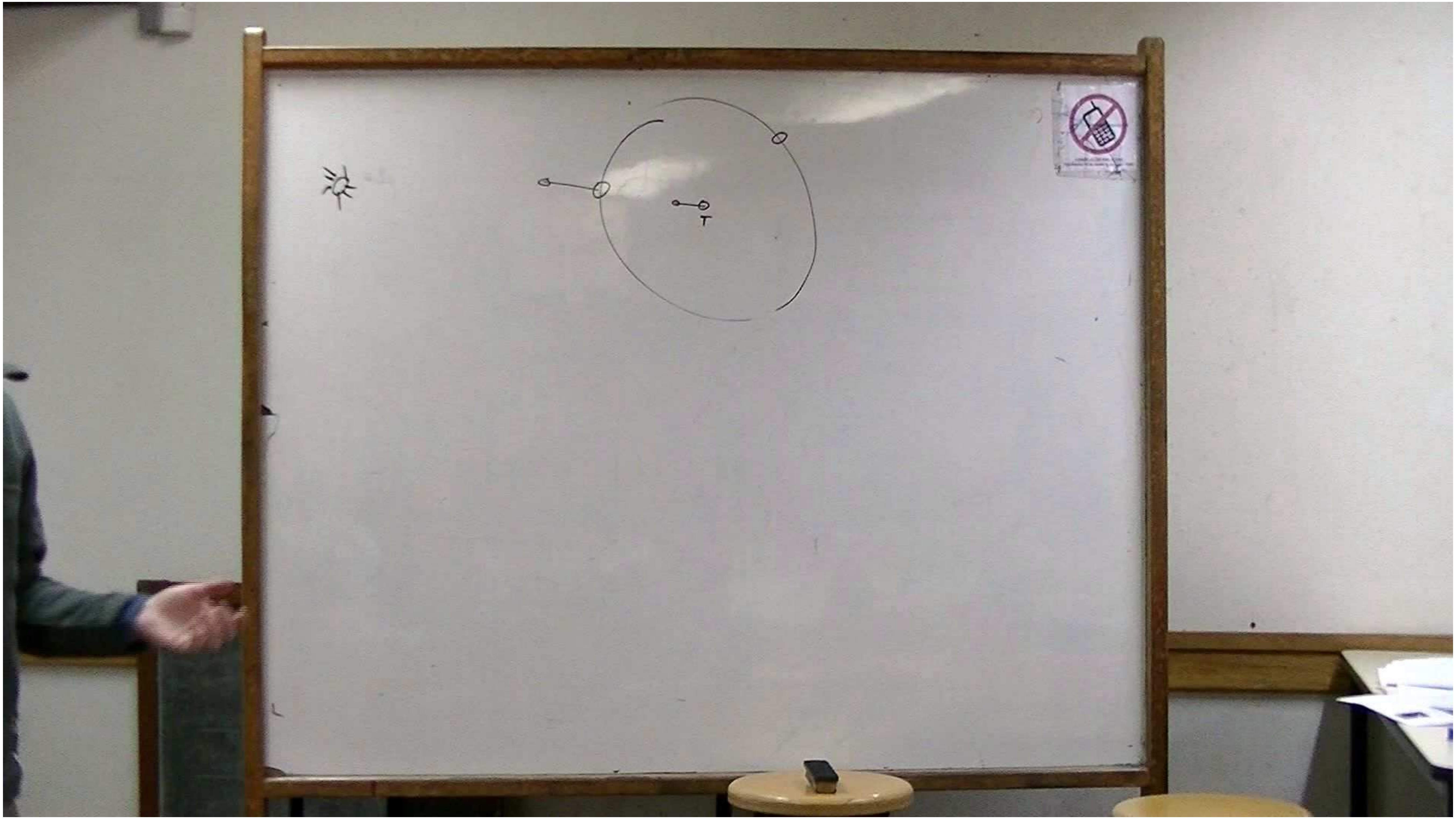
$$\vec{L}_{RT} + \cancel{\vec{L}_{RL}} + \vec{L} = CTE \quad \boxed{= I_T \omega + \frac{Mm}{M+m} \cdot r^2 \omega}$$

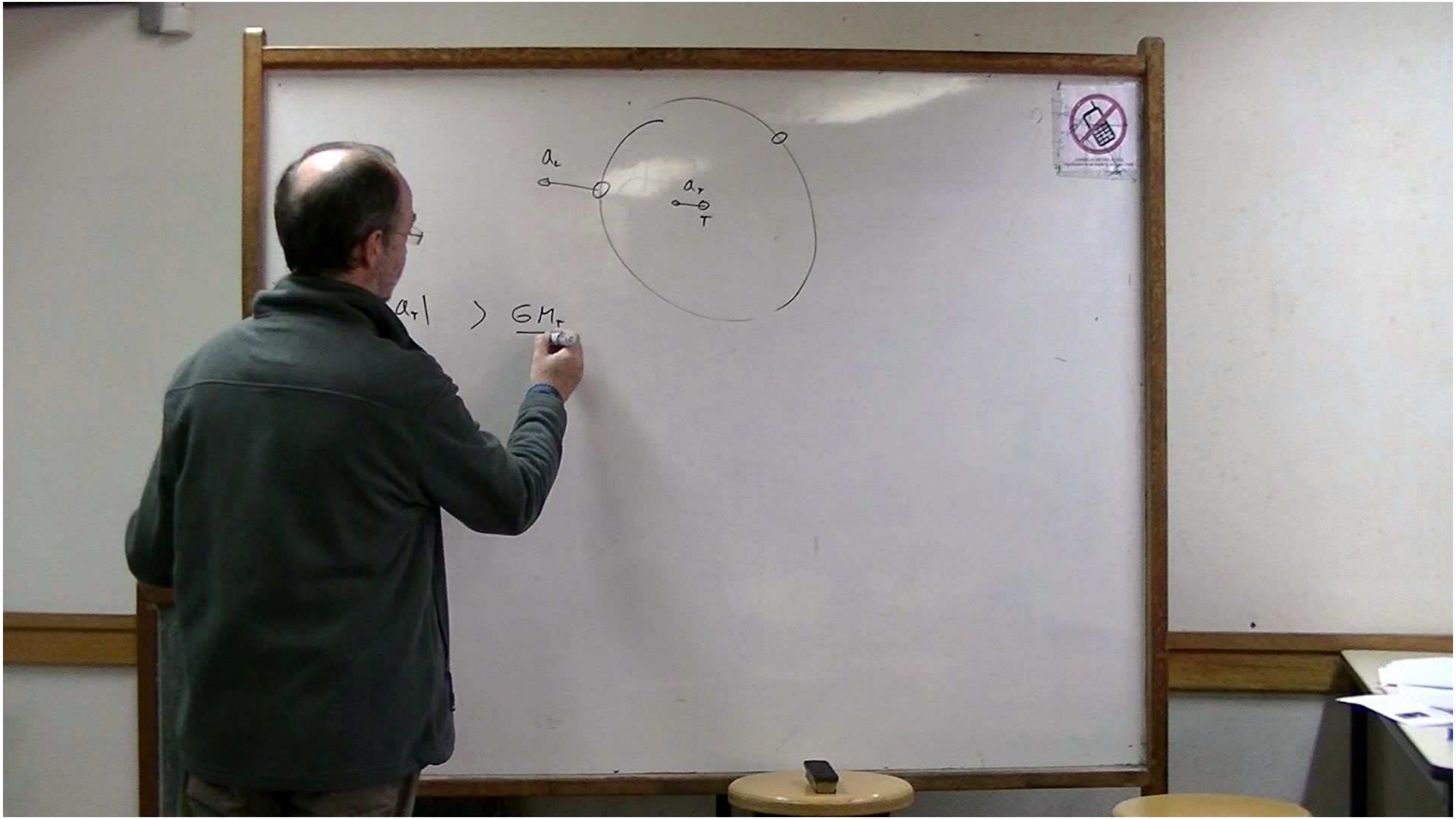
$$\frac{Mm}{M+m} \; \vec{r} \wedge \vec{v}$$

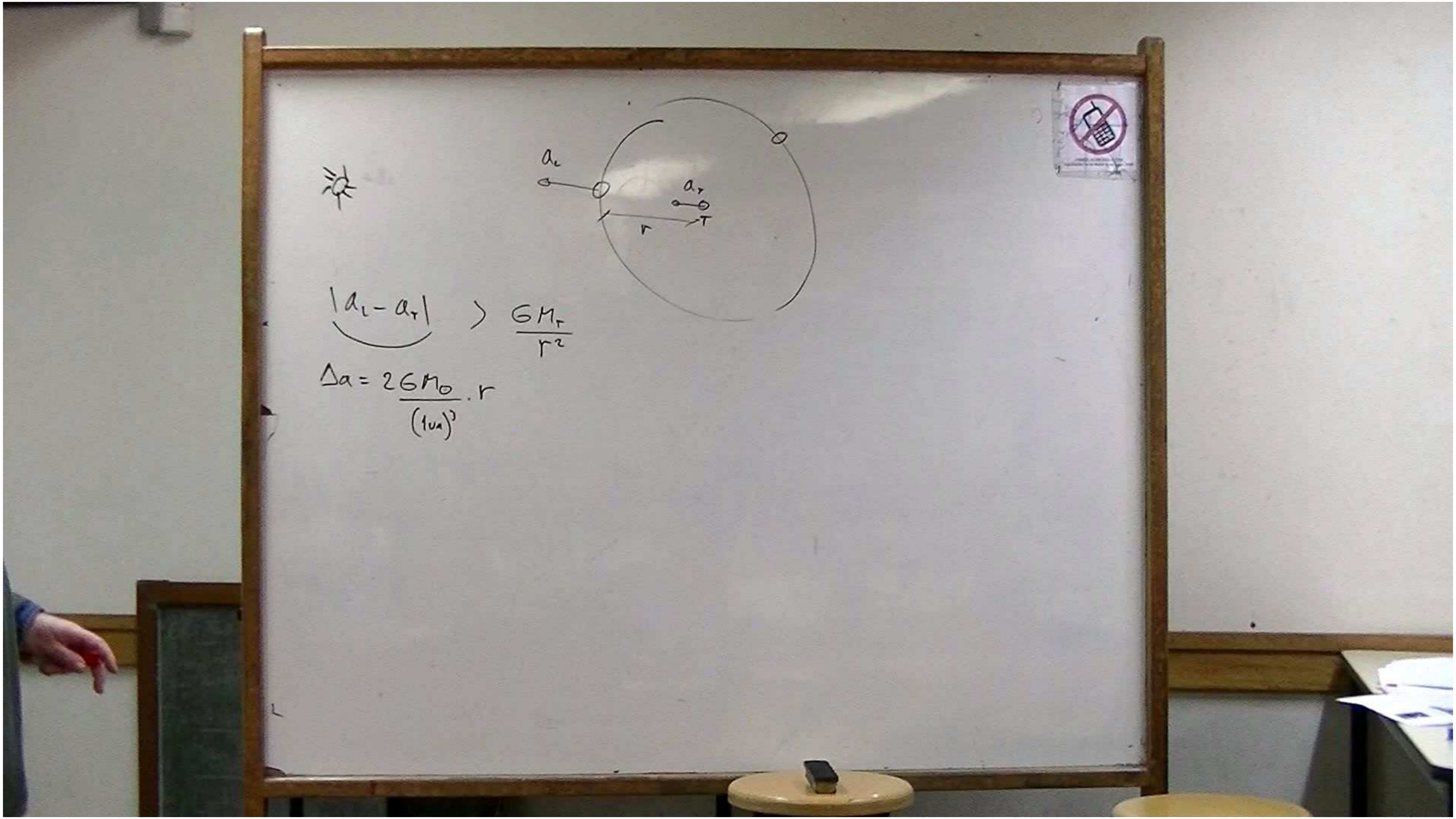
$$r . \omega r$$

$$r \simeq 100.6 \; R_T$$



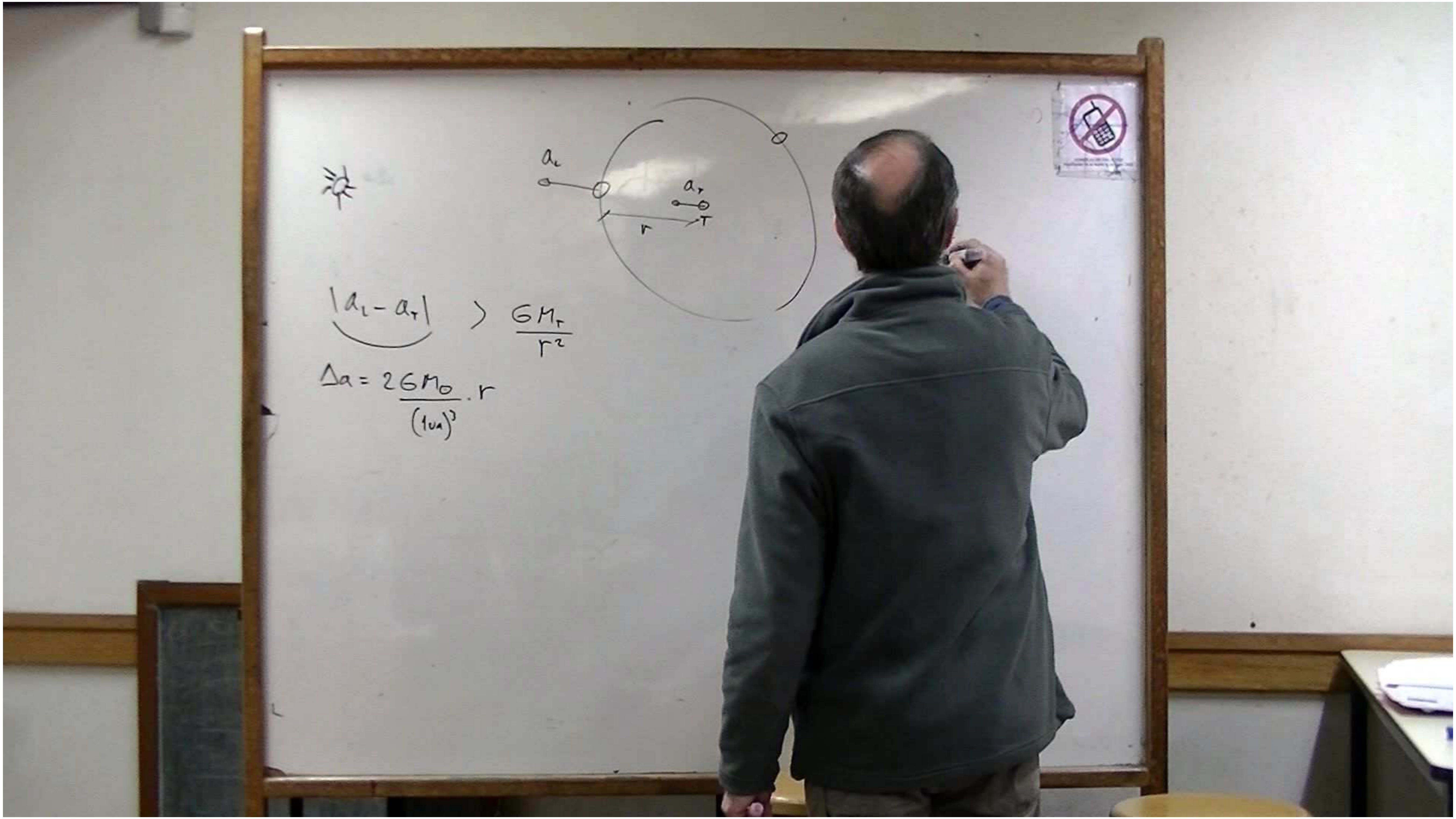

T


a_c
a_T
T
a_T| > GM_T



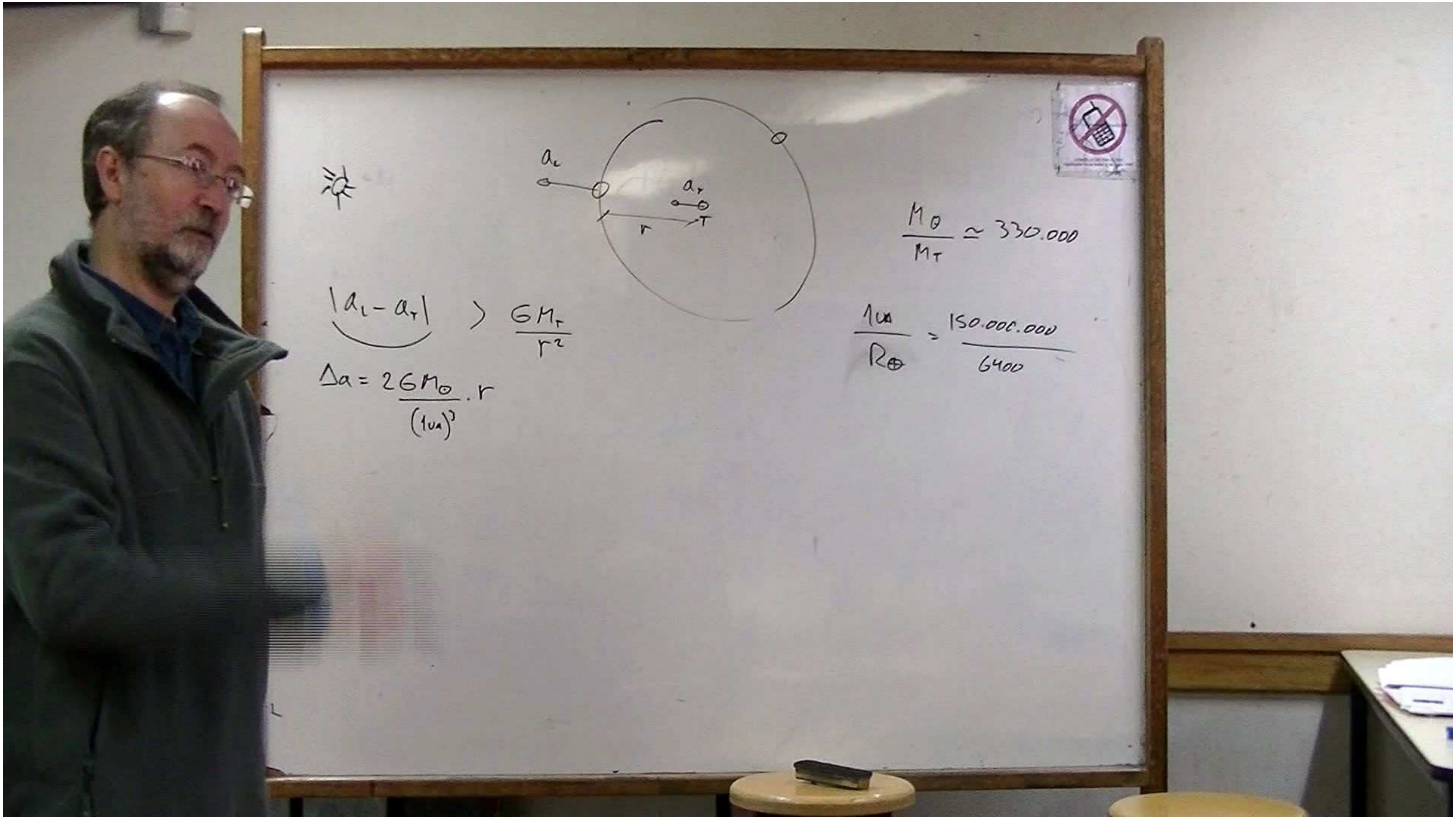
$$\underbrace{|a_L - a_T|}_{} > \frac{GM_T}{r^2}$$

$$\Delta a = 2\frac{GM_\odot}{(1ua)^3} \cdot r$$



$$\underbrace{|a_L - a_T|} > \frac{GM_T}{r^2}$$

$$\Delta a = 2\frac{GM_\odot}{(1ua)^3} \cdot r$$

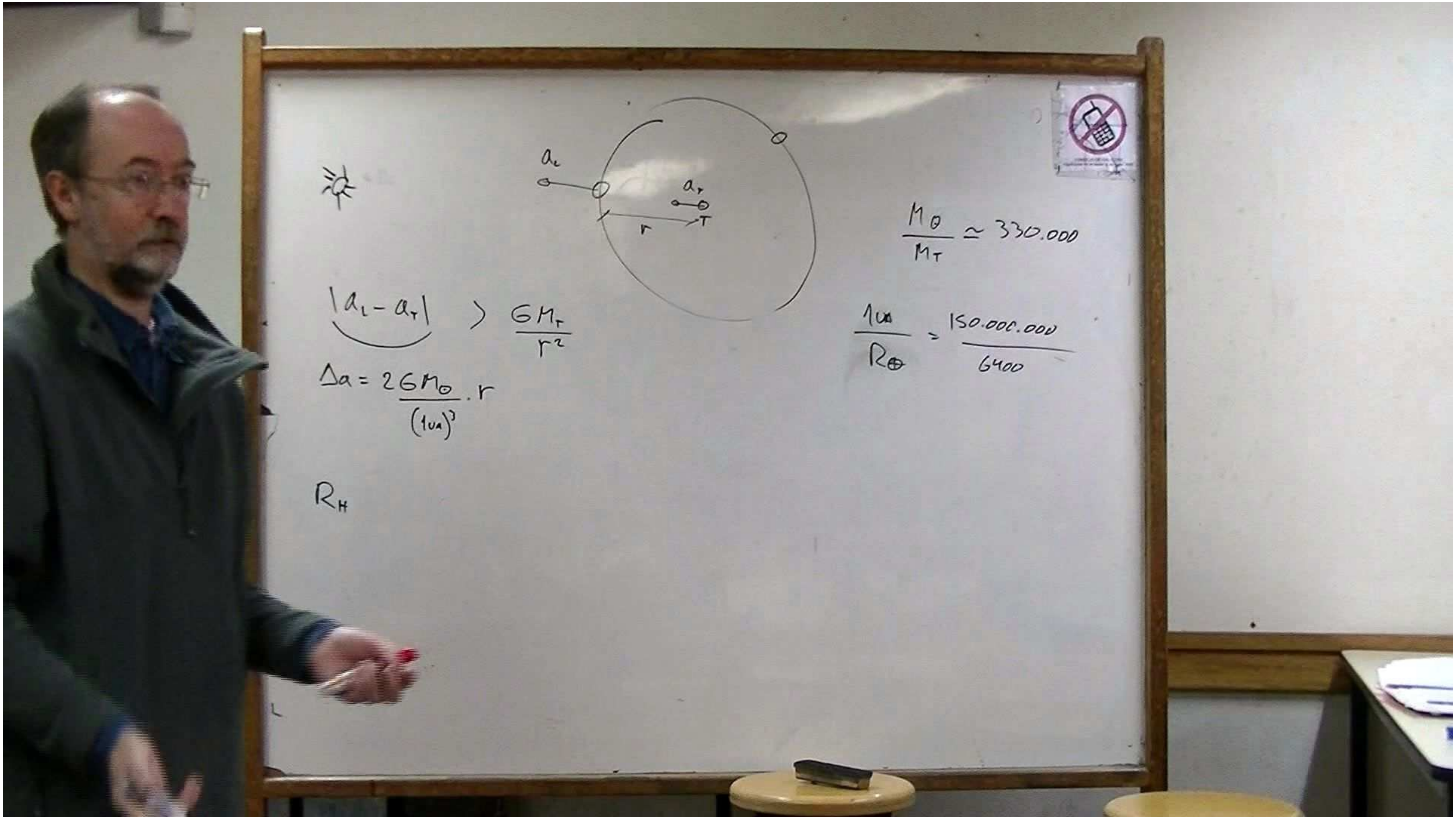


$$\underbrace{|a_L - a_T|}_{} > \frac{GM_T}{r^2}$$

$$\Delta a = 2\frac{GM_\odot}{(1ua)^3} \cdot r$$

$$\frac{M_\odot}{M_T} \simeq 330.000$$

$$\frac{1ua}{R_\oplus} = \frac{150.000.000}{6400}$$



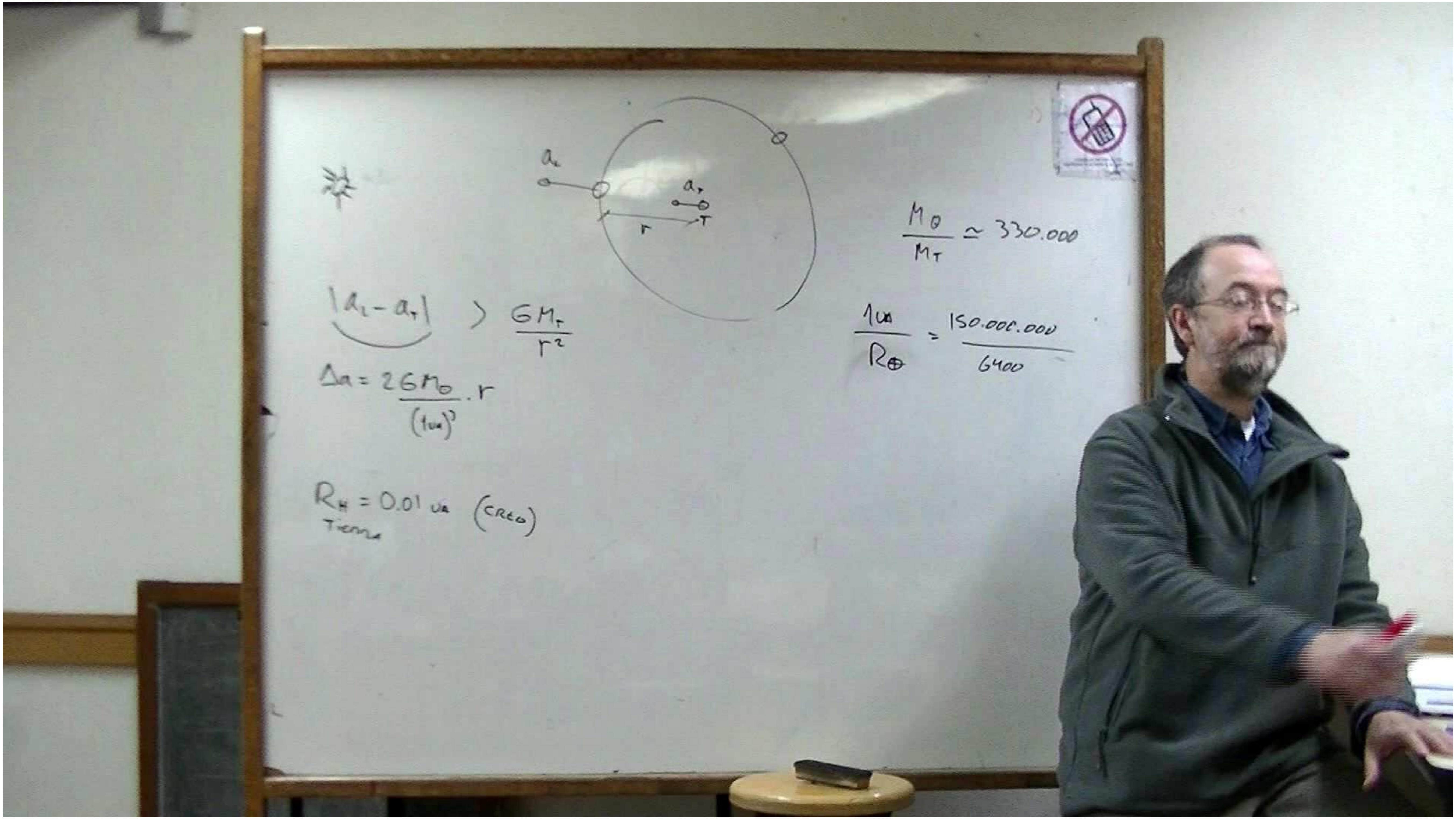
$$\underbrace{|a_L - a_T|}\ > \frac{GM_T}{r^2}$$

$$\Delta a = 2\frac{GM_\odot}{(1ua)^3}\cdot r$$

R_H

$$\frac{M_\odot}{M_T} \simeq 330.000$$

$$\frac{1ua}{R_\oplus} = \frac{150.000.000}{6400}$$



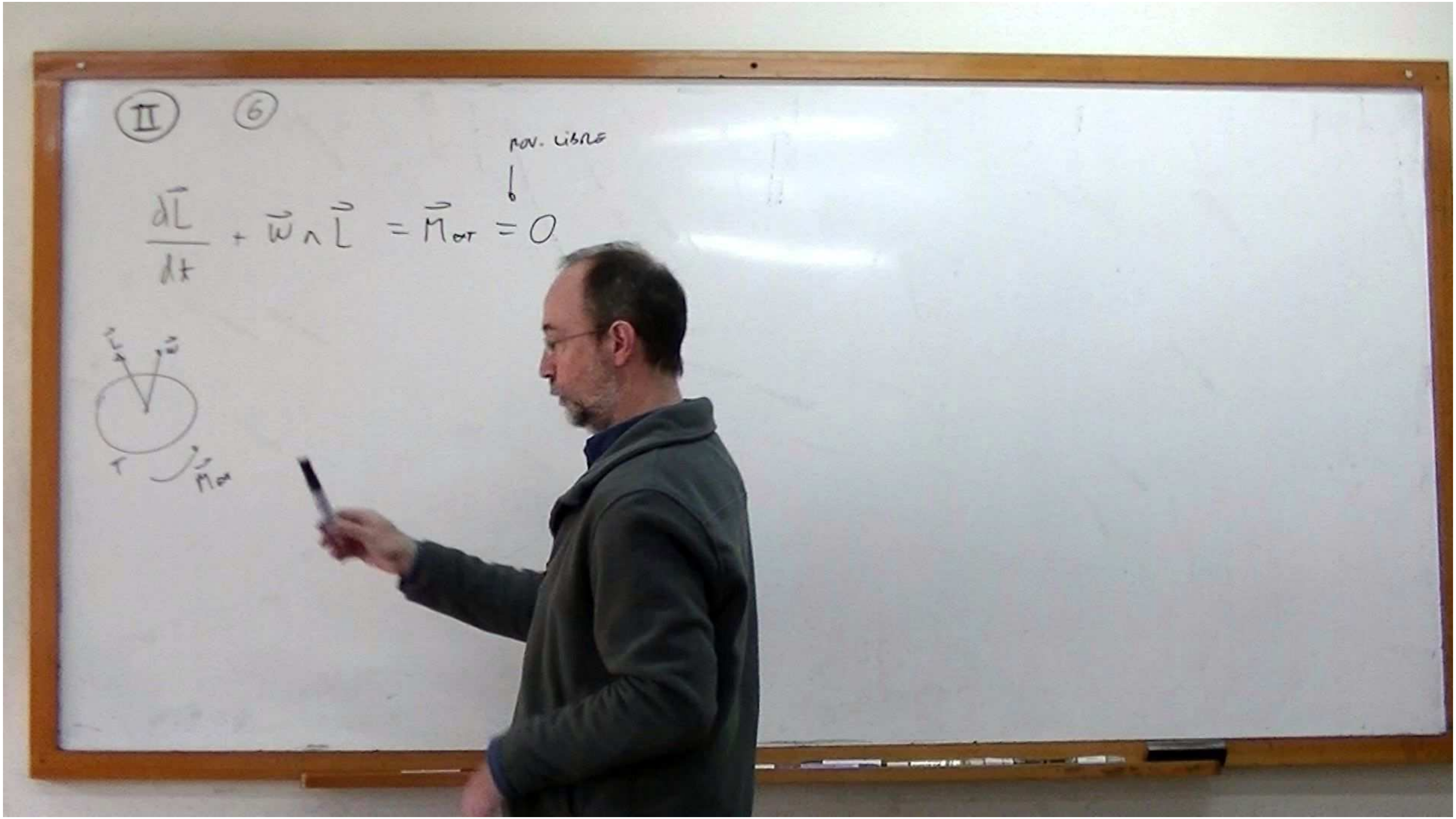
$$\underbrace{|a_L - a_T|}\ > \frac{GM_T}{r^2}$$

$$\Delta a = \frac{2GM_\odot}{(1ua)^3} \cdot r$$

$R_{H\,\text{Tierra}} = 0.01$ ua (creo)

$$\frac{M_\odot}{M_T} \simeq 330.000$$

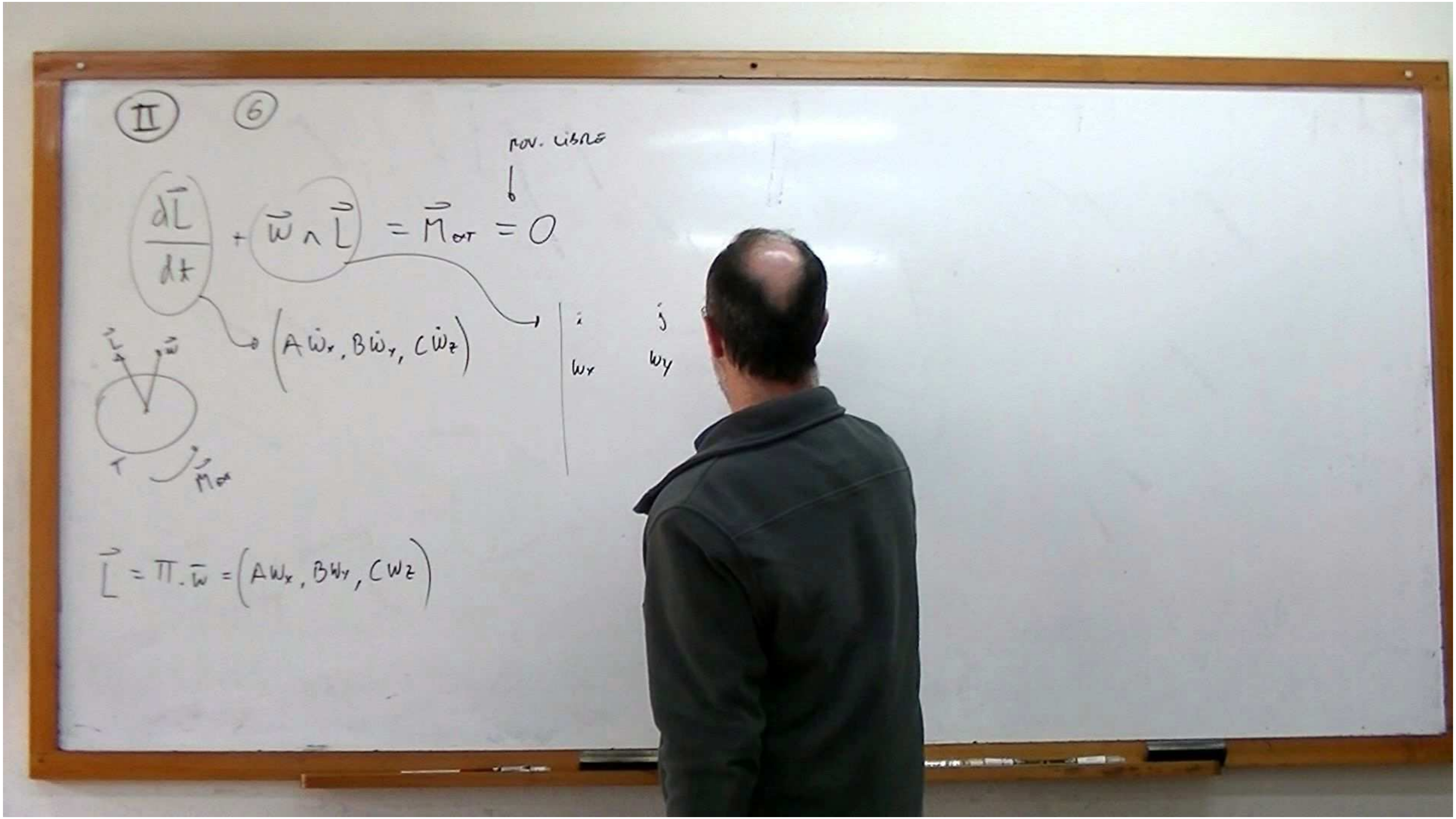
$$\frac{1ua}{R_\oplus} = \frac{150.000.000}{6400}$$



Ⓘ Ⓘ ⑥

MOV. LIBRE

$$\frac{d\vec{L}}{dt} + \vec{w} \wedge \vec{L} = \vec{M}_{ar} = 0$$



Ⅱ ⑥

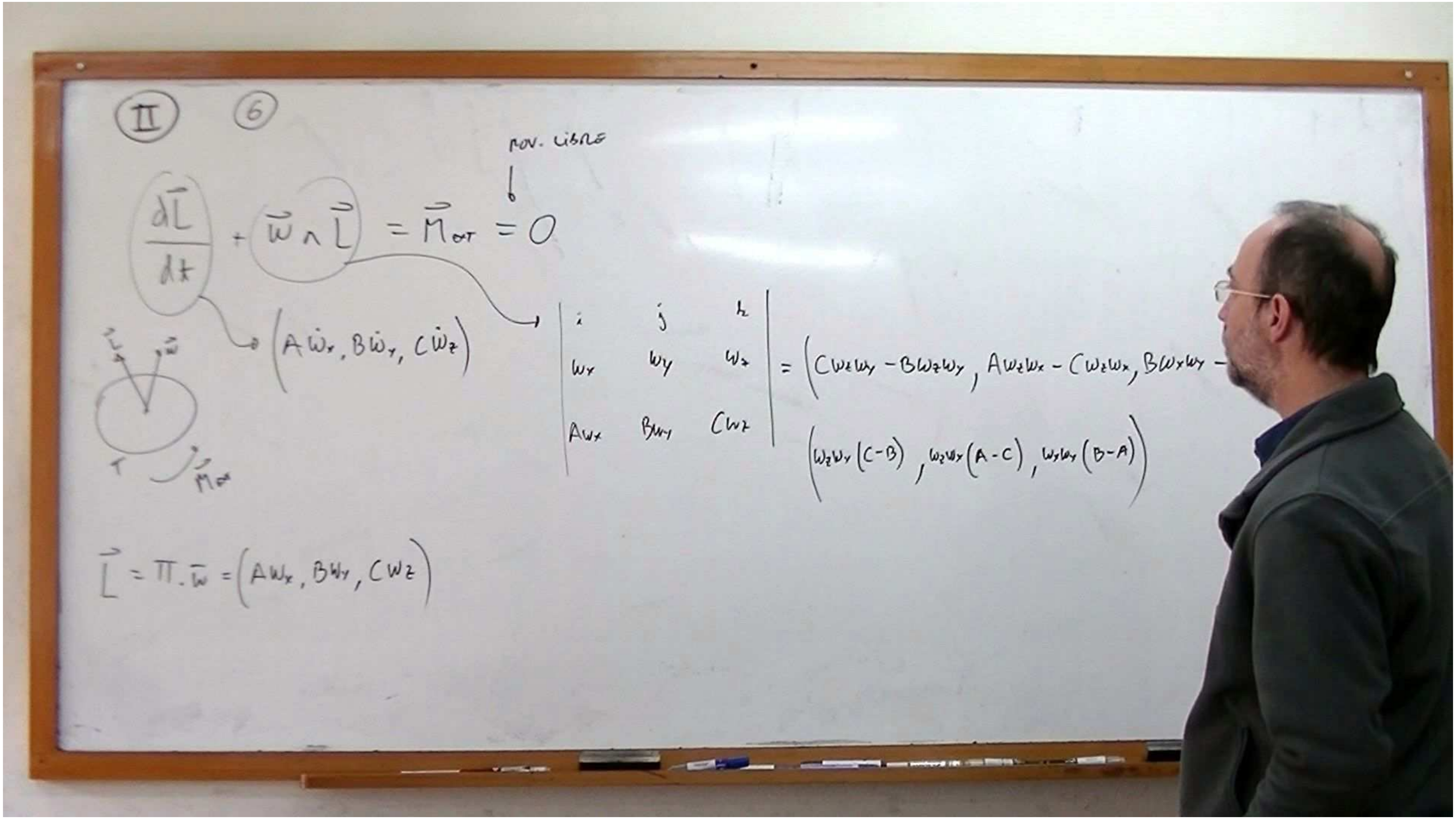
MOV. LIBRE

$$\frac{d\vec{L}}{dt} + \vec{w} \wedge \vec{L} = \vec{M}_{ext} = 0$$

$$\left(A\dot{w}_x, B\dot{w}_y, C\dot{w}_z\right)$$

$$\begin{vmatrix} i & j \\ w_x & w_y \end{vmatrix}$$

$$\vec{L} = \Pi \cdot \bar{w} = \left(A w_x, B w_y, C w_z\right)$$



II 6

MOV. LIBRE

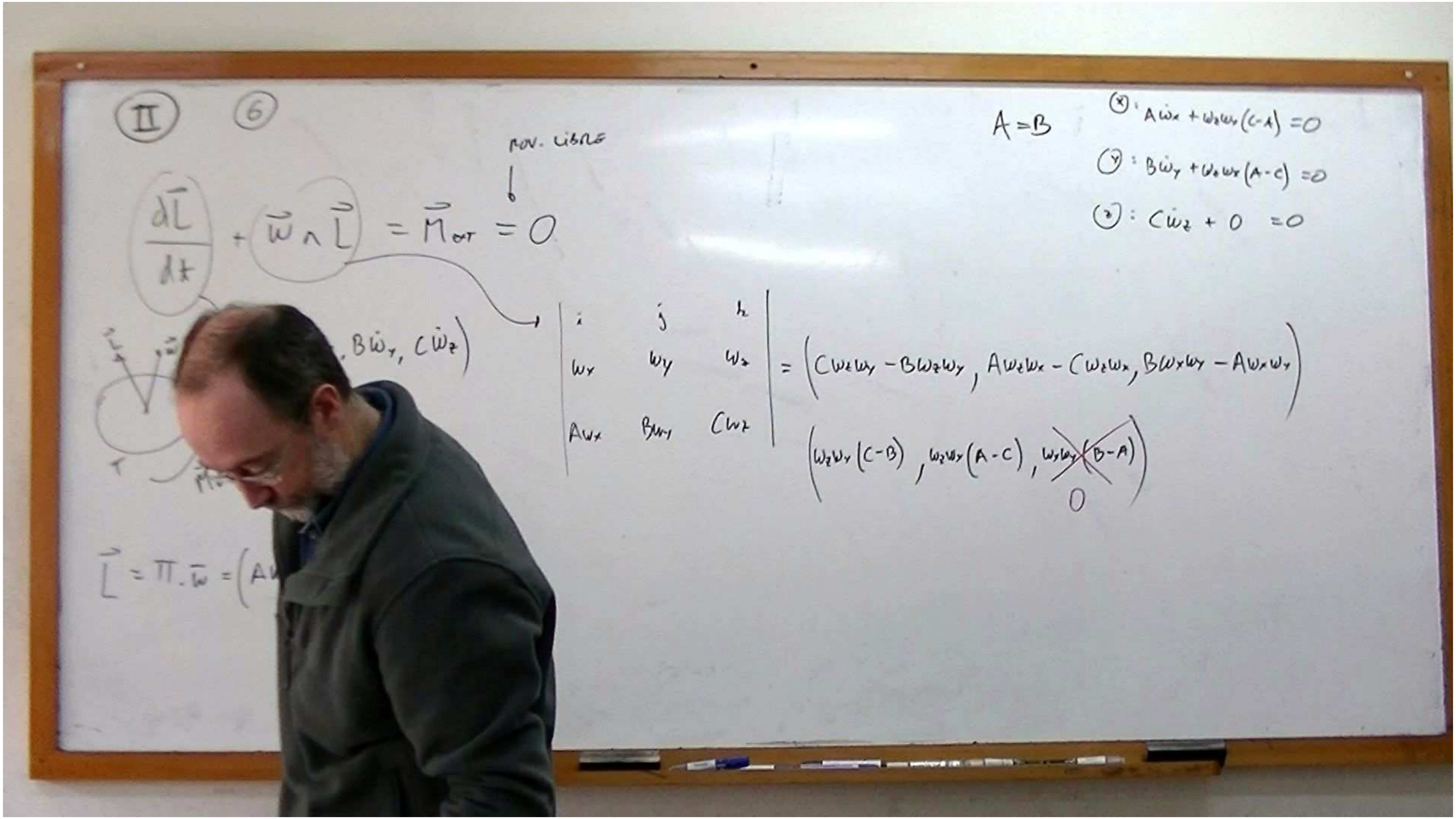
$$\frac{d\vec{L}}{dt} + \vec{w} \wedge \vec{L} = \vec{M}_{ext} = 0$$

$$\frac{d\vec{L}}{dt} \to \left(A\dot{w}_x, B\dot{w}_x, C\dot{w}_z\right)$$

$$\vec{w} \wedge \vec{L} \to \begin{vmatrix} i & j & k \\ w_x & w_y & w_z \\ Aw_x & Bw_y & Cw_z \end{vmatrix} = \left(Cw_zw_y - Bw_zw_y, Aw_zw_x - Cw_zw_x, Bw_xw_y - \right.$$

$$\left(w_zw_y(C-B), w_zw_x(A-C), w_xw_y(B-A)\right)$$

$$\vec{L} = \text{II} \cdot \bar{w} = \left(Aw_x, Bw_y, Cw_z\right)$$



II ⑥

MOV. LIBRE

$$\frac{d\vec{L}}{dt} + \vec{w} \wedge \vec{L} = \vec{M}_{ext} = 0$$

$$, B\dot{w}_y, C\dot{w}_z)$$

$$\begin{vmatrix} i & j & k \\ w_x & w_y & w_z \\ Aw_x & Bw_y & Cw_z \end{vmatrix} = (Cw_zw_y - Bw_zw_y, Aw_zw_x - Cw_zw_x, Bw_xw_y - Aw_xw_y)$$

$$(w_zw_y(C-B), w_zw_x(A-C), \underbrace{\cancel{w_xw_y(B-A)}}_{0})$$

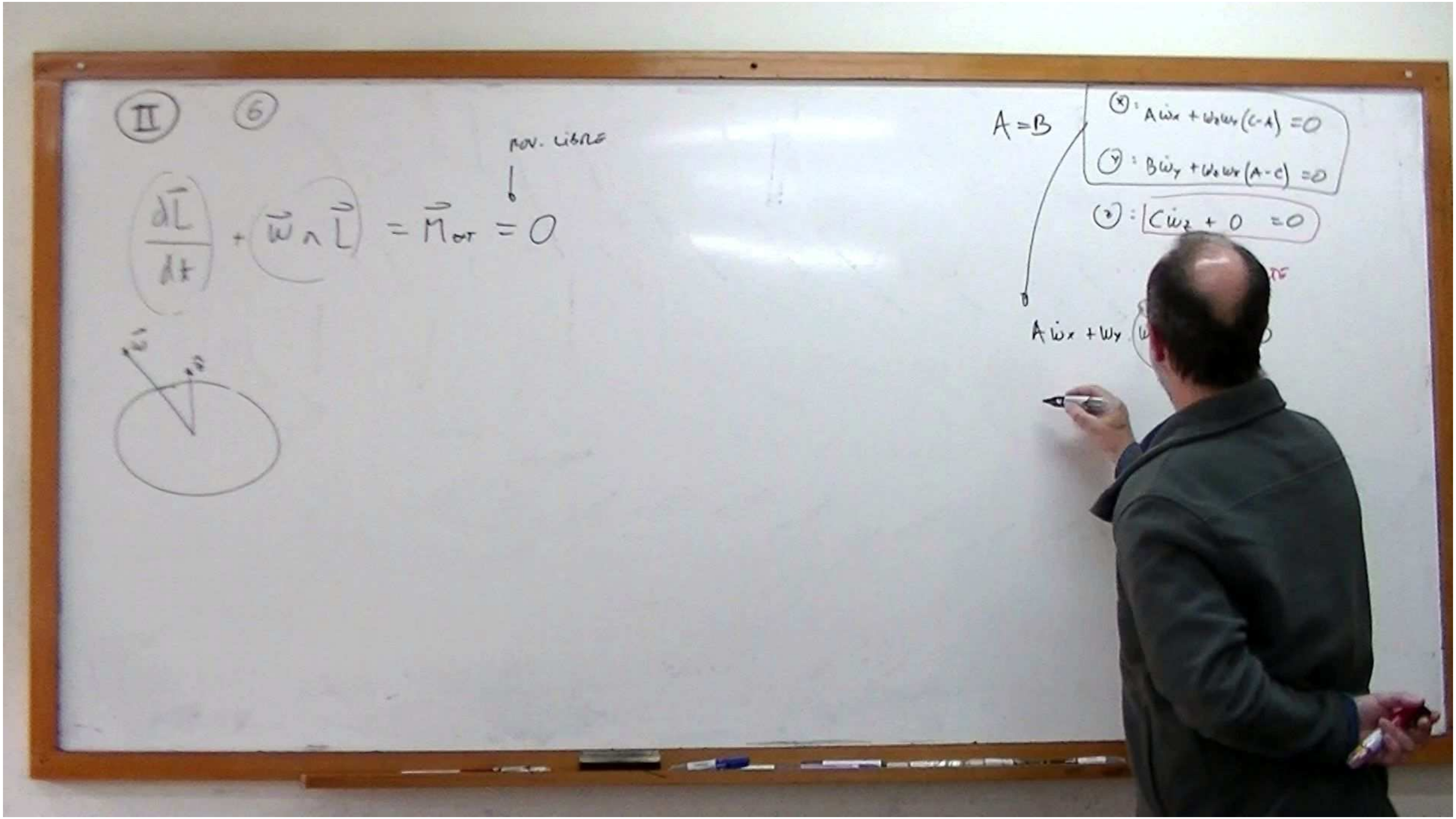
$$\vec{L} = \Pi . \vec{w} = (A$$

A = B

$$\text{Ⓧ}: A\dot{w}_x + w_zw_y(C-A) = 0$$

$$\text{Ⓨ}: B\dot{w}_y + w_zw_x(A-C) = 0$$

$$\text{Ⓩ}: C\dot{w}_z + 0 = 0$$



Ⅱ ⑥

MOV. LIBRE

$$\frac{d\vec{L}}{dt} + \vec{\omega} \wedge \vec{L} = \vec{M}_{ext} = 0$$

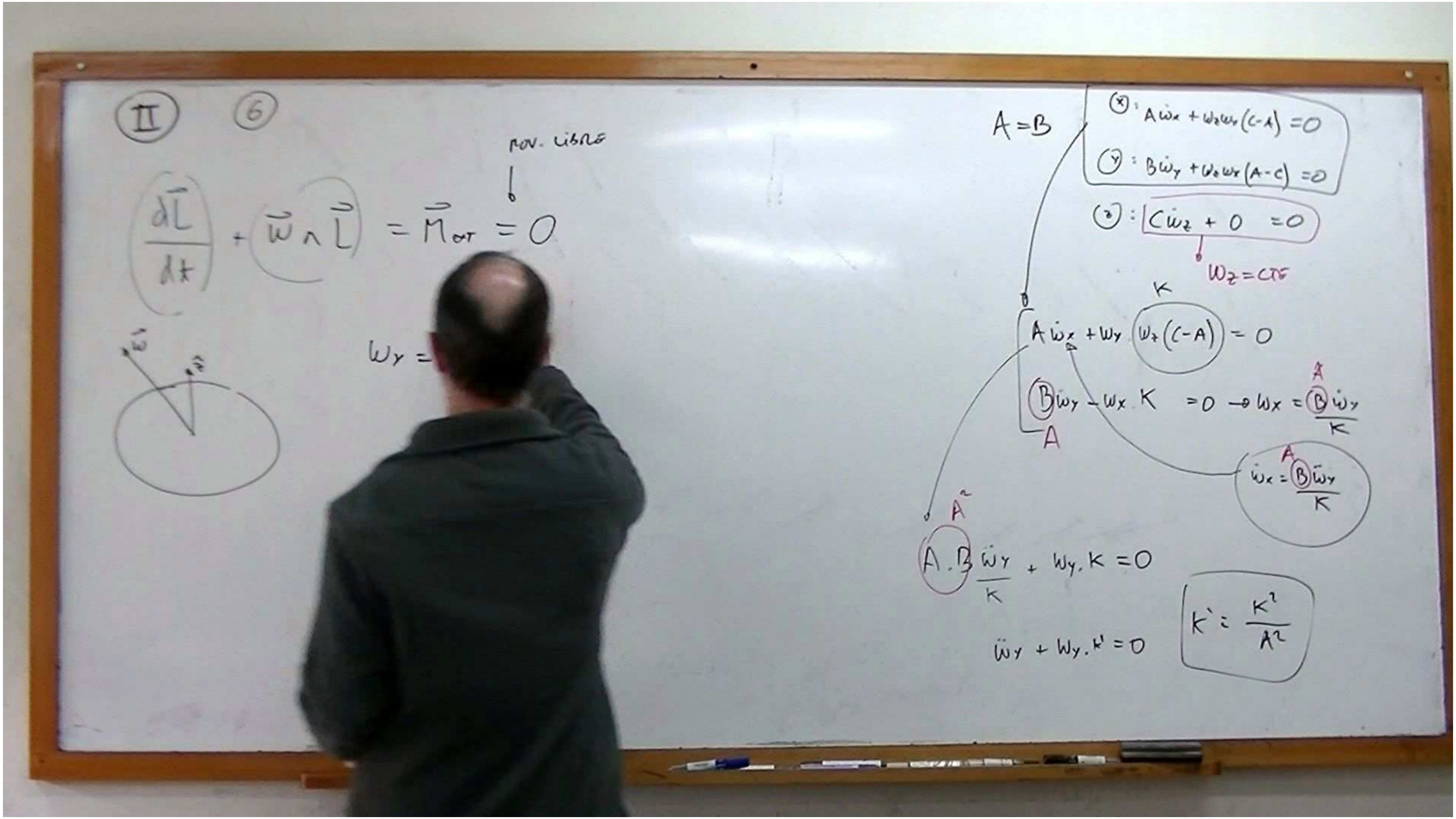
$A = B$

$(x): A\dot{\omega}_x + \omega_z\omega_y(C-A) = 0$

$(y): B\dot{\omega}_y + \omega_z\omega_x(A-C) = 0$

$(z): C\dot{\omega}_z + 0 = 0$

$A\dot{\omega}_x + \omega_y(\omega$



II ⑥

MOV. LIBRE

$$\frac{d\vec{L}}{dt} + \vec{w} \wedge \vec{L} = \vec{M}_{ext} = 0$$

$\omega_y =$

$A = B$

$(x): A\dot{\omega}_x + \omega_z\omega_y(C-A) = 0$

$(y): B\dot{\omega}_y + \omega_z\omega_x(A-C) = 0$

$(z): C\dot{\omega}_z + 0 = 0$

$\omega_z = CTE$

$A\dot{\omega}_x + \omega_y \overset{K}{\omega_z(C-A)} = 0$

$\overset{A}{B}\dot{\omega}_y - \omega_x K = 0 \rightarrow \omega_x = \frac{\overset{A}{B}\dot{\omega}_y}{K}$

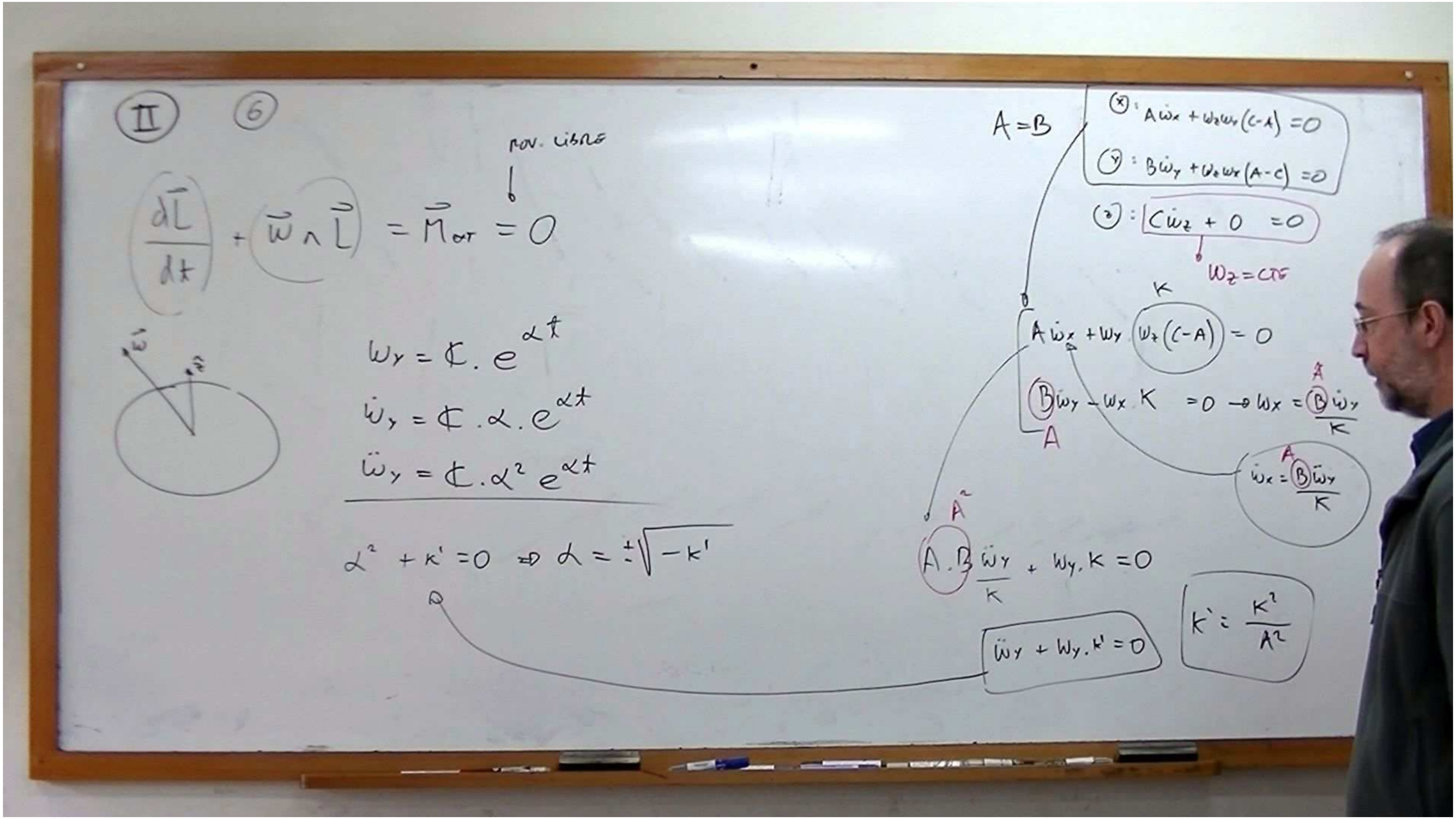
A

$\dot{\omega}_x = \frac{\overset{A}{B}\ddot{\omega}_y}{K}$

$\overset{A^2}{A.B}\frac{\ddot{\omega}_y}{K} + \omega_y . K = 0$

$\ddot{\omega}_y + \omega_y . k' = 0$

$$\boxed{k' = \frac{K^2}{A^2}}$$



II ⑥

MOV. LIBRE

$$\frac{d\vec{L}}{dt} + \vec{w} \wedge \vec{L} = \vec{M}_{ct} = 0$$

$$w_y = \mathbb{C} . e^{\alpha t}$$

$$\dot{w}_y = \mathbb{C} . \alpha . e^{\alpha t}$$

$$\ddot{w}_y = \mathbb{C} . \alpha^2 e^{\alpha t}$$

$$\alpha^2 + k' = 0 \Rightarrow \alpha = \pm\sqrt{-k'}$$

$A = B$

(x) : $A\dot{w}_x + w_z w_y (C-A) = 0$

(y) : $B\dot{w}_y + w_z w_x (A-C) = 0$

(z) : $\boxed{C\dot{w}_z + 0 = 0}$

$w_z = \text{cte}$

$$A\dot{w}_x + w_y \overset{K}{w_z(C-A)} = 0$$

$$\overset{}{B}\dot{w}_y - w_x K = 0 \rightarrow w_x = \frac{\overset{A}{B}\dot{w}_y}{K}$$

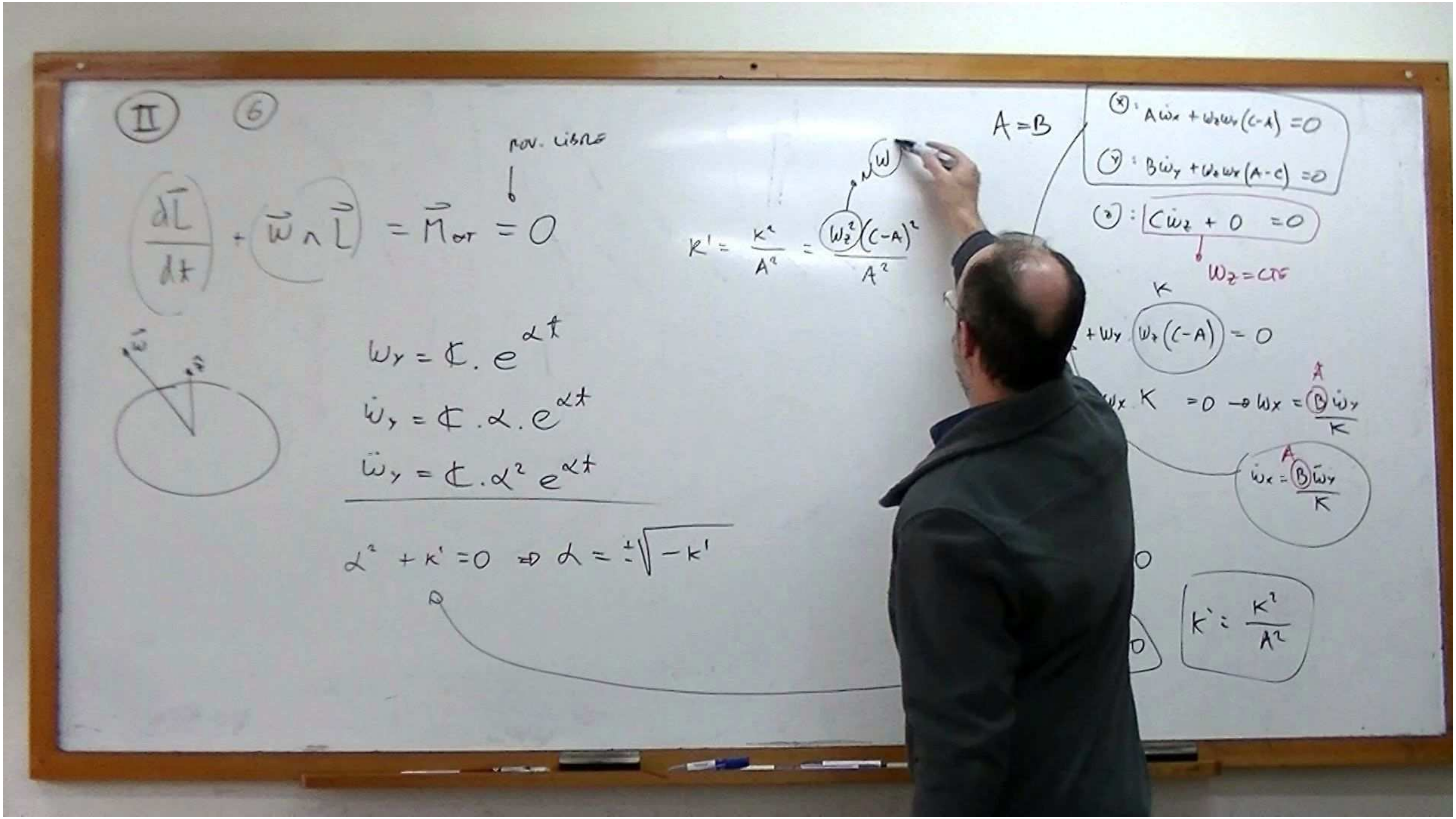
A

$$\dot{w}_x = \frac{\overset{A}{B}\ddot{w}_y}{K}$$

$$\overset{A^2}{A.B}\frac{\ddot{w}_y}{K} + w_y . K = 0$$

$$\boxed{\ddot{w}_y + w_y . k' = 0}$$

$$\boxed{k' = \frac{K^2}{A^2}}$$



Ⅱ ⑥

MOV. LIBRE

$$\frac{d\vec{L}}{dt} + \vec{\omega} \wedge \vec{L} = \vec{M}_{ext} = 0$$

$$\omega_y = \mathbb{C} . e^{\alpha t}$$

$$\dot{\omega}_y = \mathbb{C} . \alpha . e^{\alpha t}$$

$$\ddot{\omega}_y = \mathbb{C} . \alpha^2 e^{\alpha t}$$

$$\alpha^2 + k' = 0 \Rightarrow \alpha = \pm\sqrt{-k'}$$

$$k' = \frac{K^2}{A^2} = \frac{\omega_z^2 (C-A)^2}{A^2}$$

ω

A = B

$$(x) : A\dot{\omega}_x + \omega_z\omega_y(C-A) = 0$$

$$(y) : B\dot{\omega}_y + \omega_z\omega_x(A-C) = 0$$

$$(z) : C\dot{\omega}_z + 0 = 0$$

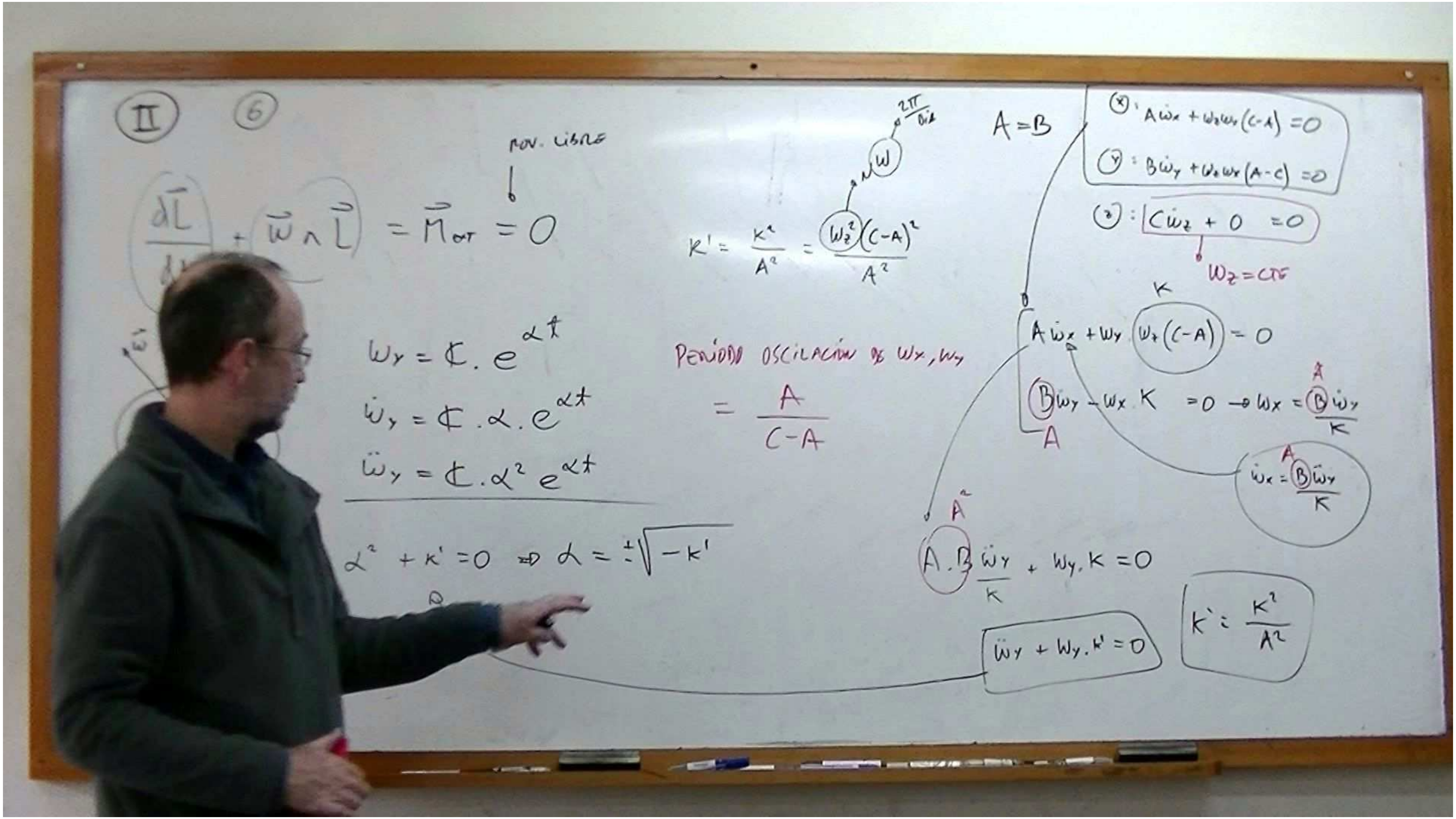
$\omega_z = CTE$

$$+ \omega_y \overset{K}{\omega_z(C-A)} = 0$$

$$\omega_x K = 0 \rightarrow \omega_x = \frac{\overset{A}{B}\dot{\omega}_y}{K}$$

$$\dot{\omega}_x = \frac{\overset{A}{B}\ddot{\omega}_y}{K}$$

$$k' = \frac{K^2}{A^2}$$



II ⑥

MOV. LIBRE

$$\frac{d\vec{L}}{dt} + \vec{w} \wedge \vec{L} = \vec{M}_{ET} = 0$$

$$w_y = \mathbb{C} . e^{\alpha t}$$

$$\dot{w}_y = \mathbb{C} . \alpha . e^{\alpha t}$$

$$\ddot{w}_y = \mathbb{C} . \alpha^2 e^{\alpha t}$$

$$\alpha^2 + k' = 0 \Rightarrow \alpha = \pm\sqrt{-k'}$$

$$k' = \frac{k^2}{A^2} = \frac{\overset{\overset{\frac{2\pi}{Dit}}{w}}{w_z^2}(C-A)^2}{A^2}$$

PERIODO OSCILACIÓN DE w_x, w_y

$$= \frac{A}{C-A}$$

$A = B$

(x): $A\dot{w}_x + w_z w_y (C-A) = 0$

(y): $B\dot{w}_y + w_z w_x (A-C) = 0$

(z): $\boxed{C\dot{w}_z + 0 = 0}$

$w_z = CTE$

$$A\dot{w}_x + w_y \overset{K}{w_z(C-A)} = 0$$

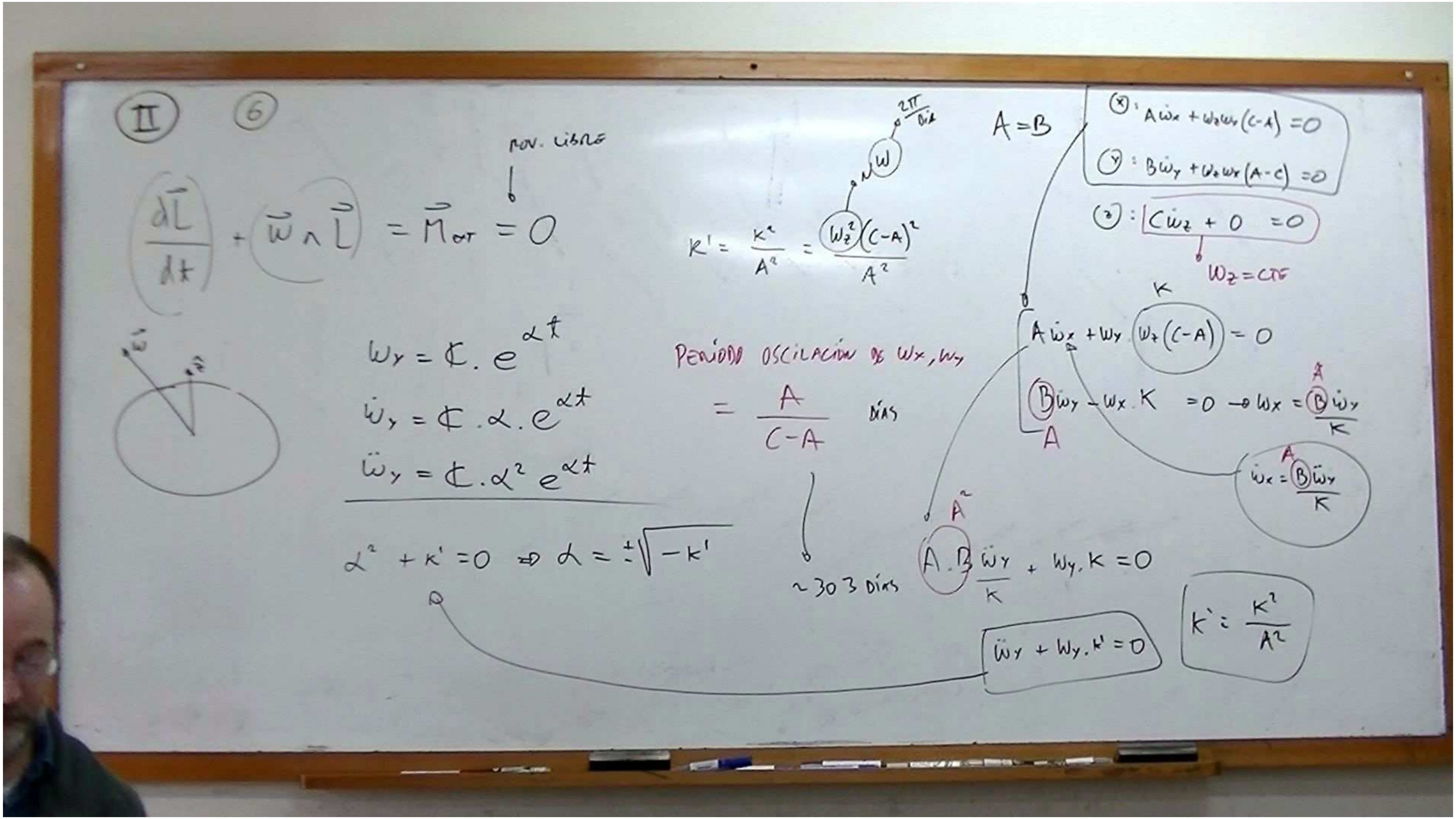
$$\overset{A}{B}\dot{w}_y - w_x K = 0 \rightarrow w_x = \frac{\overset{A}{B}\dot{w}_y}{K}$$

$$\dot{w}_x = \frac{\overset{A}{B}\ddot{w}_y}{K}$$

$$\overset{A^2}{A.B}\frac{\ddot{w}_y}{K} + w_y . K = 0$$

$$\boxed{\ddot{w}_y + w_y . k' = 0}$$

$$\boxed{k' = \frac{K^2}{A^2}}$$



II ⑥

MOV. LIBRE

$$\frac{d\vec{L}}{dt} + \vec{\omega} \wedge \vec{L} = \vec{M}_{ext} = 0$$

$$\omega_y = C \cdot e^{\alpha t}$$

$$\dot{\omega}_y = C \cdot \alpha \cdot e^{\alpha t}$$

$$\ddot{\omega}_y = C \cdot \alpha^2 e^{\alpha t}$$

$$\alpha^2 + k' = 0 \Rightarrow \alpha = \pm\sqrt{-k'}$$

$$k' = \frac{k^2}{A^2} = \frac{\omega_z^2 (C-A)^2}{A^2}$$

$\omega_z \sim \omega \to \frac{2\pi}{\text{Día}}$

PERIODO OSCILACIÓN DE ω_x, ω_y

$$= \frac{A}{C-A} \text{ DÍAS}$$

~ 303 DÍAS

$A = B$

ⓧ: $A\dot{\omega}_x + \omega_z\omega_y(C-A) = 0$

ⓨ: $B\dot{\omega}_y + \omega_z\omega_x(A-C) = 0$

ⓩ: $C\dot{\omega}_z + 0 = 0$

$\omega_z = CTE$

$$A\dot{\omega}_x + \omega_y \overbrace{\omega_z(C-A)}^{K} = 0$$

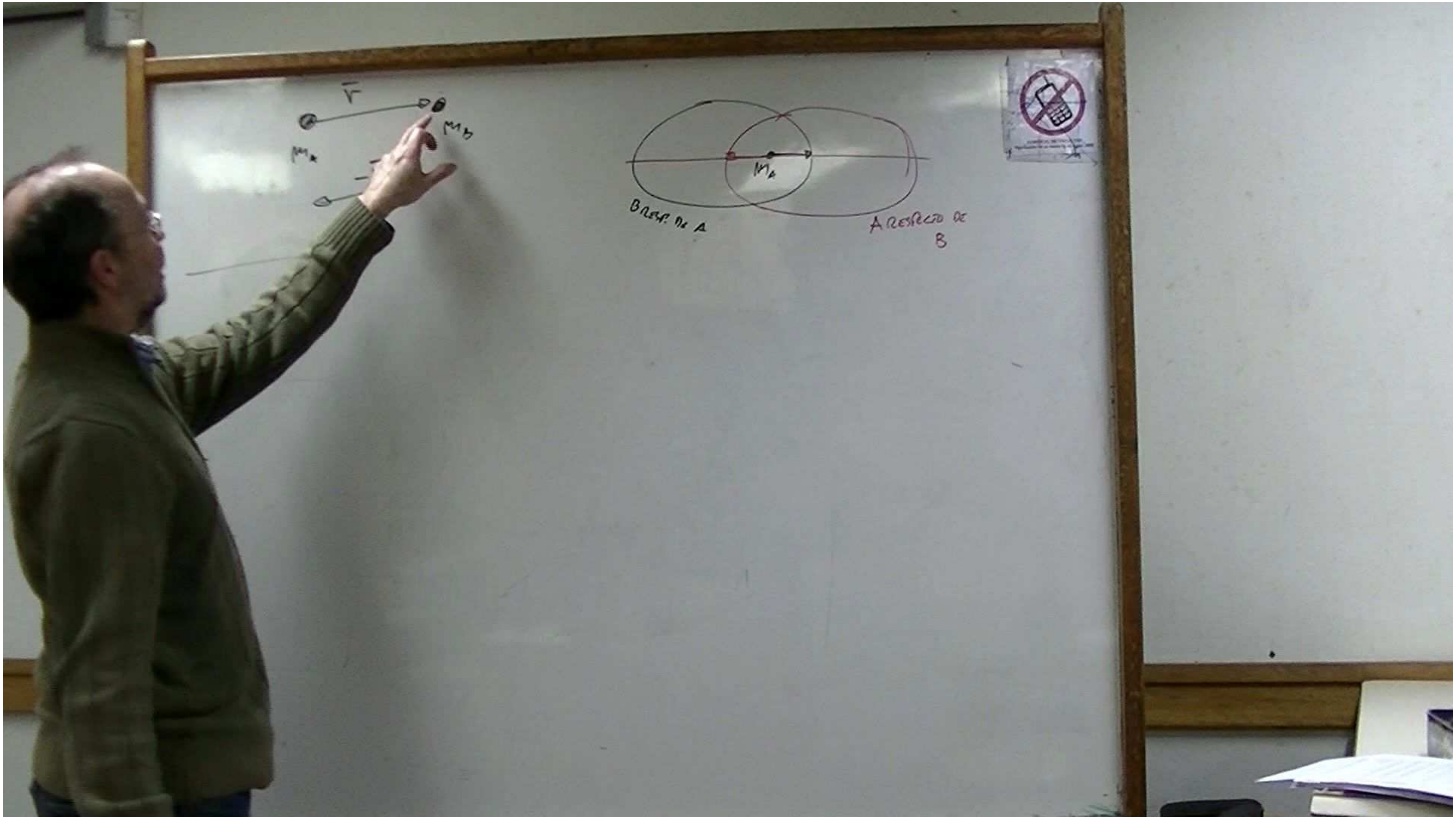
$$\overset{A}{B}\dot{\omega}_y - \omega_x . K = 0 \to \omega_x = \frac{\overset{A}{B}\dot{\omega}_y}{K}$$

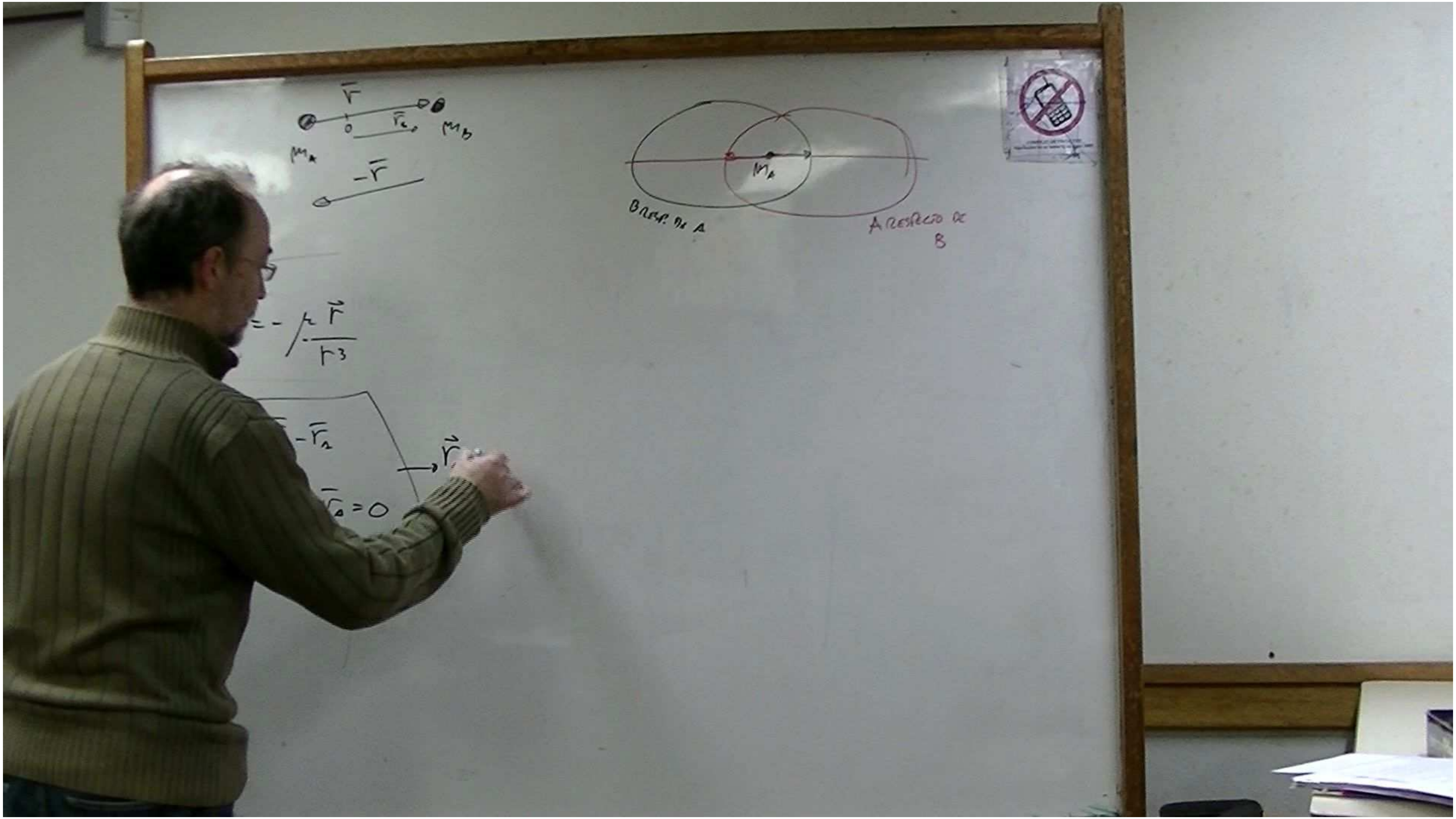
$$\dot{\omega}_x = \frac{\overset{A}{B}\ddot{\omega}_y}{K}$$

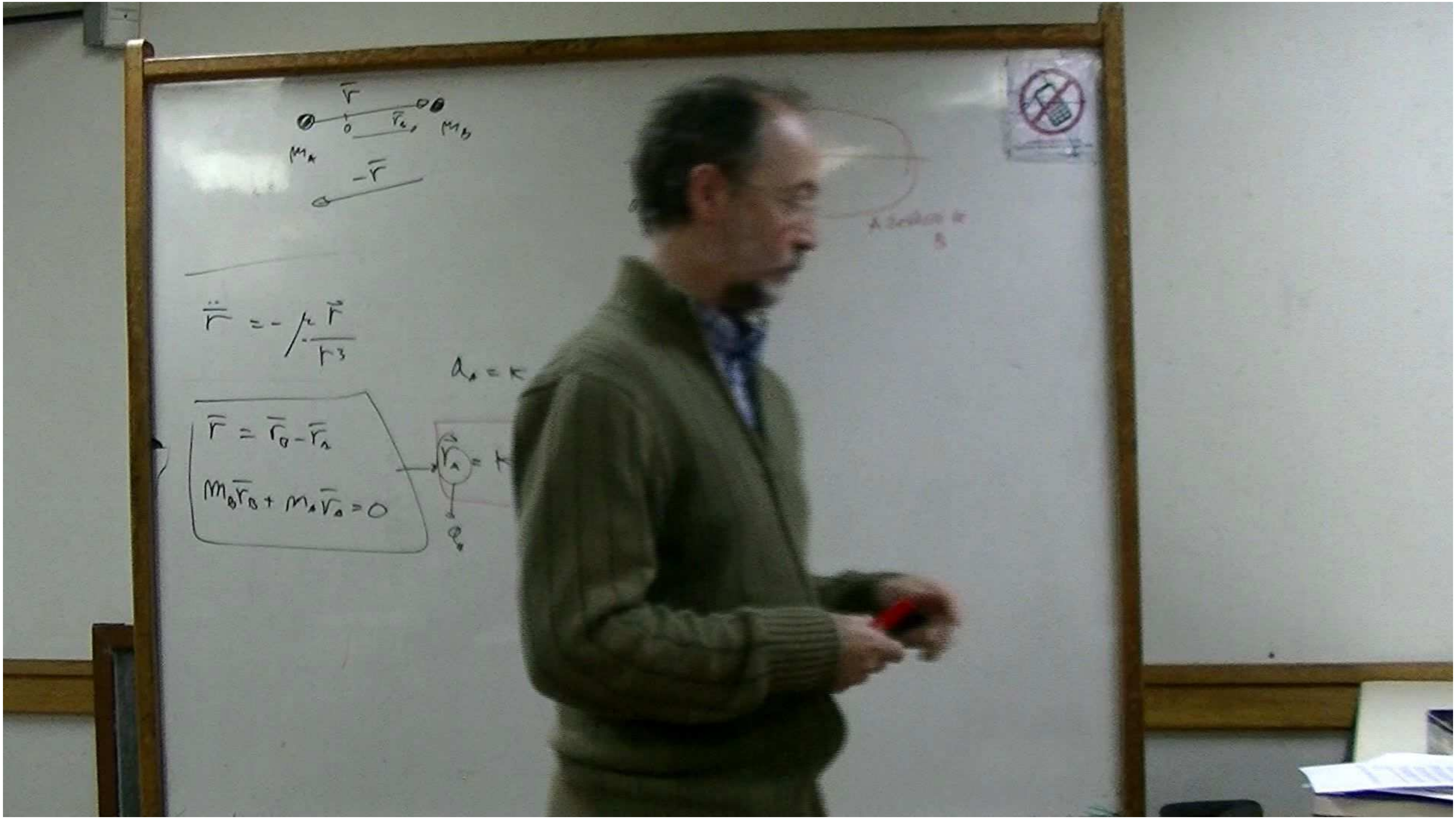
$$\overset{A^2}{A.B}\frac{\ddot{\omega}_y}{K} + \omega_y . K = 0$$

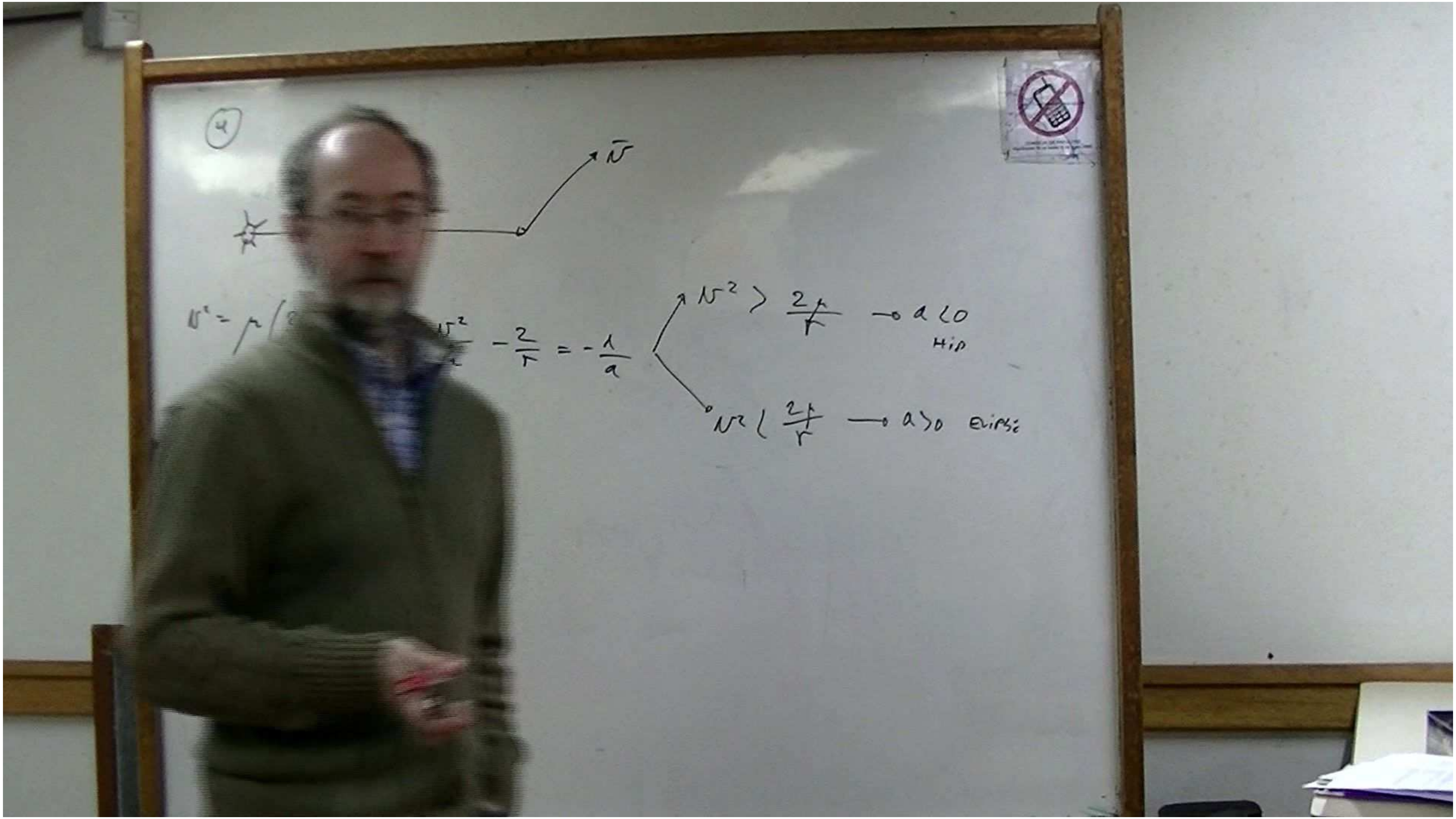
$$\boxed{\ddot{\omega}_y + \omega_y . k' = 0}$$

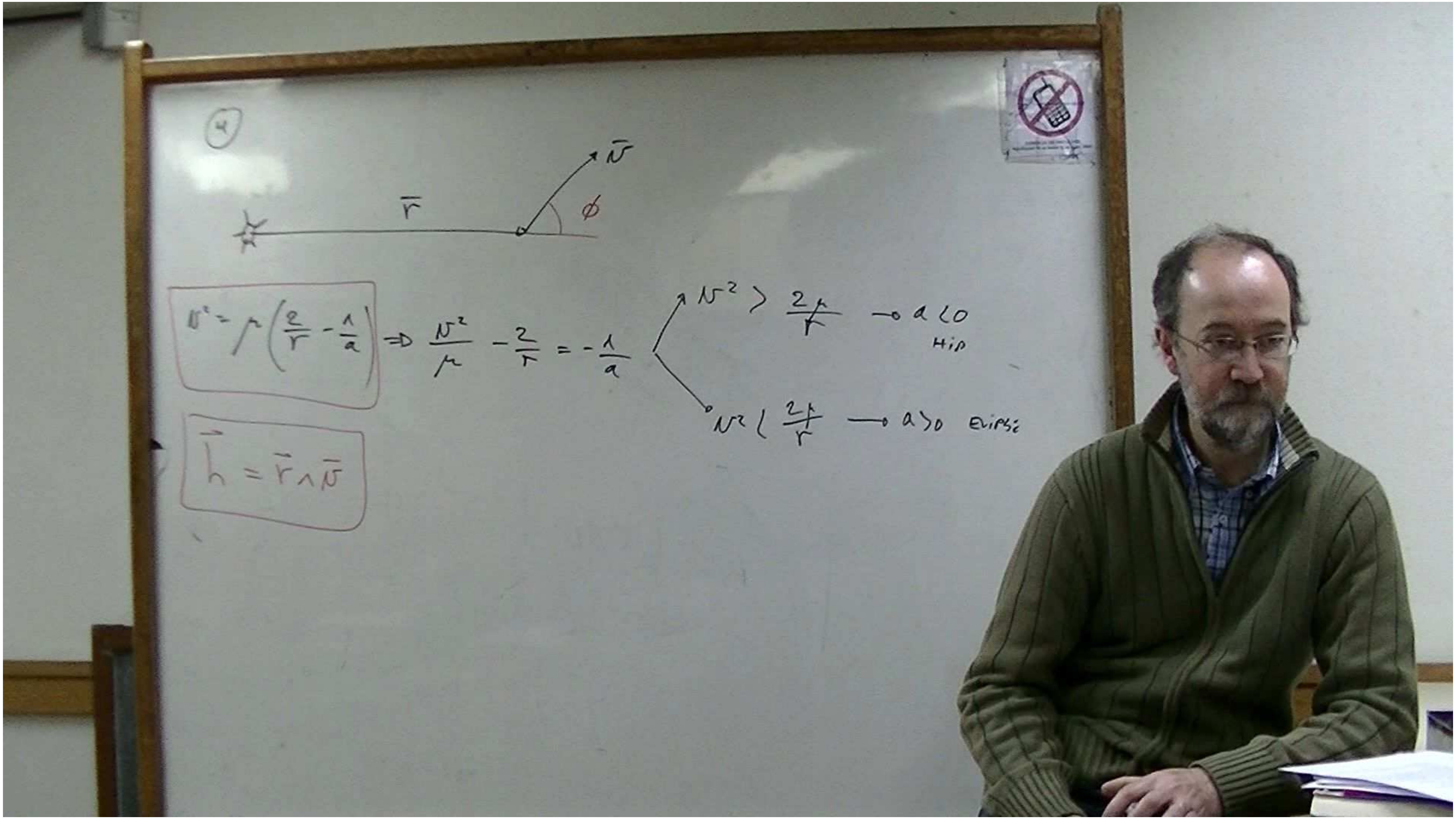
$$\boxed{k' = \frac{K^2}{A^2}}$$


r̄
m_A
m_B
M_A
B RESP. DE A
A RESPECTO DE B


$\bar{r}$
0
$\bar{r}_c$
m_A
m_B
$-\bar{r}$
$= -\mu \frac{\vec{r}}{r^3}$
$-\bar{r}_2$
$\rightarrow \vec{r}$
$\bar{r}_c = 0$
m_A
B resp. de A
A respecto de B


r̄
0
r̄_B
m_B
m_A
−r̄
r̈ = −μ r̄ / r³
a_A = k
r̄ = r̄_B − r̄_A
m_B r̄_B + m_A r̄_A = 0
r̄_A = k
A alrededor de B


4
$\bar{v}$
$v^2 = \mu($
$\frac{v^2}{\mu} - \frac{2}{r} = -\frac{1}{a}$
$v^2 > \frac{2\mu}{r} \rightarrow a < 0$
Hip
$v^2 < \frac{2\mu}{r} \rightarrow a > 0$ Elipse



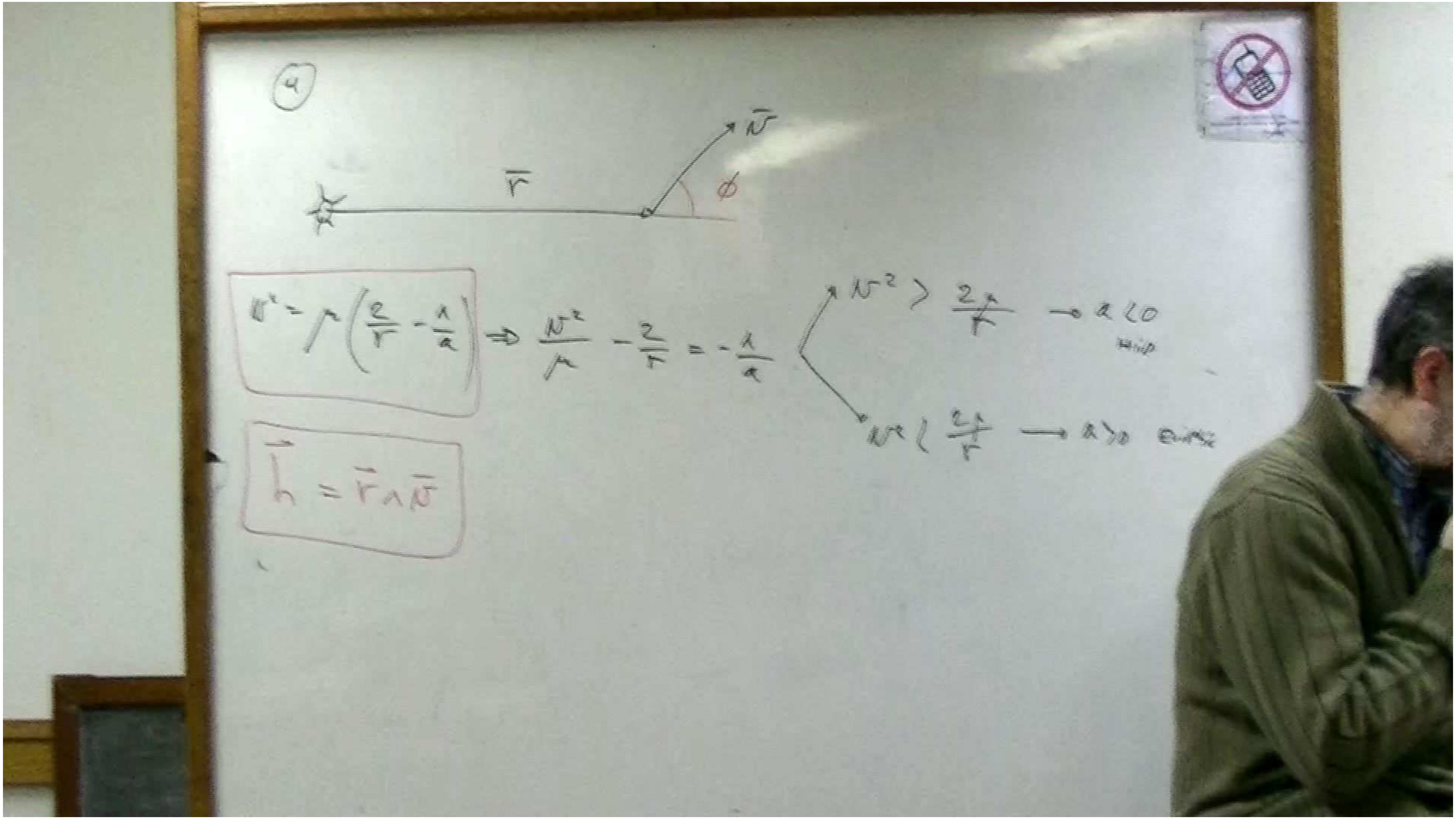
④

$$\boxed{v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)} \Rightarrow \frac{v^2}{\mu} - \frac{2}{r} = -\frac{1}{a}$$

$v^2 > \frac{2\mu}{r} \rightarrow a < 0$ Hip

$v^2 < \frac{2\mu}{r} \rightarrow a > 0$ Elipsi

$$\boxed{\vec h = \vec r \wedge \bar v}$$



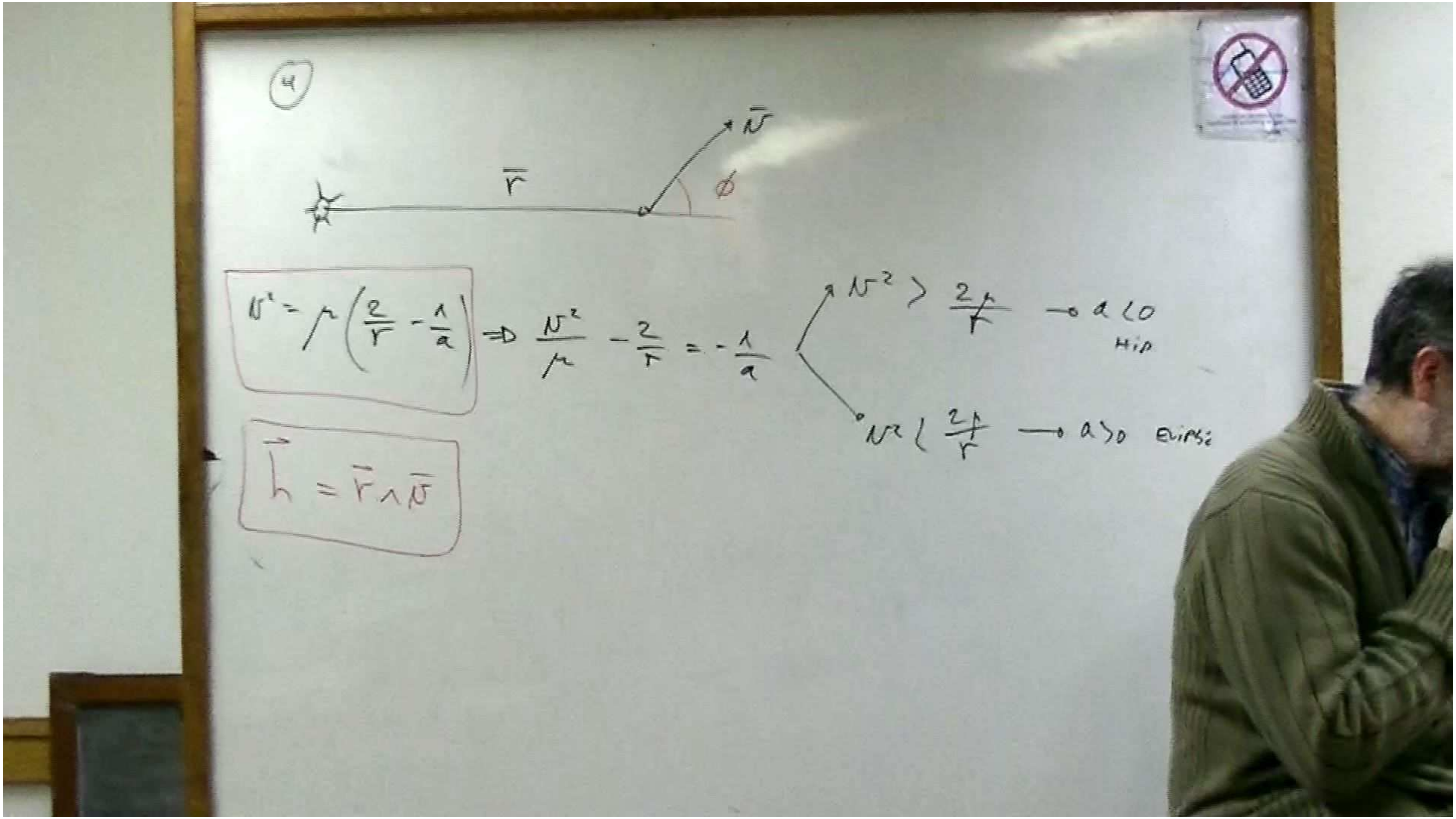
④

$$\boxed{v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)} \Rightarrow \frac{v^2}{\mu} - \frac{2}{r} = -\frac{1}{a}$$

$v^2 > \frac{2\mu}{r} \longrightarrow a < 0$ hip

$v^2 < \frac{2\mu}{r} \longrightarrow a > 0$ elipse

$$\boxed{\vec h = \vec r \wedge \bar v}$$



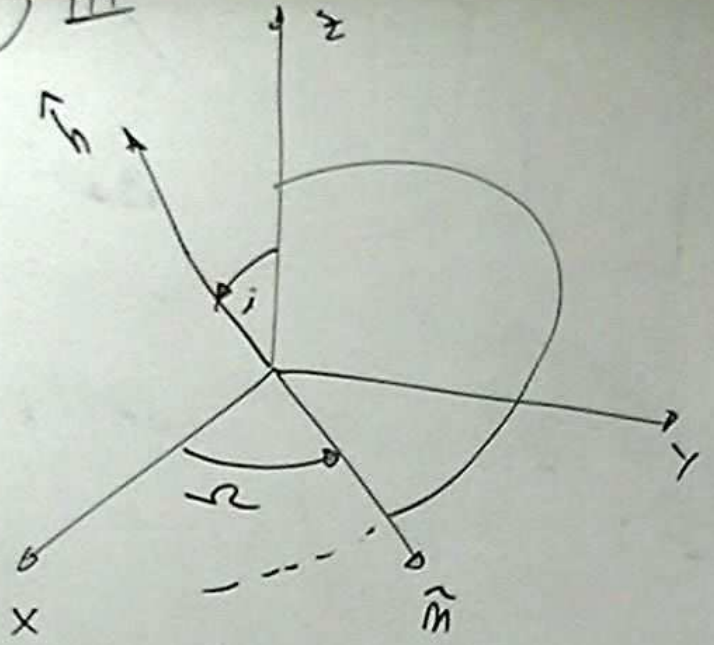
$$\boxed{v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)} \Rightarrow \frac{v^2}{\mu} - \frac{2}{r} = -\frac{1}{a}$$

$v^2 > \frac{2\mu}{r} \to a < 0$ Hip

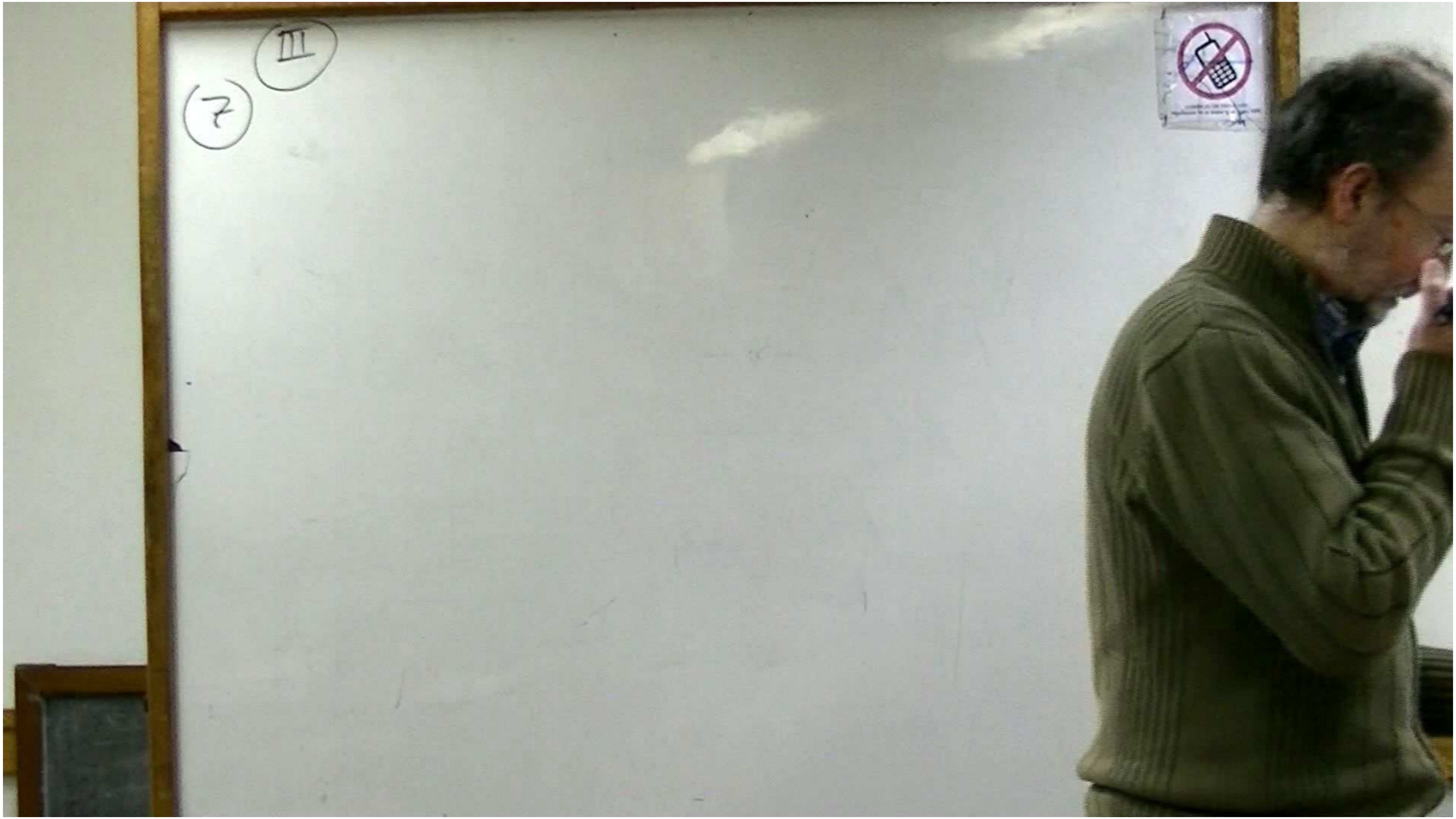
$v^2 < \frac{2\mu}{r} \to a > 0$ Elips

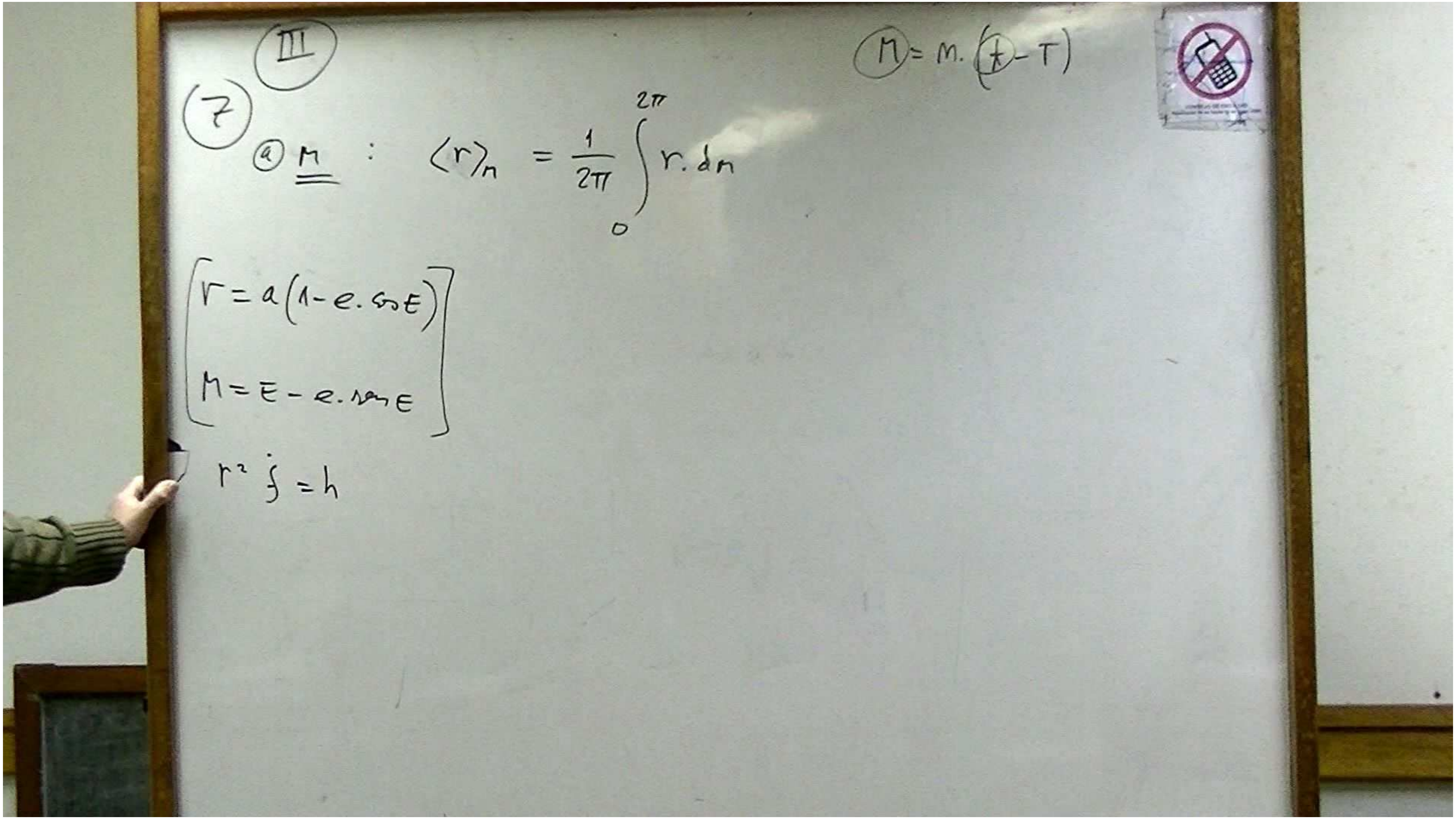
$$\boxed{\vec{h} = \bar{r} \wedge \bar{v}}$$

⑥ III



$$\hat{z} \wedge \hat{h} = \text{sen}\, i \,.\, \hat{m}$$


III
7



Ⅲ

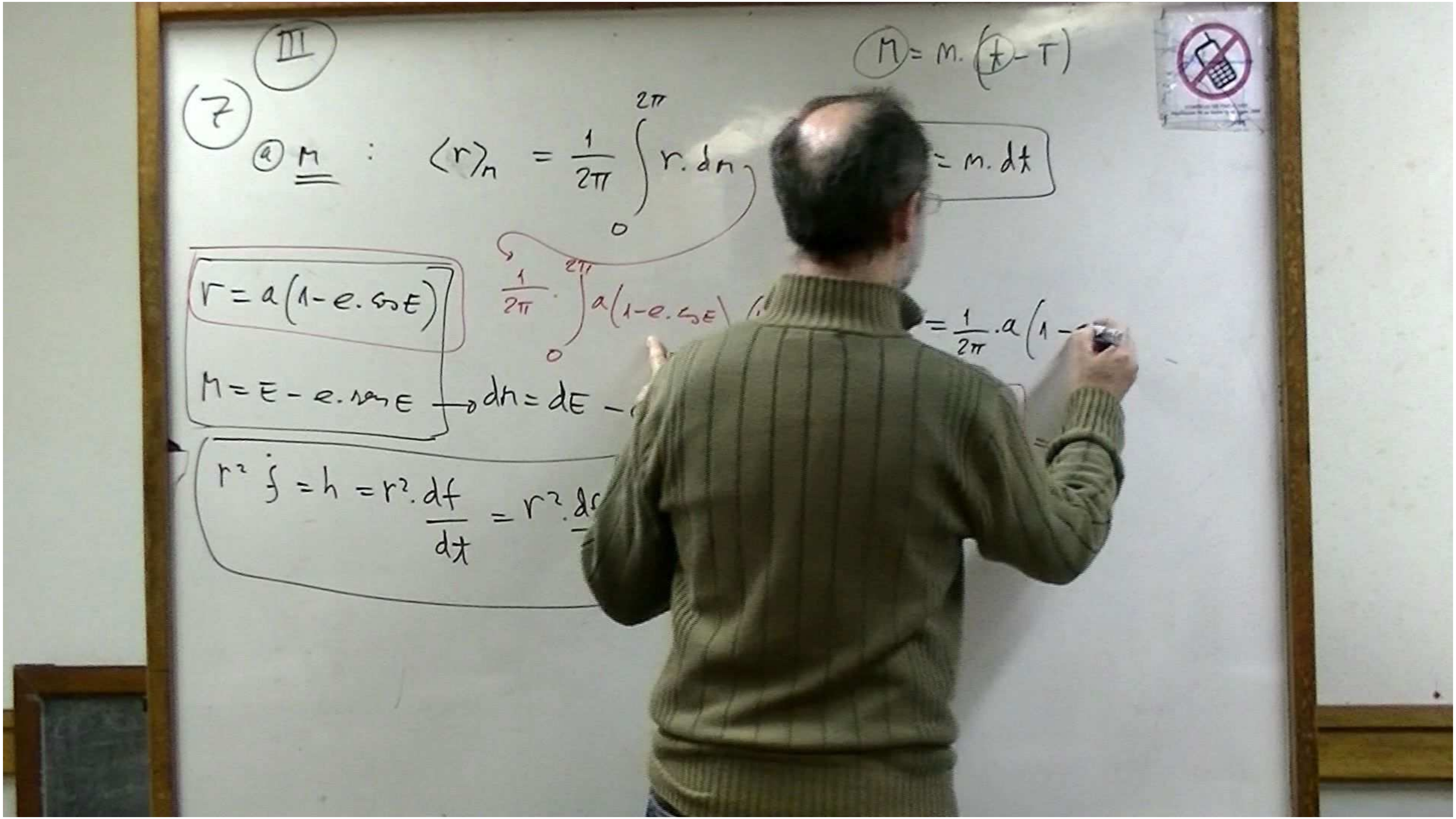
⑦

ⓐ $\underline{\underline{M}}$: $\langle r \rangle_M = \frac{1}{2\pi} \int_0^{2\pi} r . dM$

$M = n.(t - T)$

$$\left[\begin{array}{l} r = a(1 - e.\cos E) \\ M = E - e.\,\text{sen}\,E \end{array}\right]$$

$r^2 \dot{f} = h$



Ⅲ

⑦

ⓐ $\underline{M}$: $\langle r \rangle_M = \frac{1}{2\pi} \int_0^{2\pi} r \,.\, dM$

$M = m.(t - T)$

$= m.dt$

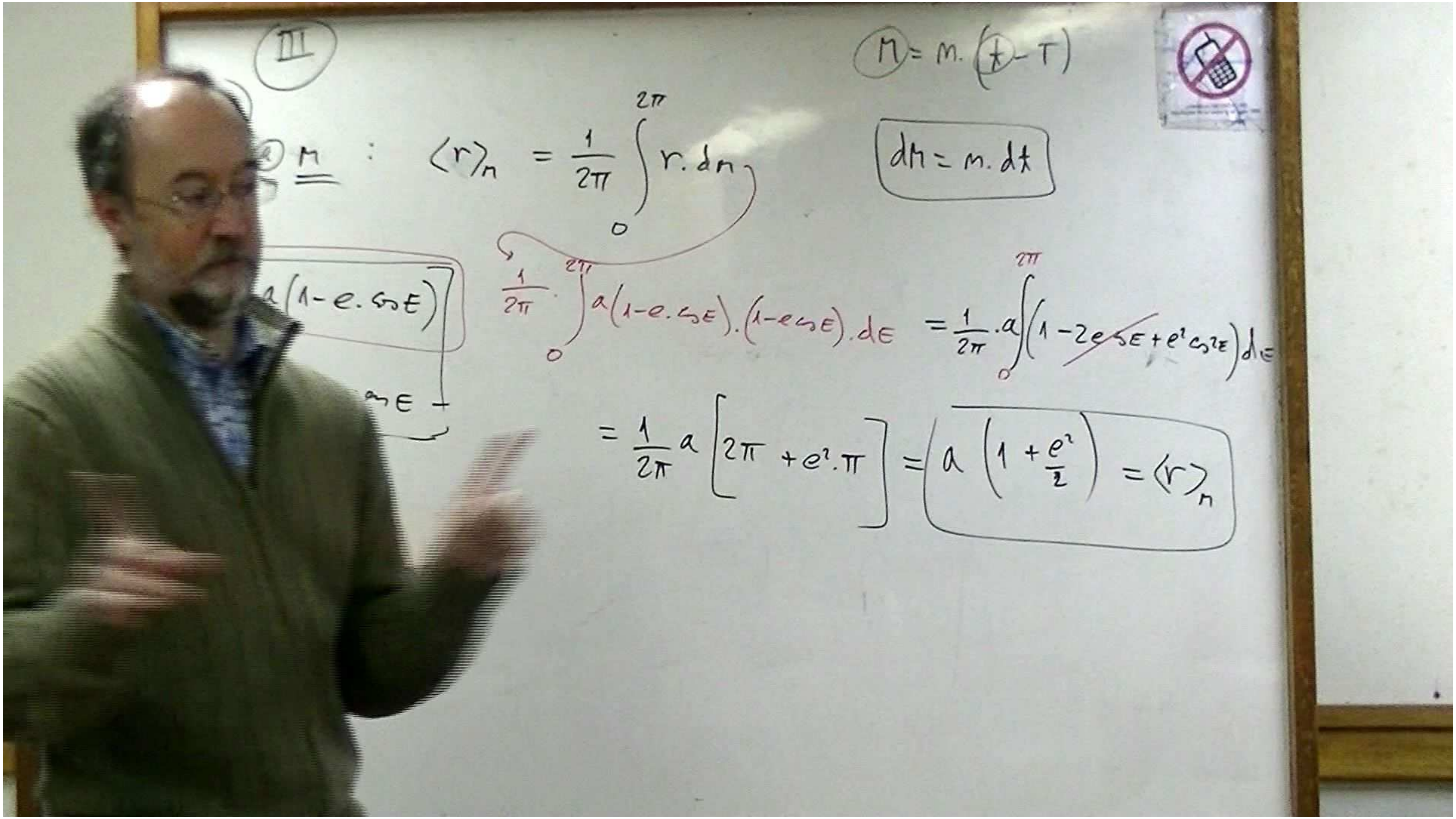
$r = a(1 - e.\cos E)$

$M = E - e.\operatorname{sen} E \rightarrow dM = dE -$

$\frac{1}{2\pi} \cdot \int_0^{2\pi} a(1 - e.\cos E)$

$= \frac{1}{2\pi} . a(1 -$

$r^2 \dot{f} = h = r^2 . \frac{df}{dt} = r^2 . \frac{d}{}$



III

$$M = n.(t - T)$$

$$\boxed{dM = n.dt}$$

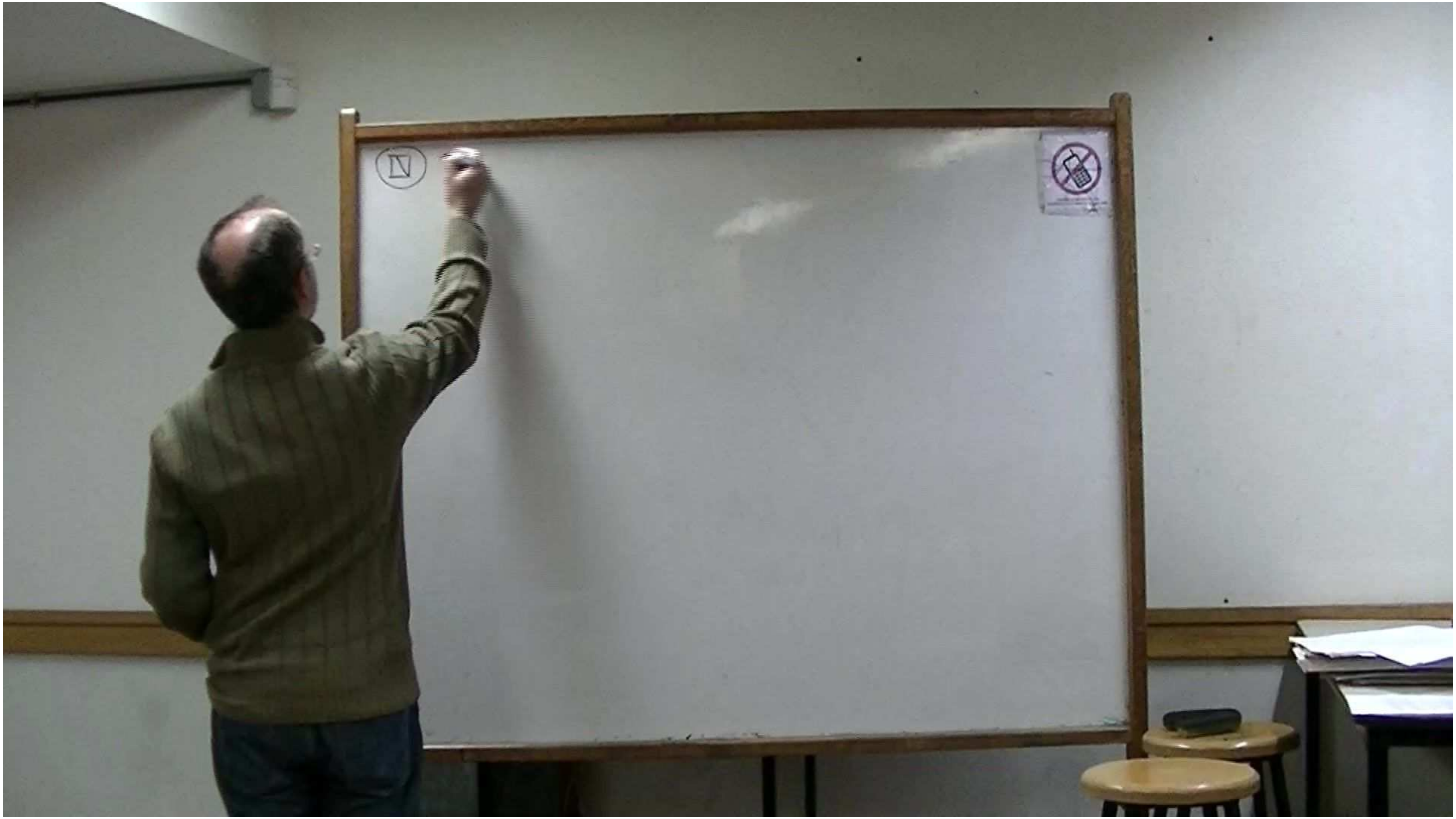
a) M : $\langle r\rangle_M = \frac{1}{2\pi}\int_0^{2\pi} r.dM$

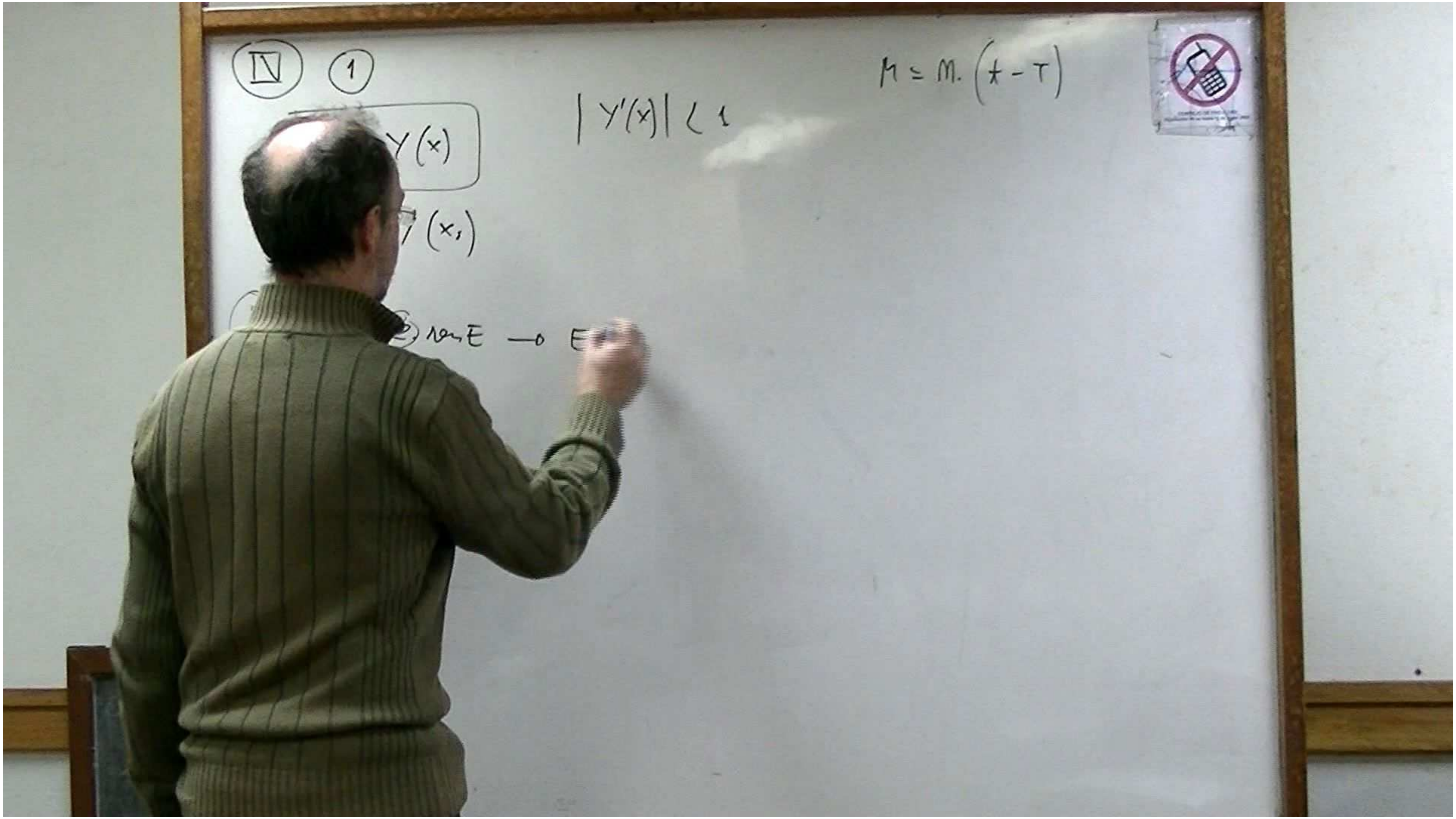
$a(1-e.\cos E)$

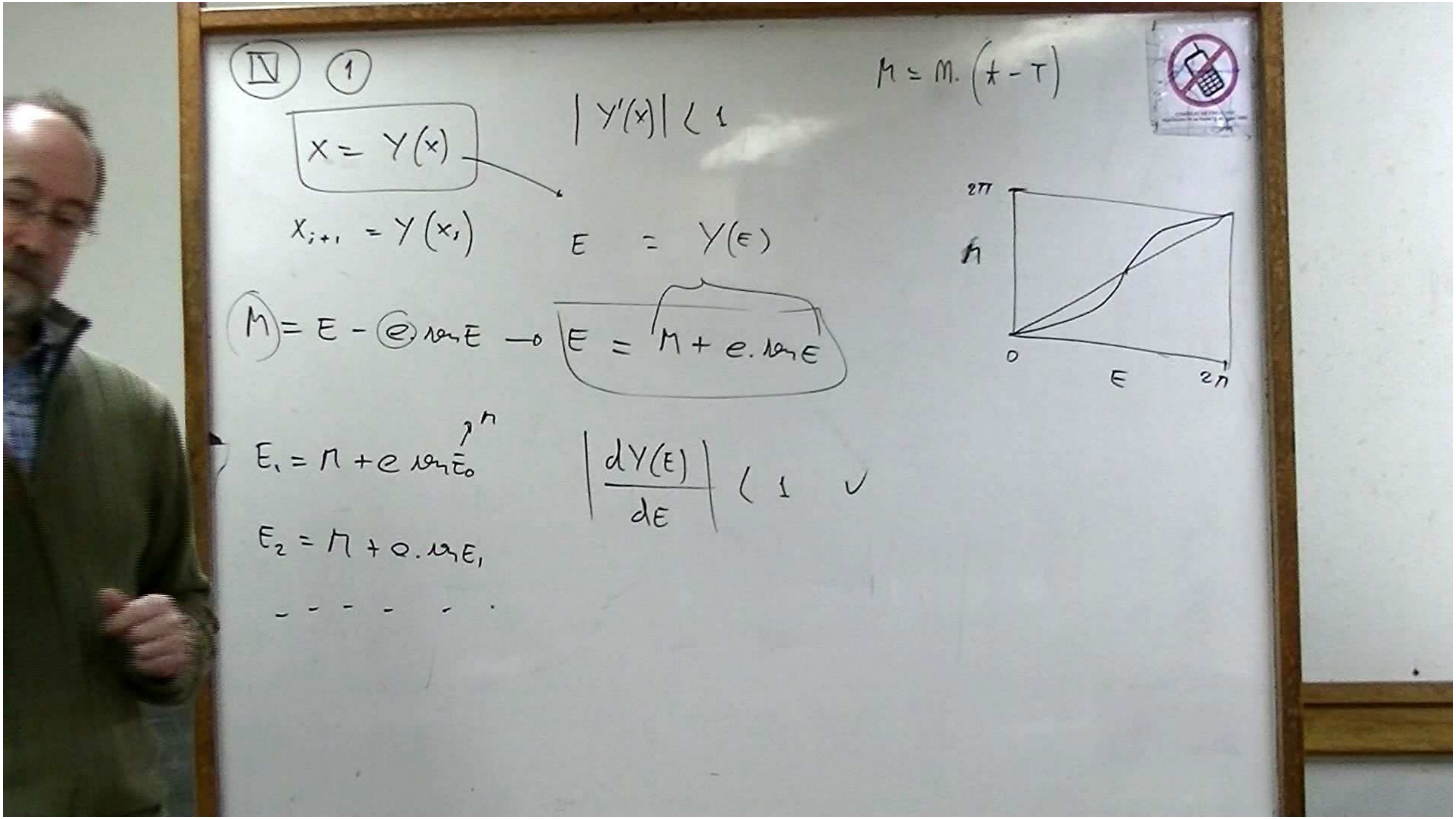
$\sin E$

$$\frac{1}{2\pi}\int_0^{2\pi} a(1-e.\cos E).(1-e\cos E).dE = \frac{1}{2\pi}.a\int_0^{2\pi}\left(1 - \cancel{2e\cos E} + e^2\cos^2 E\right)dE =$$

$$= \frac{1}{2\pi}a\left[2\pi + e^2.\pi\right] = \boxed{a\left(1+\frac{e^2}{2}\right) = \langle r\rangle_M}$$


IV


IV
1
Y(x)
(x₁)
|Y'(x)| < 1
M = M.(t - T)
2) sen E → E



IV ①

$\boxed{x = \gamma(x)}$ $\longrightarrow$ $|\gamma'(x)| < 1$

$x_{i+1} = \gamma(x_i)$

$E = \gamma(E)$

$M = m.(t - T)$

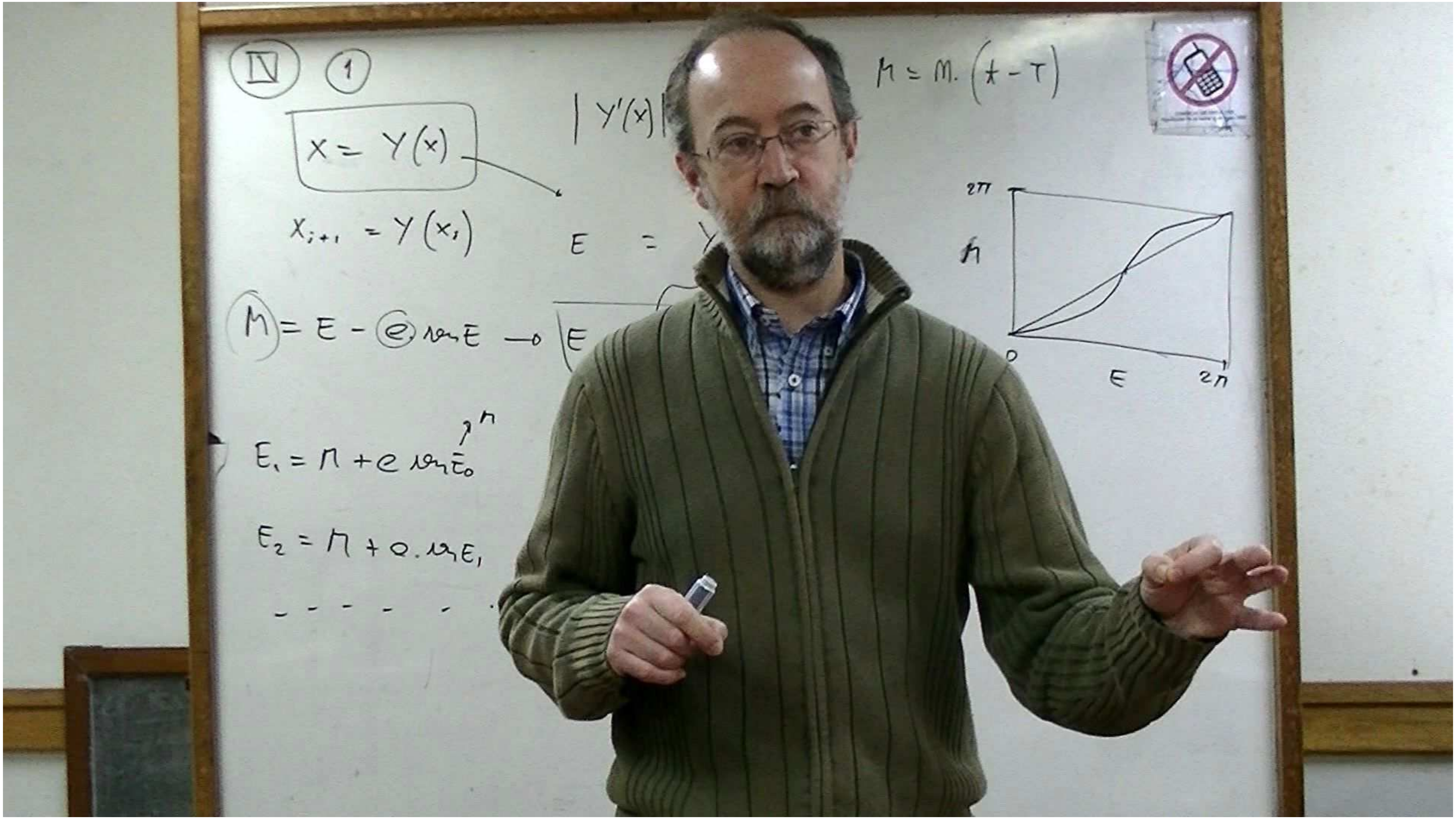
$M = E - e.\operatorname{sen} E \longrightarrow \boxed{E = \overbrace{M + e.\operatorname{sen} E}}$

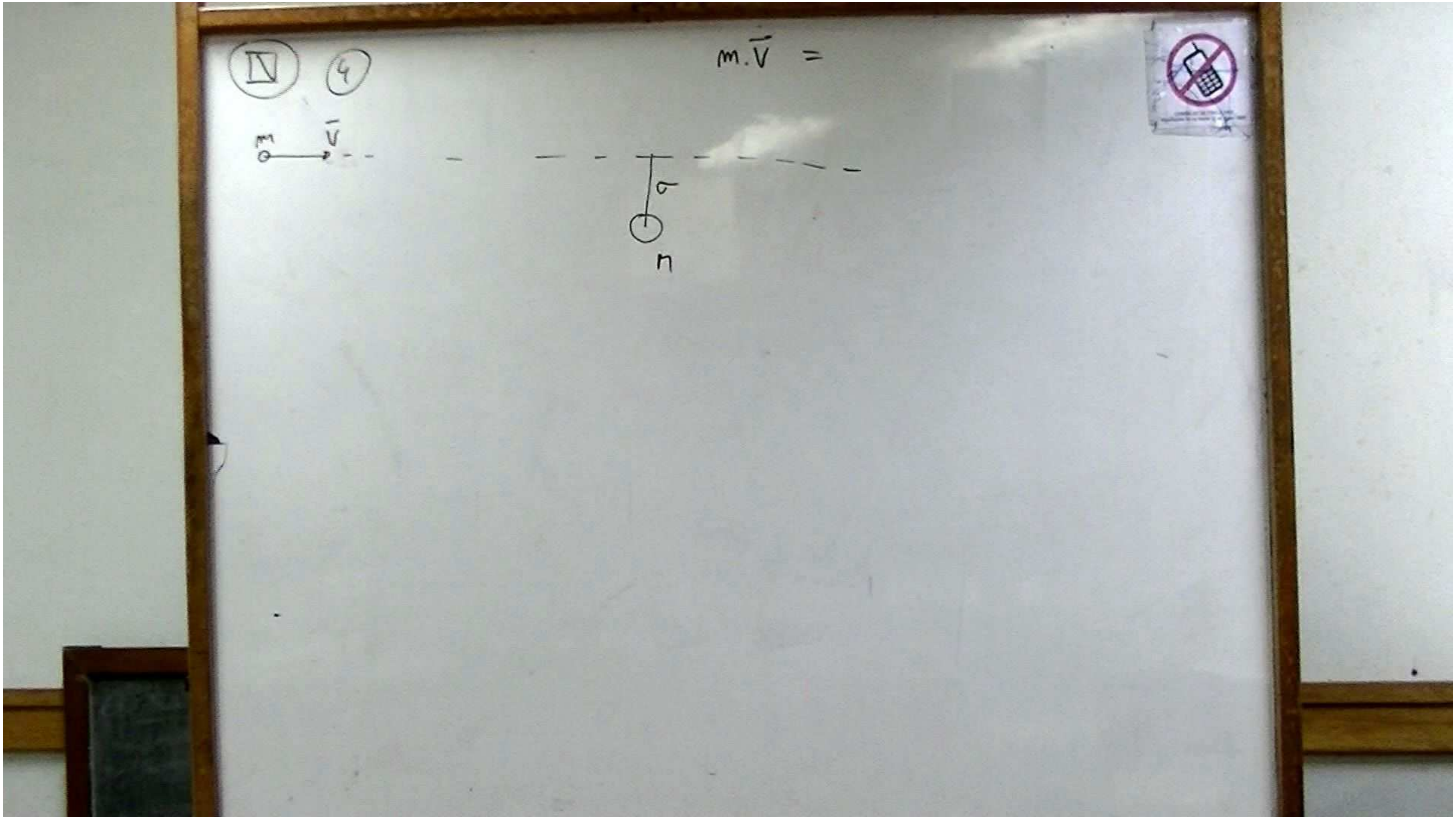
$E_1 = M + e \operatorname{sen} \overset{M}{E_0}$

$E_2 = M + e.\operatorname{sen} E_1$

$- - - - - .$

$\left|\frac{d\gamma(E)}{dE}\right| < 1$ ✓

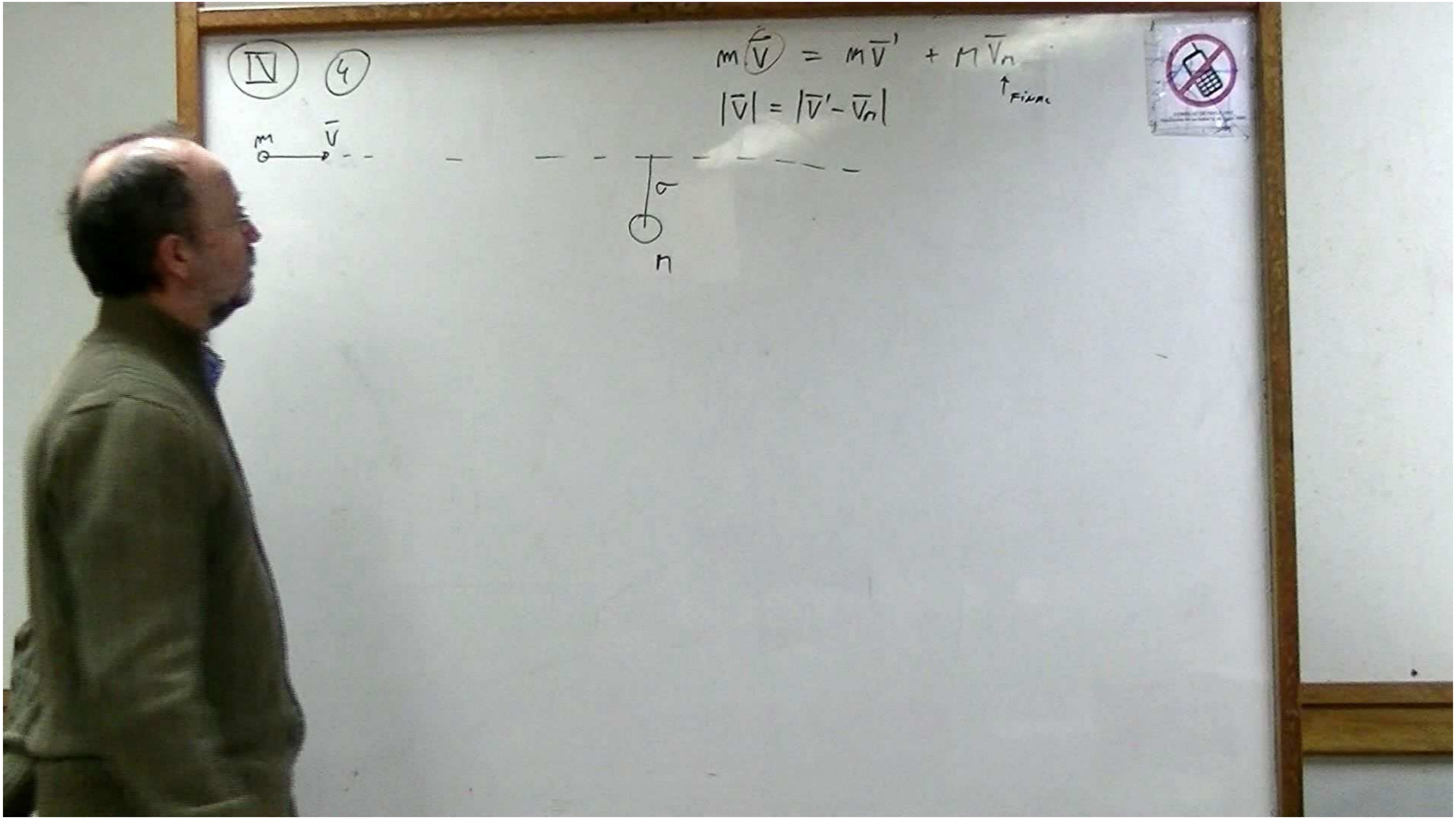

IV
1
x = Y(x)
x_{i+1} = Y(x_i)
|Y'(x)|
E = Y
M = E - e sen E → E
E_1 = M + e sen E_0
E_2 = M + e. sen E_1
M = M. (t - T)
2π
M
0
E
2π



IV

4

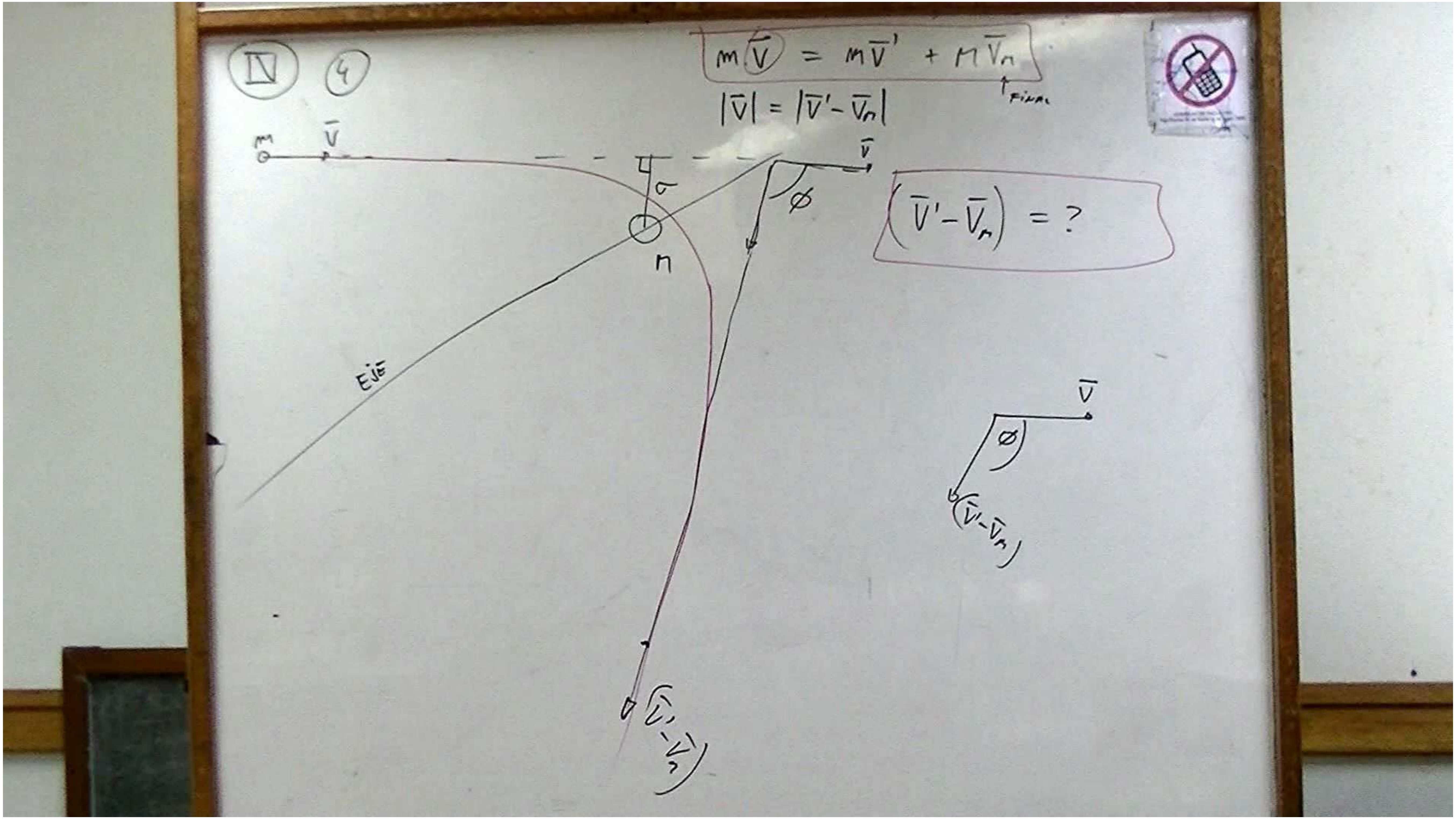
$m.\bar{V} =$



$$m\bar{V} = m\bar{V}' + M\bar{V}_M$$

↑ FINAL

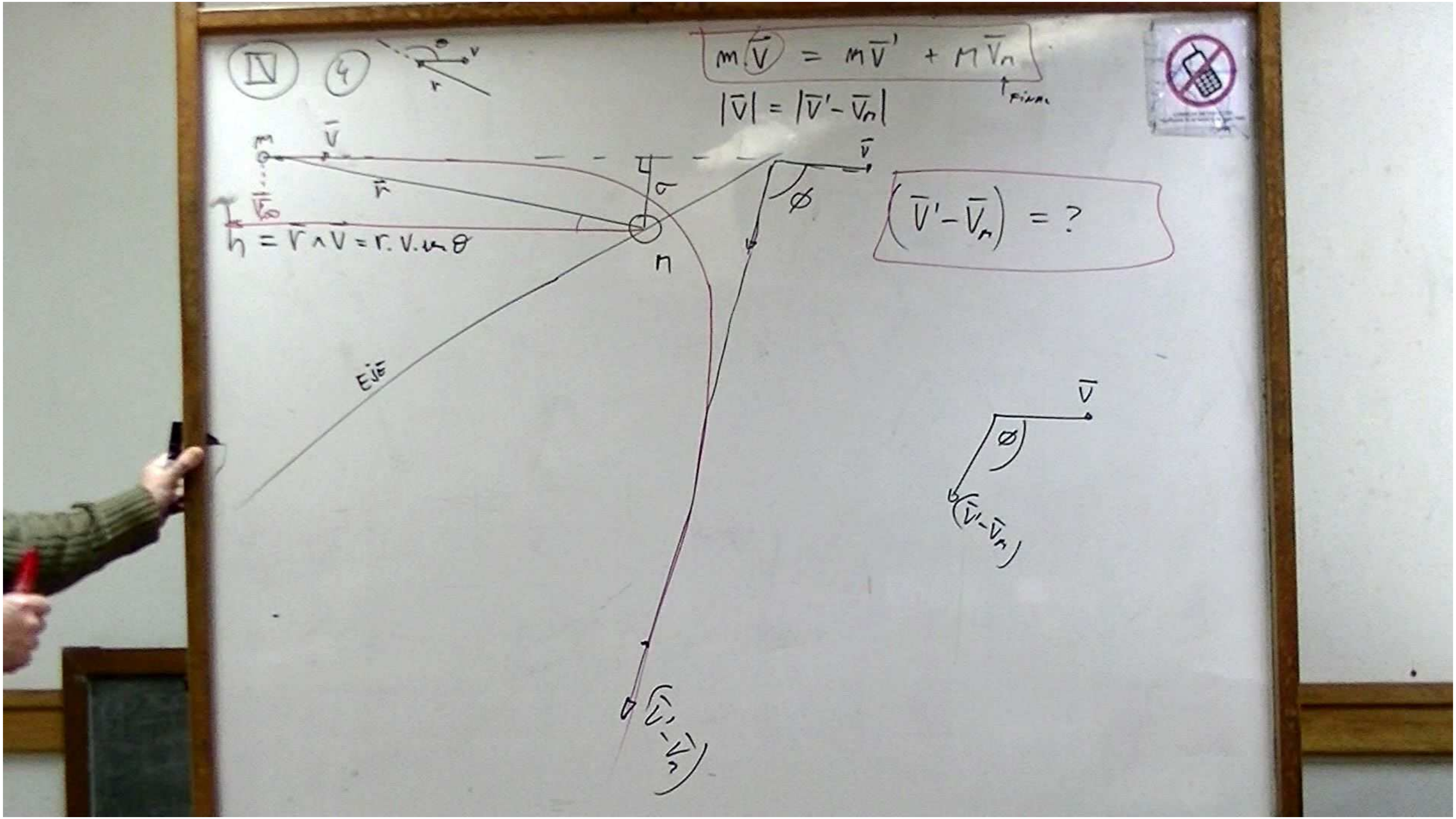
$$|\bar{V}| = |\bar{V}' - \bar{V}_M|$$



$$\boxed{m\bar{V} = m\bar{V}' + M\bar{V}_M}$$

$$|\bar{V}| = |\bar{V}'-\bar{V}_M|$$

$$\boxed{(\bar{V}'-\bar{V}_M) = ?}$$



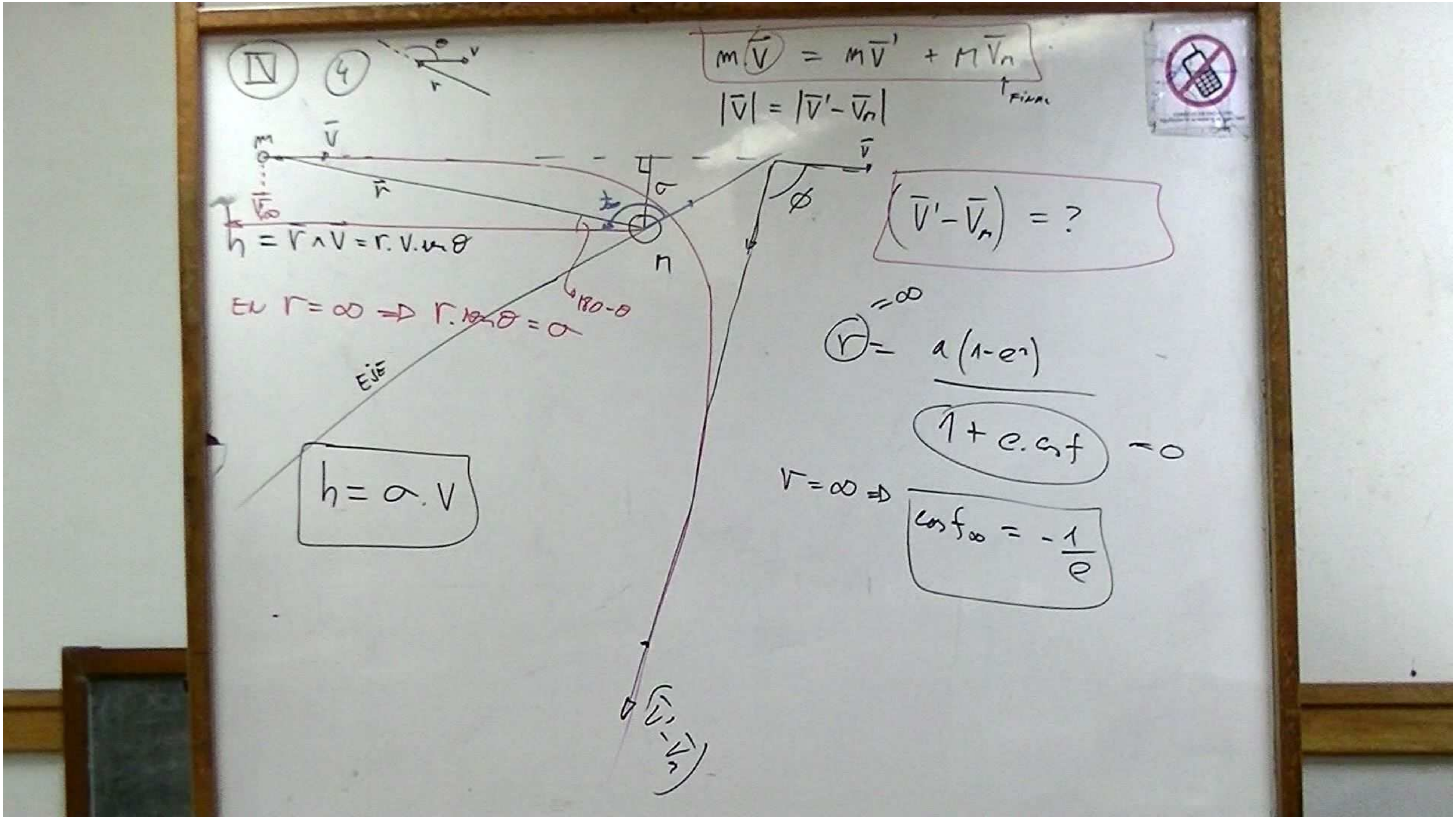
$$m\bar{V} = m\bar{V}' + M\bar{V}_n$$

FINAL

$$|\bar{V}| = |\bar{V}' - \bar{V}_n|$$

$$(\bar{V}' - \bar{V}_n) = ?$$

$$h = \bar{r} \wedge \bar{V} = r.V.\mathrm{sen}\,\theta$$



$$\boxed{m\vec V = m\vec V' + M\vec V_n}$$

$$|\vec V| = |\vec V' - \vec V_n|$$

$$h = \vec r \wedge \vec V = r.V.\sin\theta$$

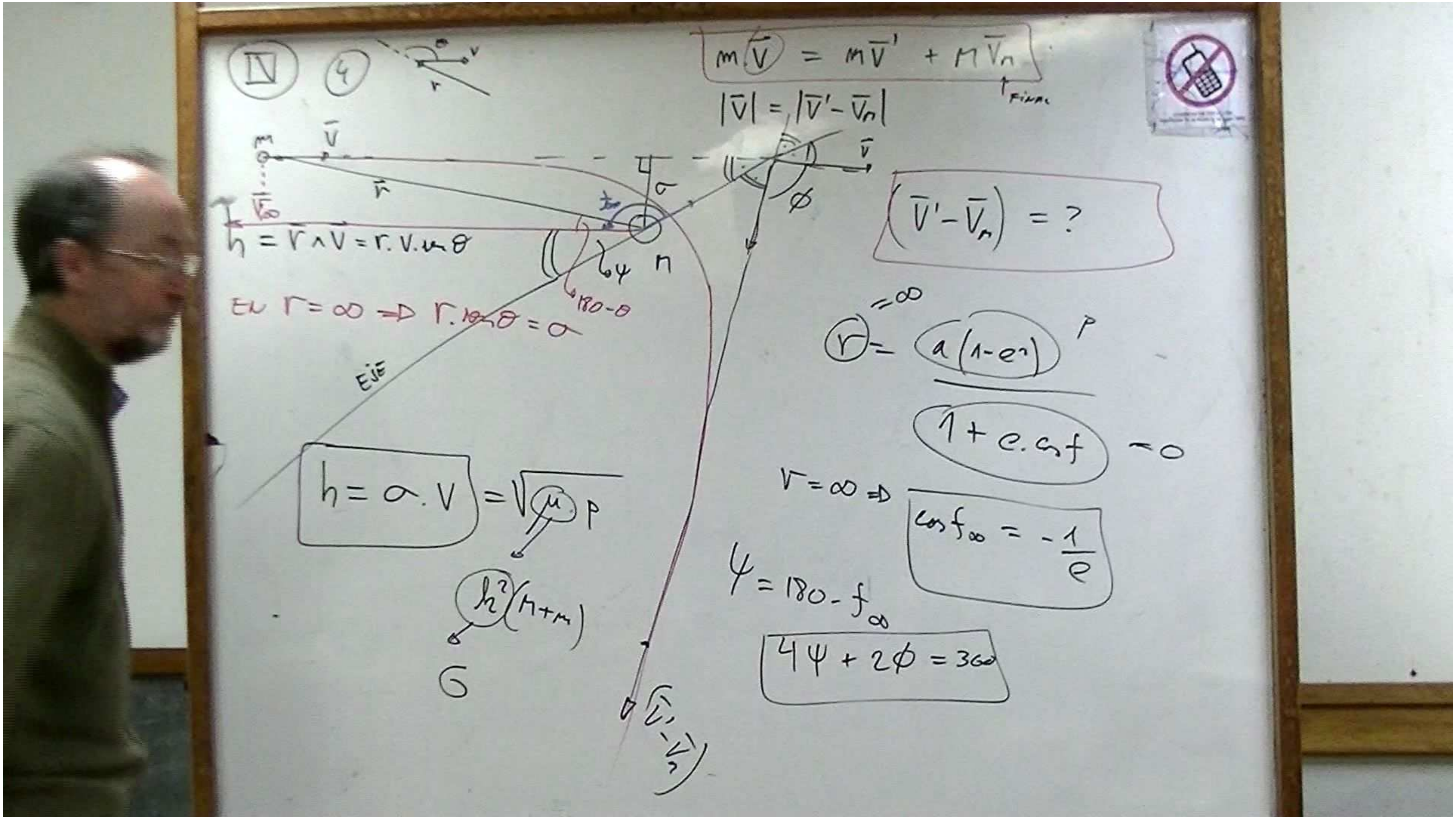
EN $r=\infty \Rightarrow r.\sin\theta = \sigma$

$$\boxed{h = \sigma . V}$$

$$\boxed{(\vec V' - \vec V_n) = ?}$$

$$\overset{=\infty}{r} = \frac{a(1-e^2)}{\underbrace{1+e.\cos f}_{\to 0}}$$

$$r=\infty \Rightarrow \boxed{\cos f_\infty = -\frac{1}{e}}$$



$$\boxed{m\bar{V} = m\bar{V}' + M\bar{V}_n}$$

$$|\bar{V}| = |\bar{V}' - \bar{V}_n|$$

$$h = \bar{r} \wedge \bar{V} = r.V.\sin\theta$$

EN $r = \infty \Rightarrow r.\sin\theta = \sigma$

$$\boxed{h = \sigma . V} = \sqrt{\mu . p}$$

$h^2 (M+m)$

G

$$\boxed{(\bar{V}' - \bar{V}_n) = ?}$$

$$r = \frac{a(1-e^2)}{1 + e.\cos f}$$

$=\infty$

p

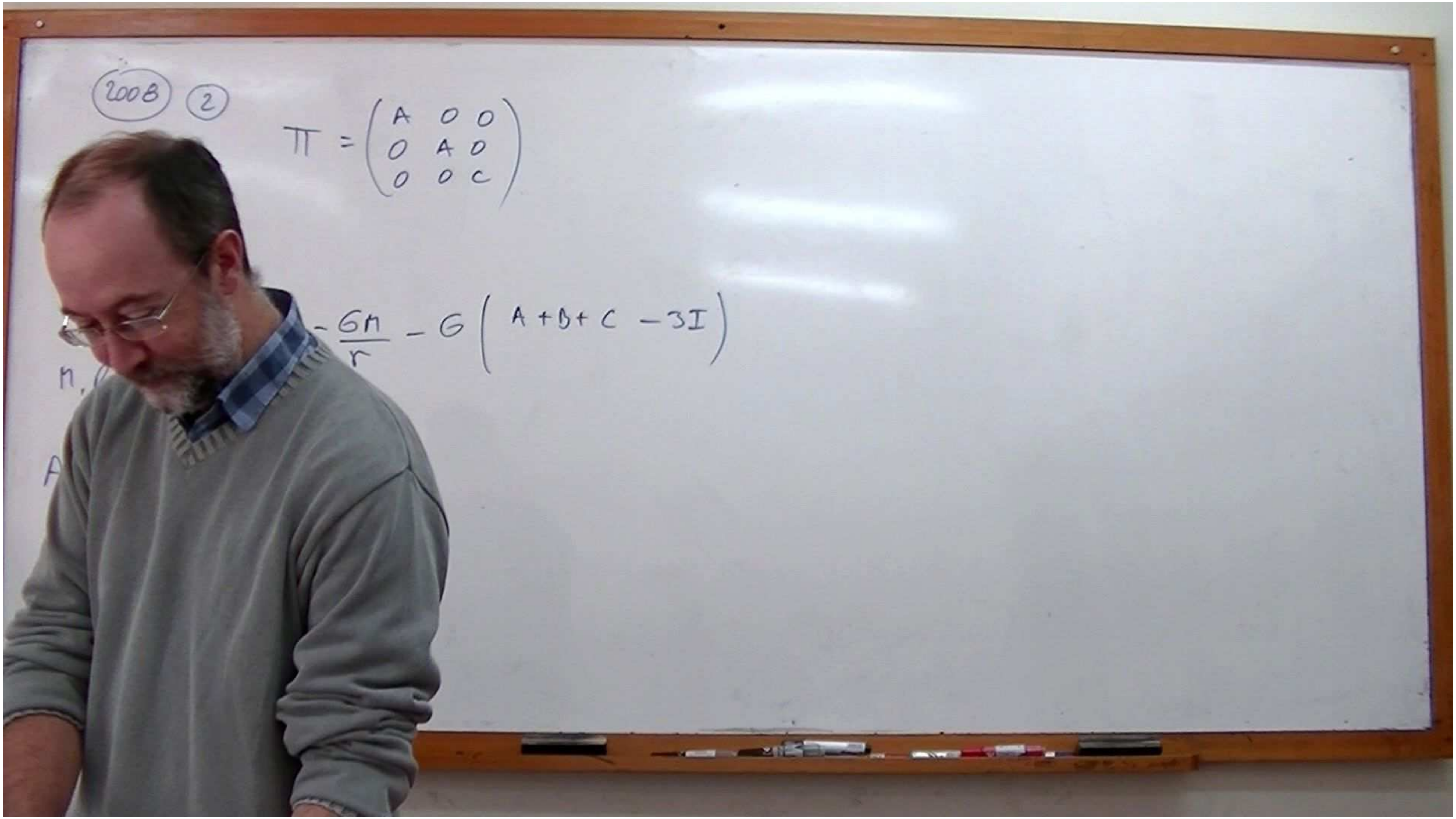
$\to 0$

$$r = \infty \Rightarrow \boxed{\cos f_\infty = -\frac{1}{e}}$$

$$\psi = 180 - f_\infty$$

$$\boxed{4\psi + 2\phi = 360}$$


2008
2



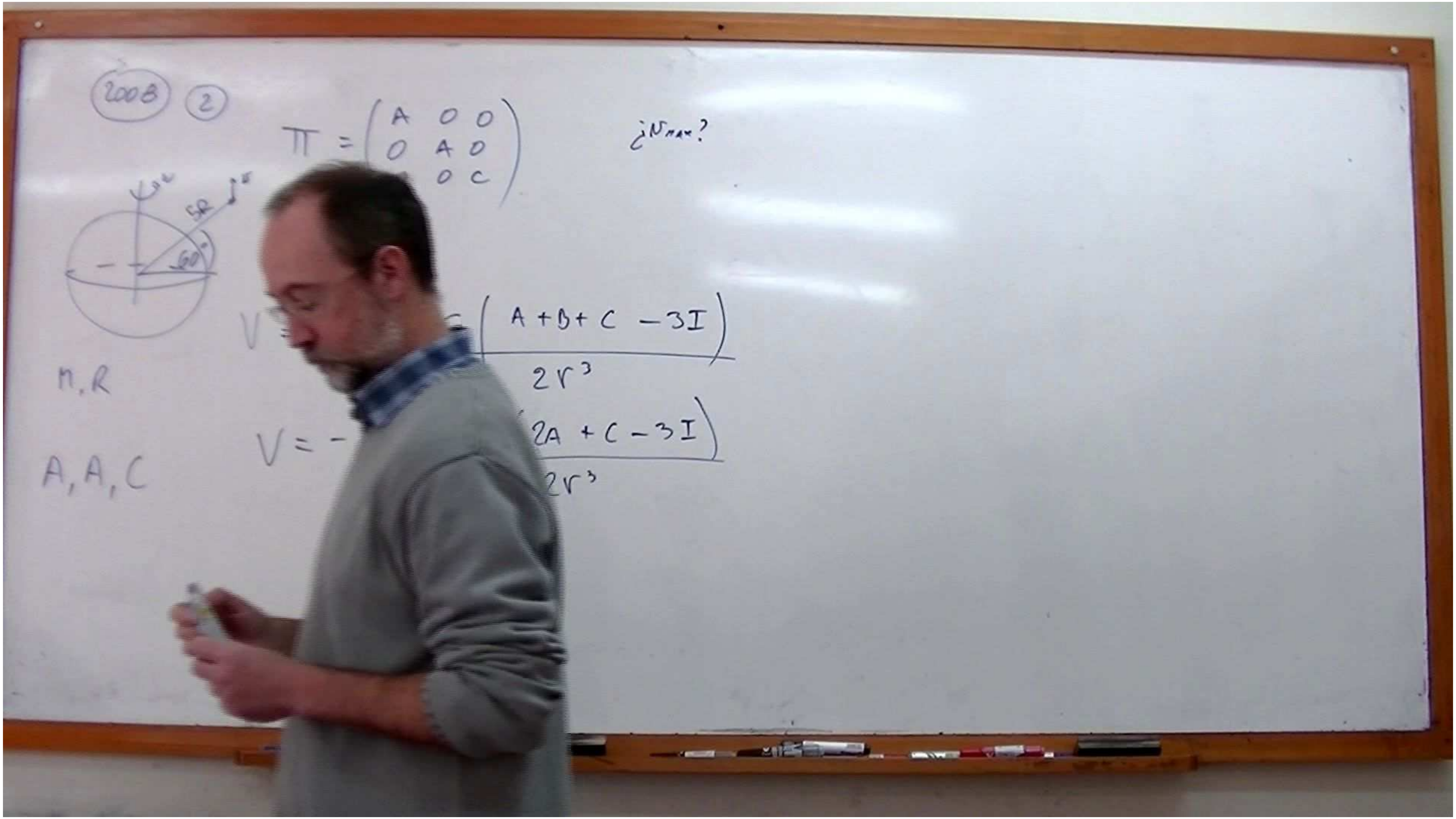
2008 ②

$$\Pi = \begin{pmatrix} A & 0 & 0 \\ 0 & A & 0 \\ 0 & 0 & C \end{pmatrix}$$

$$-\frac{Gm}{r} - G\left(A + B + C - 3I \right)$$

n,

A



$\Pi = \begin{pmatrix} A & 0 & 0 \\ 0 & A & 0 \\ & 0 & C \end{pmatrix}$

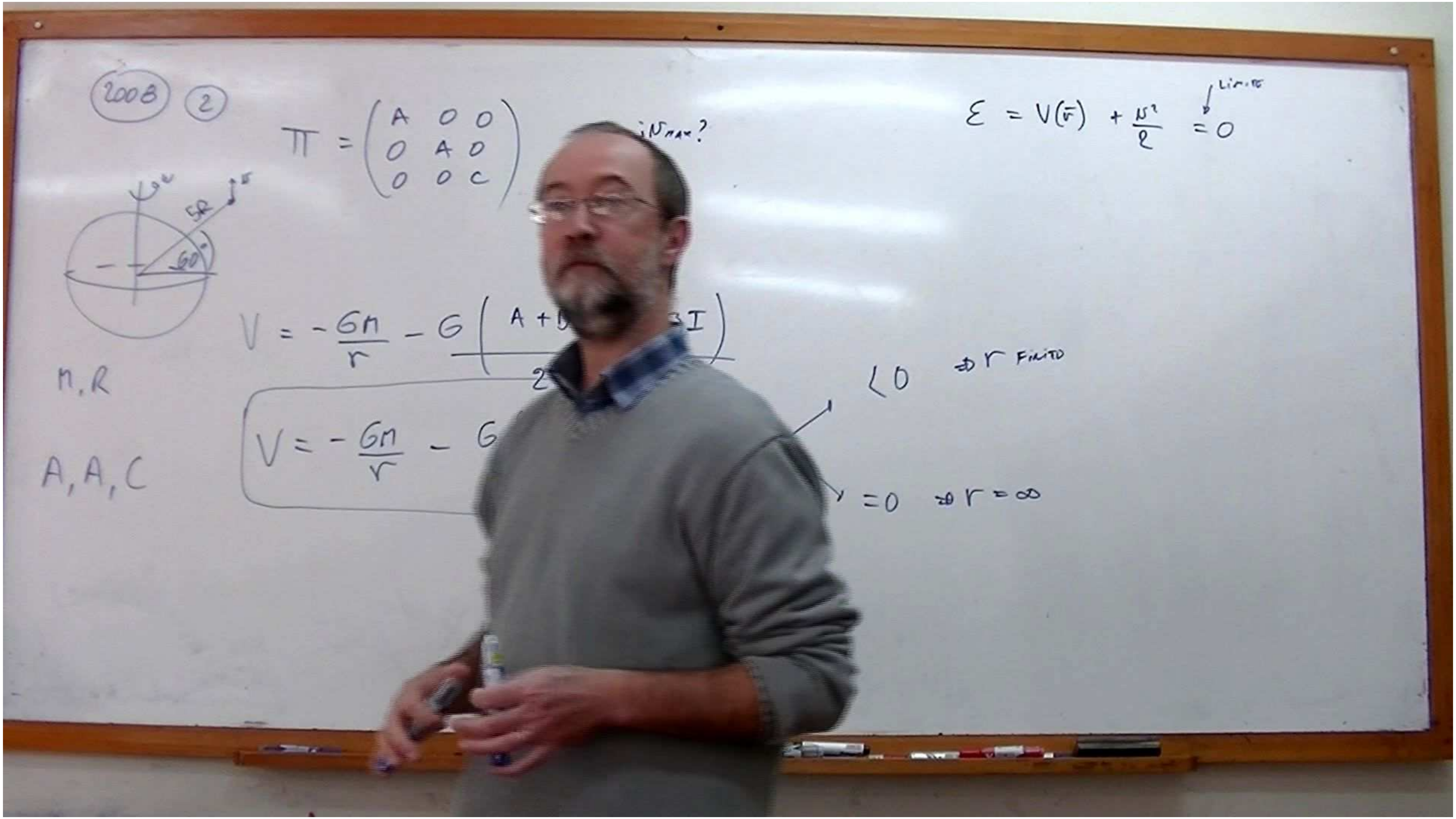
¿N_{max}?

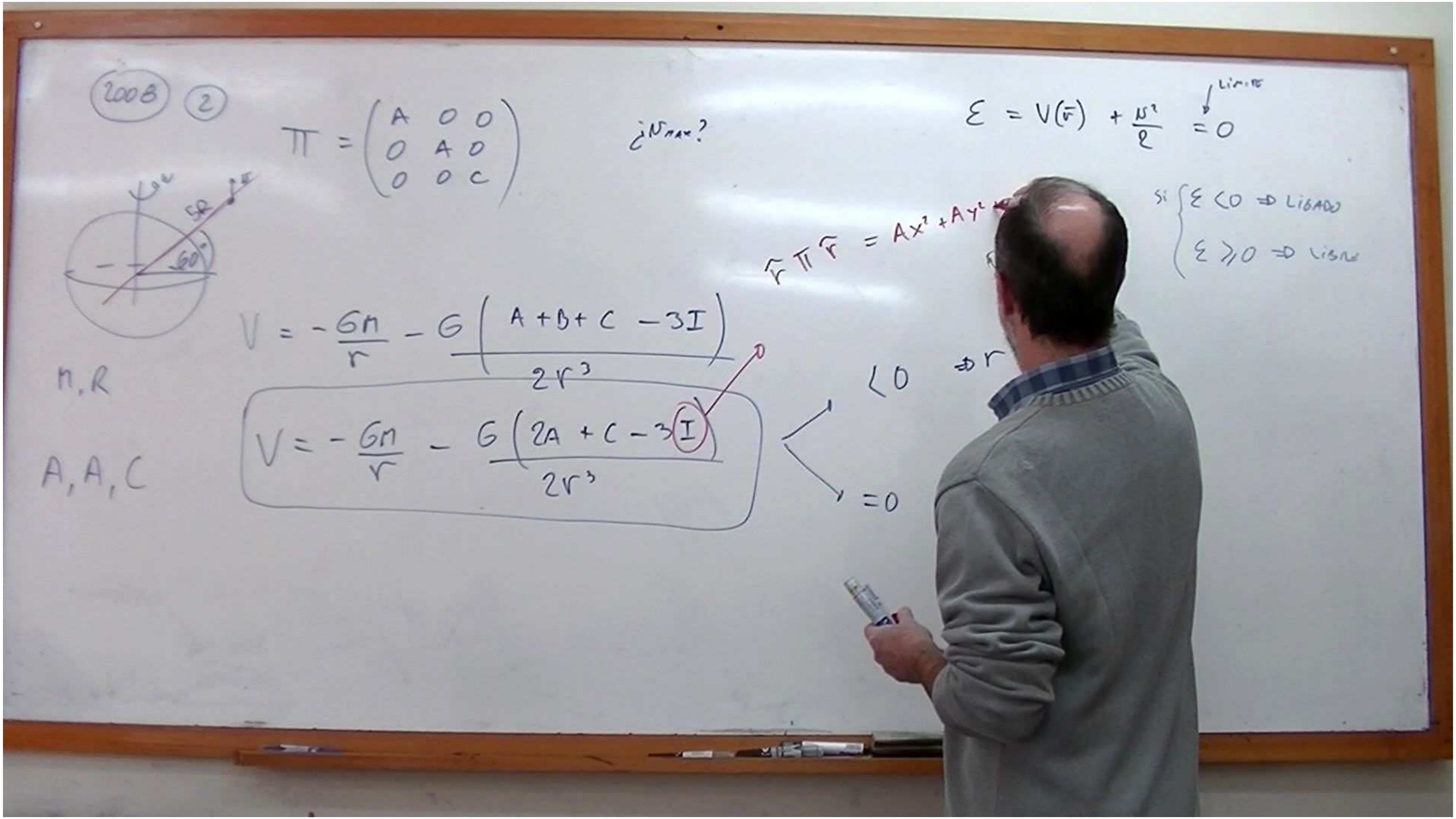
M, R

A, A, C

$V =$ $\frac{(A+B+C-3I)}{2r^3}$

$V = -$ $\frac{(2A+C-3I)}{2r^3}$


2008
2
Π = (A 0 0 / 0 A 0 / 0 0 C)
¿v max?
5R
v
60°
m, R
A, A, C
V = - Gm/r - G (A + B ... 3I) / 2
V = - Gm/r - G
E = V(r) + v²/2 = 0
Limite
< 0 ⇒ r finito
= 0 ⇒ r = ∞



2008 ②

$$\Pi = \begin{pmatrix} A & 0 & 0 \\ 0 & A & 0 \\ 0 & 0 & C \end{pmatrix}$$

¿v_{max}?

$$\mathcal{E} = V(\bar{r}) + \frac{v^2}{2} \overset{\text{Limite}}{=} 0$$

Si $\begin{cases} \mathcal{E} < 0 \Rightarrow \text{LIGADO} \\ \mathcal{E} \geq 0 \Rightarrow \text{LIBRE} \end{cases}$

$$\hat{r}\,\Pi\,\hat{r} = Ax^2 + Ay^2 +$$

$$V = -\frac{Gm}{r} - G\frac{\left(A+B+C-3I\right)}{2r^3}$$

$$\boxed{V = -\frac{Gm}{r} - G\frac{\left(2A+C-3I\right)}{2r^3}}$$

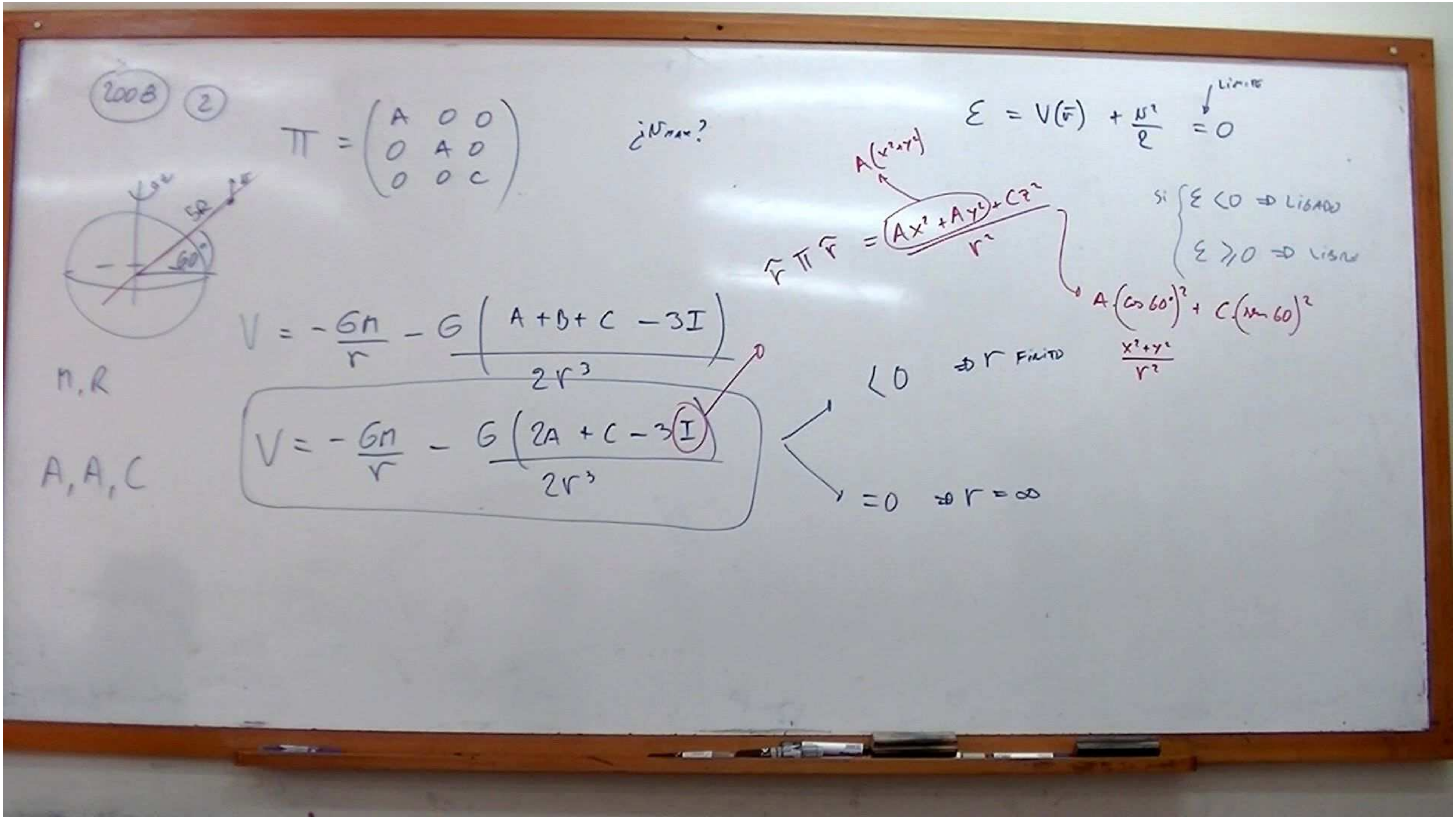
0

$< 0 \Rightarrow r$

$= 0$

m, R

A, A, C



2008 ②

$$\Pi = \begin{pmatrix} A & 0 & 0 \\ 0 & A & 0 \\ 0 & 0 & C \end{pmatrix}$$

¿v_{max}?

m, R

A, A, C

$$V = -\frac{Gm}{r} - G\frac{(A+B+C-3I)}{2r^3}$$

$$\boxed{V = -\frac{Gm}{r} - G\frac{(2A+C-3I)}{2r^3}}$$

$$\mathcal{E} = V(\bar{r}) + \frac{v^2}{2} \overset{\text{Limite}}{=} 0$$

$$\hat{r}\,\Pi\,\hat{r} = \frac{Ax^2 + Ay^2 + Cz^2}{r^2}$$

$A(x^2+y^2)$

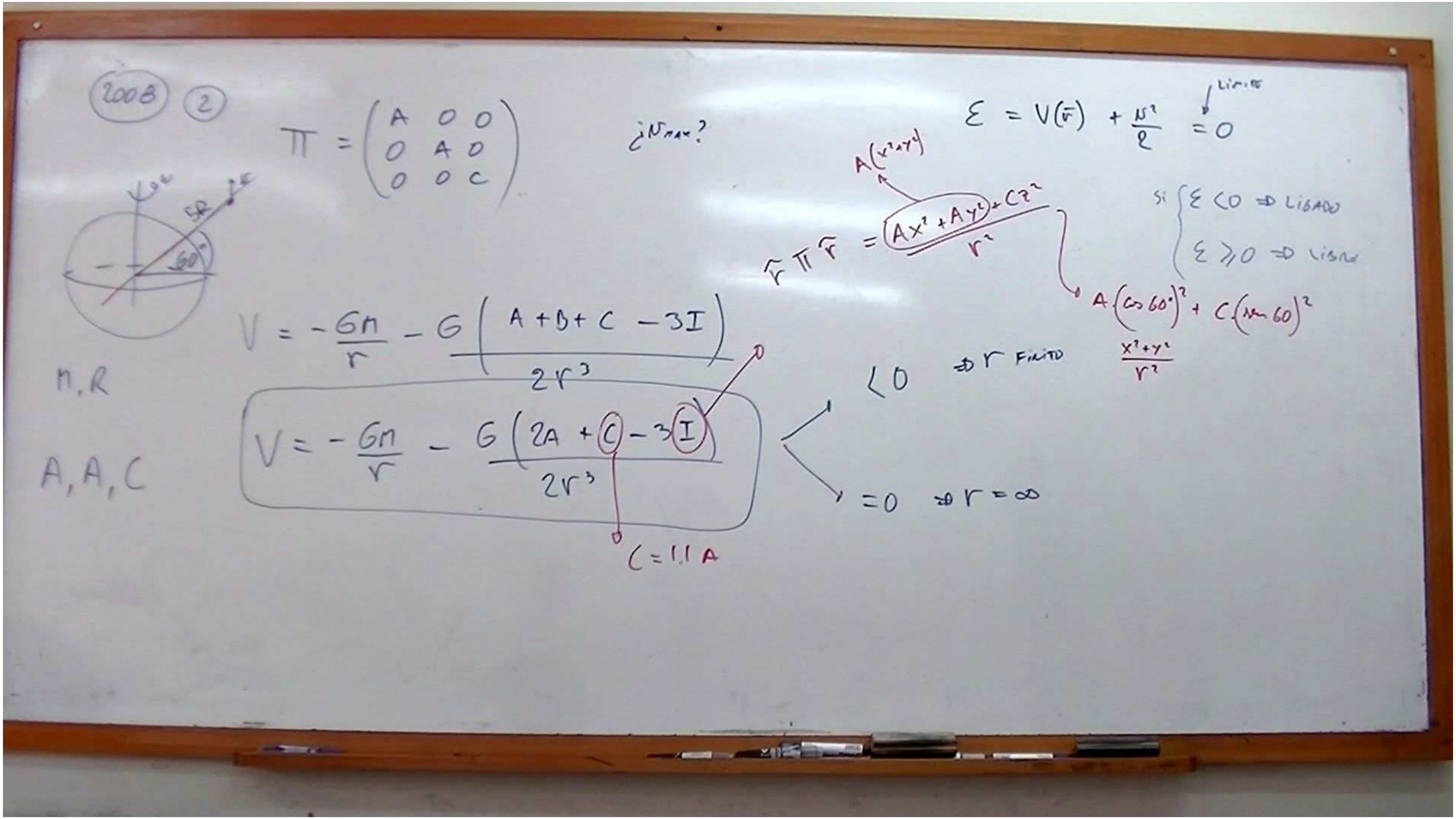
$\rightarrow A(\cos 60°)^2 + C(\sin 60)^2$

$\frac{x^2+y^2}{r^2}$

Si $\begin{cases} \mathcal{E} < 0 \Rightarrow \text{LIGADO} \\ \mathcal{E} \geq 0 \Rightarrow \text{LIBRE} \end{cases}$

$< 0 \Rightarrow r$ FINITO

$= 0 \Rightarrow r = \infty$



2008 ②

$$\Pi = \begin{pmatrix} A & 0 & 0 \\ 0 & A & 0 \\ 0 & 0 & C \end{pmatrix}$$

¿v_{max}?

m, R

A, A, C

$$V = -\frac{Gm}{r} - G\frac{(A+B+C-3I)}{2r^3}$$

$$\boxed{V = -\frac{Gm}{r} - G\frac{(2A+C-3I)}{2r^3}}$$

$C = 1.1\,A$

$<0 \Rightarrow r$ FINITO

$=0 \Rightarrow r = \infty$

$$\mathcal{E} = V(\bar{r}) + \frac{v^2}{2} \overset{\text{Limite}}{=} 0$$

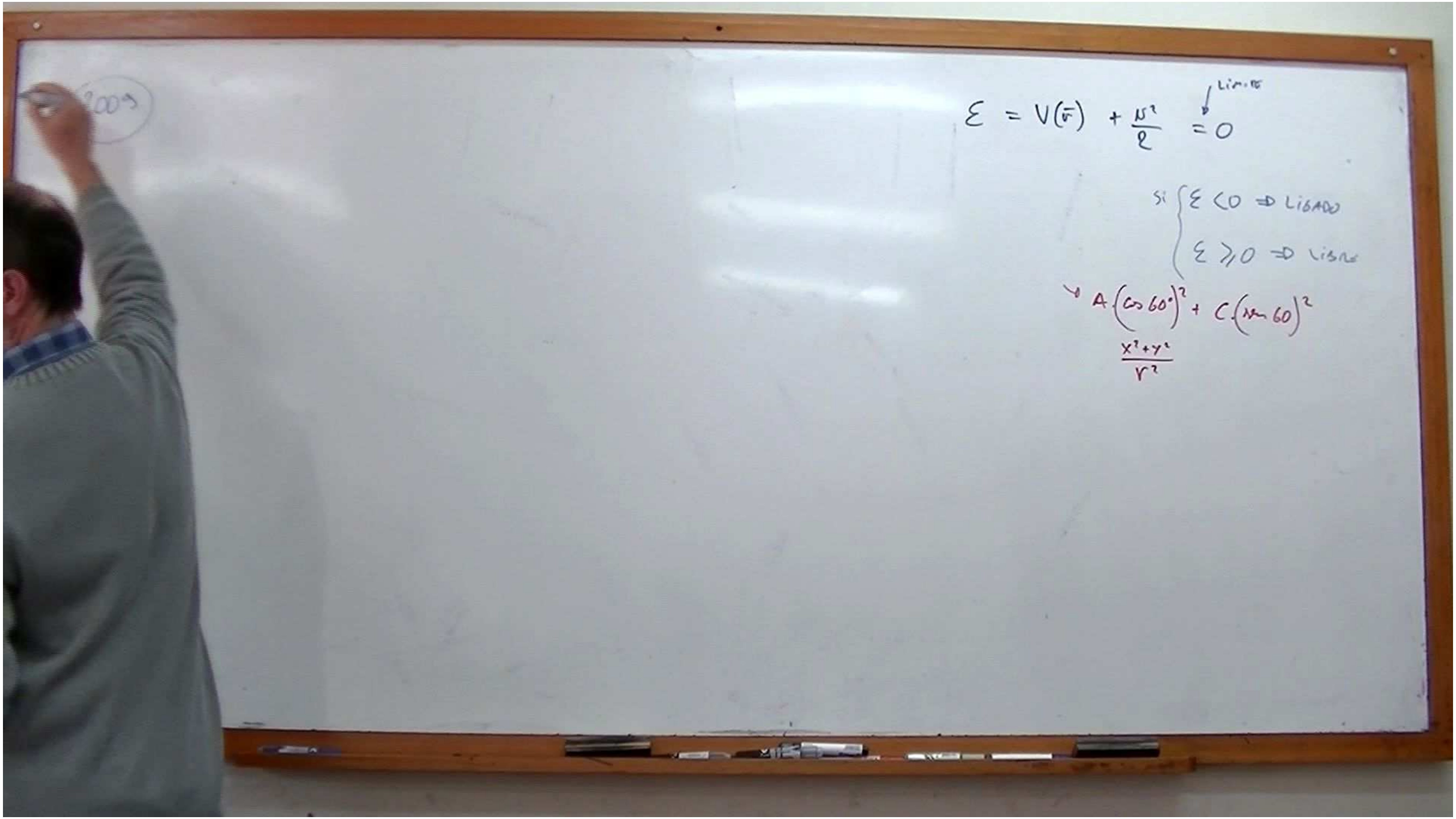
Si $\begin{cases} \mathcal{E} < 0 \Rightarrow \text{LIGADO} \\ \mathcal{E} \geq 0 \Rightarrow \text{LIBRE} \end{cases}$

$A(x^2+y^2)$

$$\hat{r}\,\Pi\,\hat{r} = \frac{Ax^2+Ay^2+Cz^2}{r^2}$$

$$A(\cos 60°)^2 + C(\text{sen } 60)^2$$

$$\frac{x^2+y^2}{r^2}$$



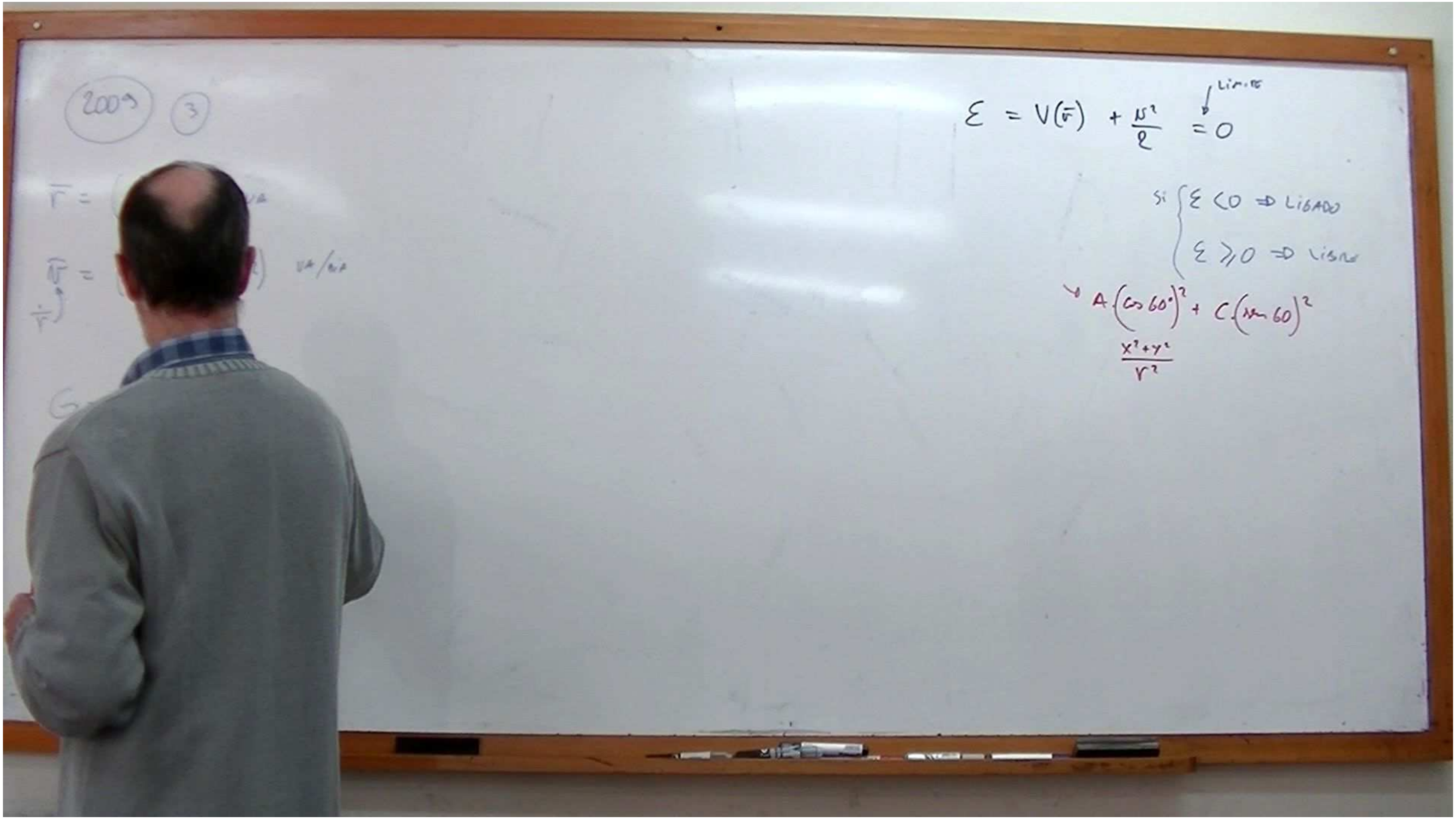
2009

$$\mathcal{E} = V(\bar{r}) + \frac{v^2}{2} \overset{\text{Limite}}{=} 0$$

$$\text{Si} \begin{cases} \mathcal{E} < 0 \Rightarrow \text{LIGADO} \\ \mathcal{E} \geq 0 \Rightarrow \text{LIBRE} \end{cases}$$

$$\to A\,(\cos 60^\circ)^2 + C\,(\text{sen}\,60)^2$$

$$\frac{x^2+y^2}{r^2}$$

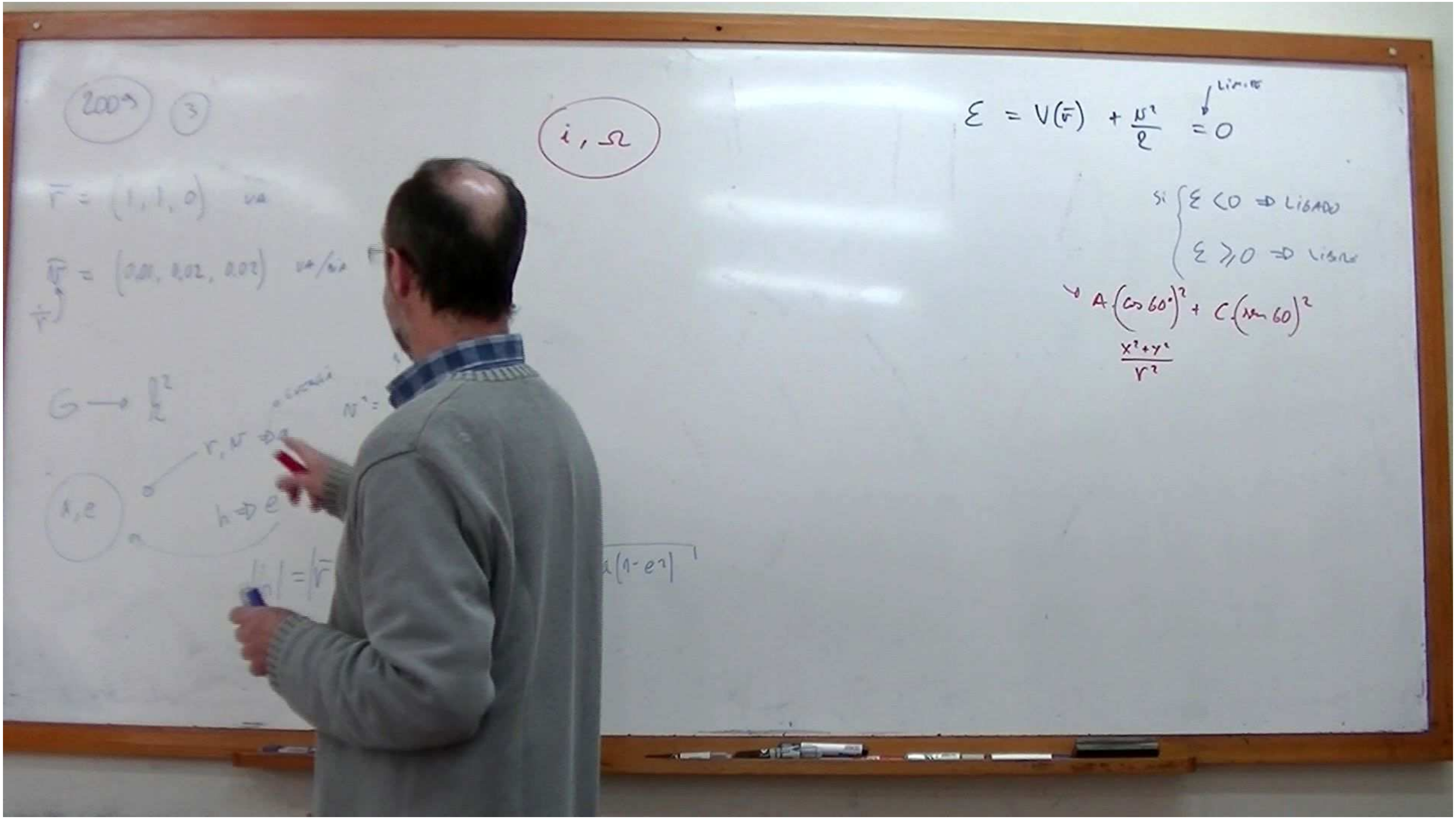


Limite

$$\mathcal{E} = V(\bar{r}) + \frac{v^2}{2} = 0$$

$$\text{Si} \begin{cases} \mathcal{E} < 0 \Rightarrow \text{LIGADO} \\ \mathcal{E} \geq 0 \Rightarrow \text{LIBRE} \end{cases}$$

$$A \cdot \underbrace{(\cos 60°)^2}_{\frac{x^2+y^2}{r^2}} + C \cdot (\operatorname{sen} 60)^2$$



2009

3

$\bar{r} = (1, 1, 0)$ UA

$\bar{v} = (0.01, 0.02, 0.02)$ UA/día

$G \rightarrow k^2$

$r, v \Rightarrow a$

a, e

$h \Rightarrow e$

$|\bar{h}| = |\bar{r}$ … $a(1-e^2)$

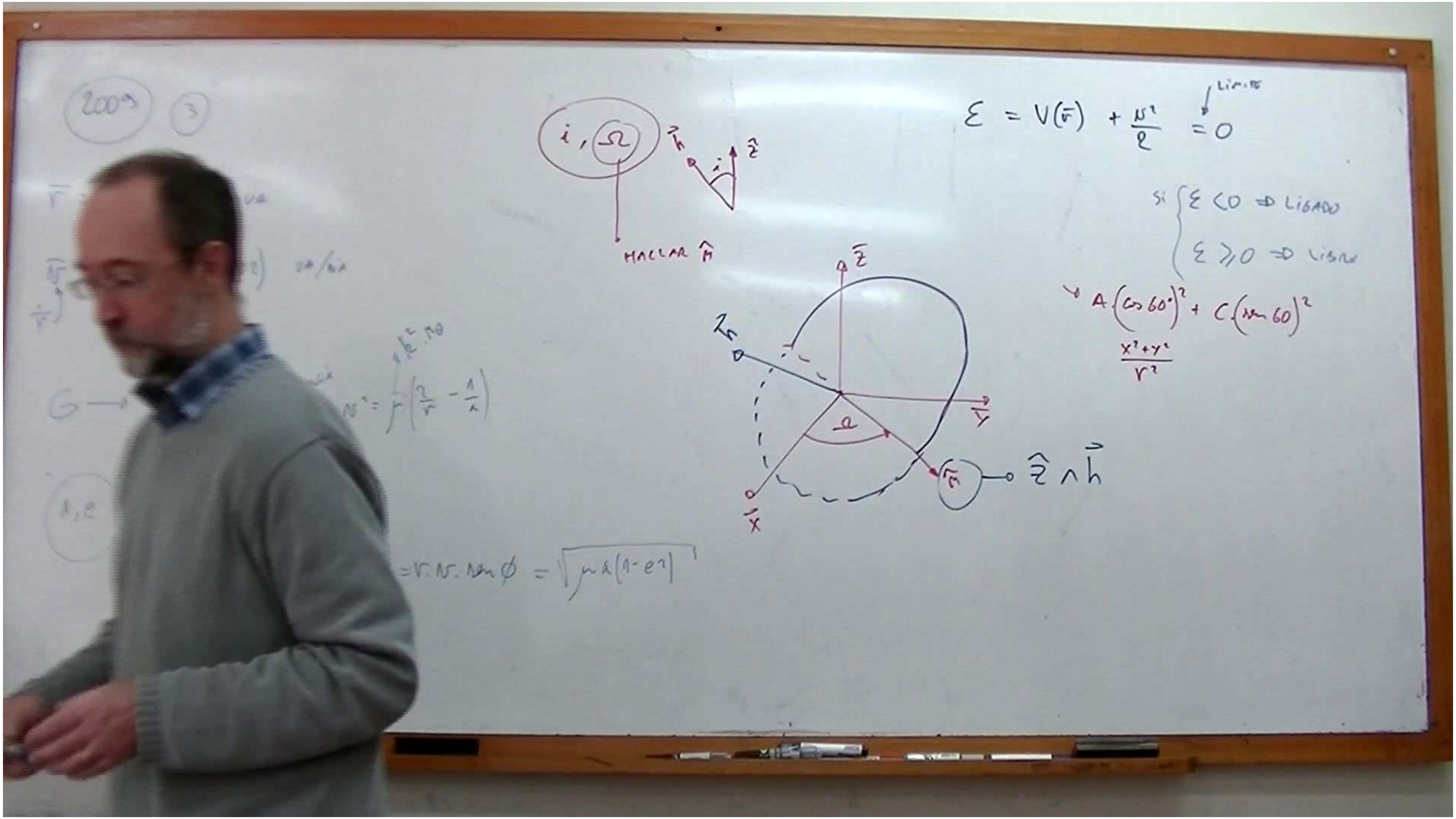
i, Ω

$$\mathcal{E} = V(\bar{r}) + \frac{v^2}{2} \overset{\text{Límite}}{=} 0$$

Si $\begin{cases} \mathcal{E} < 0 \Rightarrow \text{LIGADO} \\ \mathcal{E} \geq 0 \Rightarrow \text{LIBRE} \end{cases}$

$$A(\cos 60°)^2 + C(\operatorname{sen} 60)^2$$

$$\frac{x^2+y^2}{r^2}$$



i, Ω — HALLAR $\hat{n}$

$$\mathcal{E} = V(\bar{r}) + \frac{v^2}{2} \overset{\text{Limite}}{=} 0$$

Si $\begin{cases} \mathcal{E} < 0 \Rightarrow \text{LIGADO} \\ \mathcal{E} \geq 0 \Rightarrow \text{LIBRE} \end{cases}$

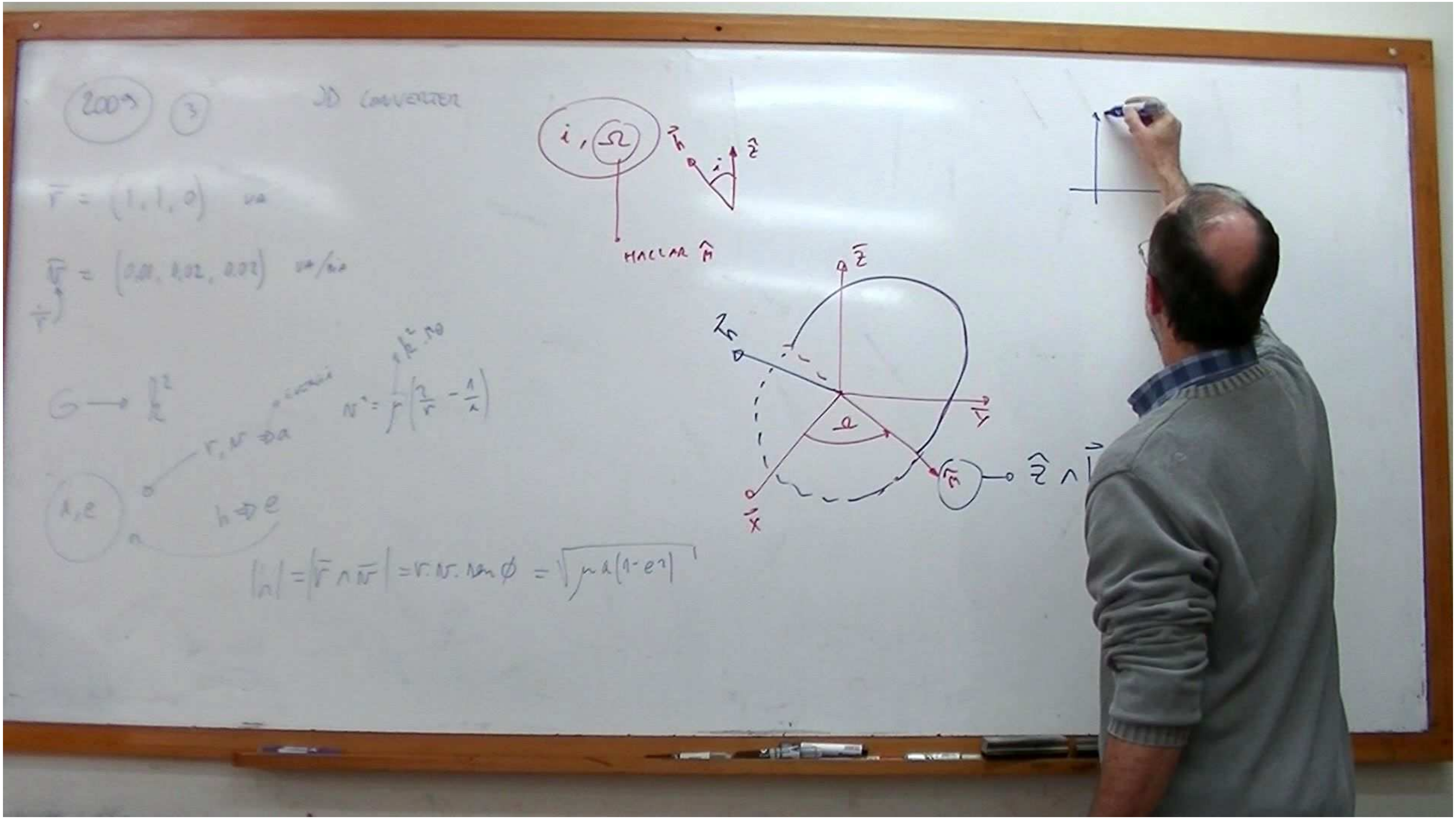
$A(\cos 60°)^2 + C(\text{sen } 60)^2$

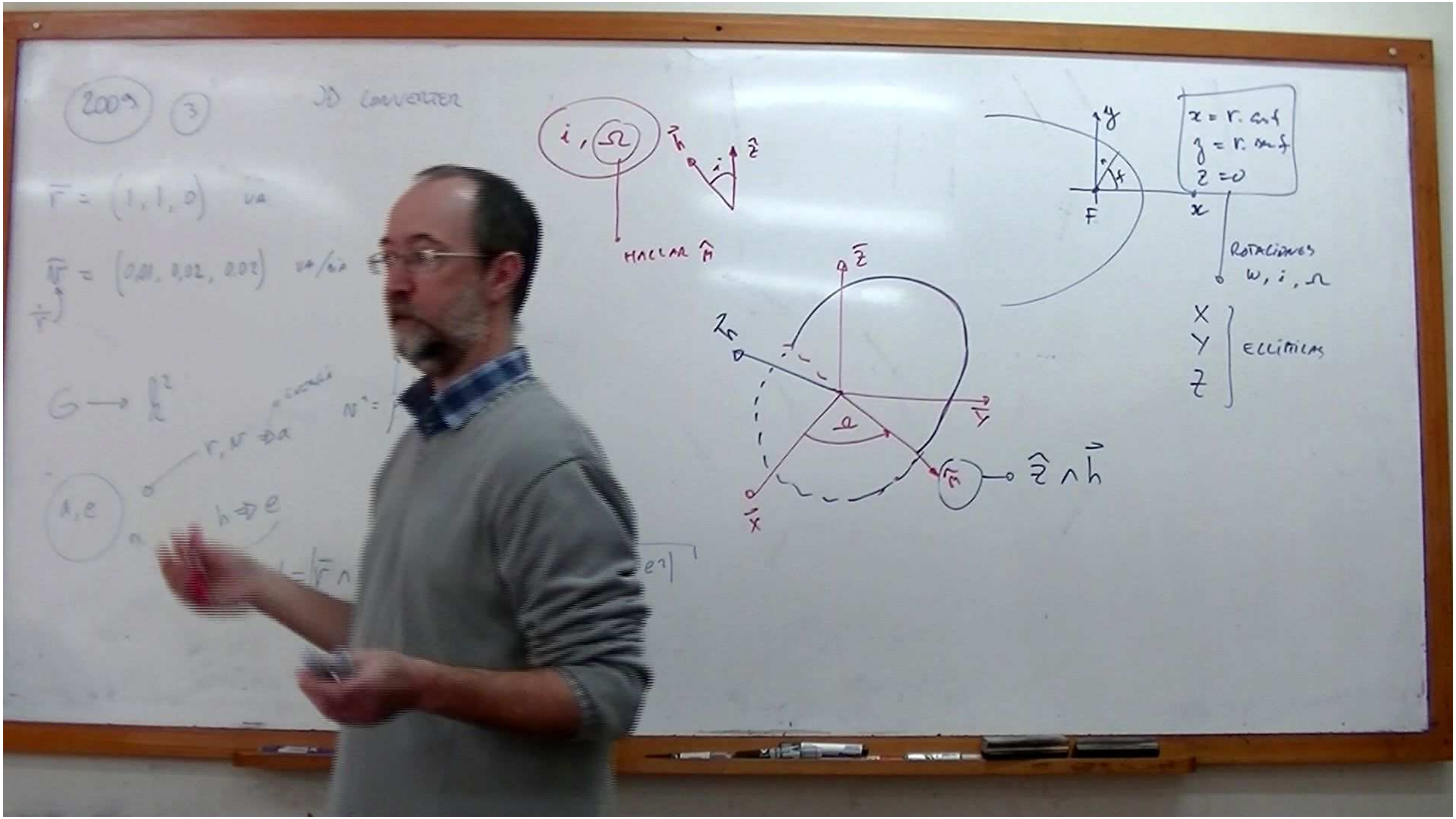
$\frac{x^2+y^2}{r^2}$

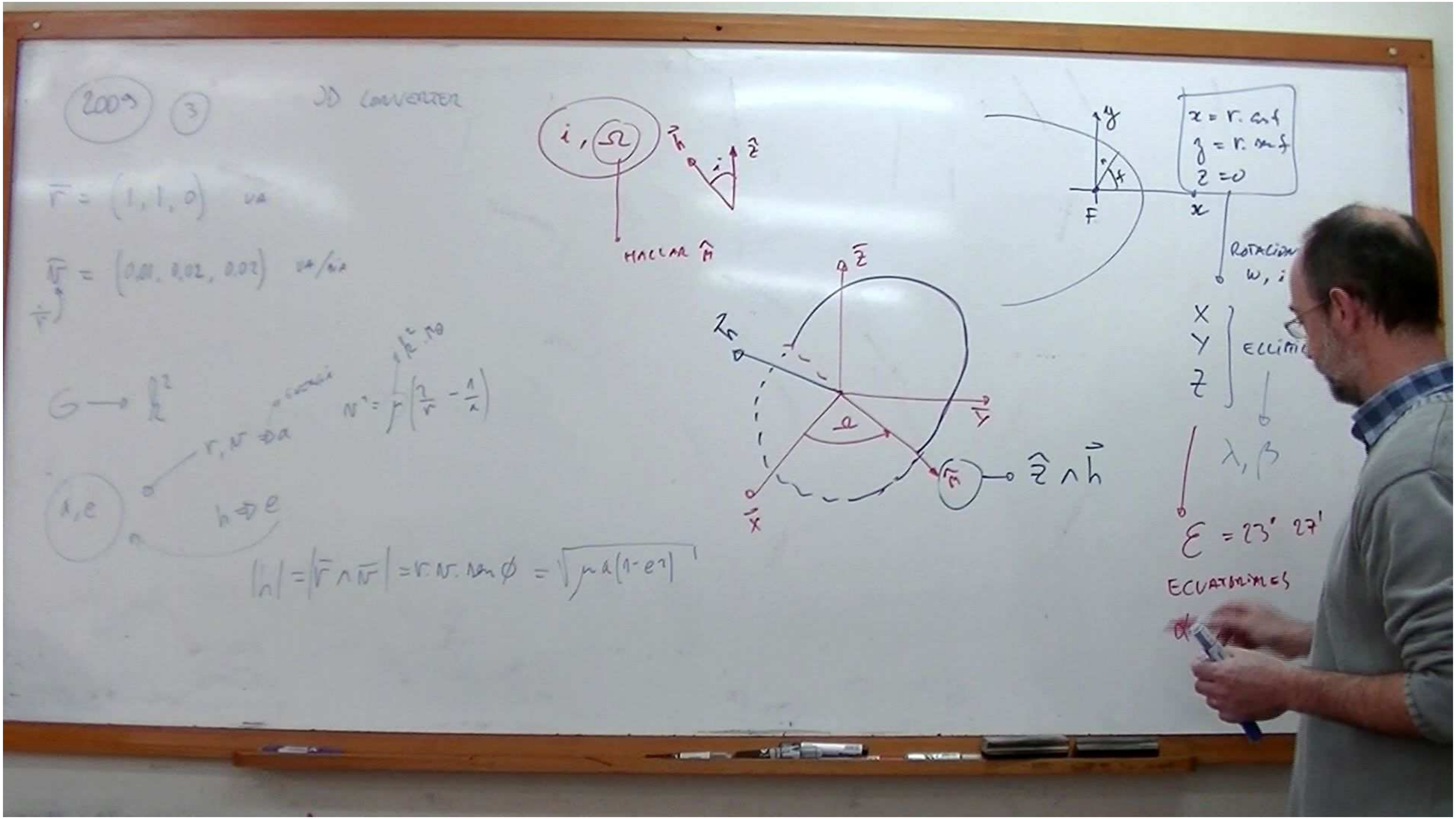
$\hat{n}$ — $\hat{z} \wedge \vec{h}$

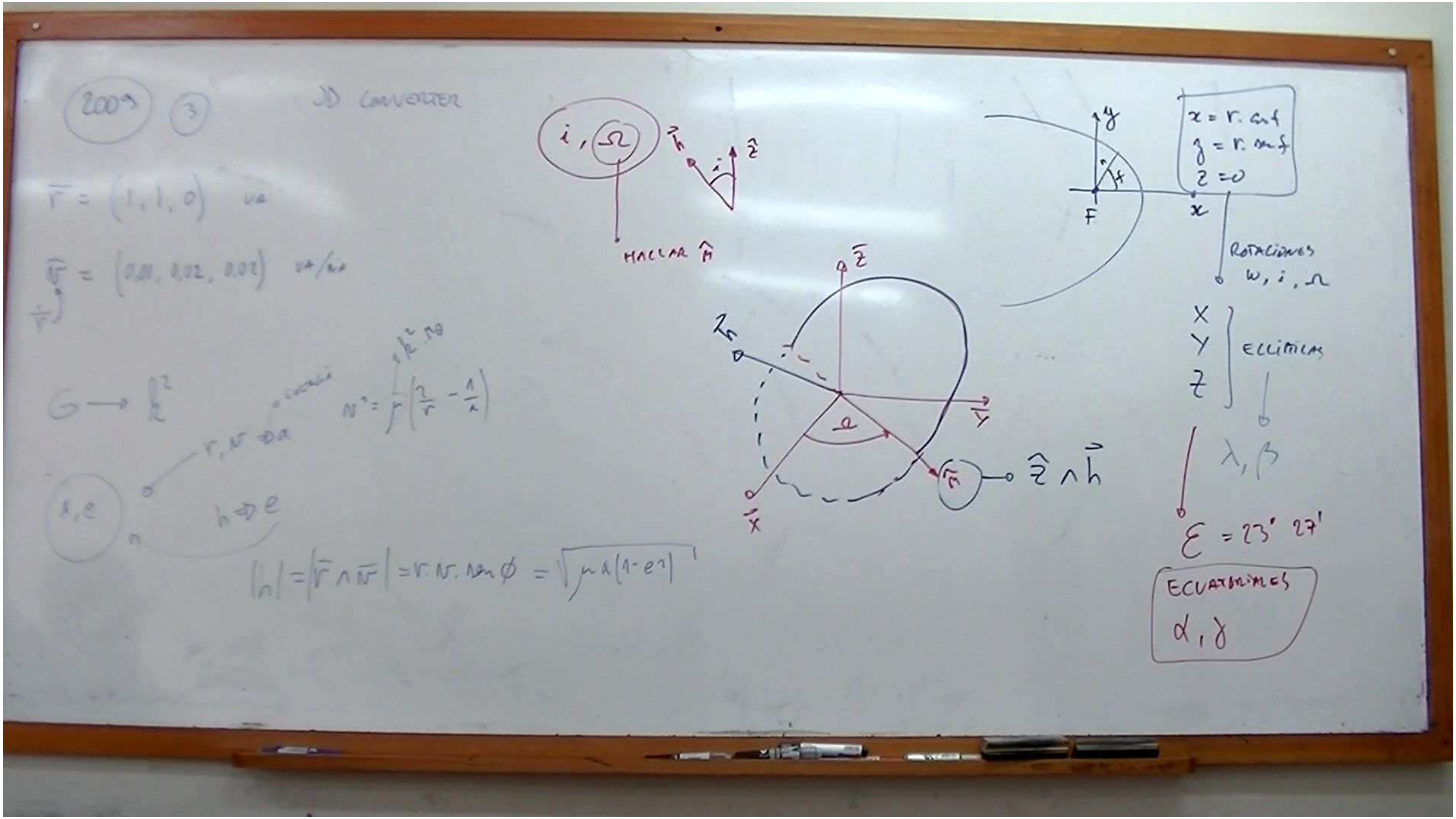
$v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$

$= r \cdot v \cdot \text{sen } \phi = \sqrt{\mu a(1-e^2)}$


2009
3
DD CONVERTER
r̄ = (1, 1, 0) ua
v̄ = (0.01, 0.02, 0.02) ua/día
G → k²
r, v ⇒ a
h, e
h ⇒ e
v² = μ (2/r − 1/a)
|h| = |r̄ ∧ v̄| = r. v. sen φ = √μa(1−e²)
i, Ω
HALLAR n̂
ĥ
ẑ
i
Z
h
Y
X
n̂
ẑ ∧ h̄


2009
3
JD CONVERTER
r̄ = (1, 1, 0) UA
v̄ = (0,01, 0,02, 0,02) UA/día
G → h²
r, v ⇒ a
a, e
h ⇒ e
i, Ω
ĥ
ẑ
i
HALLAR n̂
Z
X
Y
e
n̂
ẑ ∧ h⃗
y
f
F
x
x = r. cos f
y = r. sen f
z = 0
ROTACIONES
ω, i, Ω
X
Y
Z
ECLÍPTICAS


2009
3
3D CONVERTER
r̄ = (1, 1, 0) UA
v̄ = (0.01, 0.02, 0.02) UA/día
G → h̄
r, v ⇒ a
v² = μ(2/r − 1/a)
λ, e
h ⇒ e
|h| = |r̄ ∧ v̄| = r.v. sen φ = √(μa(1−e²))
i, Ω
HALLAR n̂
h̄
ẑ
i
Z̄
X̄
Ȳ
ω
n̂
ẑ ∧ h̄
y
x
F
f
x = r. cos f
y = r. sen f
z = 0
ROTACIÓN ω, i
X Y Z
ECLÍPTIC
λ, β
ε = 23° 27'
ECUATORIALES
α



2009 ③ JD CONVERTER

$\bar{r} = (1,1,0)$ UA

$\bar{v} = (0.01, 0.02, 0.02)$ UA/día

$\dot{\bar{r}}$

$G \longrightarrow k^2$

$v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$ $\mu = k^2 M_\odot$

a, e

r, v ⇒ a

h ⇒ e

$|h| = |\bar{r} \wedge \bar{v}| = r.v.\sin\phi = \sqrt{\mu a(1-e^2)}$

i, Ω → HALLAR $\hat{n}$

$\hat{n} \to \hat{z} \wedge \vec{h}$

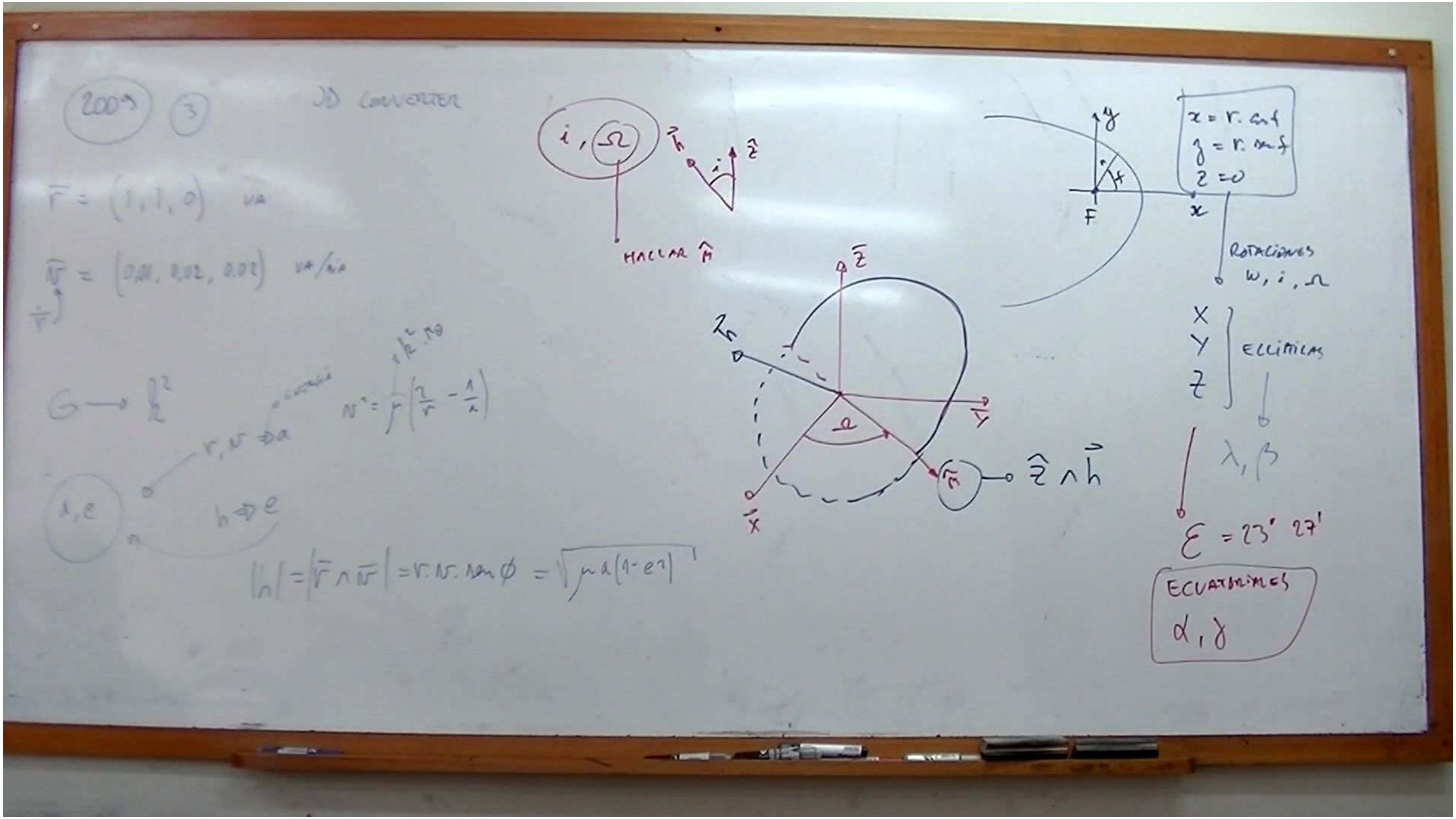
$x = r.\cos f$
$y = r.\sin f$
$z = 0$

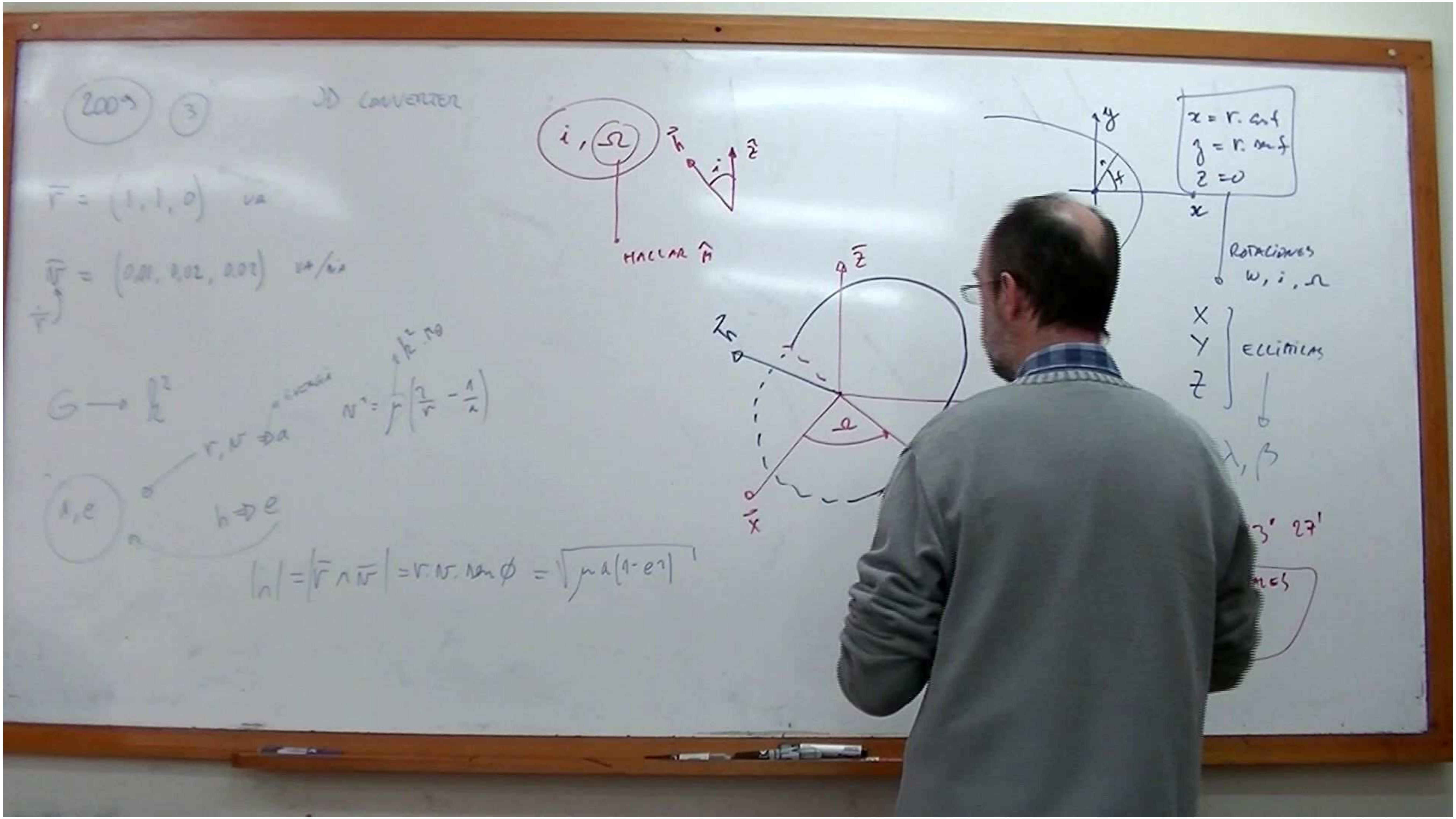
ROTACIONES ω, i, Ω

X, Y, Z } ECLÍPTICAS → λ, β

$\varepsilon = 23° 27'$

ECUATORIALES α, δ


2009
3
JD CONVERTER
r = (1, 1, 0) UA
v = (0.01, 0.02, 0.02) UA/día
ṙ
G → h²
r, v ⇒ a
v² = μ(2/r − 1/a)
λ, e
h ⇒ e
|h| = |r ∧ v| = r.v. sen φ = √μa(1−e²)
i, Ω
HALLAR n̂
h
ẑ
i
Z
Y
X
n̂
ẑ ∧ h
y
x
F
f
x = r. cos f
y = r. sen f
z = 0
ROTACIONES ω, i, Ω
X
Y
Z
ECLIPTICAS
λ, β
ε = 23° 27'
ECUATORIALES
α, δ


2009
3
JD CONVERTER
r̄ = (1, 1, 0) UA
v̄ = (0.01, 0.02, 0.02) UA/día
G → k²
r, v ⇒ a
v² = μ(2/r − 1/a)
k² ~ μ
a, e
h ⇒ e
|h| = |r̄ ∧ v̄| = r.v. sen ϕ = √(μ a(1−e²))
i, Ω
HALLAR ĥ
ĥ
ẑ
i
Z̄
X̄
Ω
y
x
f
x = r. cos f
y = r. sen f
z = 0
ROTACIONES
ω, i, Ω
X
Y
Z
ECLÍPTICAS
λ, β
3' 27'


IV
②
Sn

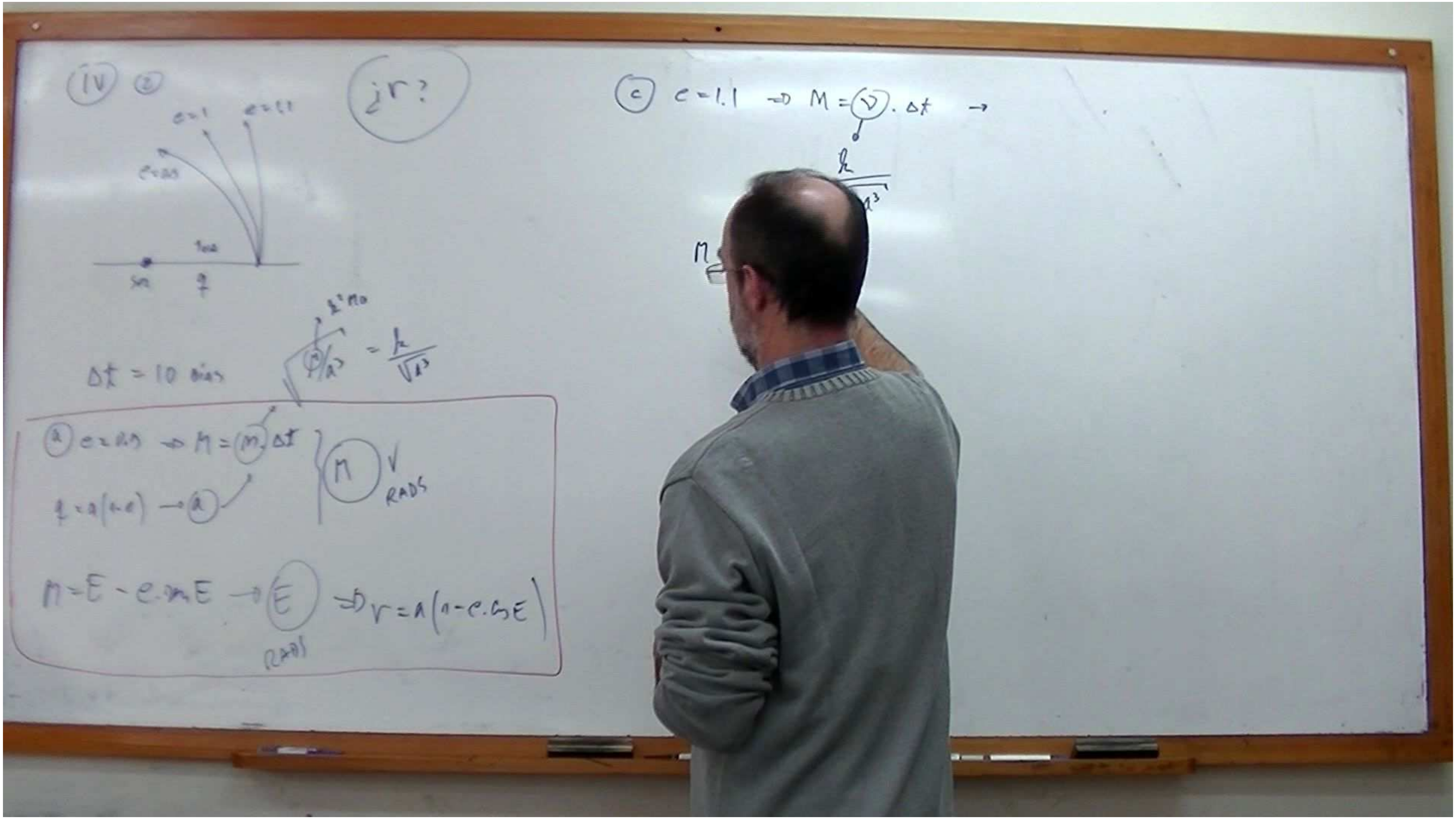

IV
2
e=1
e=1.1
e=0.5
Sn
Δt = 10 días
a
e=0.5 → M =

$\Delta t = 10$ días

ⓐ $e = 0.5 \rightarrow M = n \cdot \Delta t$

$q = a(1-e) \rightarrow a$

$M = E - e \cdot \sin E \rightarrow E$



Ⓘⓥ ②

¿r?

Δt = 10 días

$\sqrt{\mu/a^3} = \frac{k}{\sqrt{a^3}}$ $\quad \mu = k^2 m_0$

ⓐ $e = 0.5 \Rightarrow M = n.\Delta t$

$q = a(1-e) \rightarrow a$

M ✓ RADS

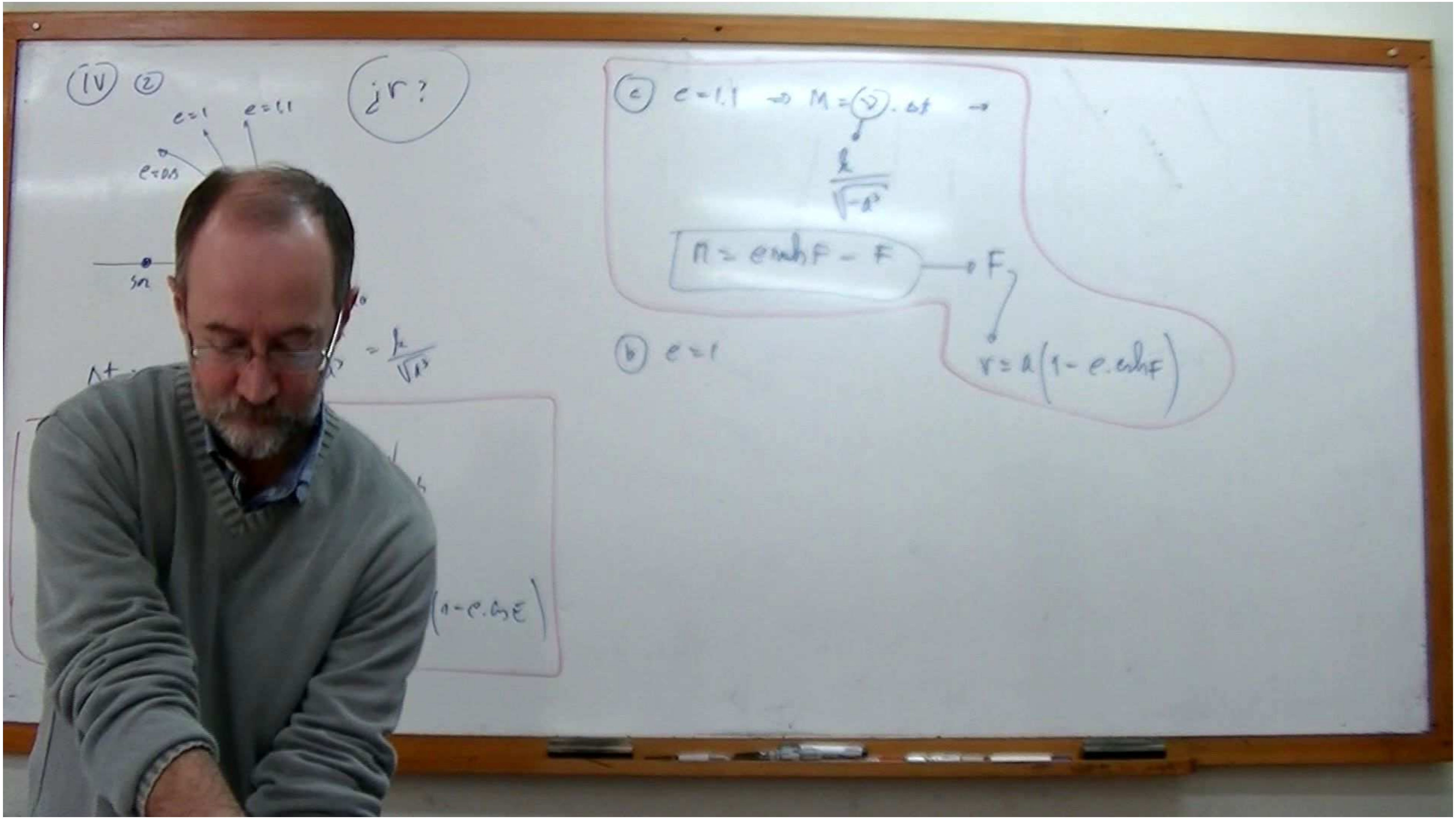
$M = E - e.\sin E \rightarrow E \Rightarrow r = a(1 - e.\cos E)$

RADS

ⓒ $e = 1.1 \Rightarrow M = \nu.\Delta t \rightarrow$

$\frac{k}{\sqrt{a^3}}$

M



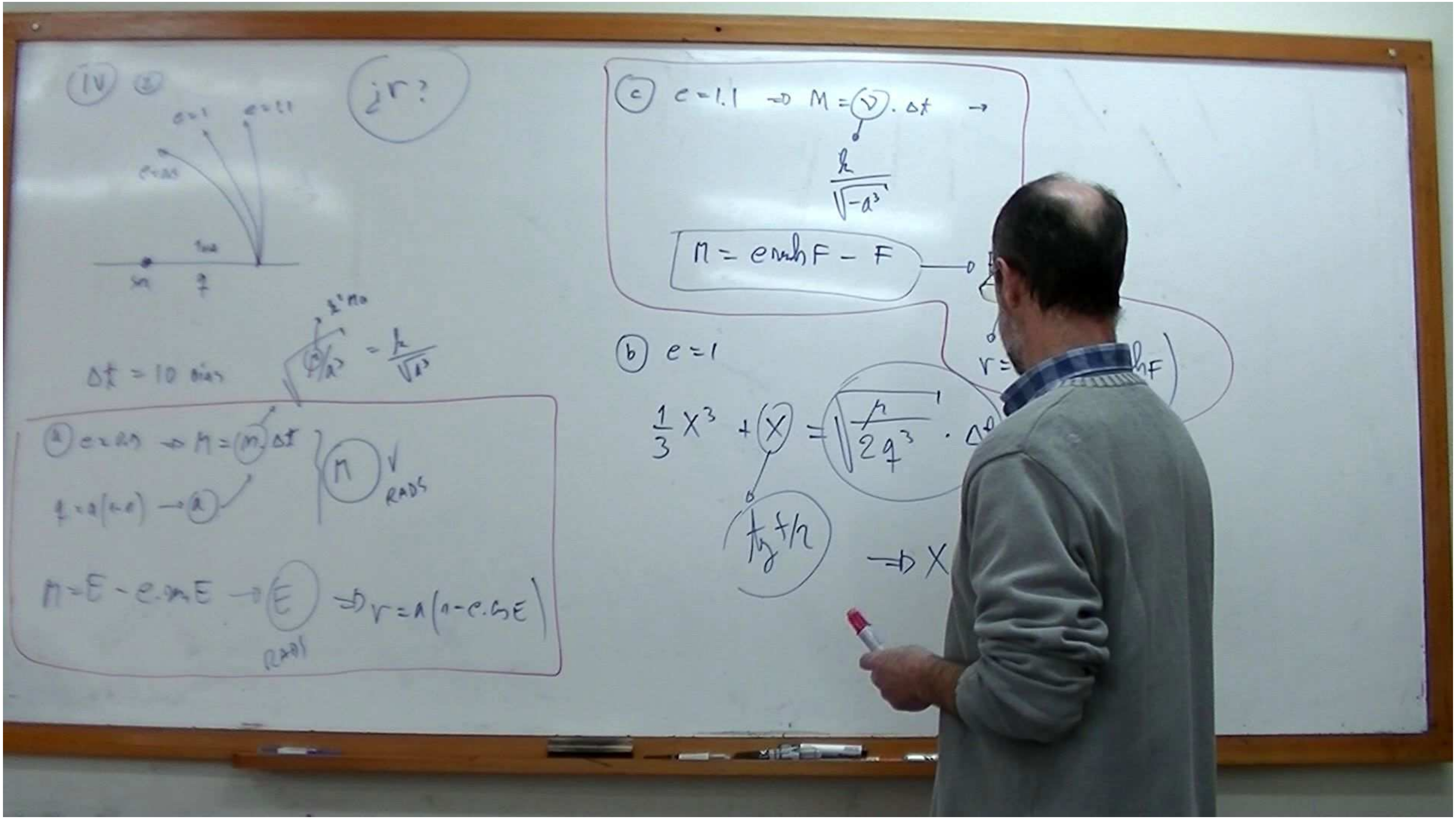
c $e = 1.1 \rightarrow M = (\nu).\Delta t \rightarrow$

$\frac{k}{\sqrt{-a^3}}$

$$\boxed{M = e\sinh F - F} \rightarrow F$$

$$r = a\left(1 - e.\cosh F\right)$$

b $e = 1$



$\Delta t = 10$ días

$\sqrt{k^2 M_0 / a^3} = \frac{k}{\sqrt{a^3}}$

ⓐ $e=0.5 \to M = n \cdot \Delta t$

$q = a(1-e) \to a$

n √ RADS

$M = E - e \cdot \text{sen} E \to E$ RADS $\Rightarrow r = a(1 - e \cdot \cos E)$

ⓒ $e = 1.1 \to M = \nu \cdot \Delta t \to$

$\frac{k}{\sqrt{-a^3}}$

$M = e \,\text{senh} F - F \to$

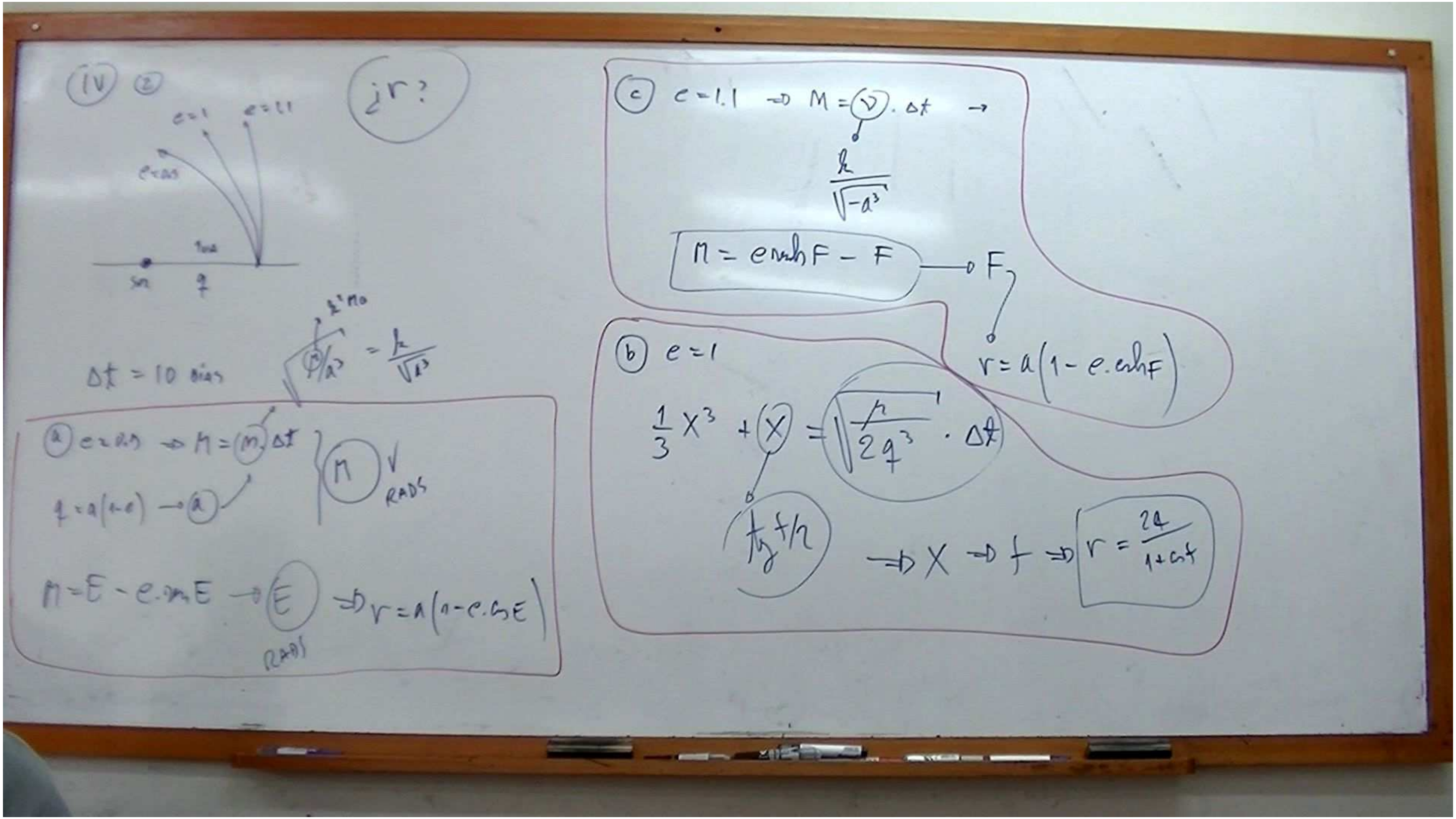
$r = \ldots hF)$

ⓑ $e = 1$

$\frac{1}{3} X^3 + X = \sqrt{\frac{k}{2q^3}} \cdot \Delta t$

$\text{tg} f/2$

$\Rightarrow X$



(IV) ②

¿r?

$\Delta t = 10$ días

$\sqrt{\mu / a^3} = \frac{k}{\sqrt{a^3}}$ $\quad k^2 M_\odot$

ⓐ $e = 0.5 \Rightarrow M = n \cdot \Delta t$

$q = a(1-e) \to a$

M ✓ RADS

$M = E - e \cdot \operatorname{sen} E \to E$ (RADS) $\Rightarrow r = a(1 - e \cdot \cos E)$

ⓒ $e = 1.1 \Rightarrow M = \nu \cdot \Delta t \to$

$\nu = \frac{k}{\sqrt{-a^3}}$

$M = e \operatorname{senh} F - F \to F$

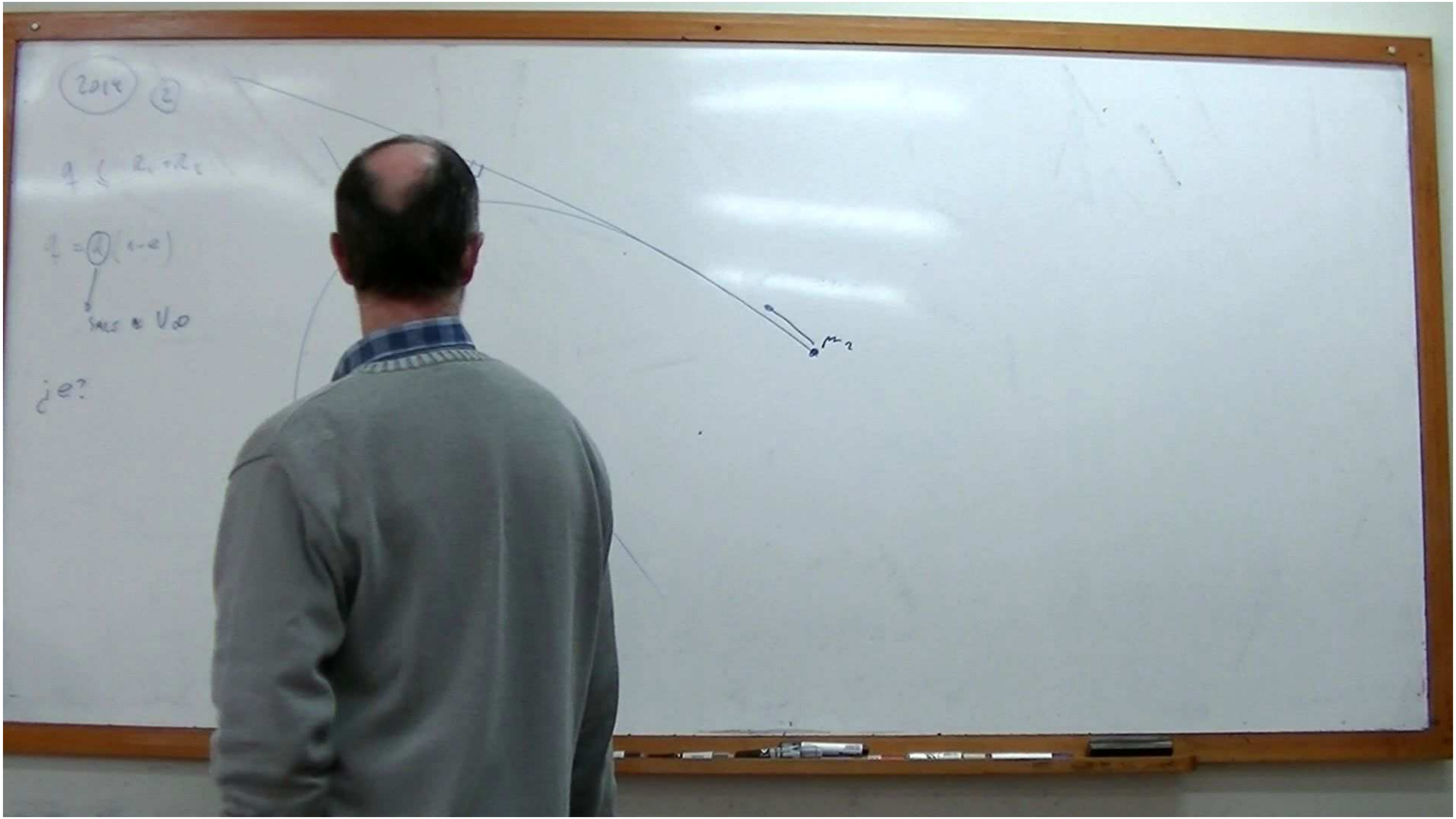
$r = a(1 - e \cdot \cosh F)$

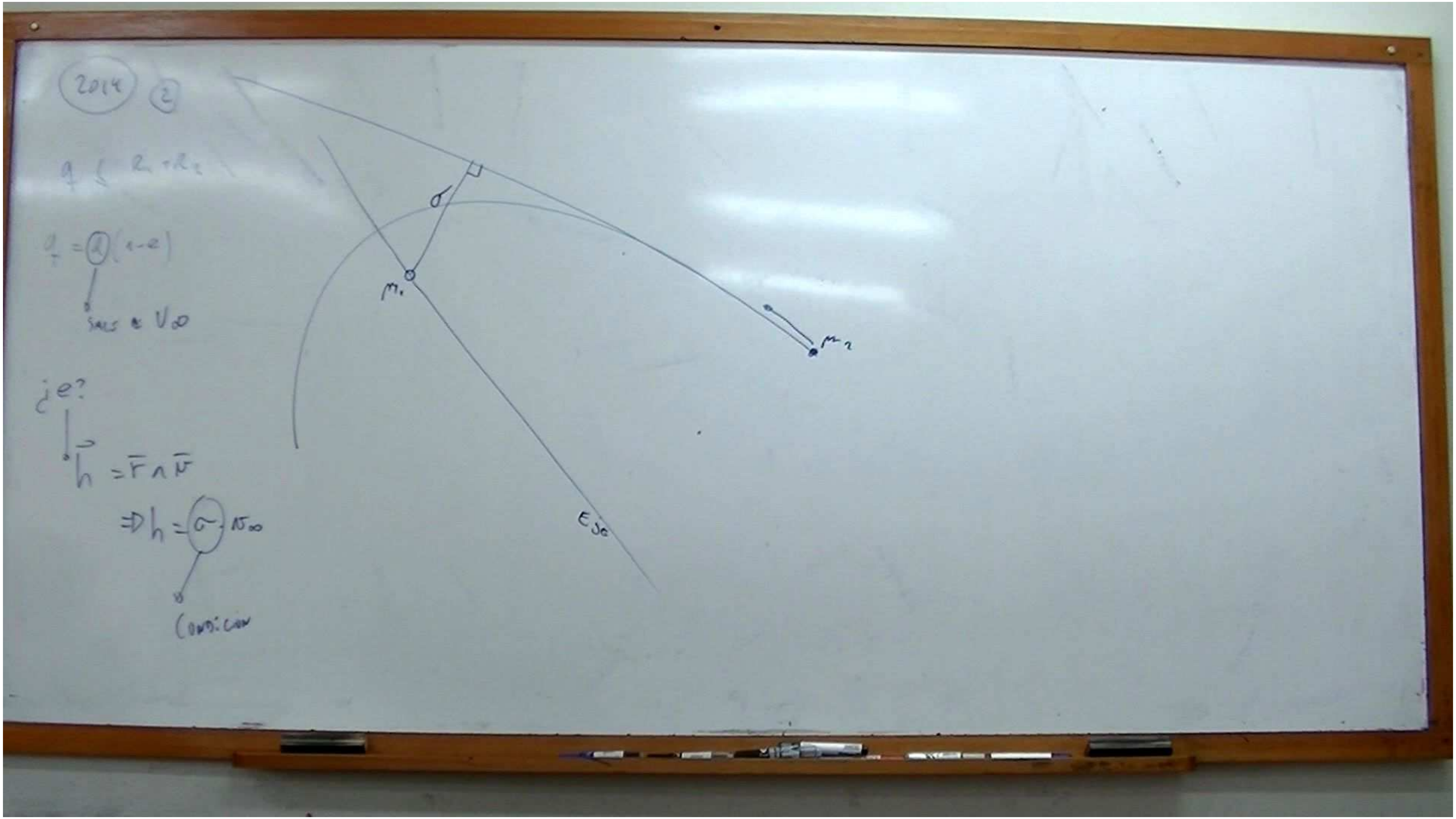
ⓑ $e = 1$

$\frac{1}{3} X^3 + X = \sqrt{\frac{k}{2q^3}} \cdot \Delta t$

$X = \operatorname{tg} f/2$

$\Rightarrow X \Rightarrow f \Rightarrow \boxed{r = \frac{2q}{1 + \cos f}}$


2014
2
q ≤ R1+R2
q = a (1-e)
sale a V∞
¿e?
m2



$\boxed{2014}$ ②

$q \leq R_1 + R_2$

$q = \boxed{a}(1-e)$

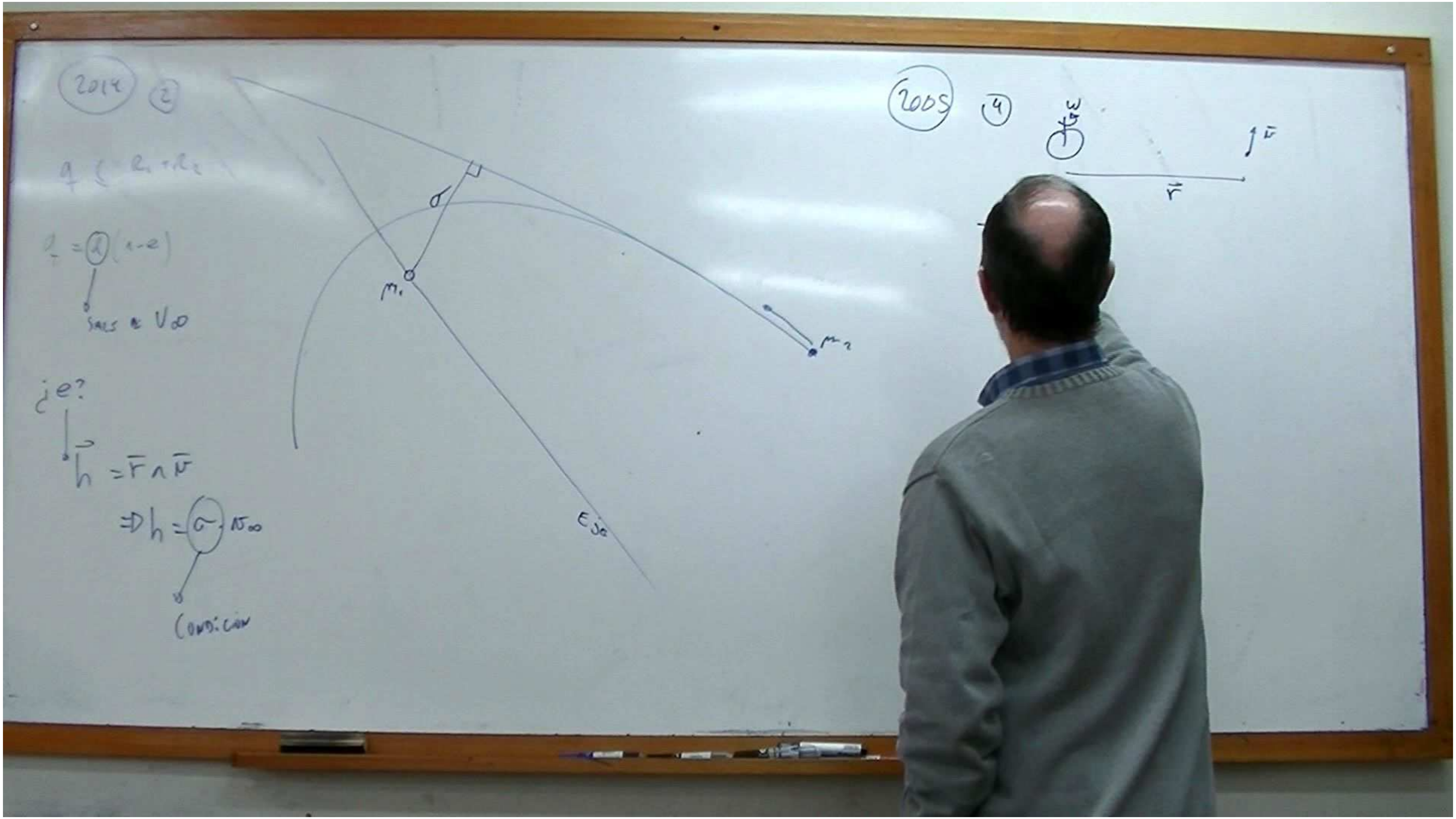
sale de V_∞

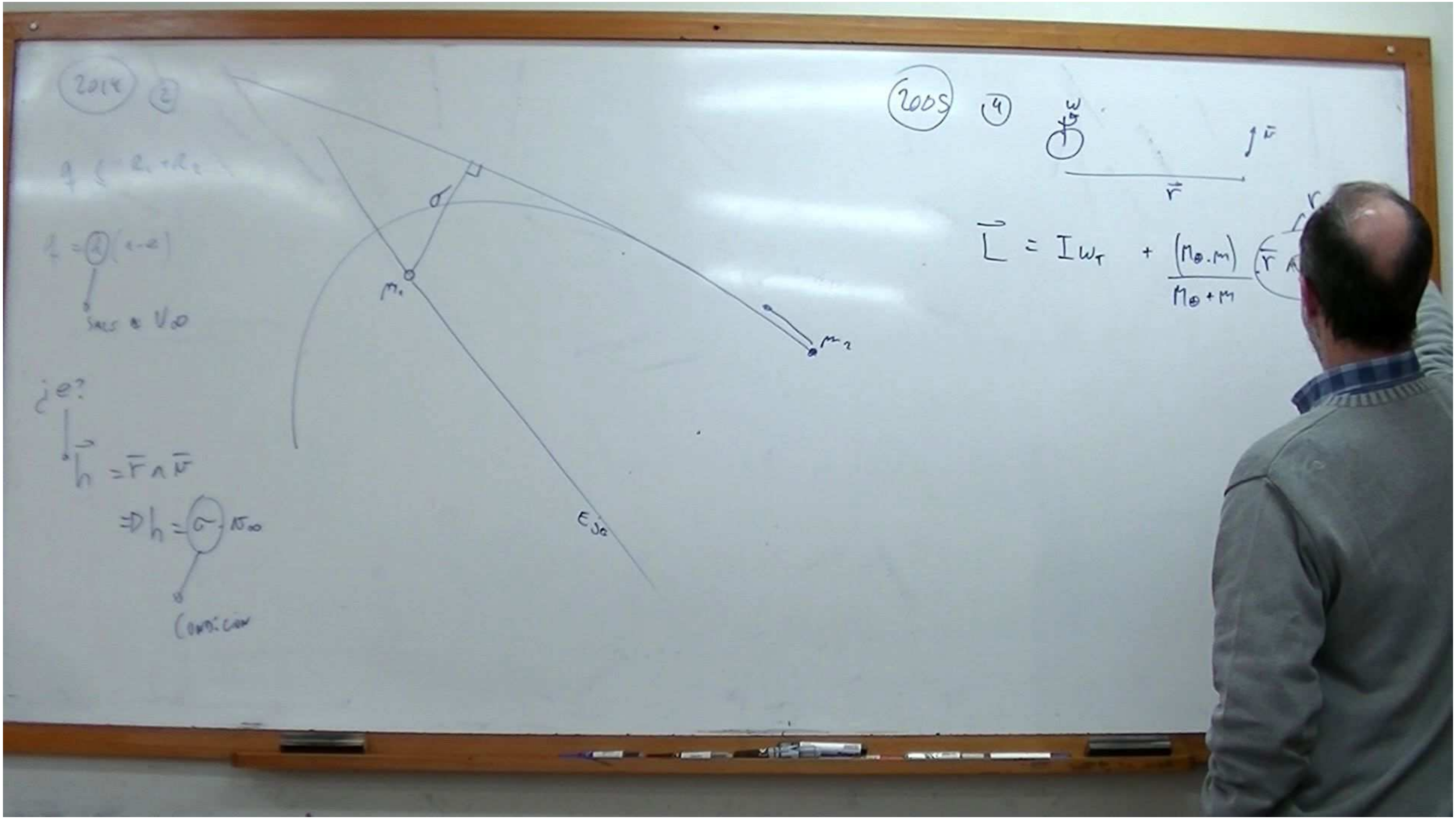
¿e?

$\vec{h} = \bar{r} \wedge \bar{v}$

$\Rightarrow h = \boxed{\sigma} \cdot v_\infty$

condicion


2014
2
q < R1+R2
q = a (1-e)
sale de V∞
¿e?
h = r ∧ v
⇒ h = σ · v∞
CONDICIÓN
σ
m1
m2
Eje
2005
4
ω
v
r



$q \leq R_1 + R_2$

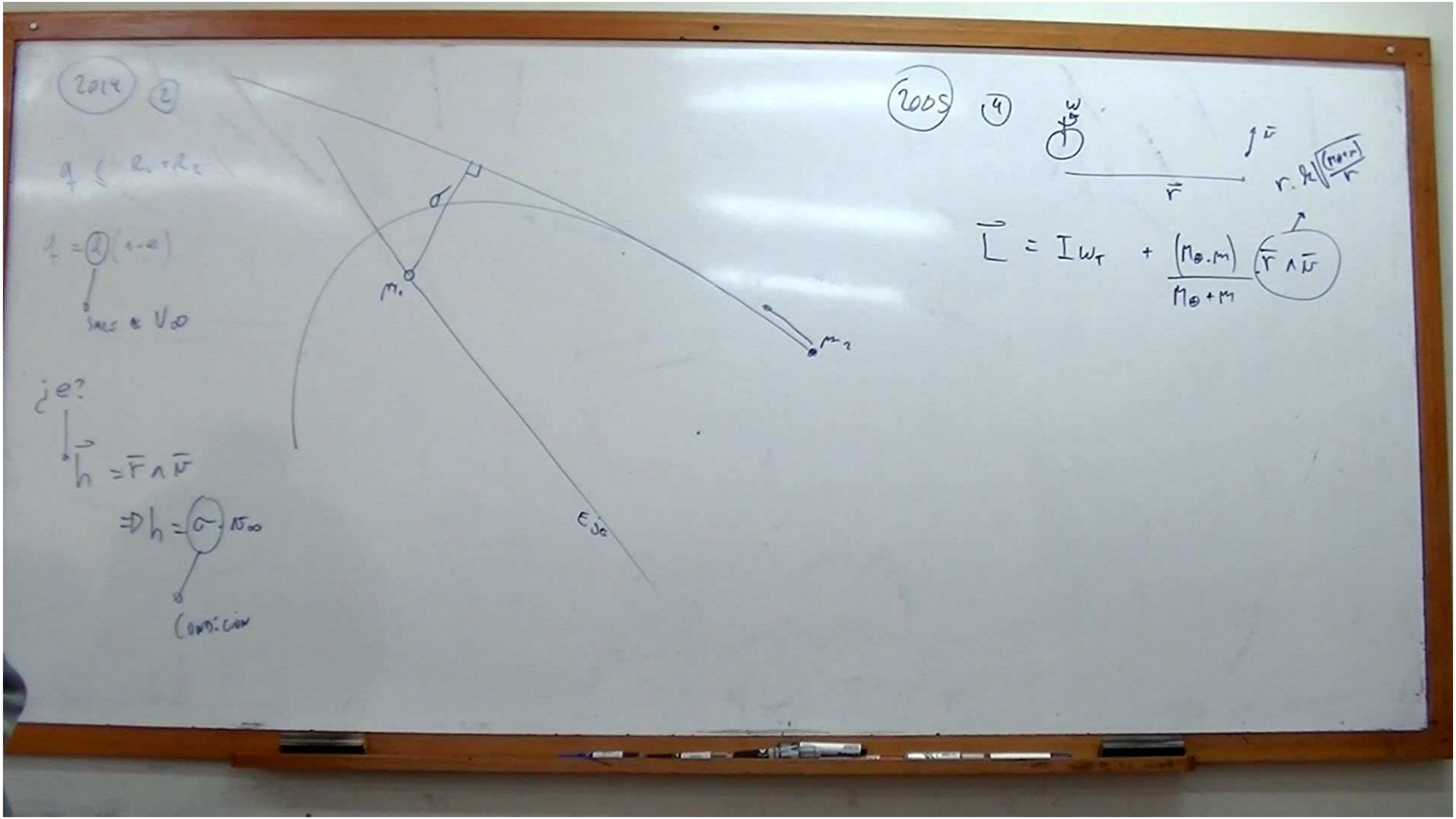
$q = \boxed{a}(1-e)$ → sale de V_∞

¿e?

$\vec{h} = \bar{r} \wedge \bar{v}$

$\Rightarrow h = \boxed{\sigma} \cdot v_\infty$ → condición

$$\vec{L} = I\omega_T + \frac{(M_\oplus \cdot m)}{M_\oplus + m}\,(\vec{r} \wedge$$



2014 ②

$q < R_1 + R_2$

$q = \boxed{a}(1-e)$

SALE DE V_∞

¿e?

$\vec{h} = \bar{r} \wedge \bar{v}$

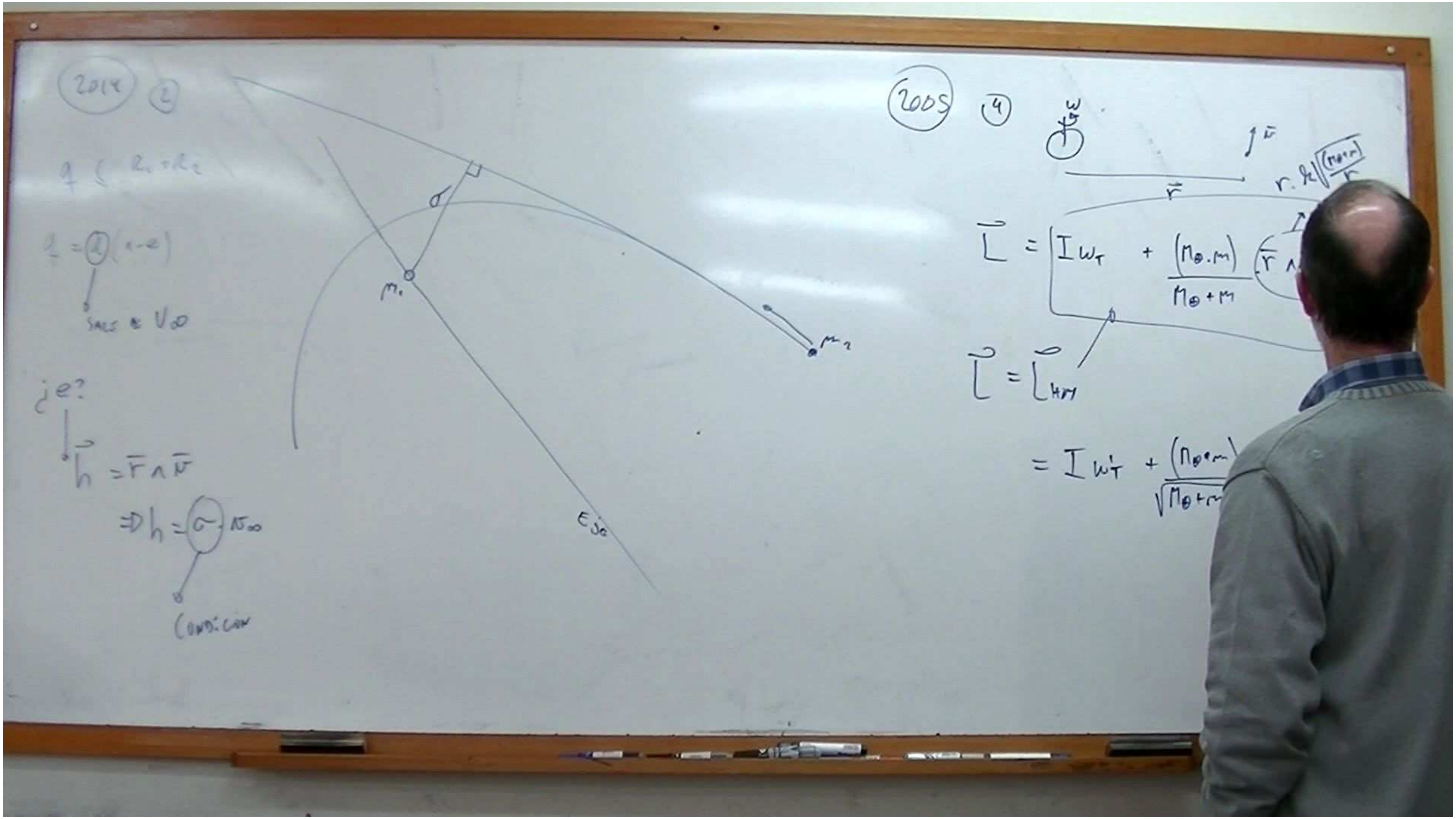
$\Rightarrow h = \sigma \cdot v_\infty$

CONDICIÓN

2005 ④

$r . k\sqrt{\frac{(M_\oplus + m)}{r}}$

$$\vec{L} = I\omega_T + \frac{(M_\oplus . m)}{M_\oplus + m} \bar{r} \wedge \bar{v}$$



$q \leq R_1 + R_2$

$q = a(1-e)$

¿e?

$\vec{h} = \bar{r} \wedge \bar{v}$

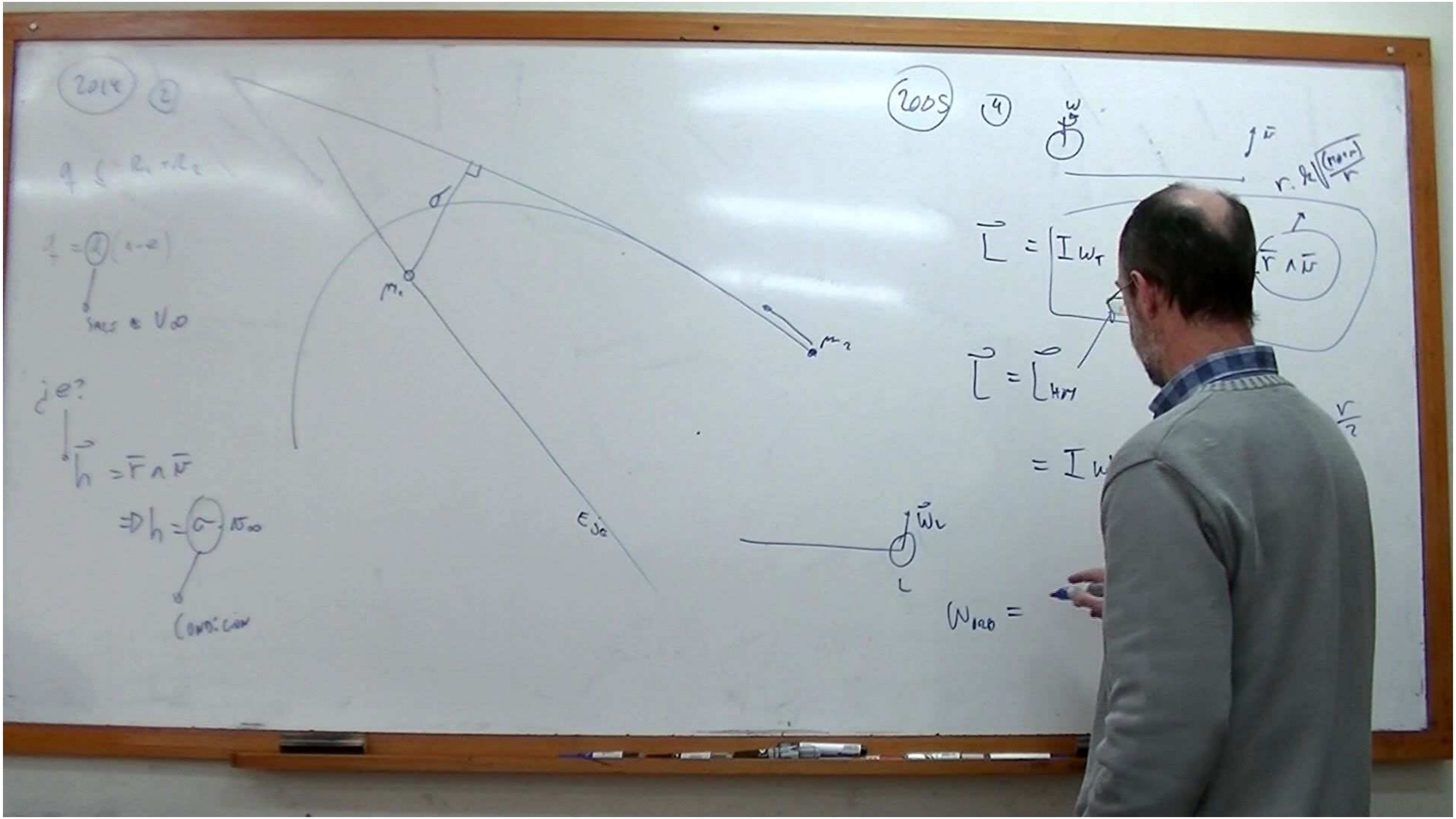
$\Rightarrow h = \sigma \cdot v_\infty$

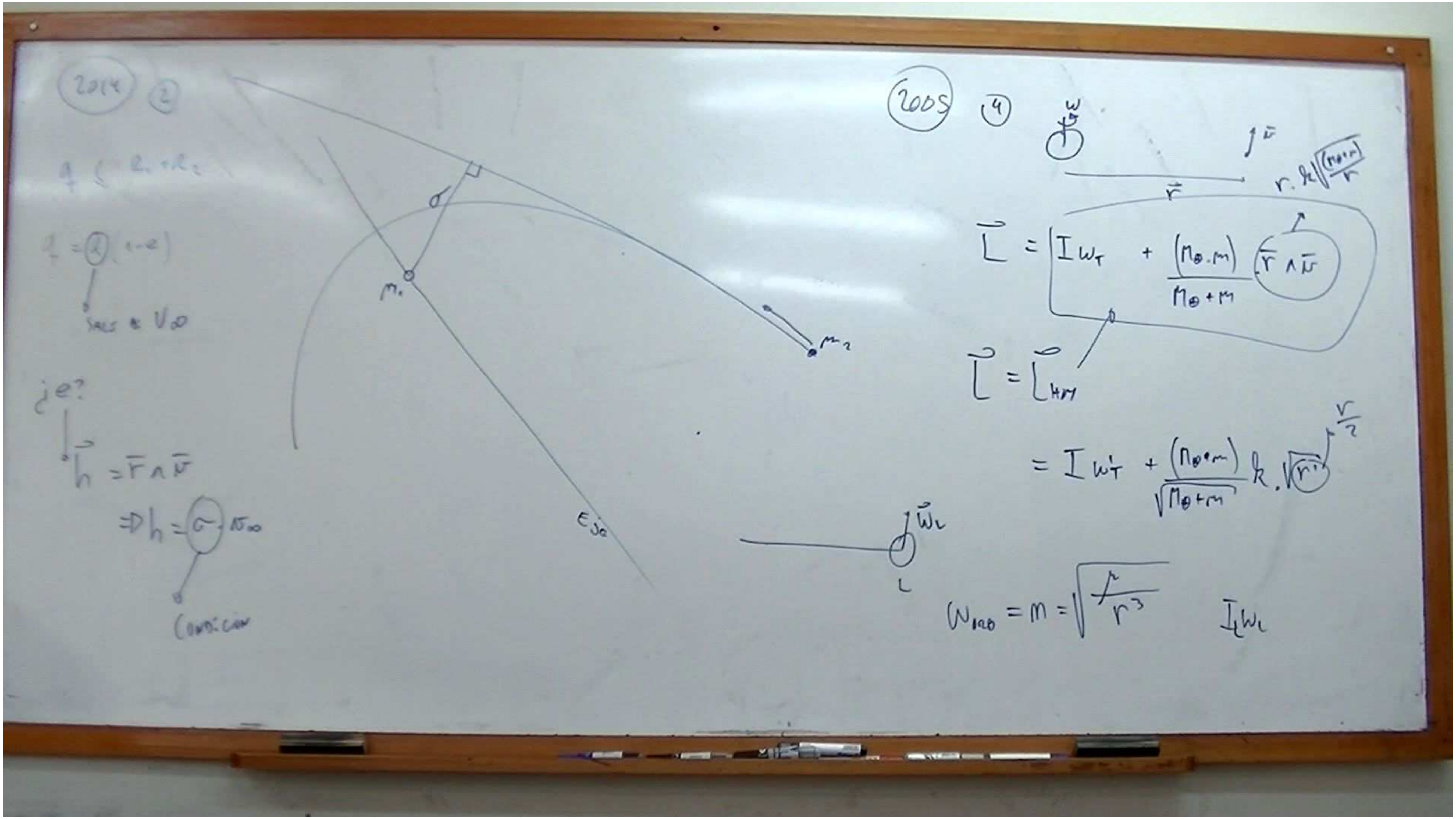
$r \cdot k \sqrt{\frac{(M_\oplus + m)}{r}}$

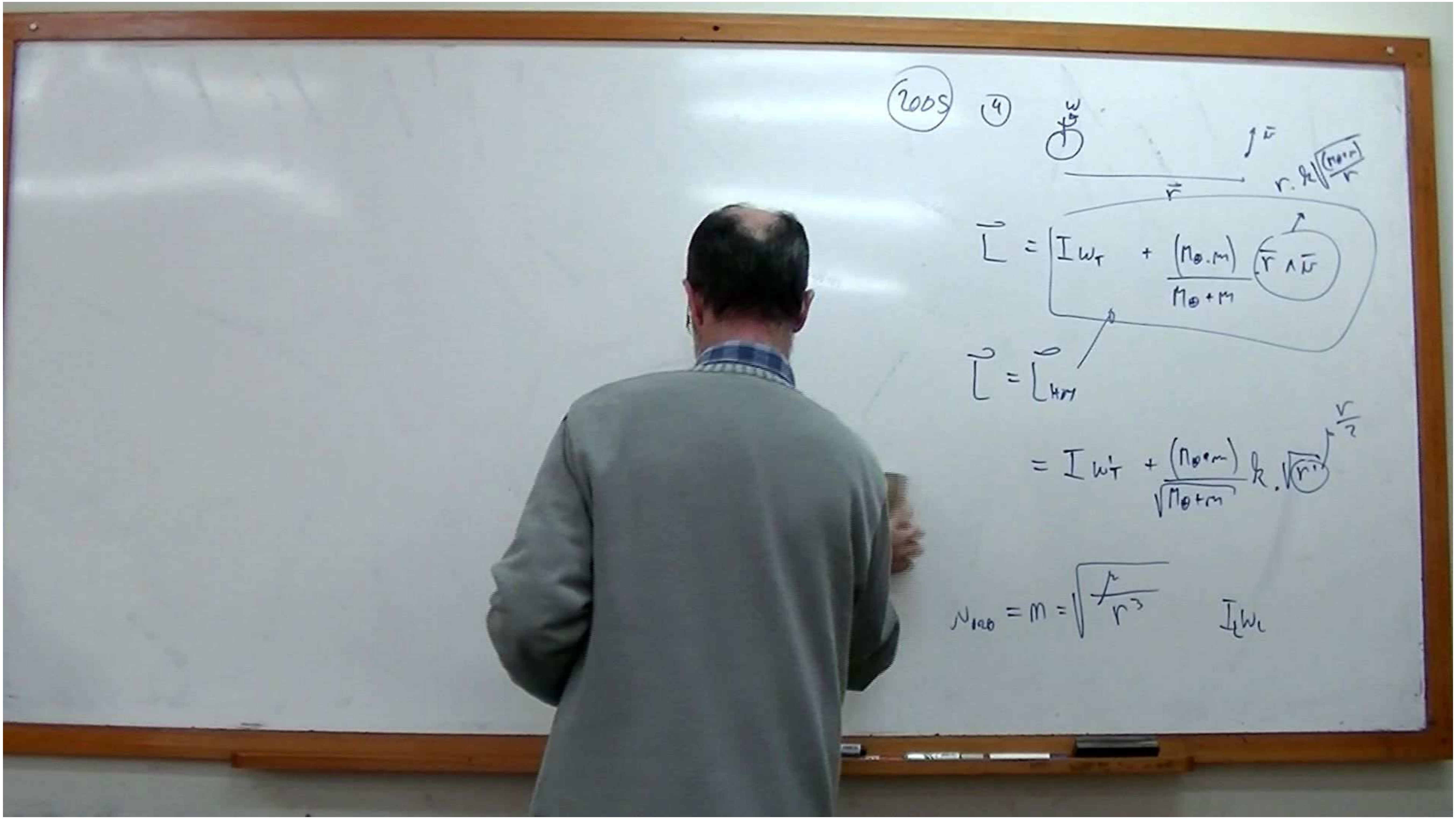
$\vec{L} = I\omega_T + \frac{(M_\oplus \cdot m)}{M_\oplus + m}(\vec{r} \wedge$

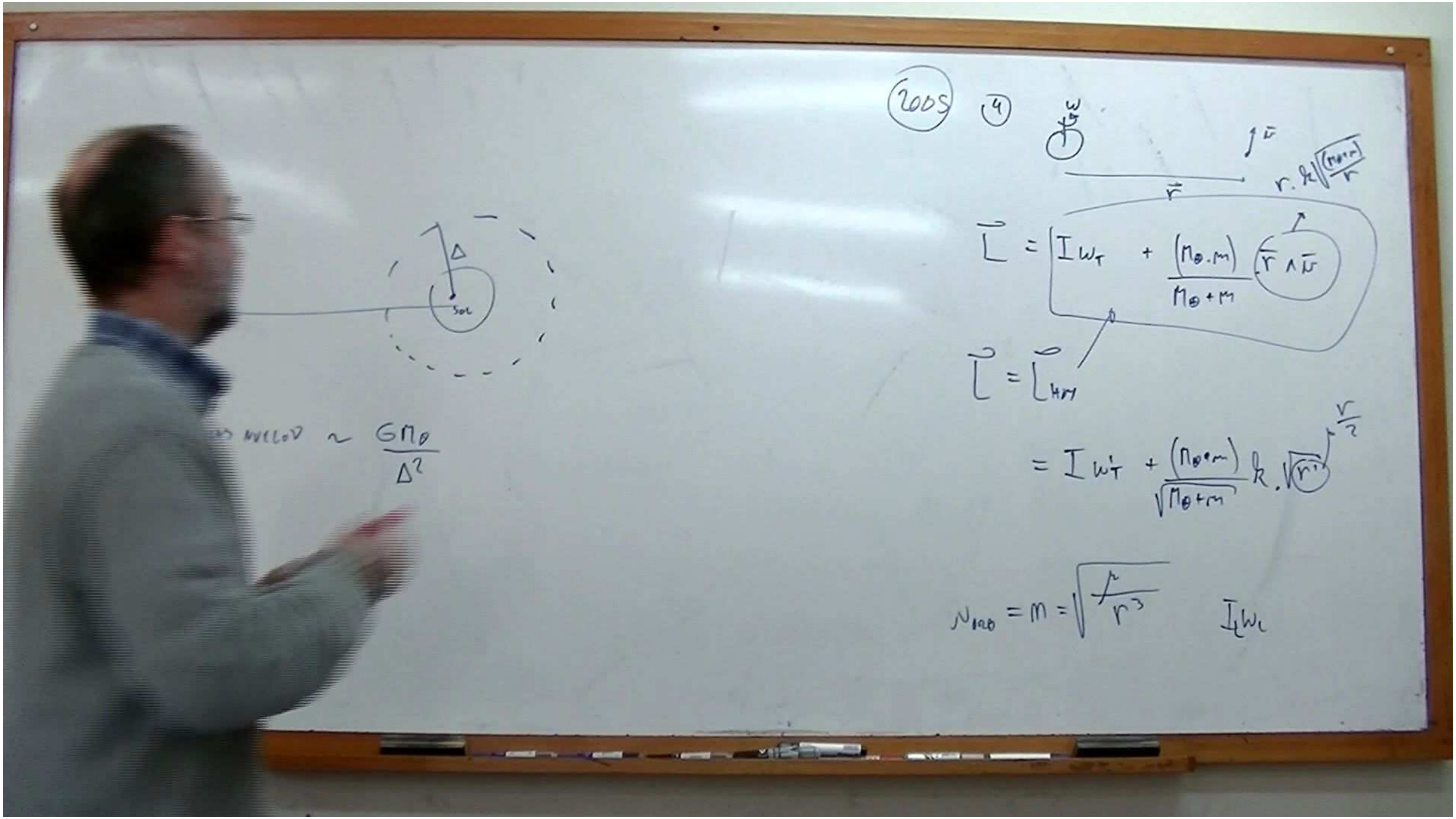
$\vec{L} = \vec{L}_{HM}$

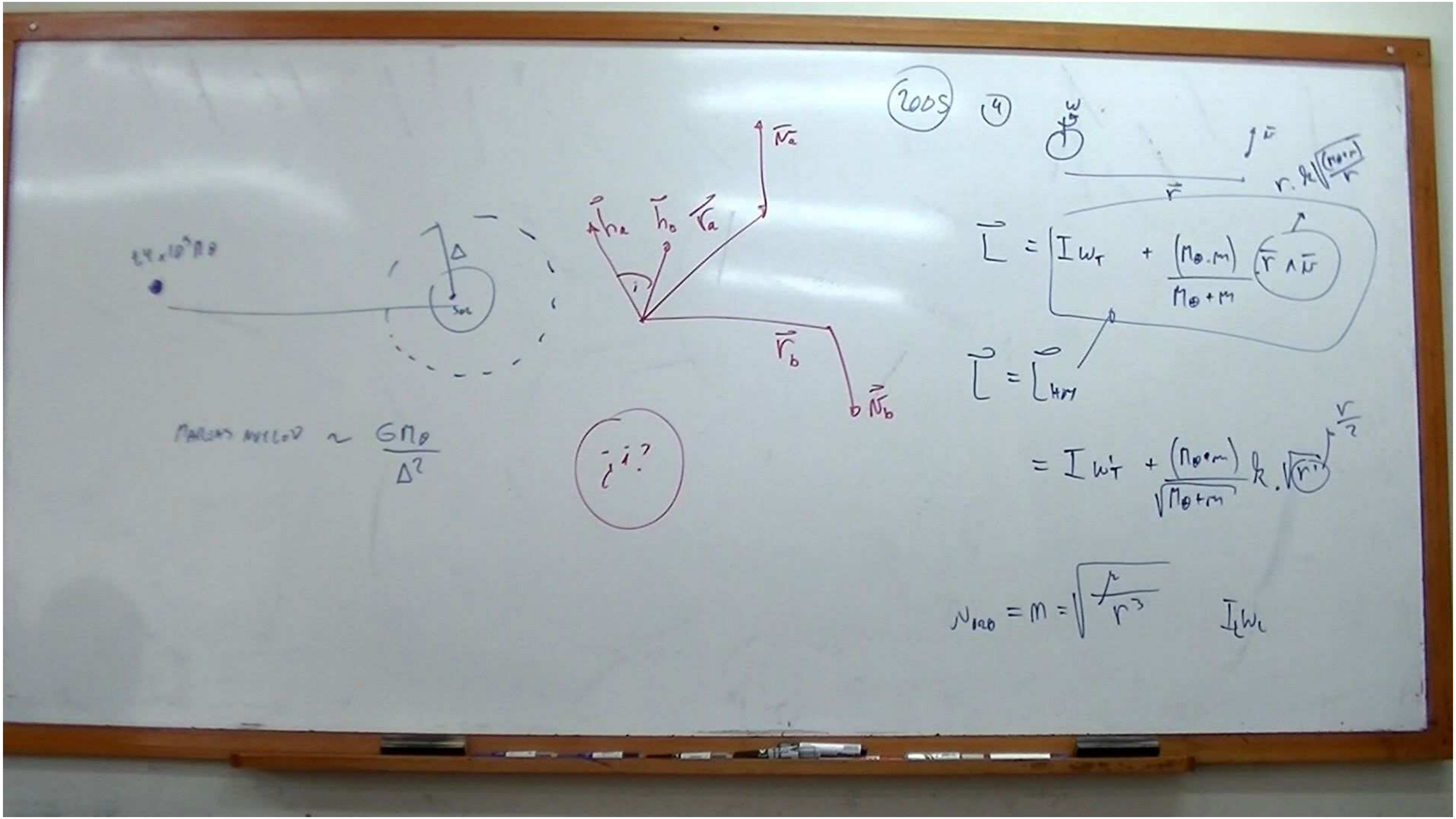
$= I\omega'_T + \frac{(M_\oplus \cdot m)}{\sqrt{M_\oplus + m}}$


2014
2
q < R1+R2
q = (R)(1-e)
sale c V∞
¿e?
h = r ∧ v
⇒ h = σ · v∞
Condicion
σ
m1
m2
Eje
2005
4
ω
v
r · R √((m+m)/r)
L = I ω_T
r ∧ v
L = L_HM
= I ω
r/2
ω_L
L
ω_ROT =


2014
2
q ≤ R1 + R2
q = R (1-e)
sale a V∞
¿e?
h = r ∧ v
⇒ h = σ · v∞
condición
σ
m1
m2
Eje
2005
4
w
v
r
r · k √((M⊕+m)/r)
L = I w_T + (M⊕·m)/(M⊕+m) r ∧ v
L = L_HM
= I w'_T + (M⊕·m)/√(M⊕+m) k · √r'
r/2
w_L
L
w_rot = n = √(μ/r³)
I_L w_L


2005
4
ω
$\vec{v}$
$\vec{r}$
$r . k \sqrt{\frac{(M_\odot + m)}{r}}$
$\vec{L} = I\omega_T + \frac{(M_\odot . m)}{M_\odot + m} \vec{r} \wedge \vec{v}$
$\vec{L} = \vec{L}_{HM}$
$= I \omega'_T + \frac{(M_\odot . m)}{\sqrt{M_\odot + m}} k . \sqrt{r'}$
$\frac{r}{2}$
$N_{100} = m = \sqrt{\frac{\mu}{r^3}}$
$I_L W_L$


2005
4
ω
v
r
r. k √((m⊙+m)/r)
Δ
Sol
L = I ω_T + (m⊙.m)/(m⊙+m) r ∧ v
L = L_{H+M}
= I ω'_T + (m⊙+m)/√(m⊙+m) k . √r'
r/2
NUCLEO ~ GM⊙/Δ²
n_MO = n = √(μ/r³)
I_L ω_L



MAREAS NUCLEO $\sim \frac{GM_\odot}{\Delta^2}$

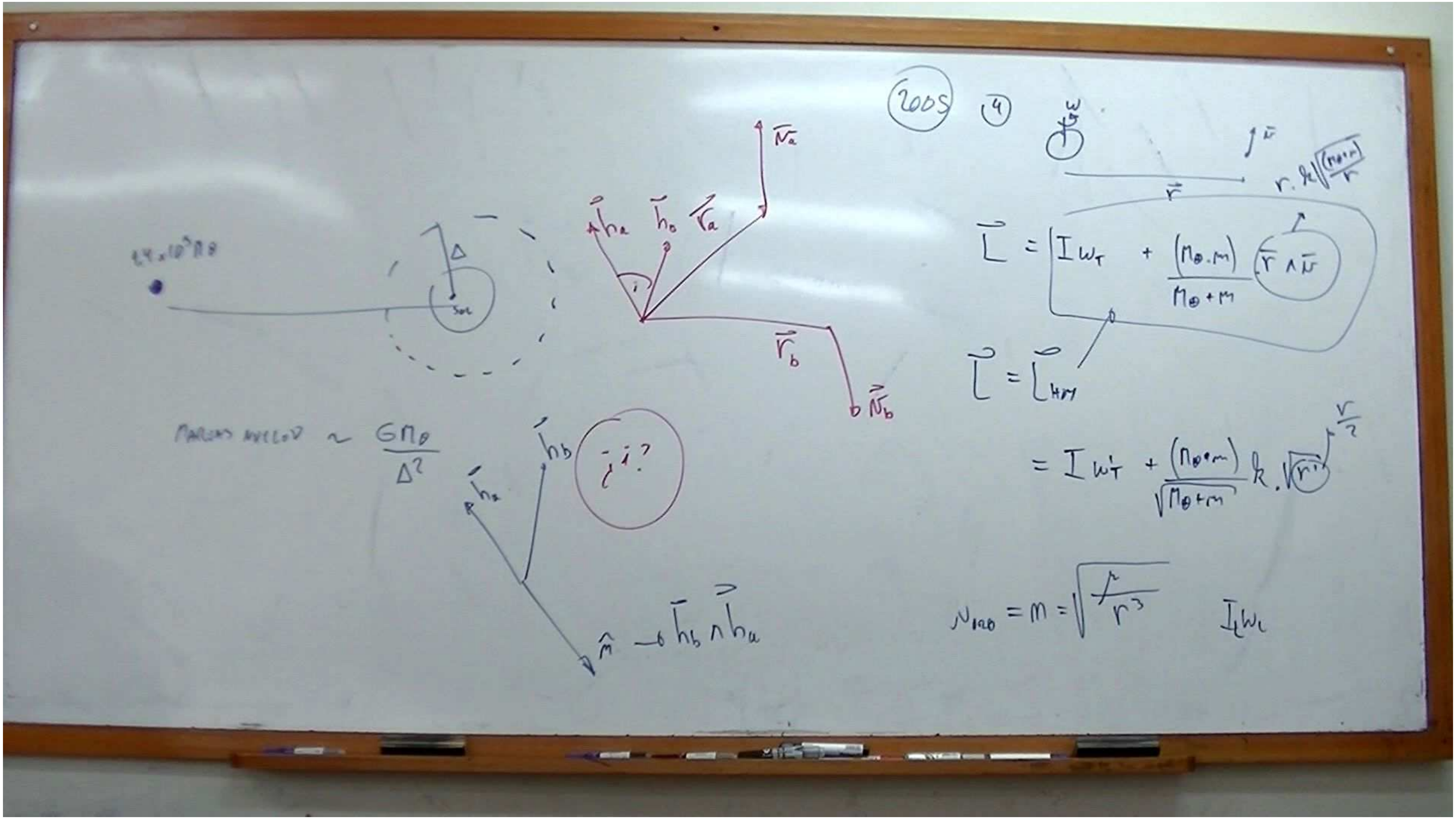
$r \cdot k\sqrt{\frac{(M_\odot+m)}{r}}$

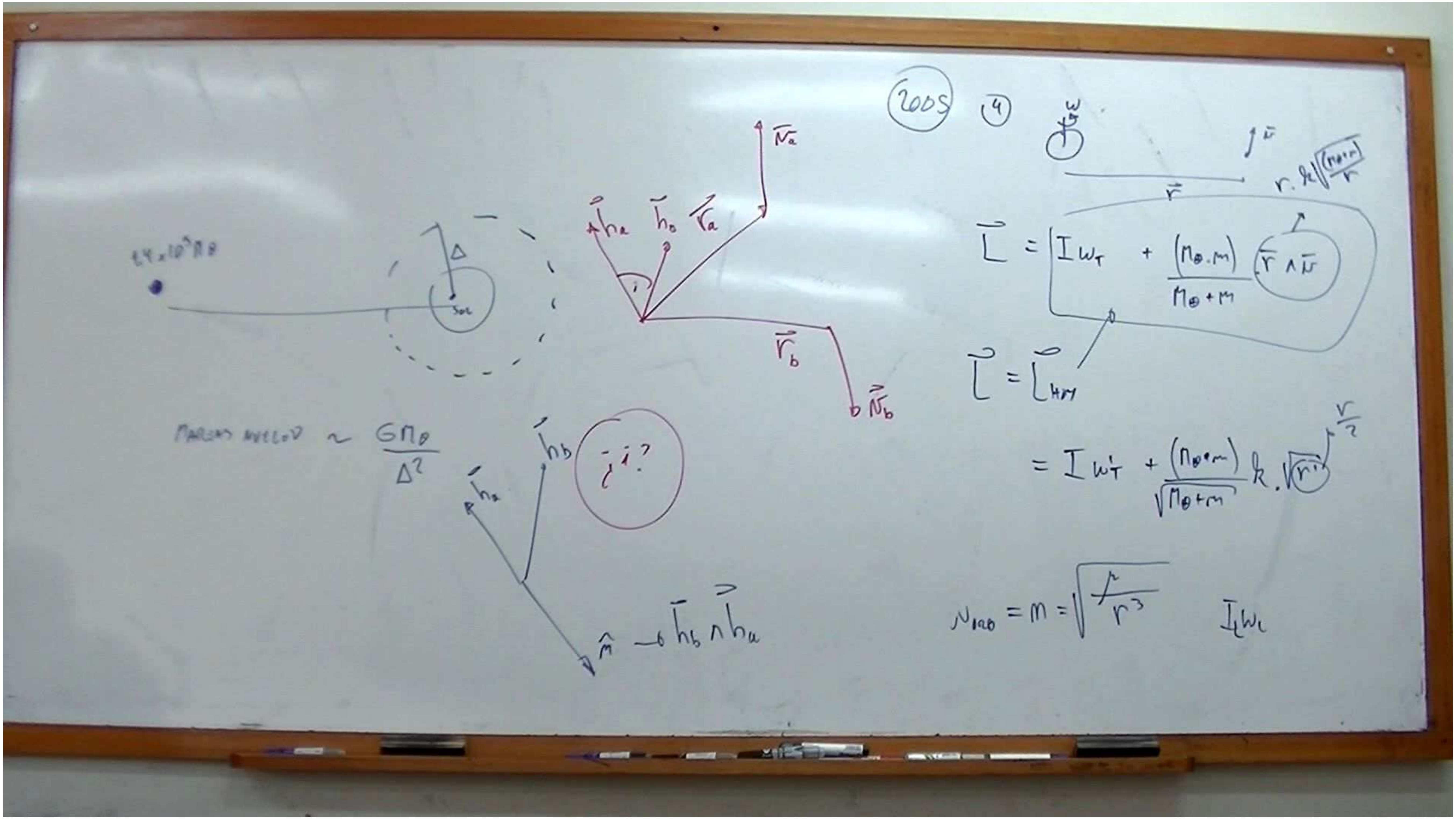
$$\vec{L} = I\omega_T + \frac{(M_\odot \cdot m)}{M_\odot + m}\,\vec{r}\wedge\vec{v}$$

$$\vec{L} = \vec{L}_{HM}$$

$$= I\omega'_T + \frac{(M_\odot m)}{\sqrt{M_\odot+m}}\,k\cdot\sqrt{r'} \quad \frac{r}{2}$$

$$n_{MED} = n = \sqrt{\frac{k^2}{r^3}} \qquad I_L\omega_L$$


2005
4
Sol
Δ
$\vec{h}_a$
$\vec{h}_b$
$\vec{r}_a$
$\vec{r}_b$
$\vec{v}_a$
$\vec{v}_b$
i
¿i?
$\hat{n} \to \vec{h}_b \wedge \vec{h}_a$
$\sim \frac{GM_\odot}{\Delta^2}$
w
$\vec{r}$
$\vec{v}$
$\vec{L} = I\omega_T + \frac{(M_\odot \cdot m)}{M_\odot + m} \vec{r} \wedge \vec{v}$
$\vec{L} = \vec{L}_{HM}$
$= I\omega'_T + \frac{(M_\odot m)}{\sqrt{M_\odot + m}} k \sqrt{r'}$
$n = \sqrt{\frac{\mu}{r^3}}$
$I_L \omega_L$



MAREAS NUCLEO $\sim \frac{GM_\odot}{\Delta^2}$

$$\hat{m} \to \bar{h}_b \wedge \vec{h}_a$$

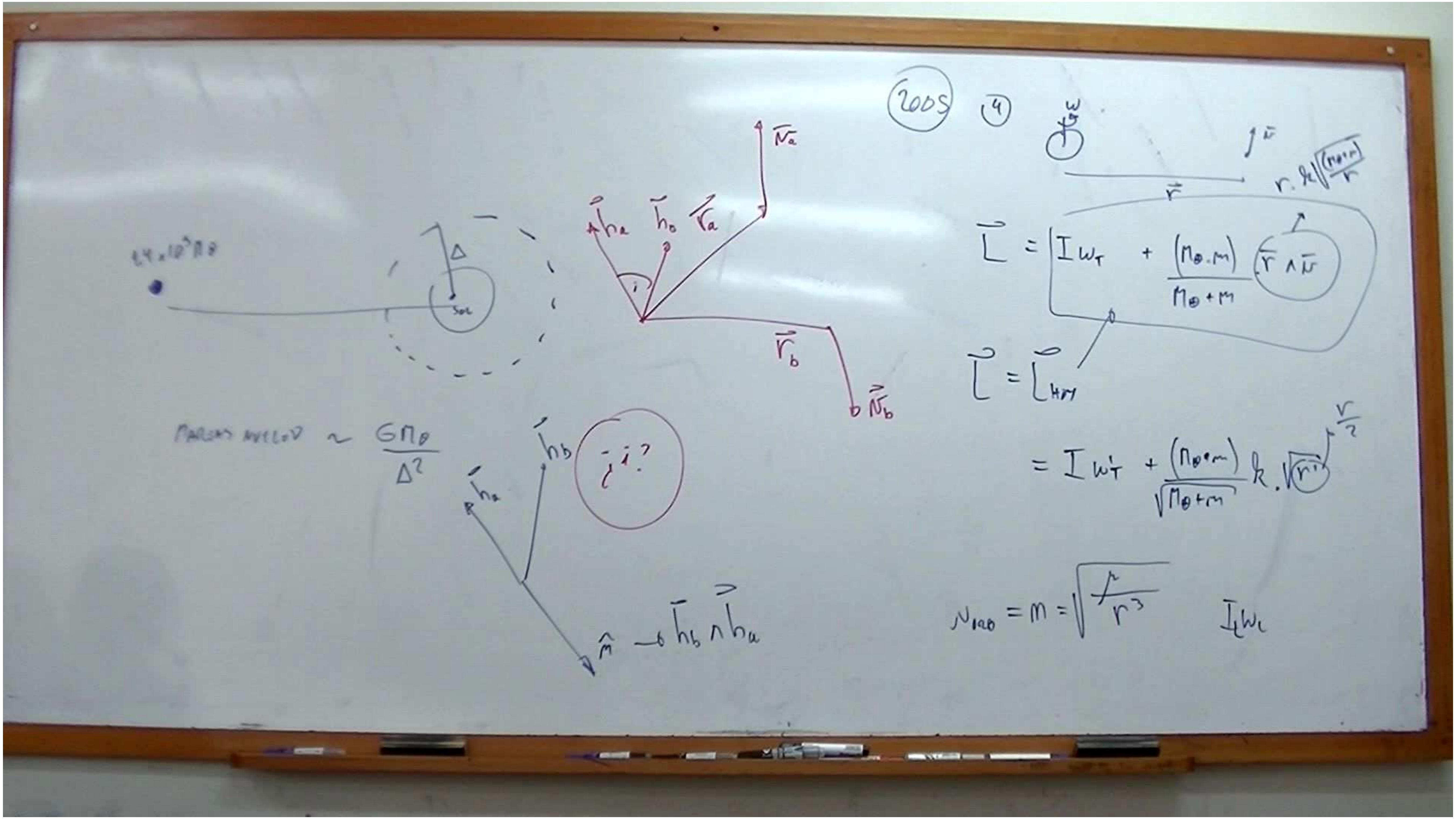
$$r . k\sqrt{\frac{(M_\odot+m)}{r}}$$

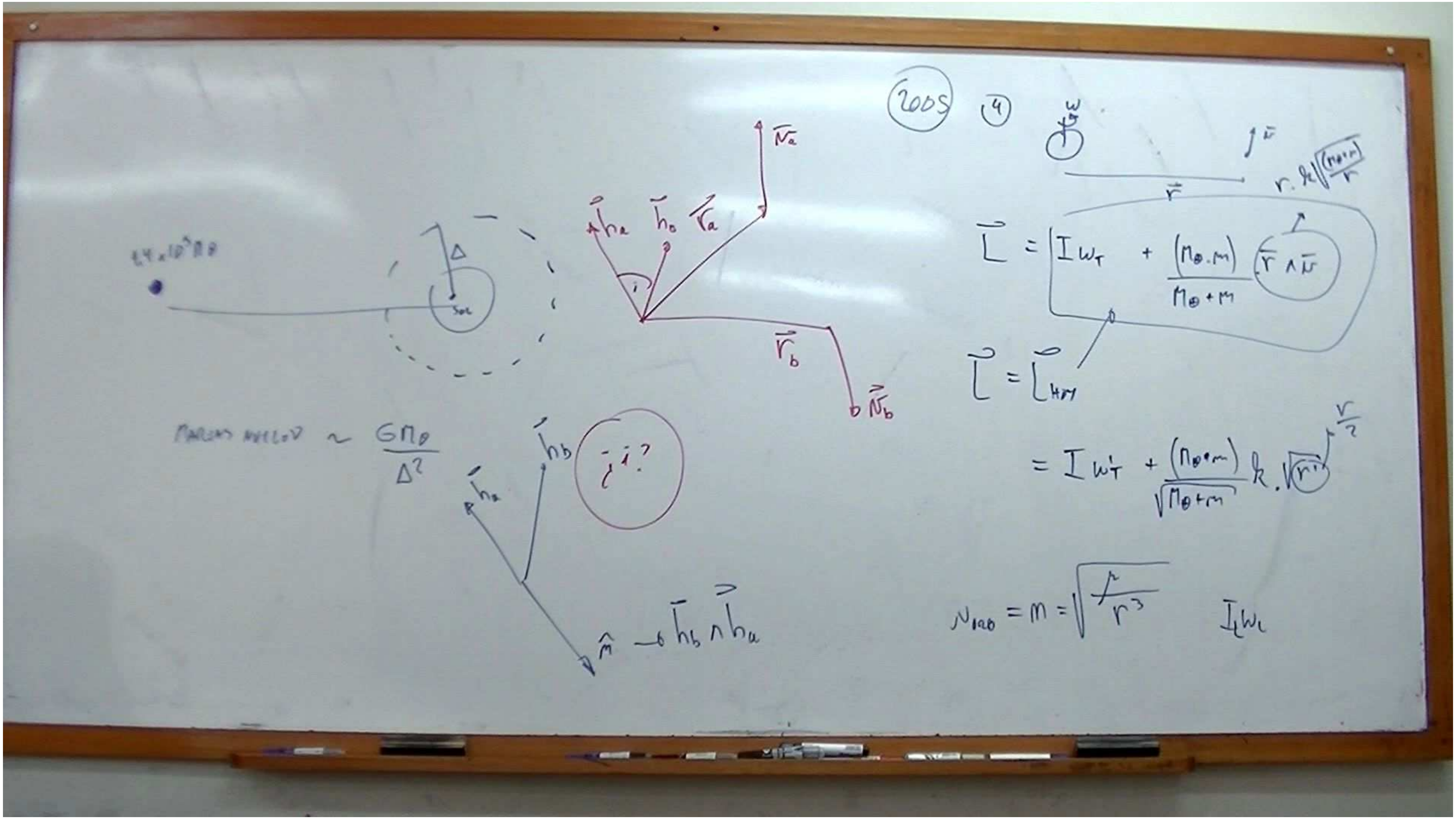
$$\vec{L} = I\omega_T + \frac{(M_\odot . m)}{M_\odot + m}\,\bar{r}\wedge\bar{v}$$

$$\vec{L} = \vec{L}_{HM}$$

$$= I\omega'_T + \frac{(M_\odot m)}{\sqrt{M_\odot + m}}\,k.\sqrt{r'} \qquad \frac{r}{2}$$

$$v_{rad} = n = \sqrt{\frac{\mu}{r^3}} \qquad I_L\omega_L$$


2005
4
ω
$\vec{v}$
$\vec{r}$
$r \cdot k \sqrt{\frac{(m_\oplus + m)}{r}}$
$\vec{L} = I\omega_T + \frac{(m_\oplus \cdot m)}{m_\oplus + m} \bar{r} \wedge \bar{v}$
$\vec{L} = \vec{L}_{HM}$
$= I\omega'_T + \frac{(m_\oplus \cdot m)}{\sqrt{m_\oplus + m}} k \cdot \sqrt{r'}$
$\frac{r}{2}$
$n_{TAB} = n = \sqrt{\frac{\mu}{r^3}}$
$I_L\omega_L$
1,4 x 10^5 R⊕
Δ
Sol
MAREAS NUCLEO ~ $\frac{GM_\oplus}{\Delta^2}$
$\vec{h}_a$
$\vec{h}_0$
$\vec{r}_a$
$\vec{v}_a$
i
$\vec{r}_b$
$\vec{v}_b$
$\vec{h}_b$
$\vec{h}_a$
¿i?
$\hat{m} \rightarrow \vec{h}_b \wedge \vec{h}_a$



MAREAS ANILLO $\sim \frac{GM_\odot}{\Delta^2}$

$\hat{n} \to \vec{h}_b \wedge \vec{h}_a$

$r \cdot k\sqrt{\frac{(M_\odot+m)}{r}}$

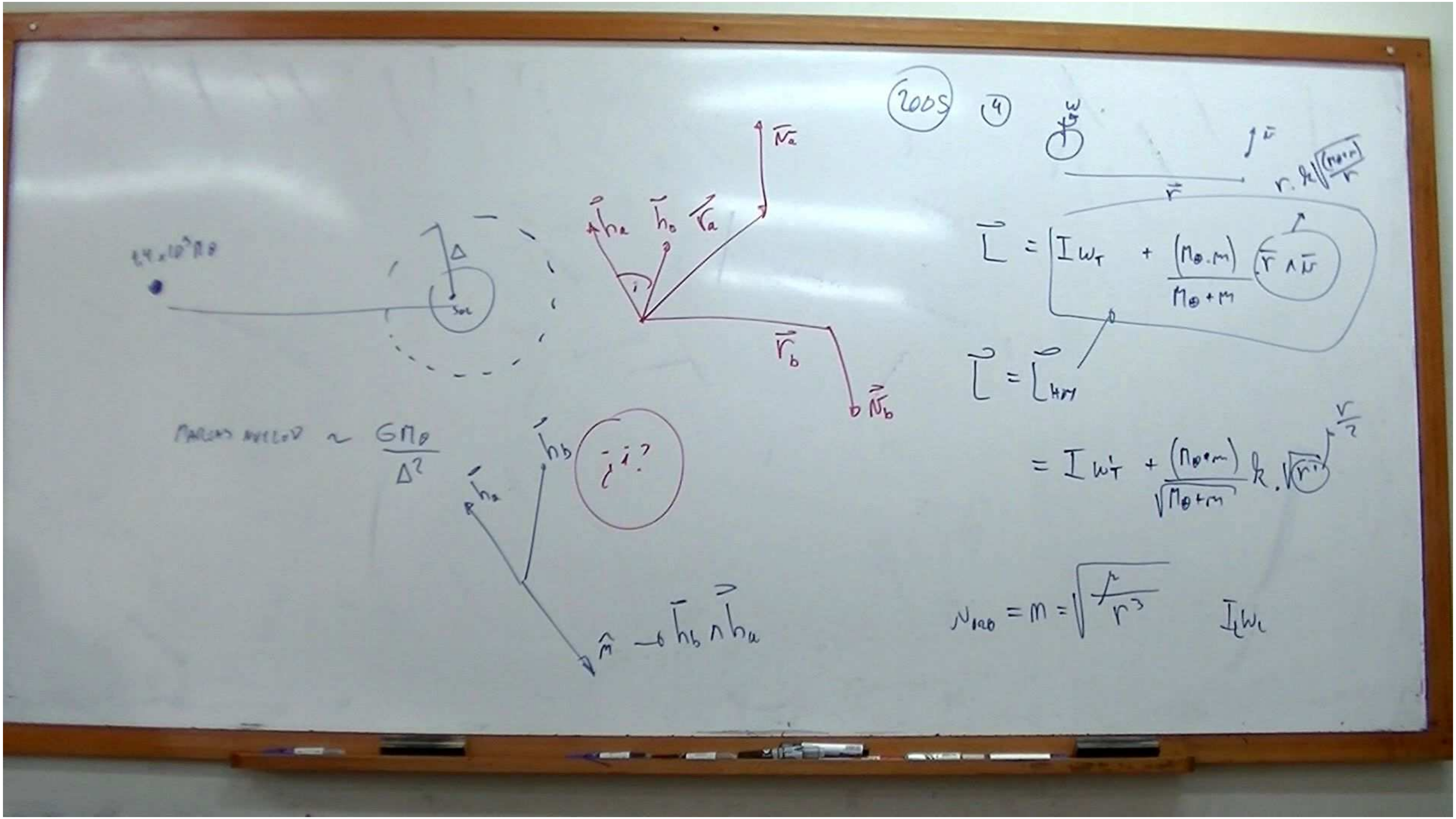
$$\vec{L} = I\omega_T + \frac{(M_\odot \cdot m)}{M_\odot + m}\, \vec{r} \wedge \vec{v}$$

$$\vec{L} = \vec{L}_{H+M}$$

$$= I\omega'_T + \frac{(M_\odot m)}{\sqrt{M_\odot + m}}\, k \cdot \sqrt{r'}$$

$\frac{r}{2}$

$$n_{100} = n = \sqrt{\frac{\mu}{r^3}} \qquad I_L \omega_L$$



MARCAS NUCLEO $\sim \frac{GM_\odot}{\Delta^2}$

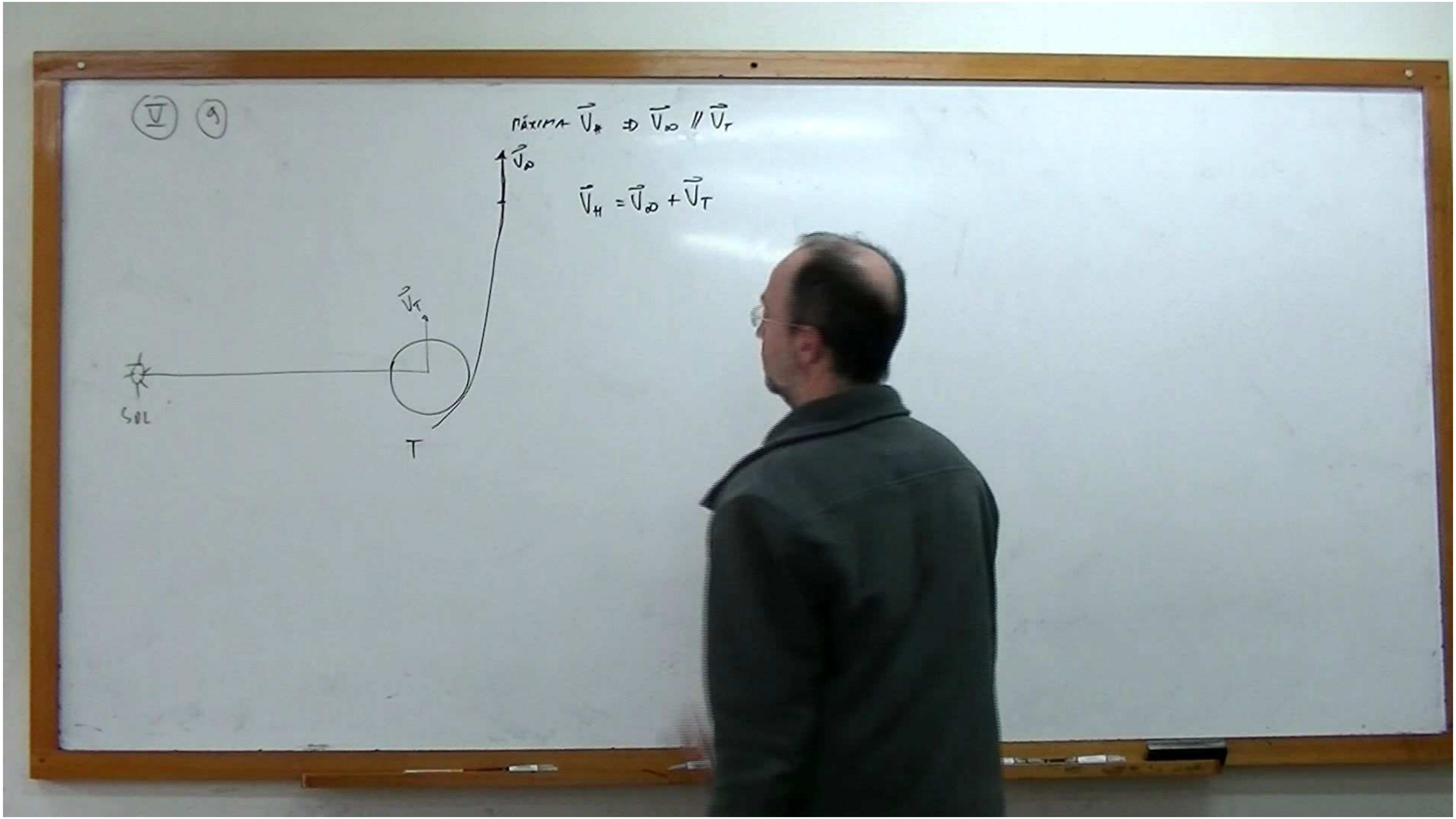
$\hat{m} \rightarrow \vec{h}_b \wedge \vec{h}_a$

$$\vec{L} = I\omega_T + \frac{(M_\odot \cdot m)}{M_\odot + m} \vec{r} \wedge \vec{v}$$

$$\vec{L} = \vec{L}_{HM}$$

$$= I\omega'_T + \frac{(M_\odot \cdot m)}{\sqrt{M_\odot + m}} k \cdot \sqrt{r'}$$

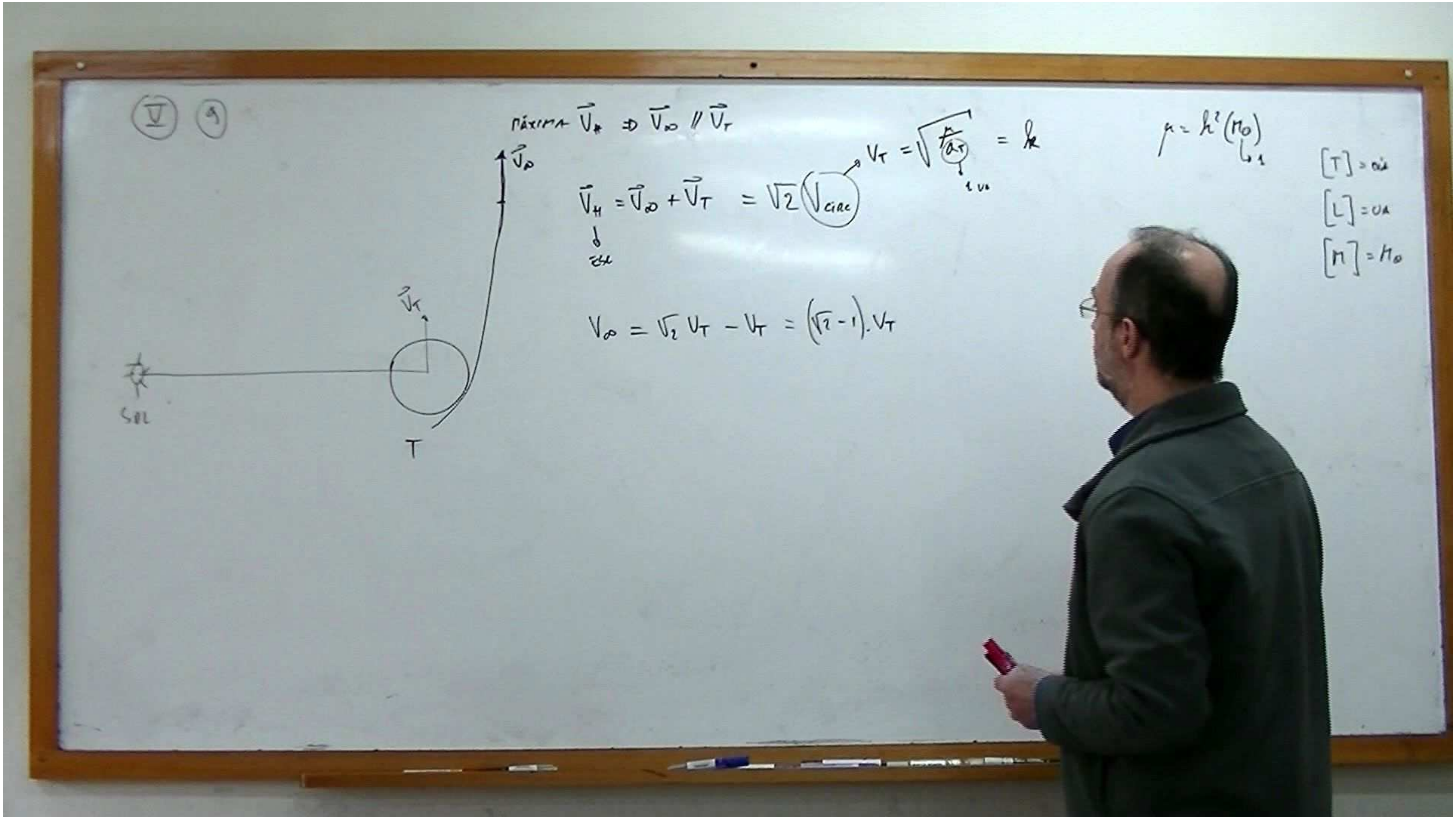
$$n_{rad} = n = \sqrt{\frac{\mu}{r^3}} \qquad I_t\omega_t$$



Ⓥ ⑨

MÁXIMA $\vec{V}_H \Rightarrow \vec{V}_\infty \parallel \vec{V}_T$

$$\vec{V}_H = \vec{V}_\infty + \vec{V}_T$$



máxima $\vec{V}_* \Rightarrow \vec{V}_\infty \parallel \vec{V}_T$

$$\underset{\substack{\downarrow \\ esc}}{\vec{V}_H} = \vec{V}_\infty + \vec{V}_T = \sqrt{2}\, V_{circ}$$

$$V_{circ} \rightarrow V_T = \sqrt{\frac{\mu}{\underset{\substack{\downarrow \\ 1\,ua}}{a_T}}} = k$$

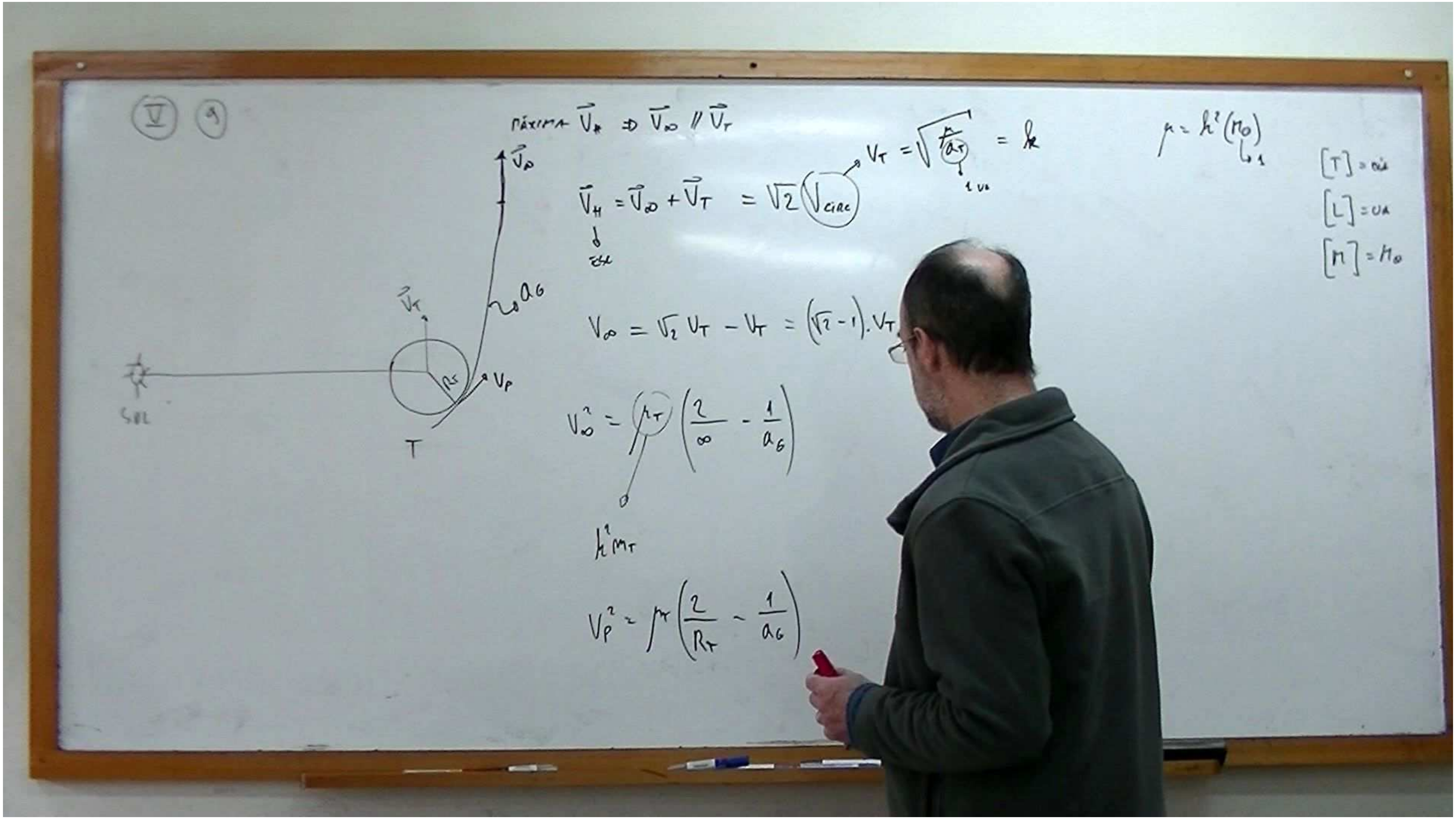
$$V_\infty = \sqrt{2}\, V_T - V_T = (\sqrt{2}-1).V_T$$

$$\mu = k^2 (\underset{\hookrightarrow 1}{M_\odot})$$

$[T] = \text{día}$

$[L] = \text{UA}$

$[M] = M_\odot$



máxima $\vec V_* \Rightarrow \vec V_\infty \parallel \vec V_T$

$\vec V_H = \vec V_\infty + \vec V_T = \sqrt{2}\, V_{circ}$

esc

$V_T = \sqrt{\frac{\mu}{a_T}} = k$

1 UA

$V_\infty = \sqrt{2}\, V_T - V_T = (\sqrt{2} - 1). V_T$

$V_\infty^2 = \mu_T \left(\frac{2}{\infty} - \frac{1}{a_G} \right)$

$k^2 M_T$

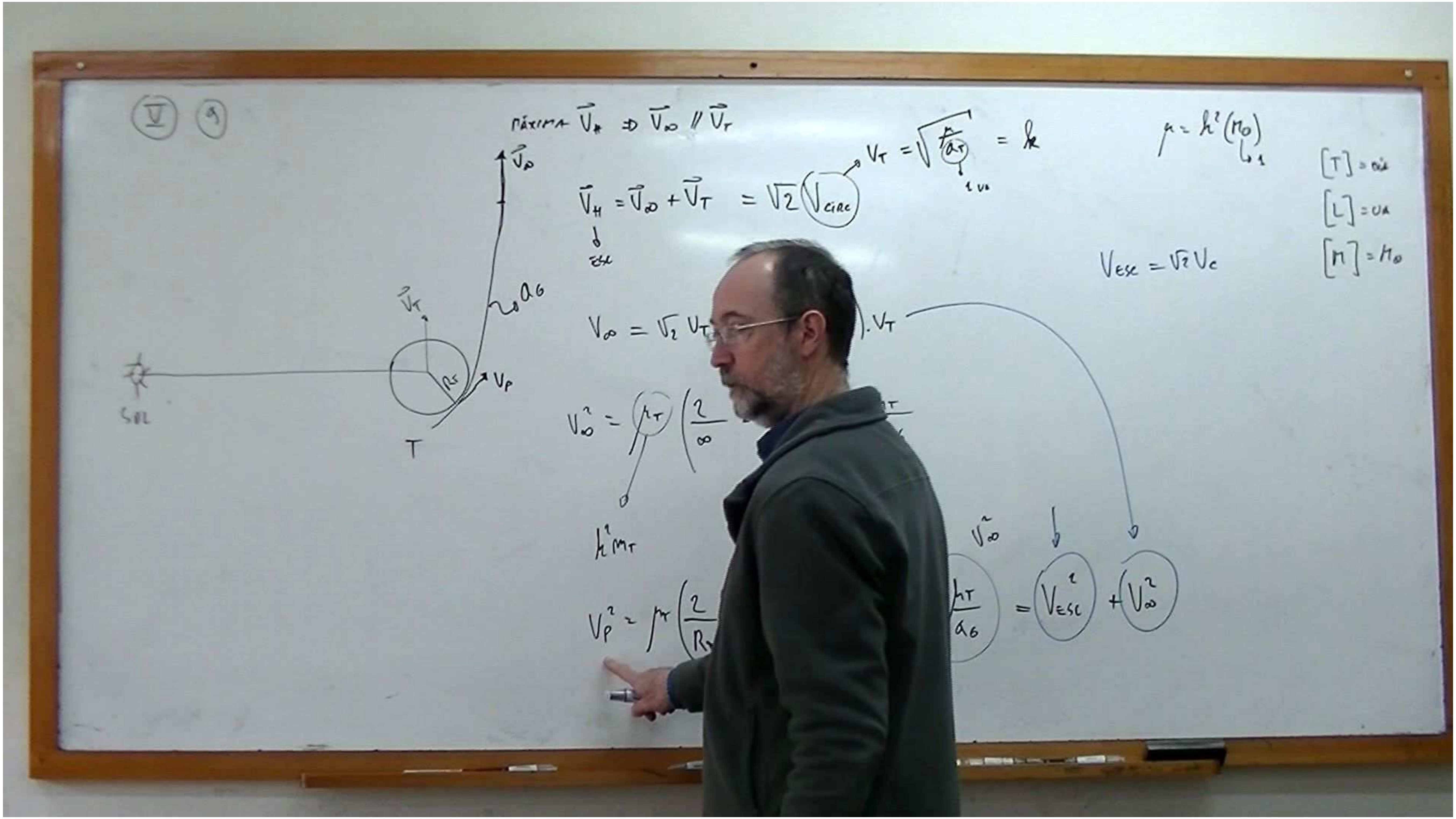
$V_P^2 = \mu_T \left(\frac{2}{R_T} - \frac{1}{a_G} \right)$

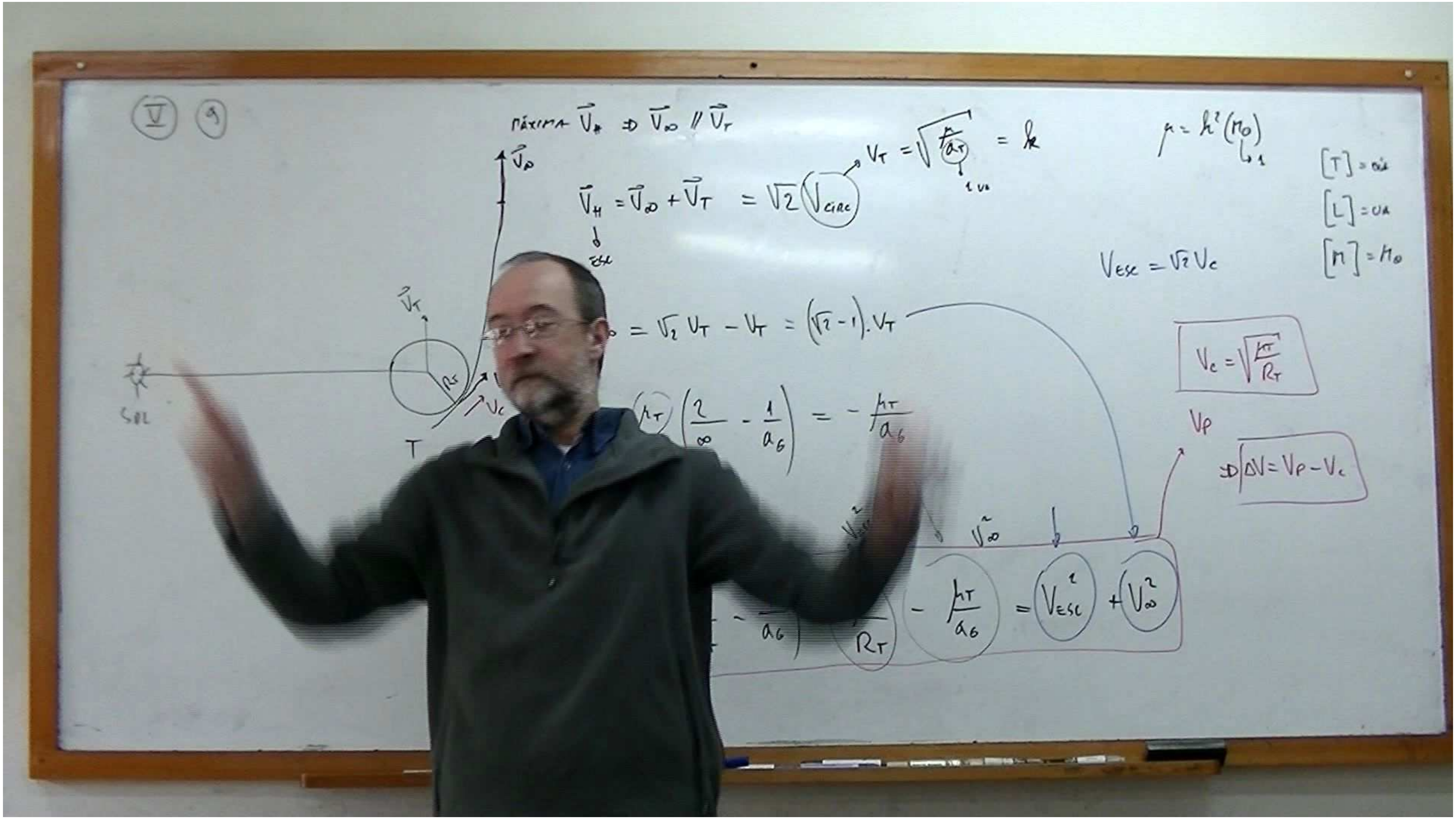
$\mu = k^2 (M_\odot)$ ↳ 1

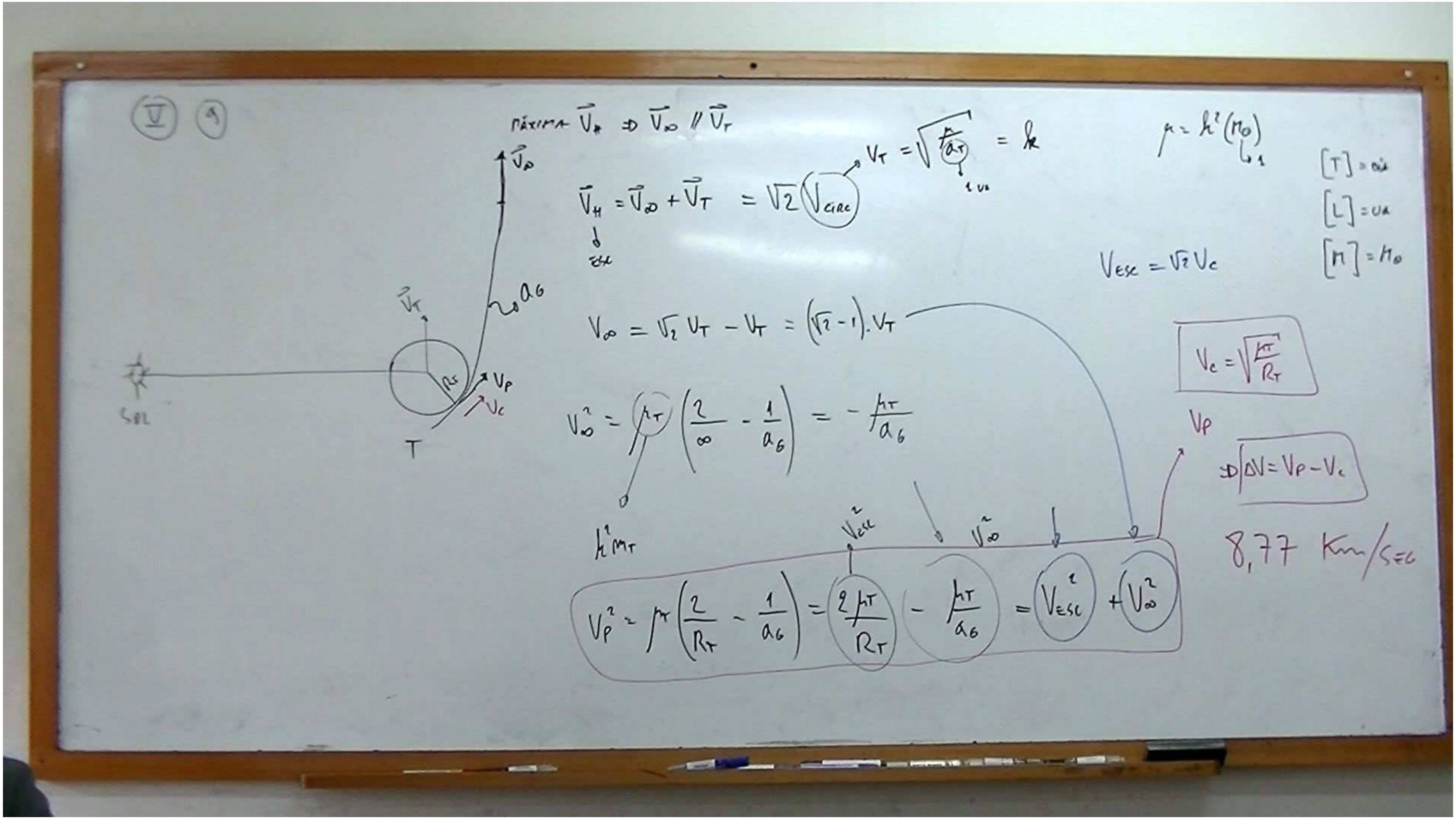
$[T] =$ día

$[L] =$ UA

$[M] = M_\odot$


MÁXIMA $\vec{V}_H \Rightarrow \vec{V}_\infty \parallel \vec{V}_T$
$\vec{V}_H = \vec{V}_\infty + \vec{V}_T = \sqrt{2}\,V_{CIRC}$
ESC
$V_T = \sqrt{\frac{\mu}{a_T}} = k$
1 UA
$\mu = k^2 (M_\odot)$
1
[T] = DÍA
[L] = UA
[M] = $M_\odot$
$V_{ESC} = \sqrt{2}\,V_C$
$V_\infty = \sqrt{2}\,V_T$
$. V_T$
$V_\infty^2 = \mu_T \left(\frac{2}{\infty}\right.$
$k^2 M_T$
$V_P^2 = \mu_T \left(\frac{2}{R_T}\right.$
V_∞^2
$\frac{\mu_T}{a_G} = V_{ESC}^2 + V_\infty^2$
$\vec{V}_\infty$
a_G
$\vec{V}_T$
R_T
V_P
SOL
T


V
a
máxima V_H ⇒ V_∞ // V_T
V_∞
V_H = V_∞ + V_T = √2 V_circ
esc
V_T = √(μ/a_T) = k
1 ua
μ = k²(M_☉)
↳ 1
[T] = día
[L] = UA
[M] = M_☉
V_esc = √2 V_c
V_T
Sol
R_T
V_c
T
= √2 V_T − V_T = (√2 − 1). V_T
V_c = √(μ_T/R_T)
μ_T (2/∞ − 1/a_G) = − μ_T/a_G
V_P
⇒ ΔV = V_P − V_c
V_esc²
V_∞²
a_G
R_T
− μ_T/a_G = V_ESC² + V_∞²



Ⓥ ⓐ

máxima $\vec{V}_* \Rightarrow \vec{V}_\infty \parallel \vec{V}_T$

$V_T = \sqrt{\frac{\mu}{\underset{1\,UA}{a_T}}} = k$

$\underset{esc}{\vec{V}_H} = \vec{V}_\infty + \vec{V}_T = \sqrt{2}\, \boxed{V_{circ}}$

$\mu = k^2 (\underset{1}{M_\odot})$

$[T] = \text{día}$

$[L] = UA$

$[M] = M_\odot$

$V_{esc} = \sqrt{2}\, V_c$

$V_\infty = \sqrt{2}\, V_T - V_T = (\sqrt{2} - 1) . V_T$

$V_\infty^2 = \underset{k^2 m_T}{\mu_T} \left(\frac{2}{\infty} - \frac{1}{a_G} \right) = - \frac{\mu_T}{a_G}$

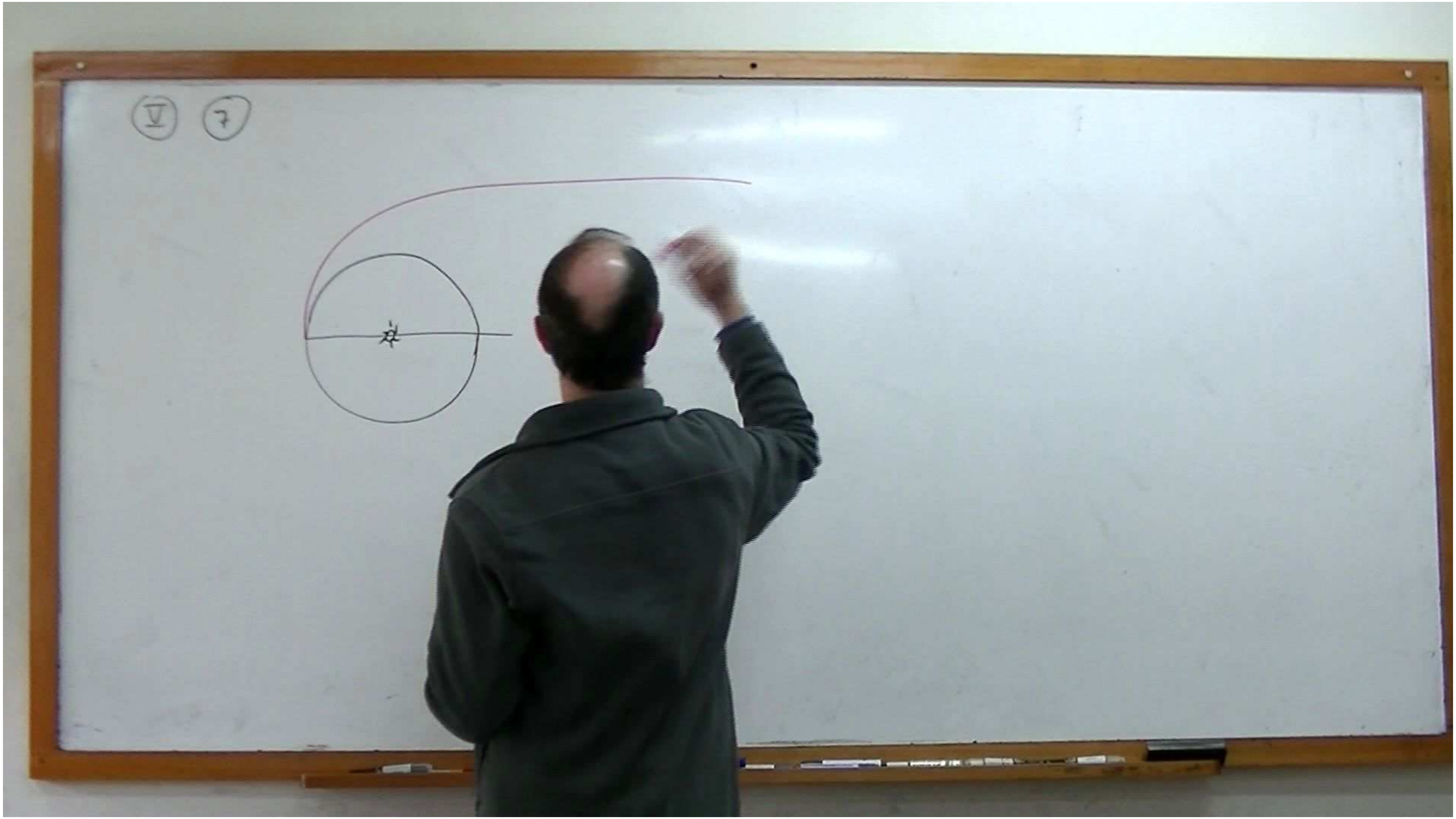
$\boxed{V_c = \sqrt{\frac{\mu_T}{R_T}}}$

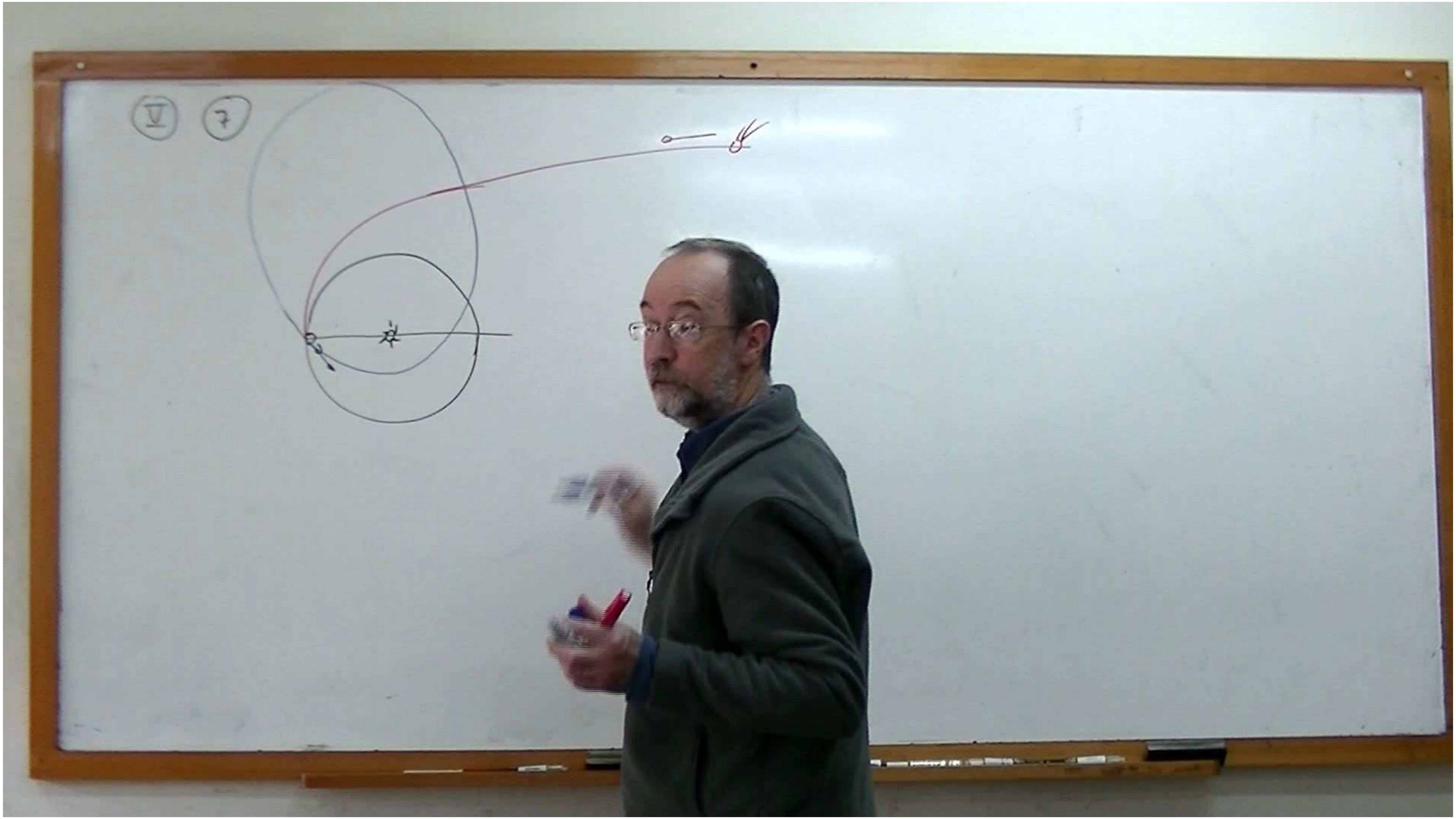
V_p

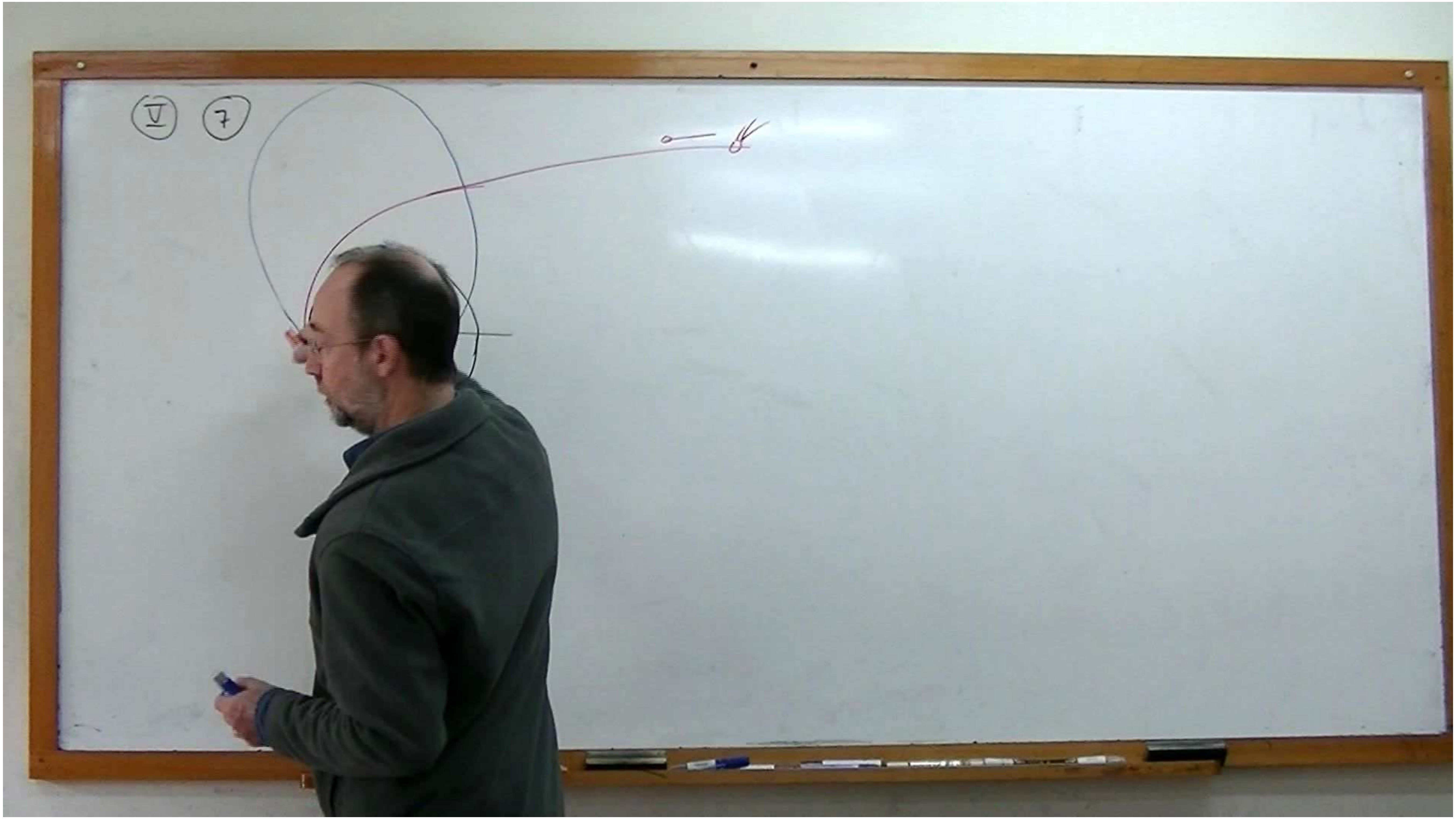
$\Rightarrow \boxed{\Delta V = V_p - V_c}$

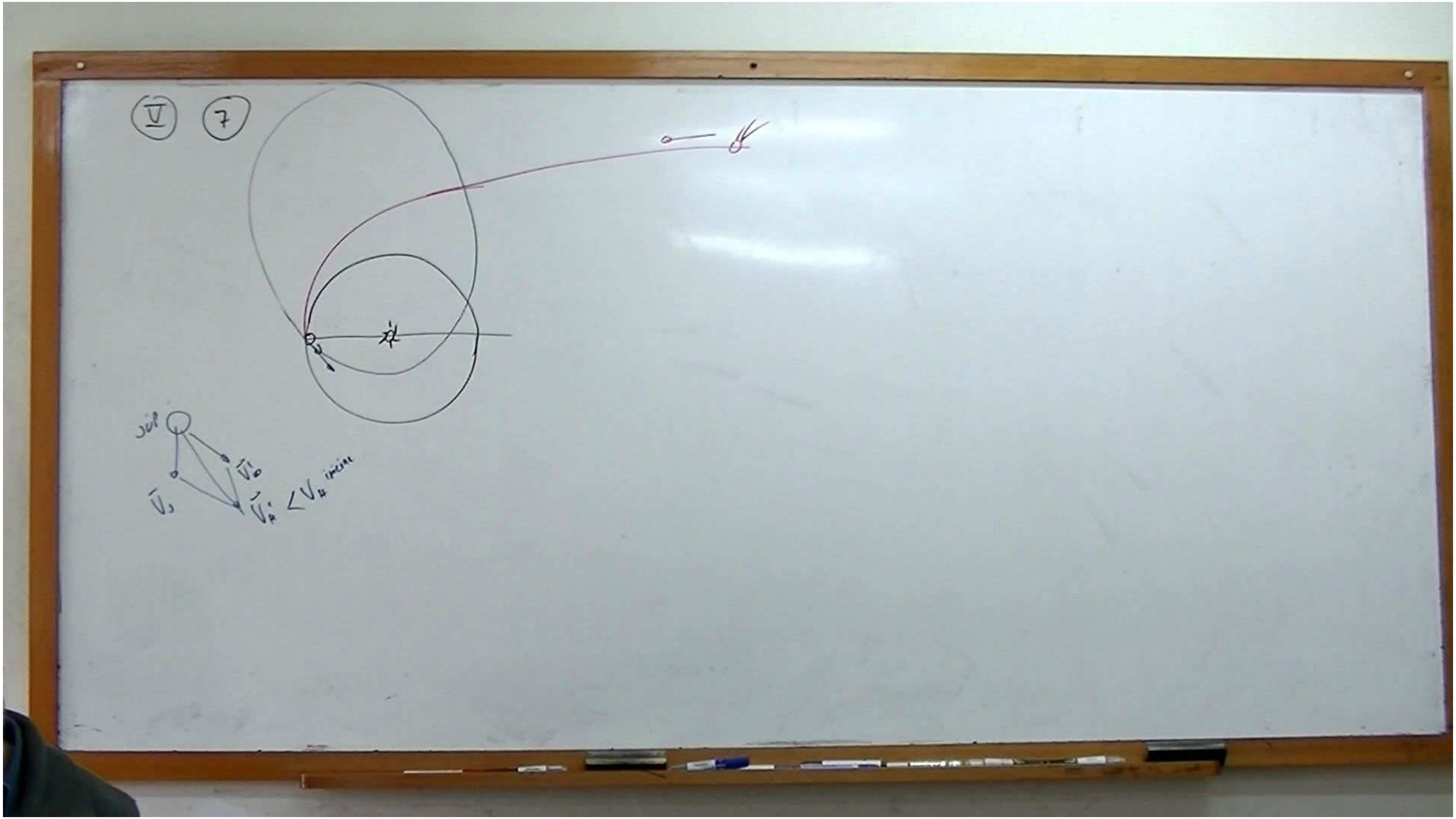
8,77 Km/sec

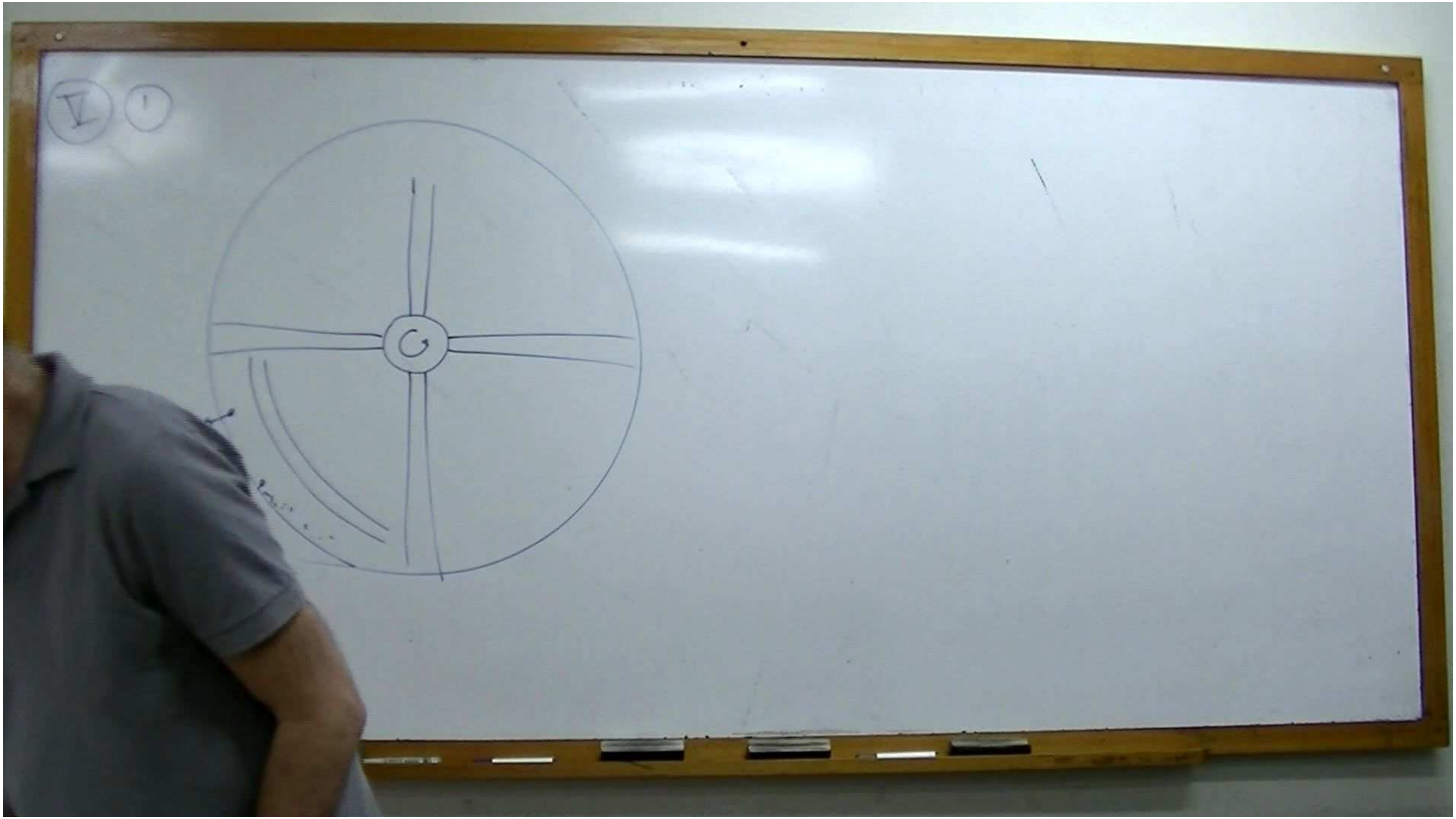
$$\boxed{V_p^2 = \mu_T \left(\frac{2}{R_T} - \frac{1}{a_G} \right) = \overset{V_{esc}^2}{\frac{2\mu_T}{R_T}} - \overset{V_\infty^2}{\frac{\mu_T}{a_G}} = V_{esc}^2 + V_\infty^2}$$

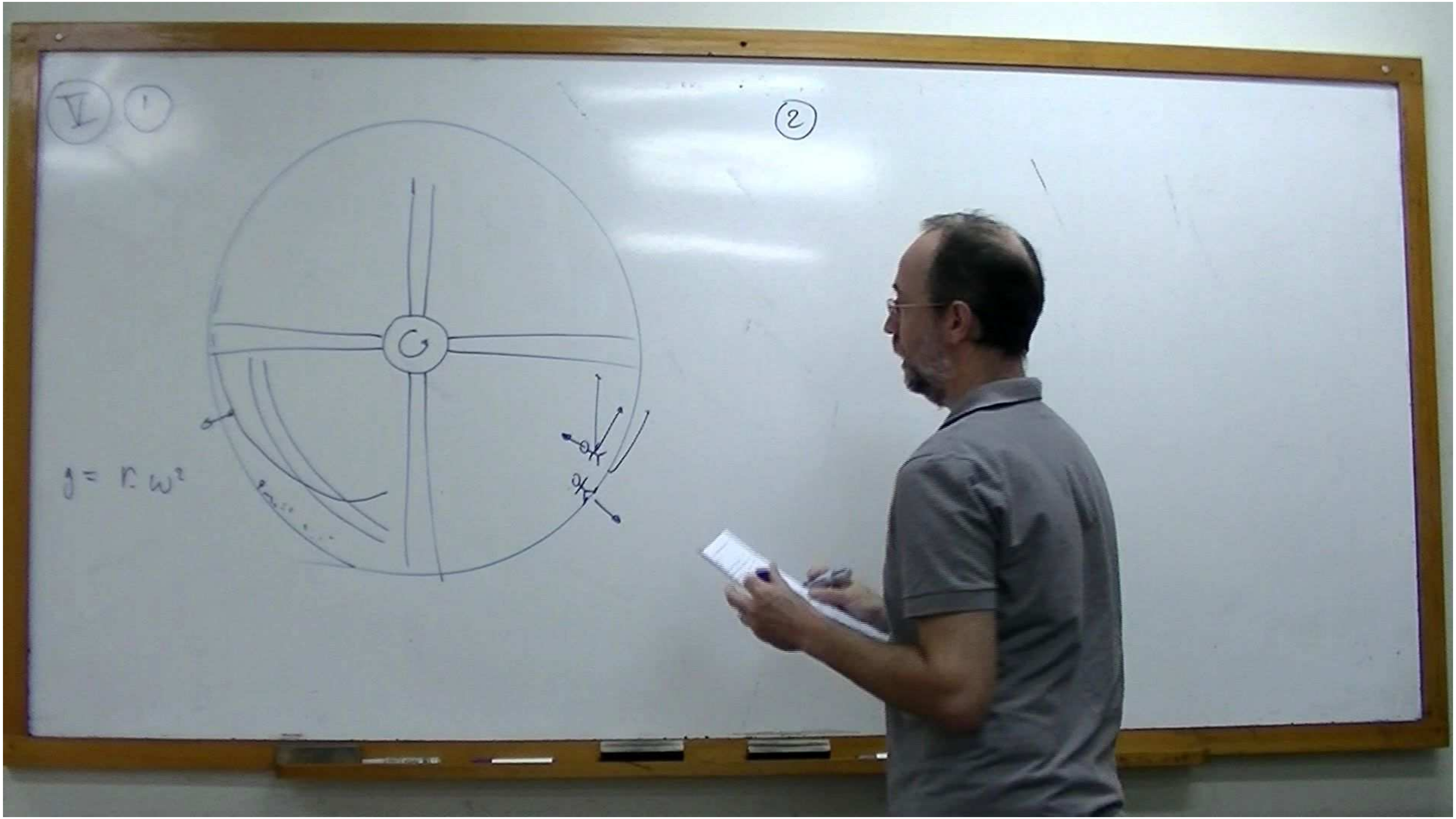

V
7

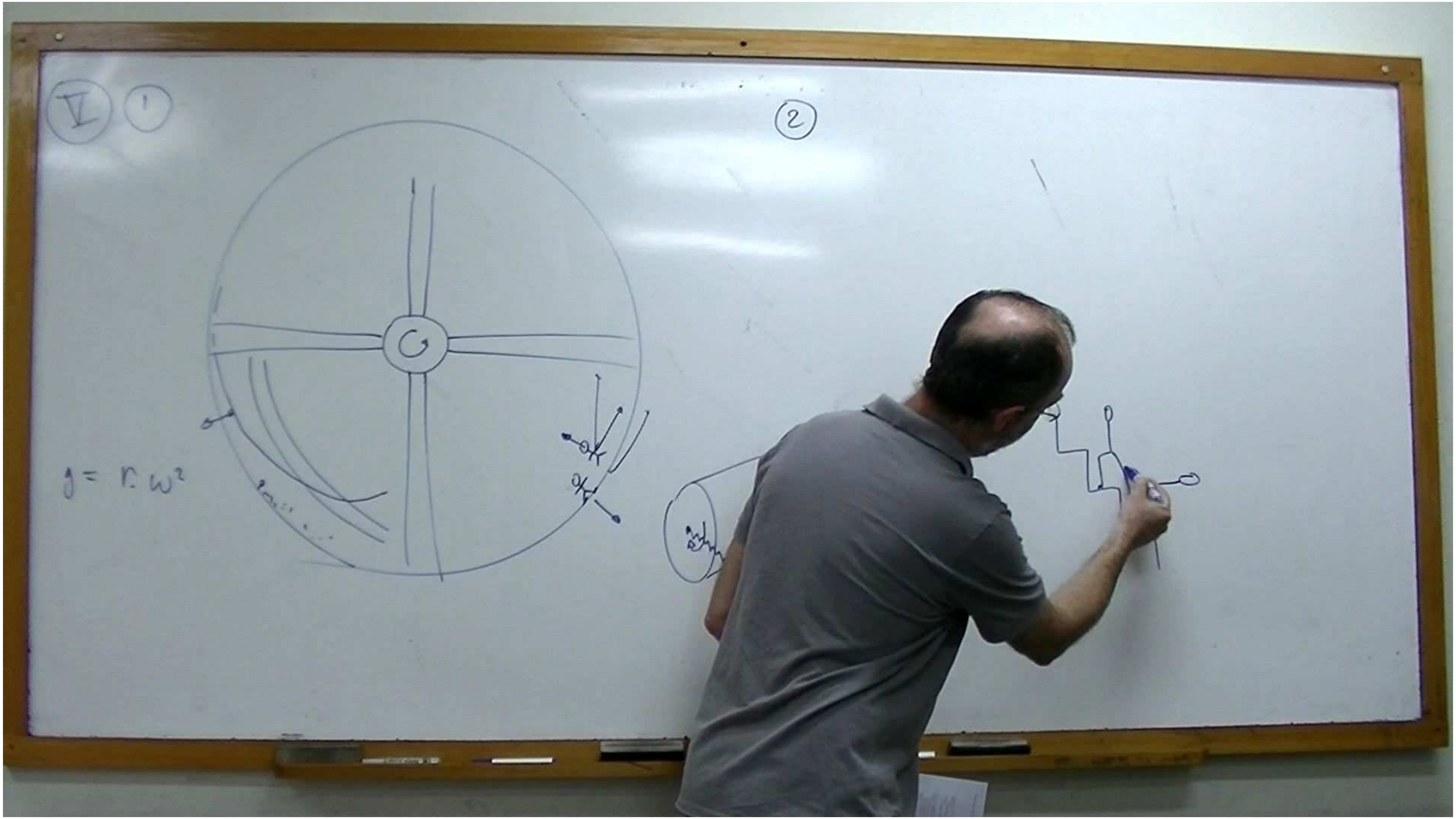

V
7

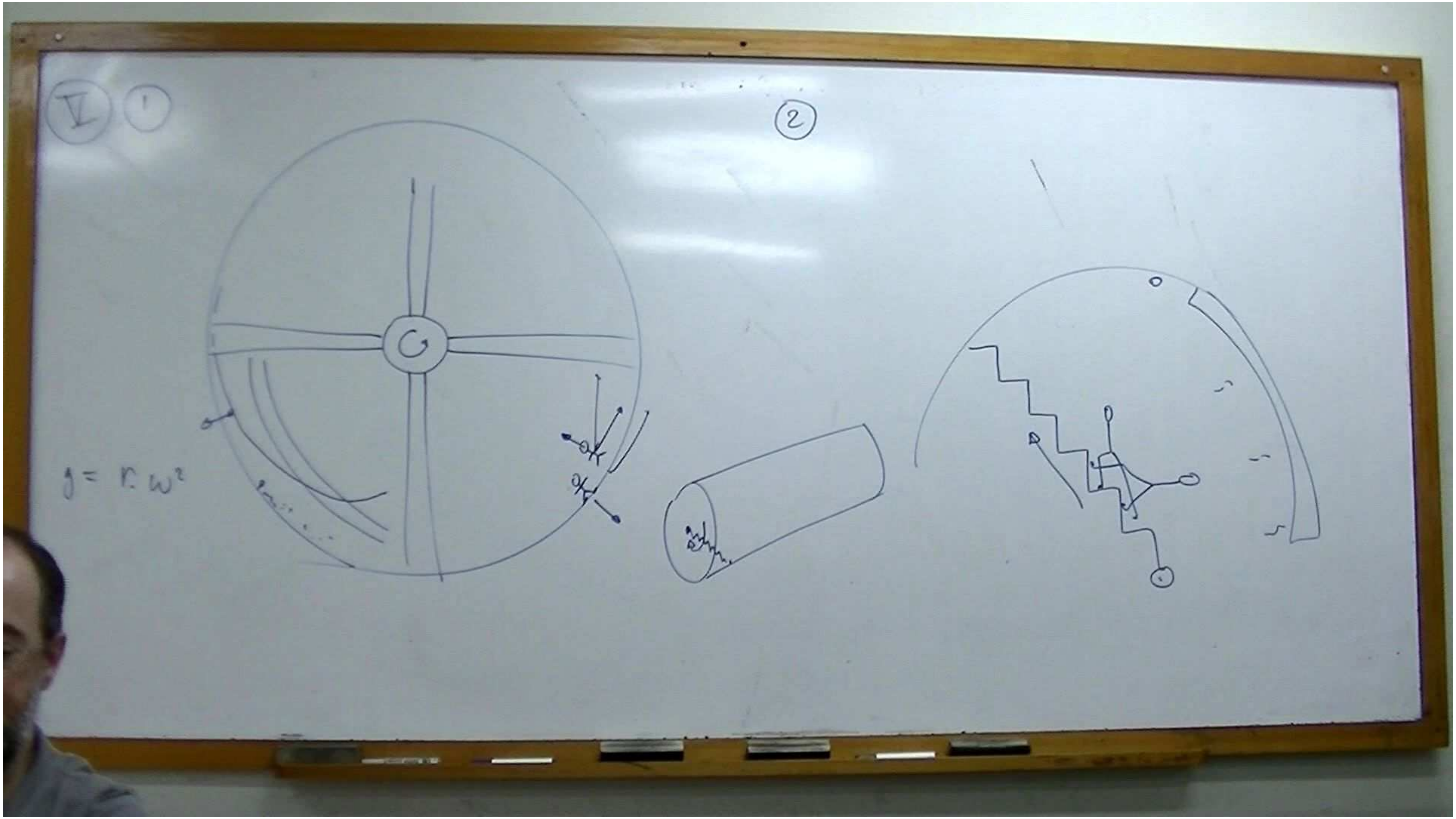

V
7

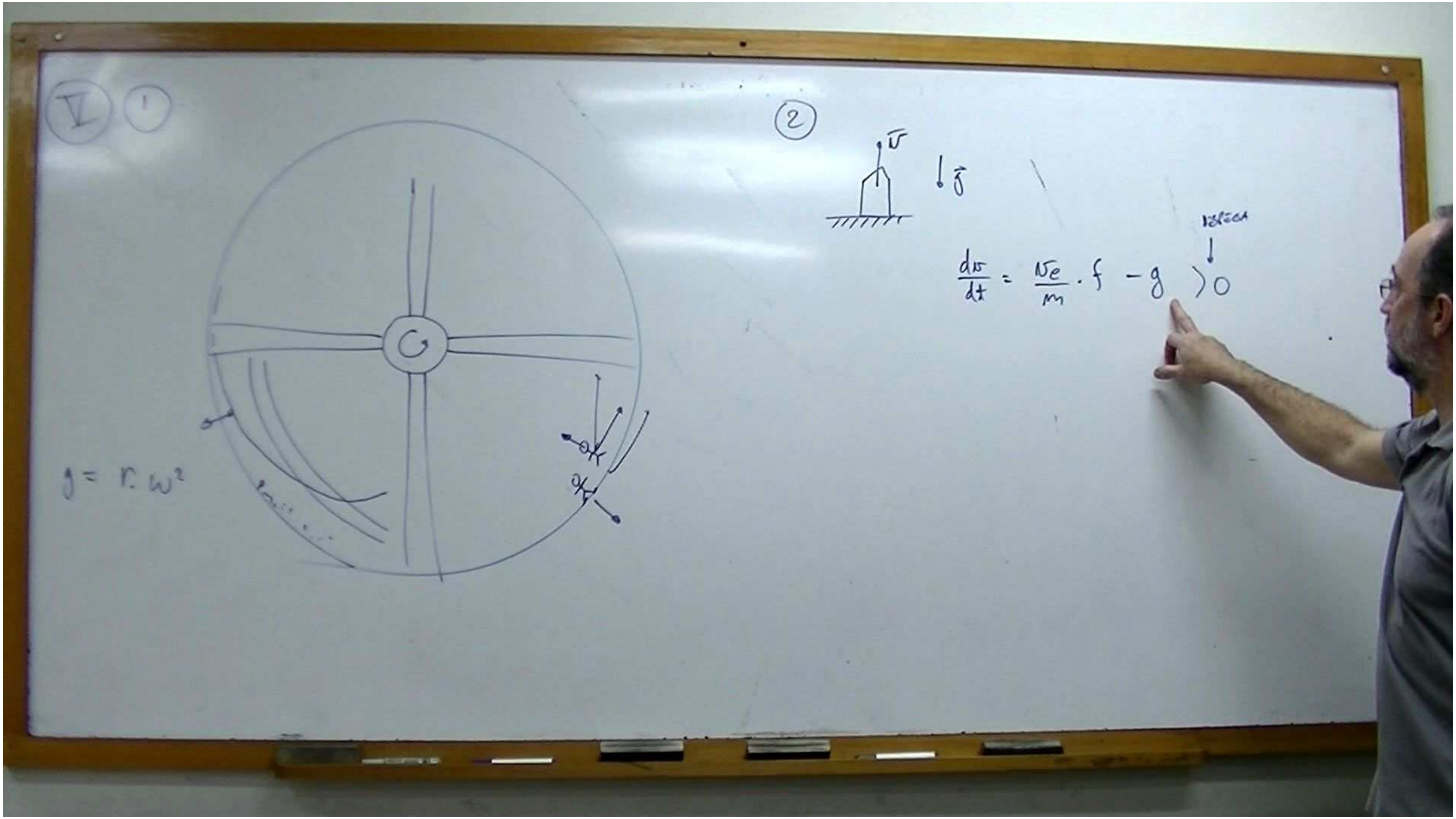

V
7
Júp
$\bar{V}_J$
$\bar{V}_0'$
$\bar{V}_H' < V_H$ inicial


V
1
G


V
1
2
g = r ω²

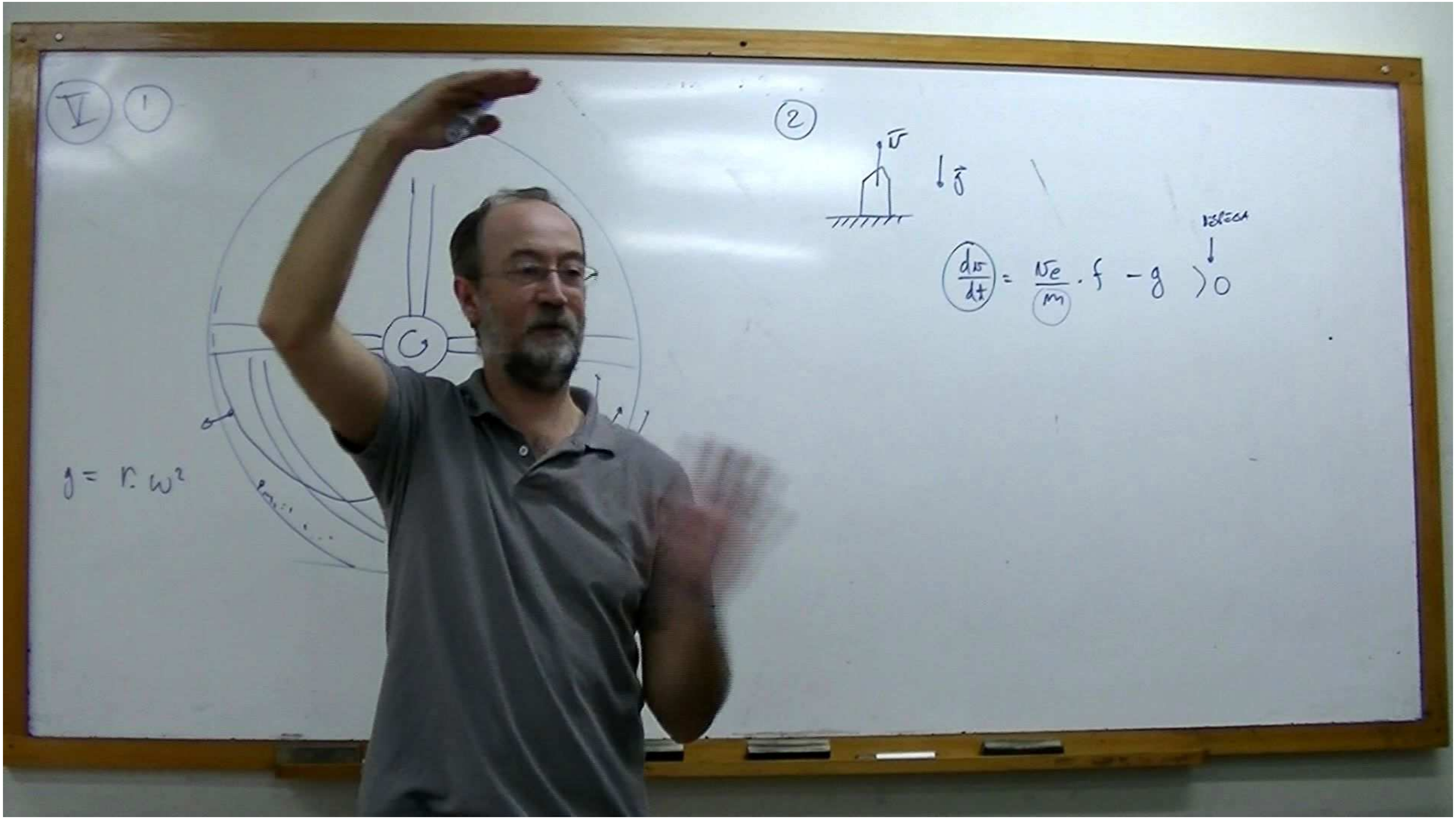

V
1
2
g = r ω²

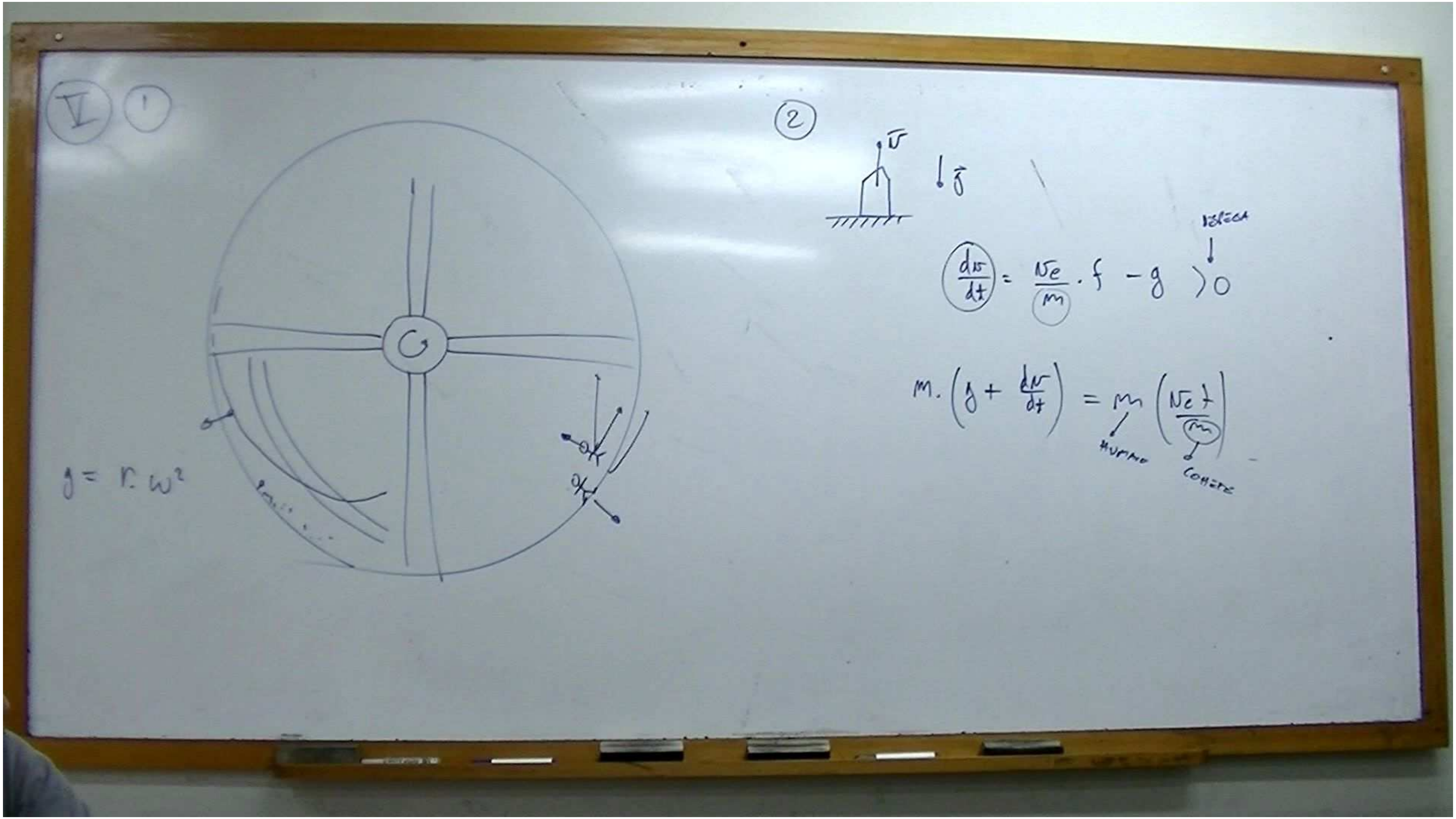

V
1
2
g = r. ω²



$g = r. \omega^2$

$$\frac{dv}{dt} = \frac{v_e}{m} . f - g > 0$$


V
1
2
$\vec{v}$
$\vec{g}$
DESPEGA
$\frac{dv}{dt} = \frac{v_e}{m} \cdot f - g > 0$
$g = r \cdot \omega^2$



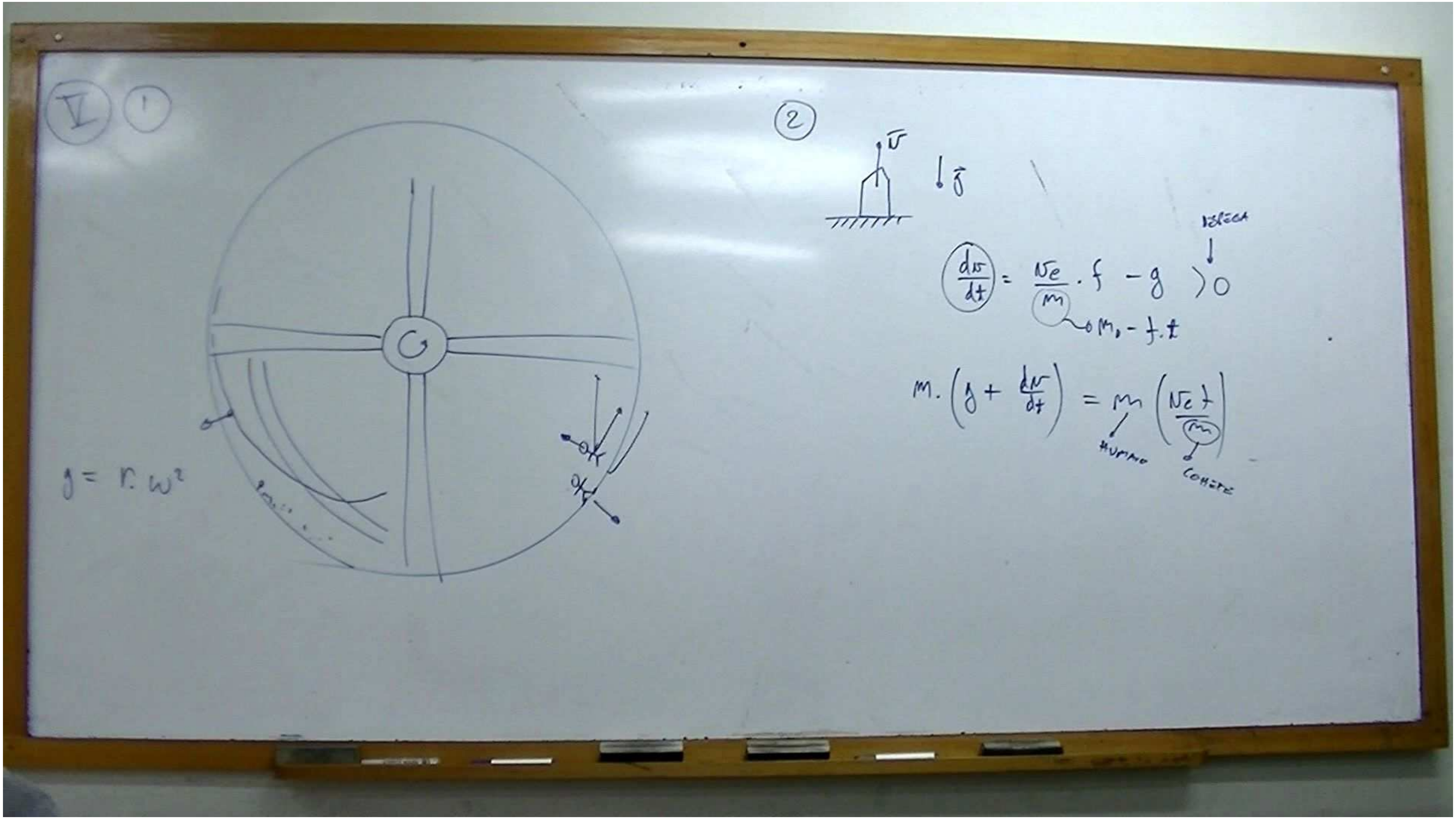
Ⓥ ①

$g = r \cdot \omega^2$

②

$$\boxed{\frac{dv}{dt}} = \frac{v_e}{\boxed{m}} \cdot f - g \overset{\text{DESPEGA}}{>} 0$$

$$m \cdot \left(g + \frac{dv}{dt} \right) = \underset{\text{HUMANO}}{m} \left(\frac{v_e f}{\underset{\text{COHETE}}{\boxed{m}}} \right)$$

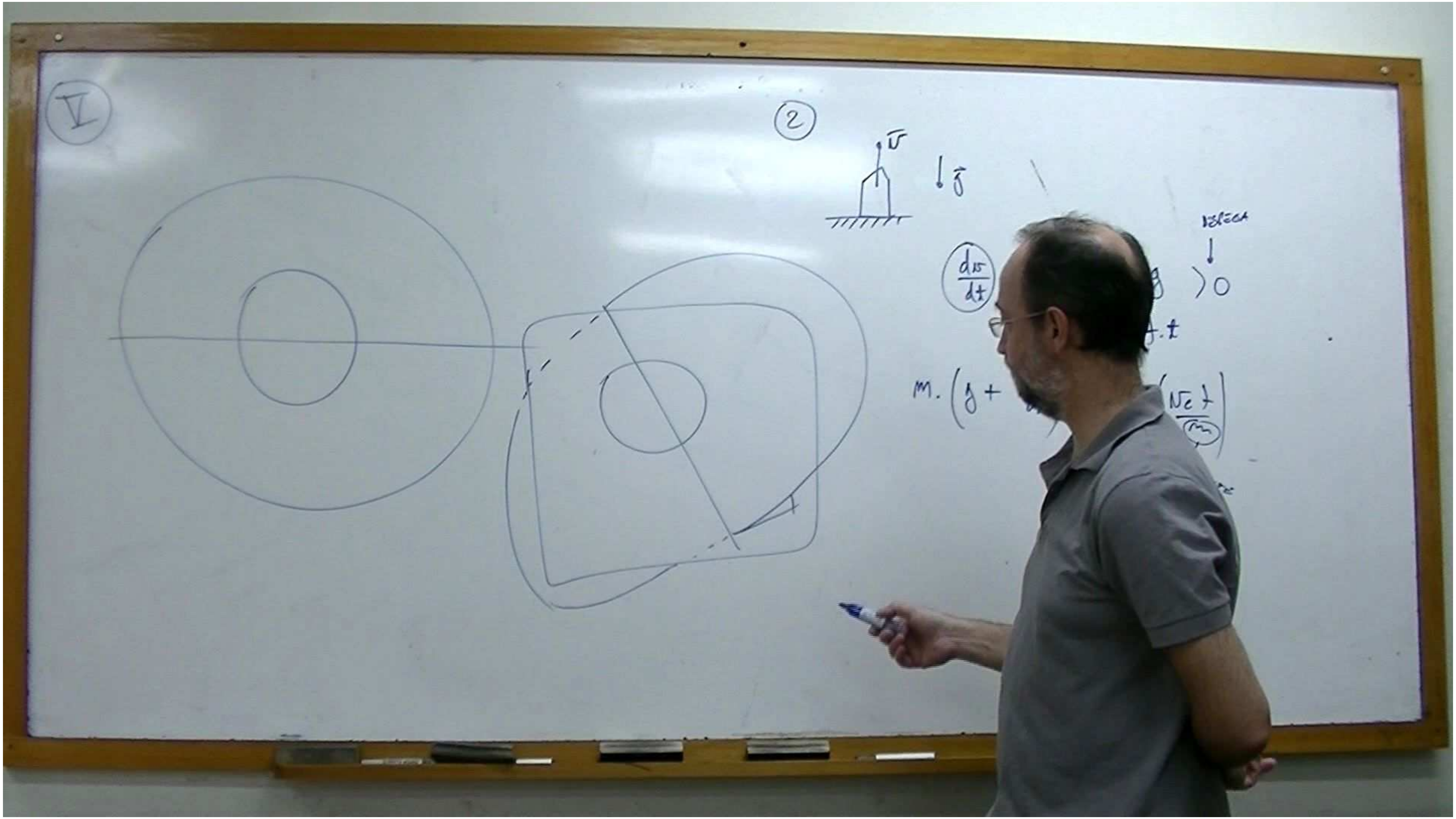


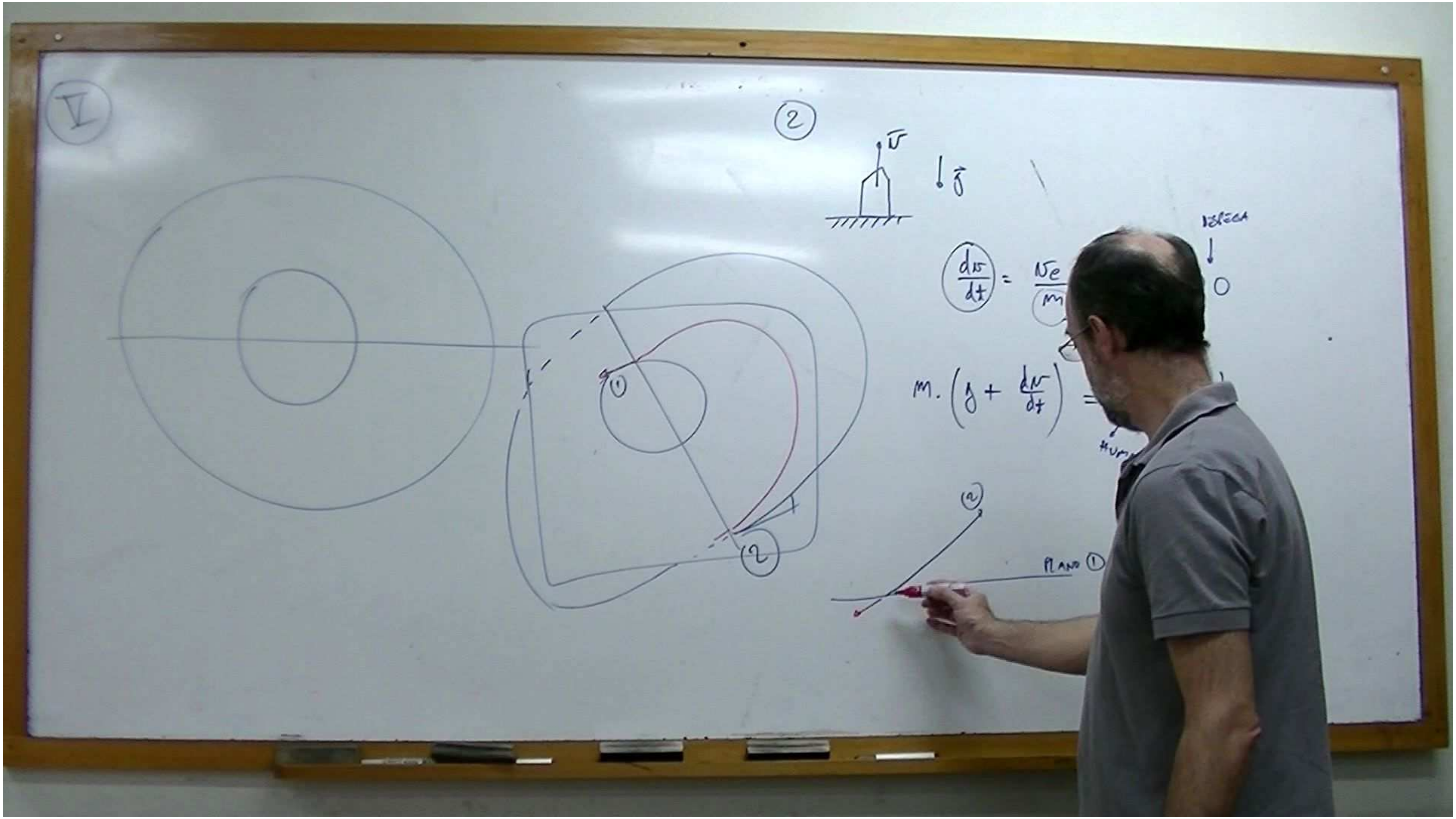
$g = r . \omega^2$

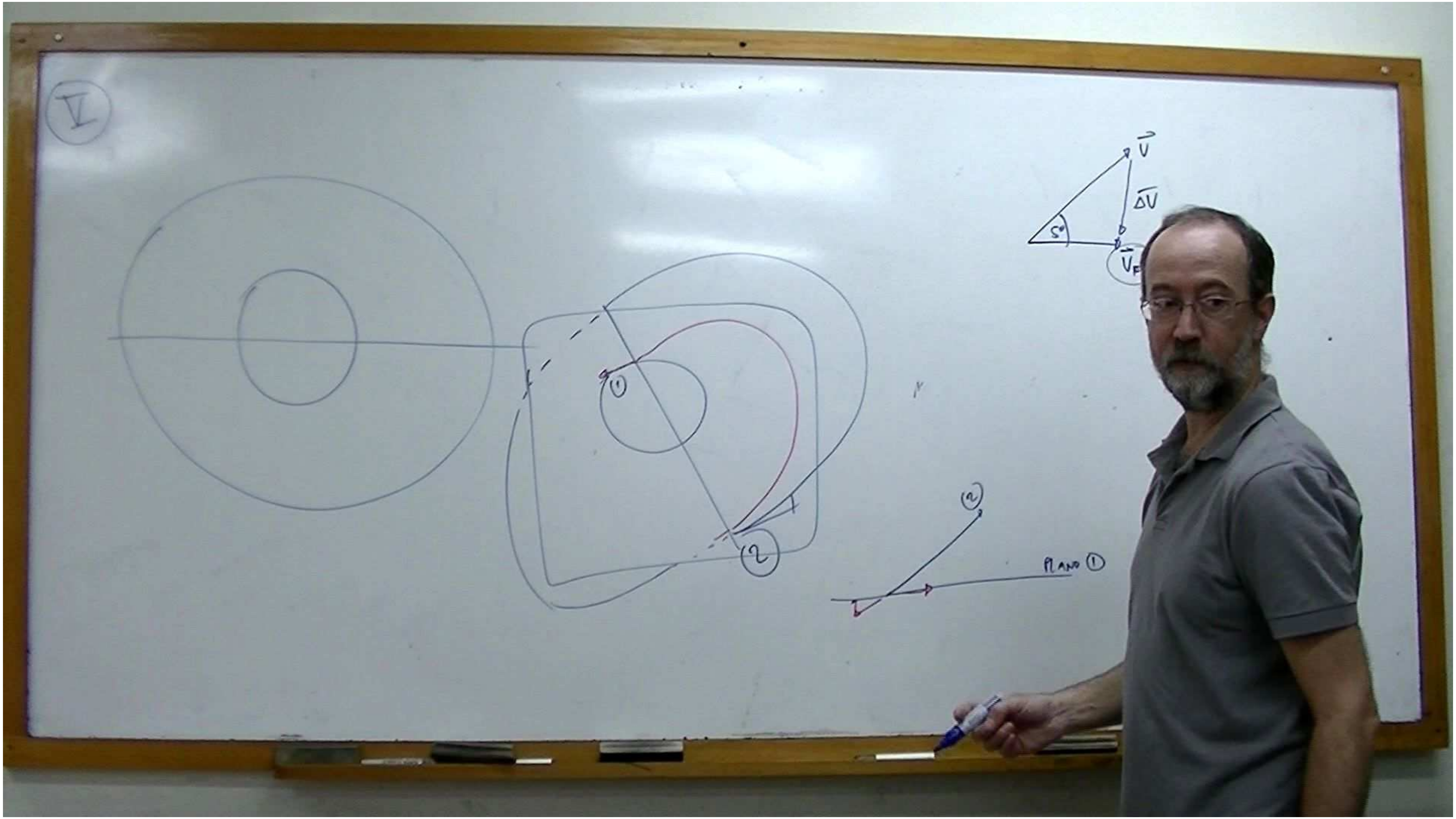
$$\frac{dv}{dt} = \frac{v_e}{m} . f - g > 0$$

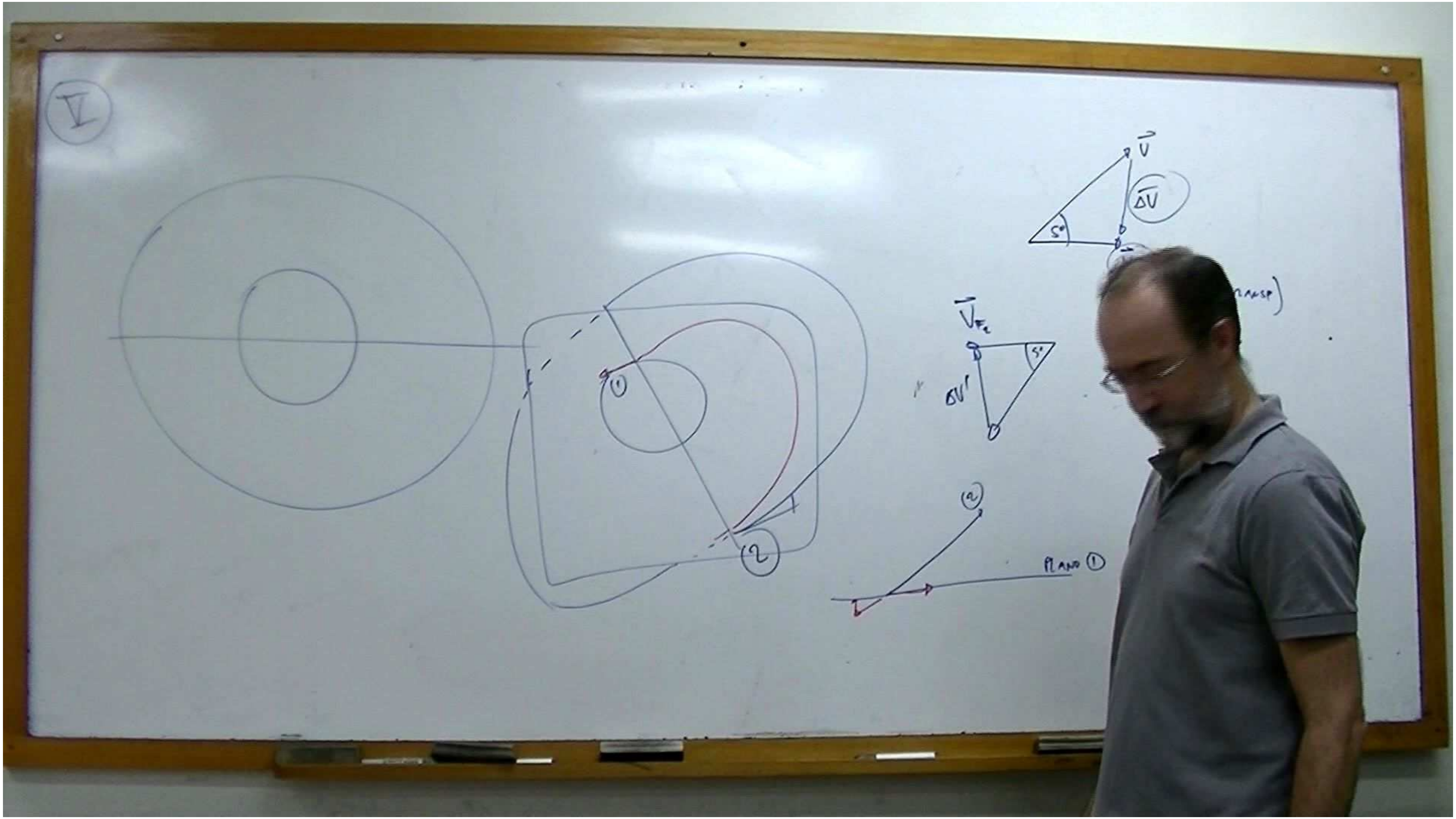
$m \to m_0 - f . t$

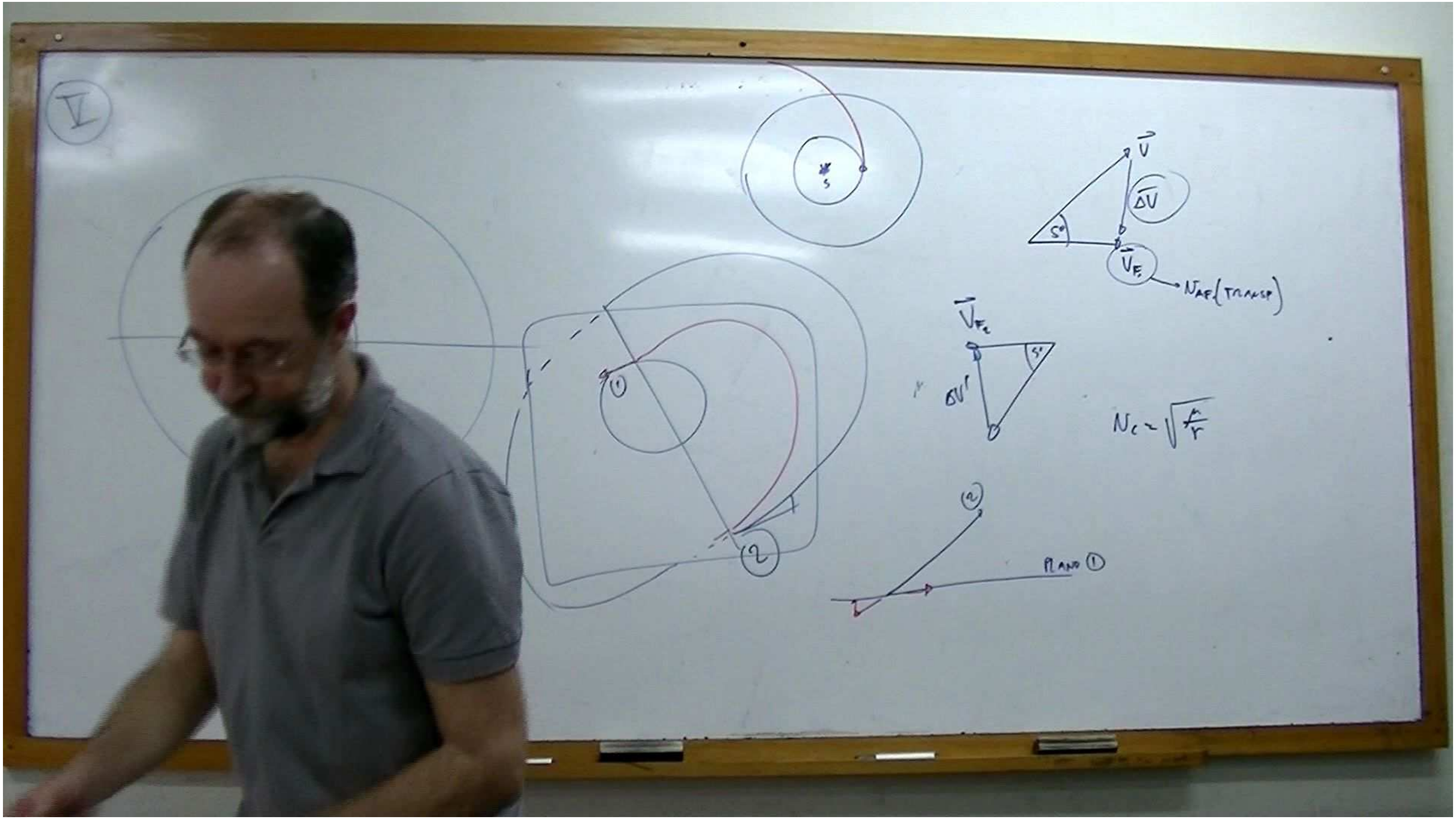
$$m . \left(g + \frac{dv}{dt} \right) = m \left(\frac{v_e f}{m} \right)$$

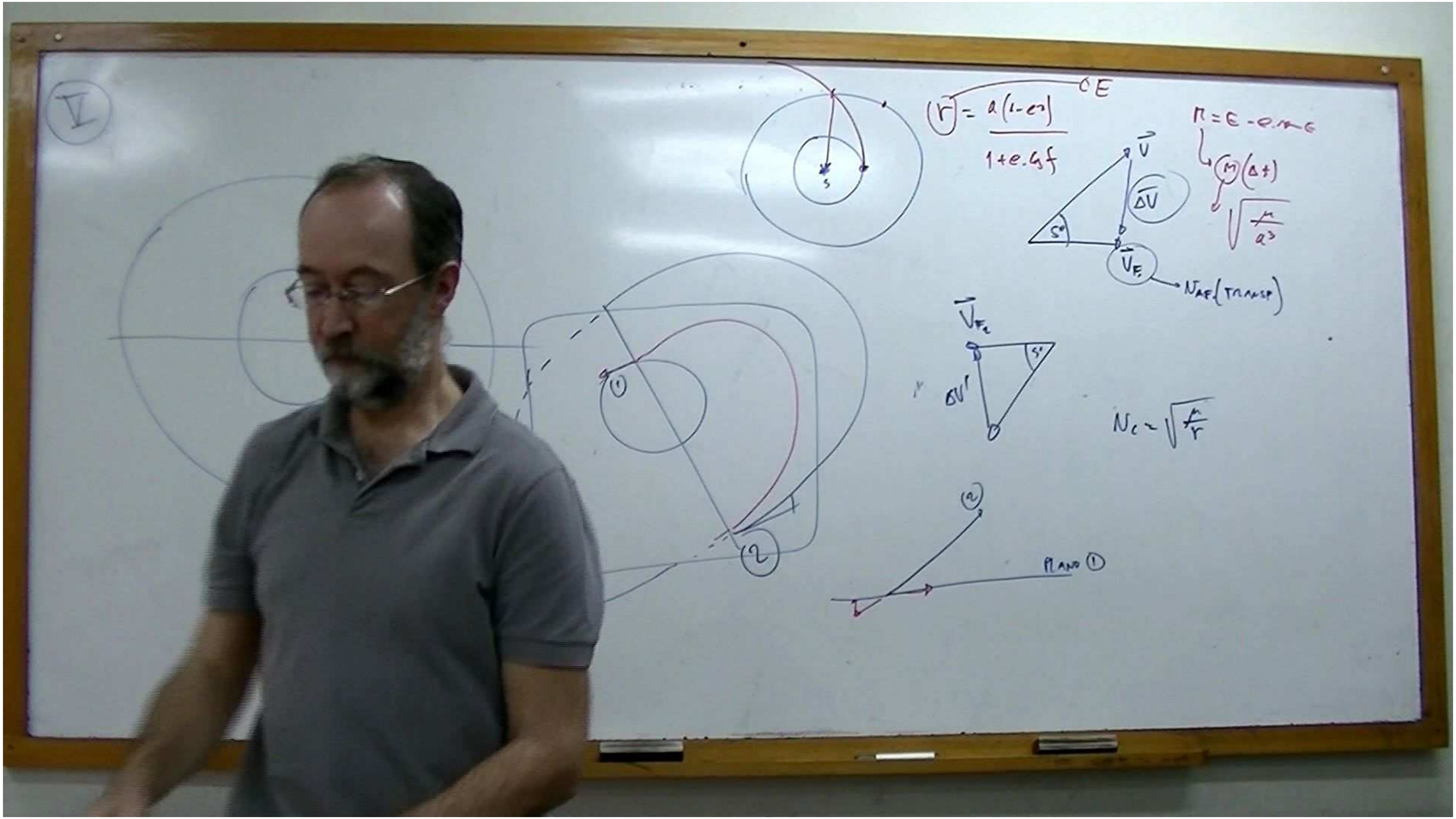

V
2
v⃗
g⃗
DESPEGA
dv/dt
g) 0
g.t
m. (g +
vc t
m

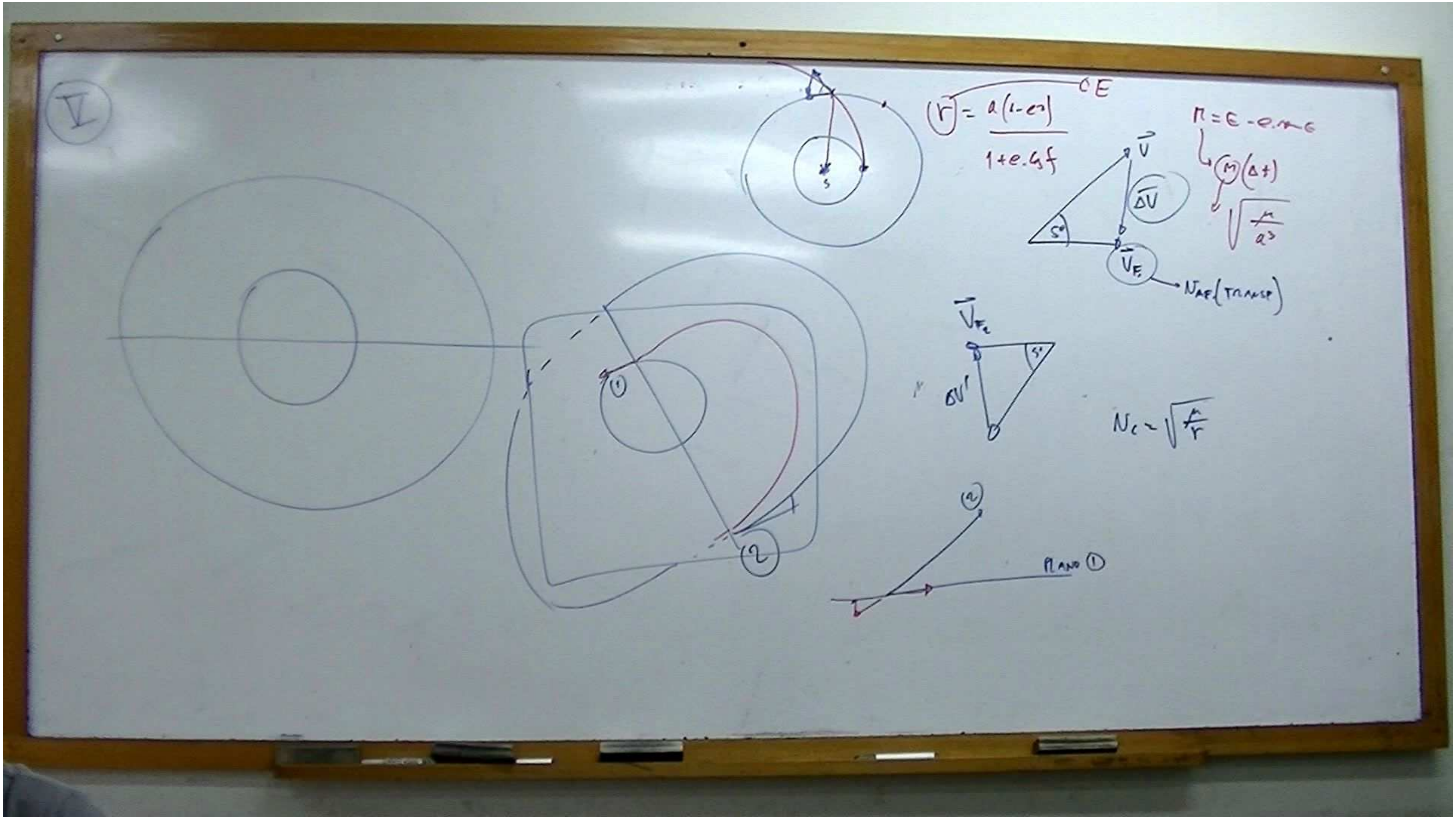

V
2
$\vec{v}$
$\vec{g}$
$\frac{dv}{dt} = \frac{V_e}{M}$
DESPEGA
0
$m.\left(g + \frac{dv}{dt}\right) =$
HUM
①
②
②
PLANO ①


V
$\vec{V}$
$\vec{\Delta V}$
5°
$\vec{V}_F$
①
②
②
PLANO ①


V
$\vec{V}$
ΔV
5°
ANSF)
$\vec{V}_{F_2}$
5°
$\Delta V'$
(1)
(2)
(2)
PLANO ①


V
S
(1)
(2)
V
ΔV
5°
V_E
N_AE (TRANSF)
V_E2
5°
ΔV'
N_c = √(μ/r)
(2)
PLANO (1)


V
E
$r = \frac{a(1-e^2)}{1+e\cos f}$
s
$r = E - e.\text{sen}\,E$
$M(\Delta t)$
$\sqrt{\frac{\mu}{a^3}}$
$\vec{V}$
ΔV
5°
$\vec{V}_E$
V_{AF} (TRANSF)
$\vec{V}_{F_2}$
5°
$\Delta V'$
$V_c = \sqrt{\frac{\mu}{r}}$
(1)
(2)
(2)
PLANO (1)



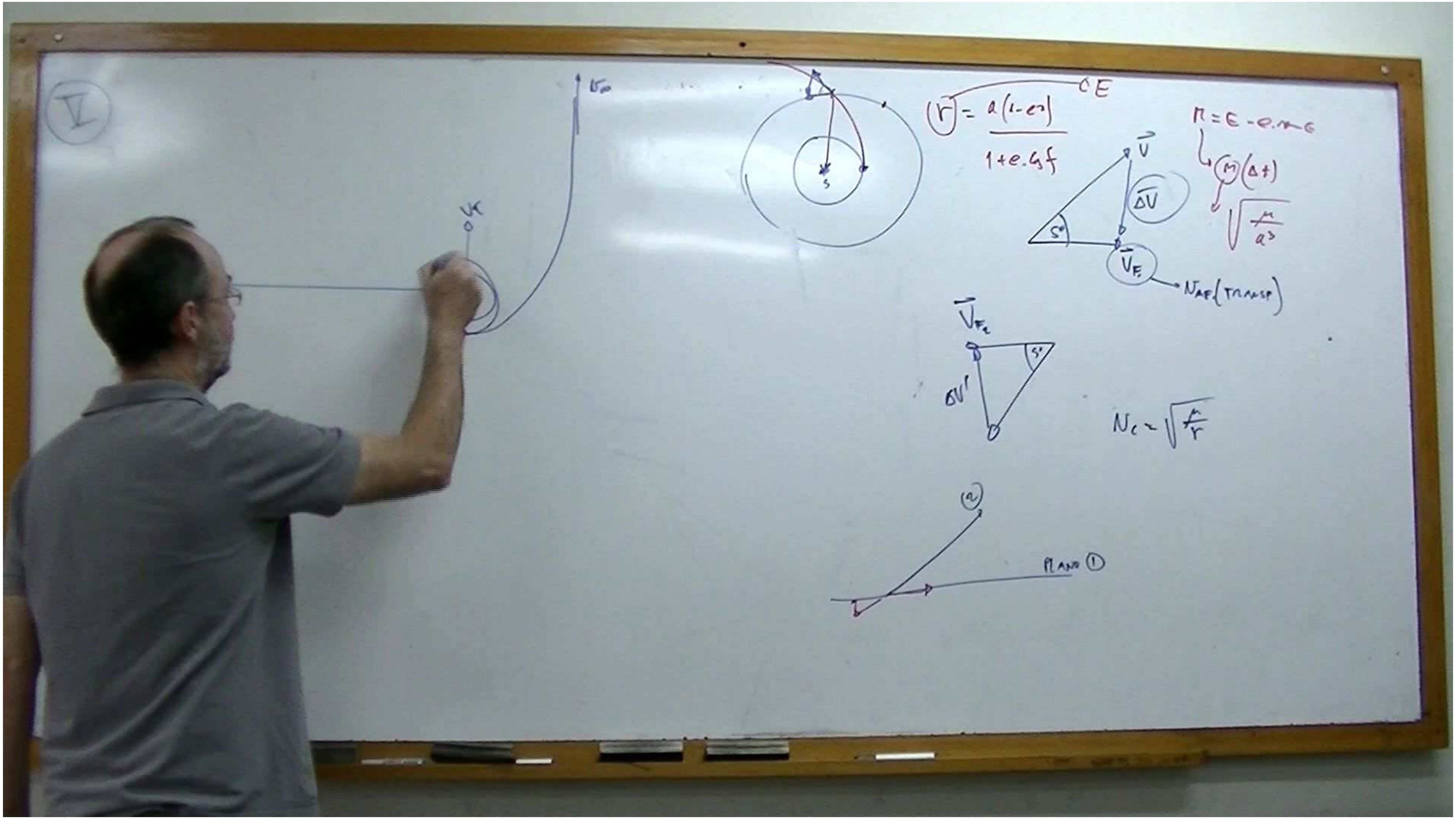
$$r = \frac{a(1-e^2)}{1+e.\cos f}$$

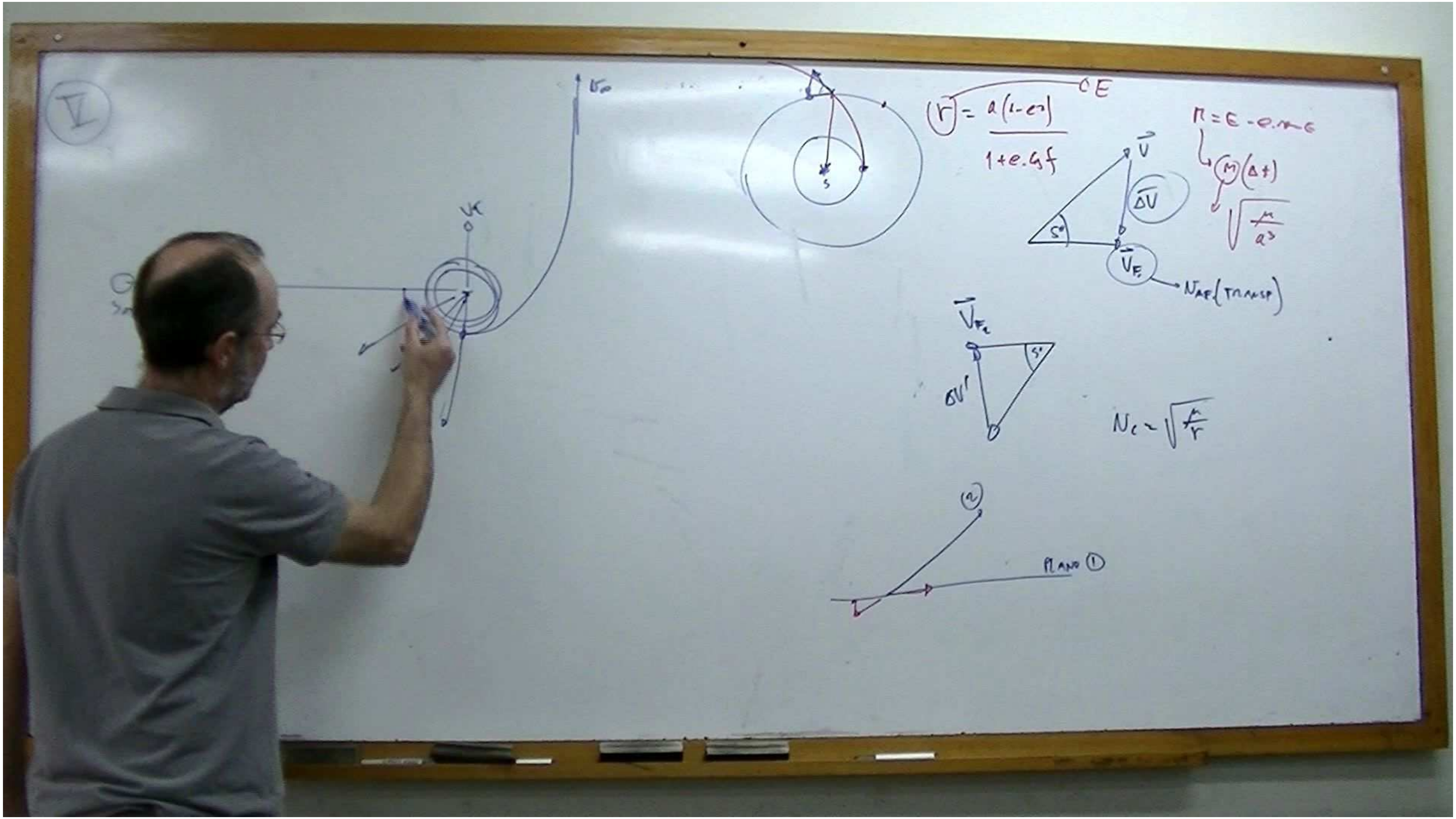
$$M = E - e.\operatorname{sen} E$$

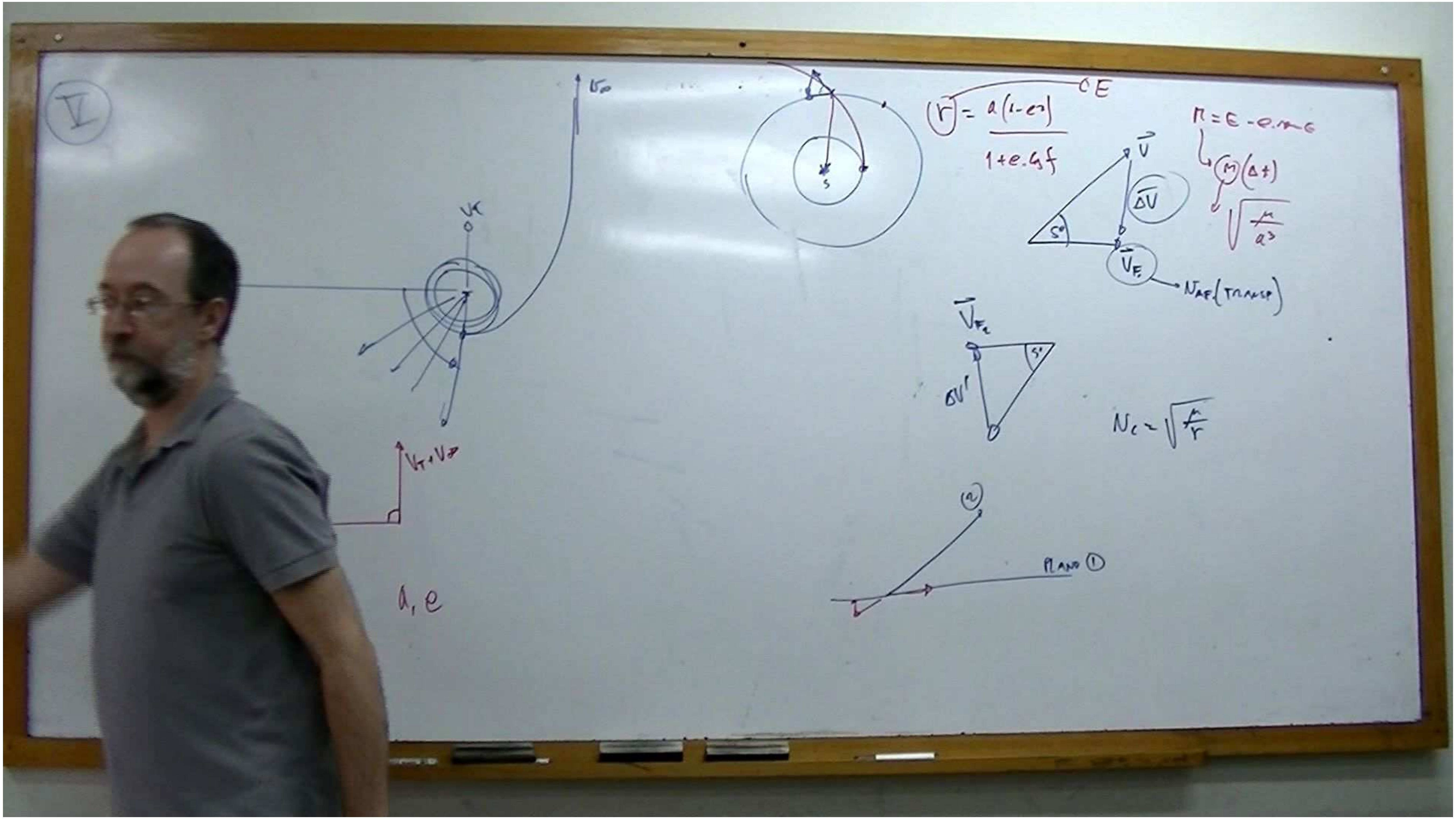
$M(\Delta t)$

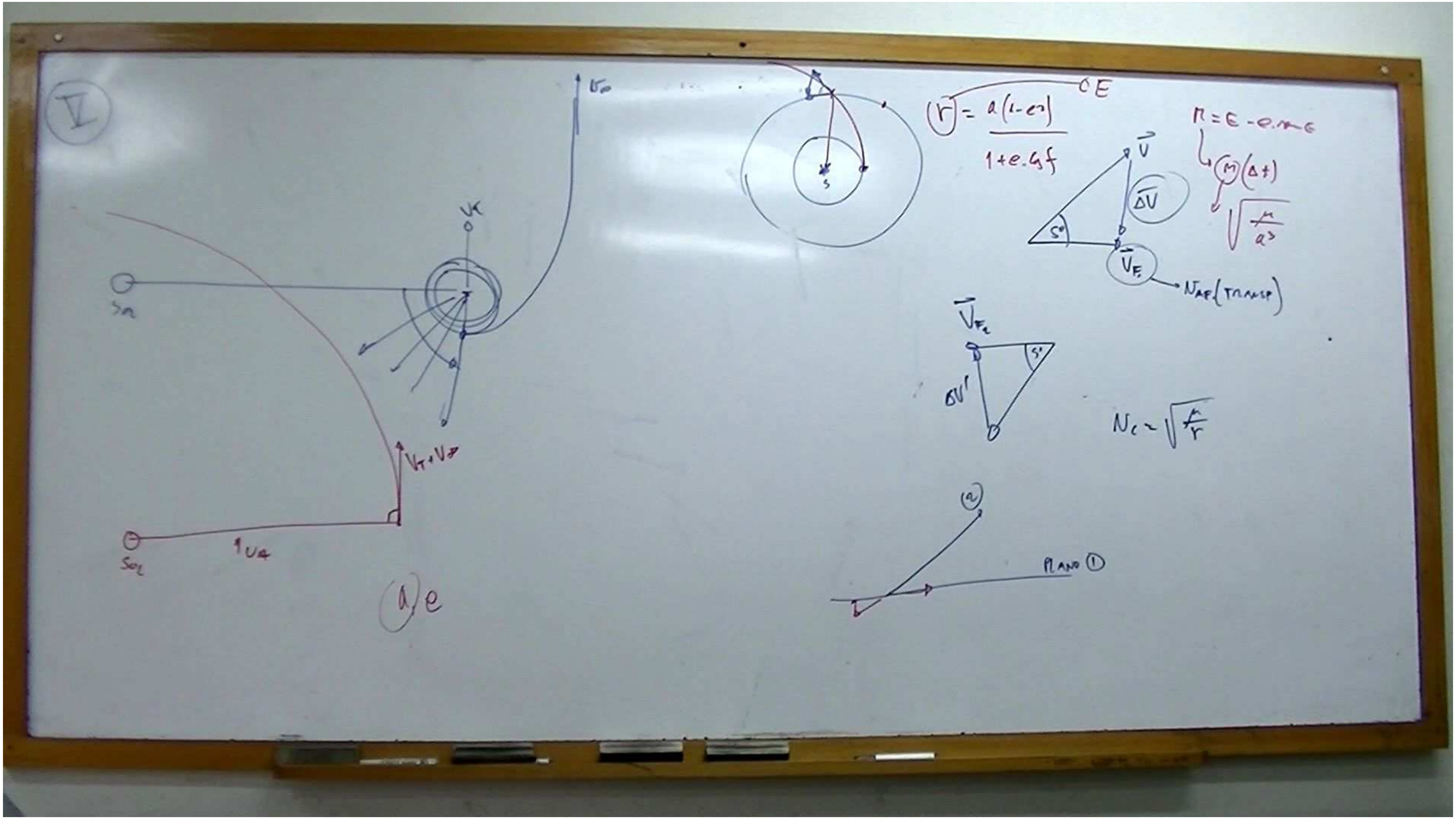
$$\sqrt{\frac{\mu}{a^3}}$$

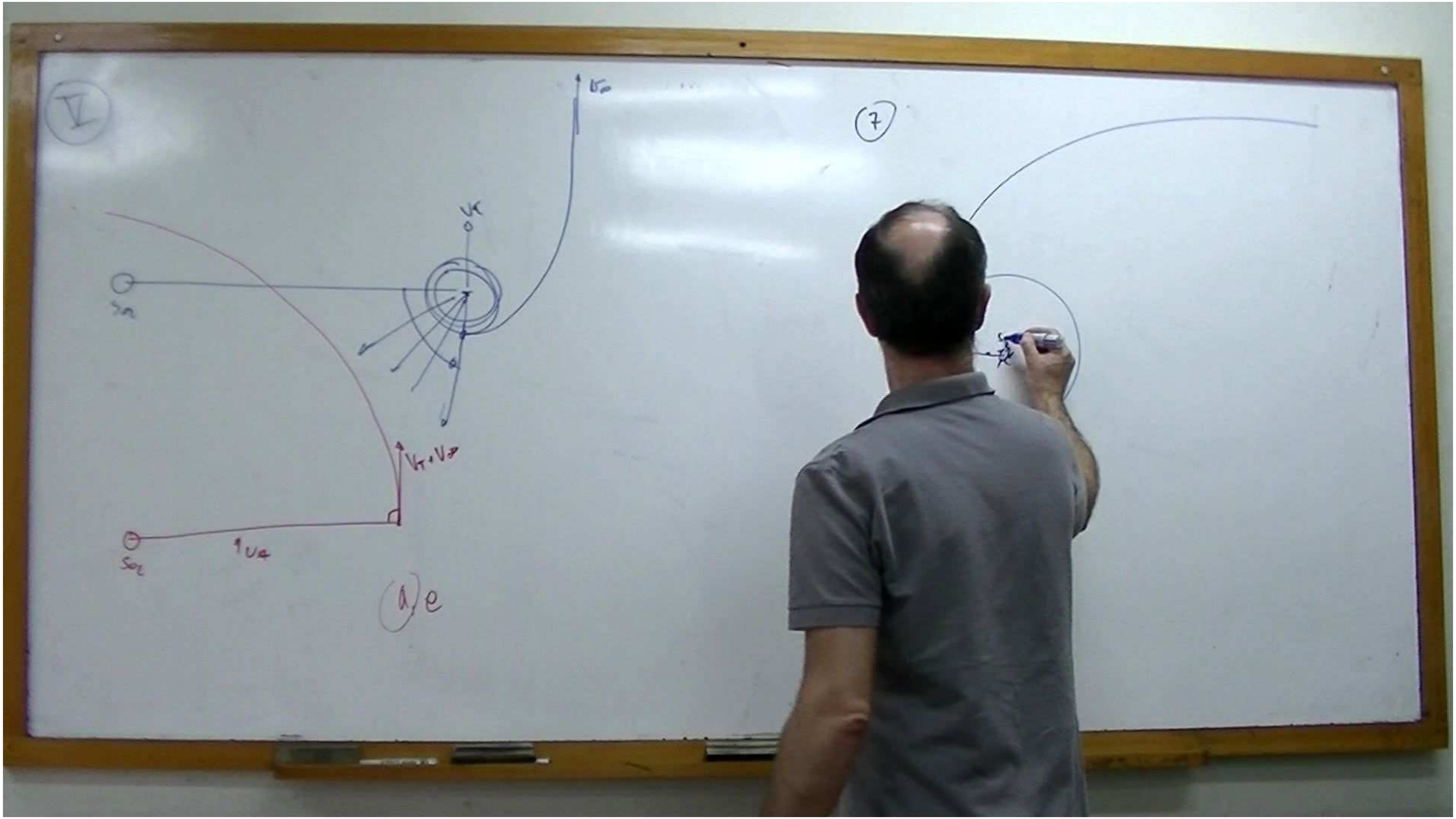
$$V_c = \sqrt{\frac{\mu}{r}}$$

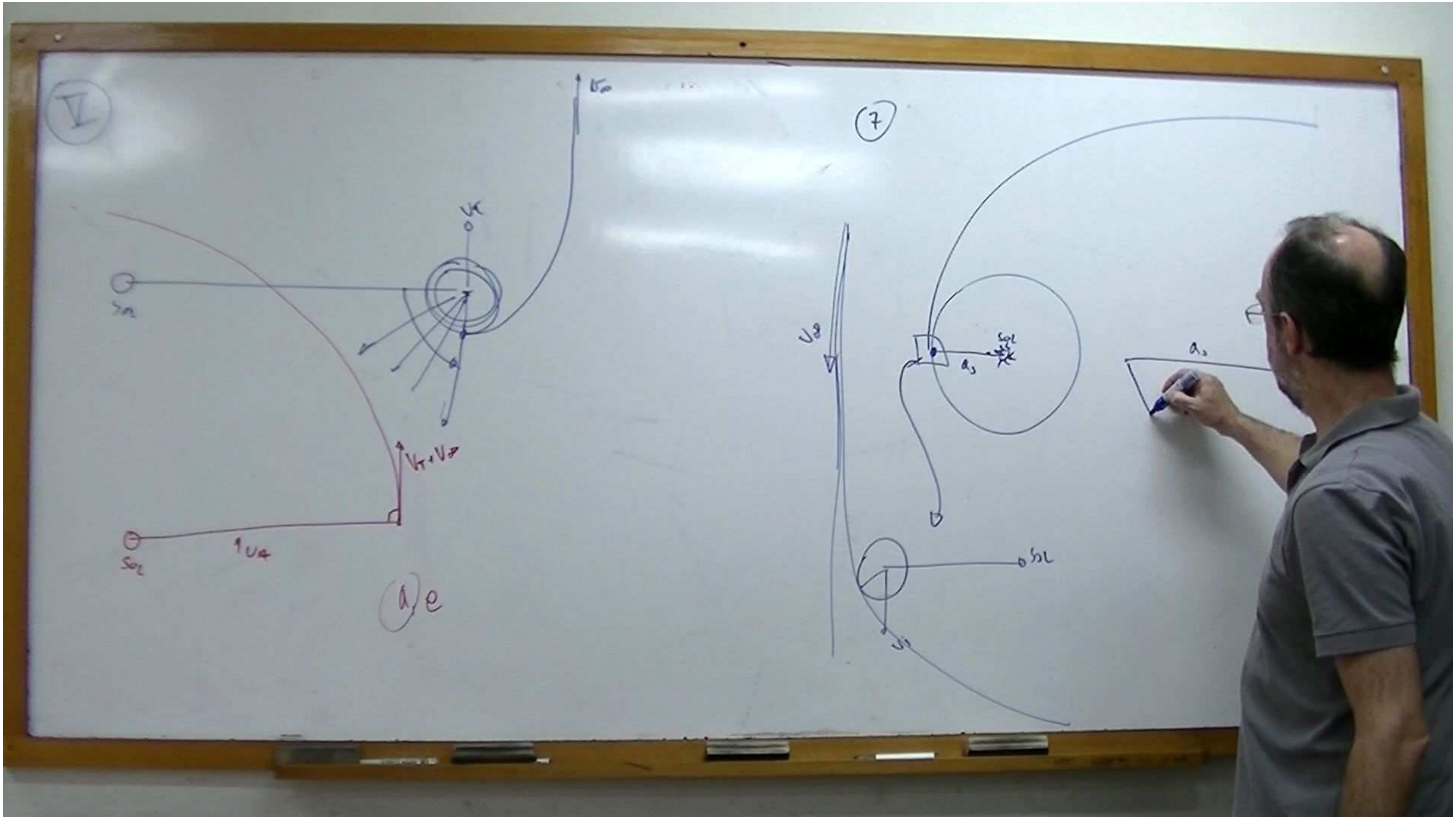

V
V∞
VK
S
CE
r = a(1-e²) / 1+e.cos f
M = E - e.sen E
M(Δt)
√(μ/a³)
V
ΔV
5°
V_E
N_AE (TRANSP)
V_F2
ΔV'
5°
N_c = √(μ/r)
(2)
PLANO (1)

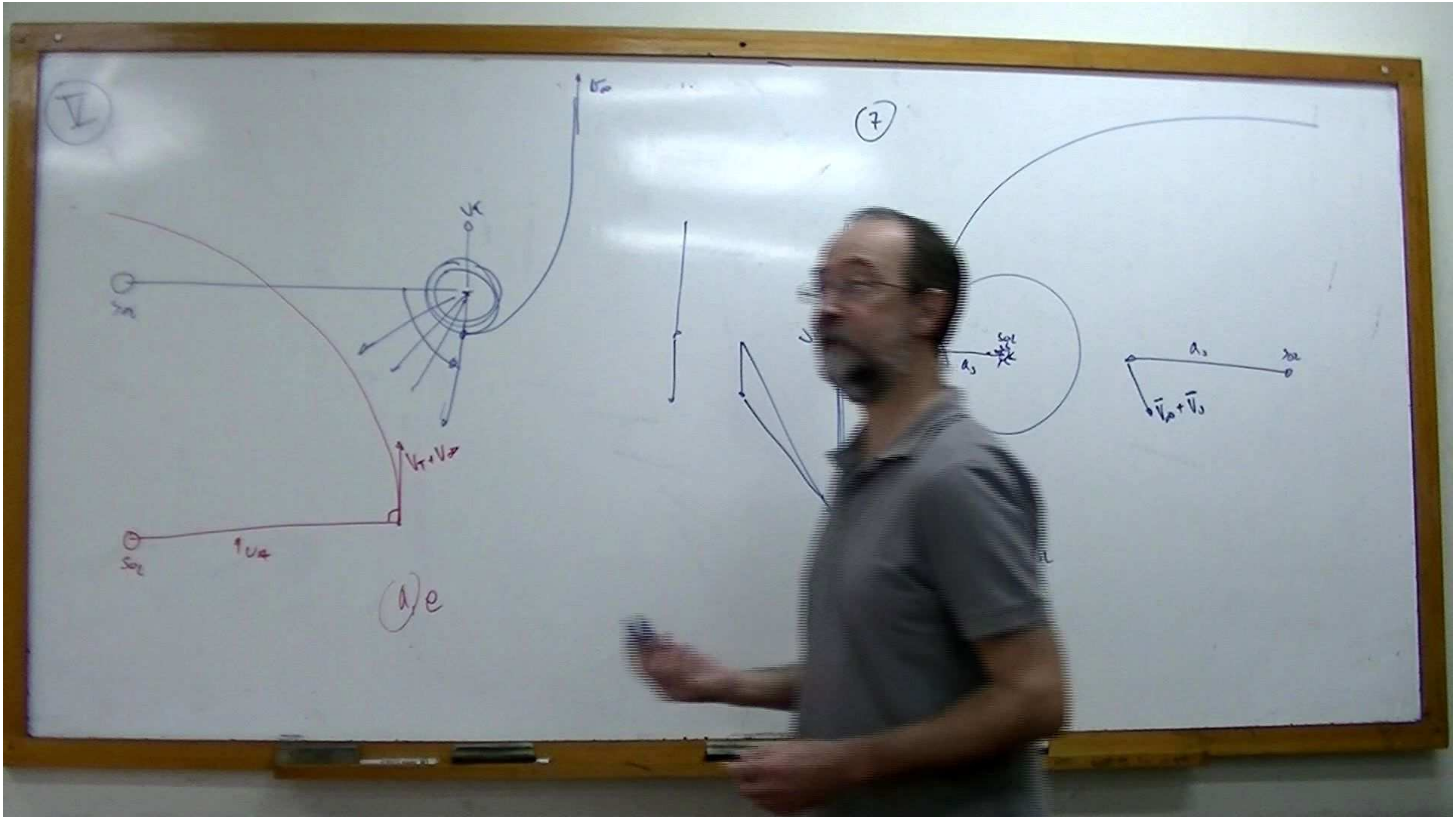

V
V∞
VK
S
E
r = a(1-e²) / 1+e.cos f
M = E - e.sen E
M(Δt)
√(μ/a³)
V
ΔV
5°
V_E
N_AF(TRANSP)
V_F2
ΔV'
5°
N_c = √(μ/r)
②
PLANO ①

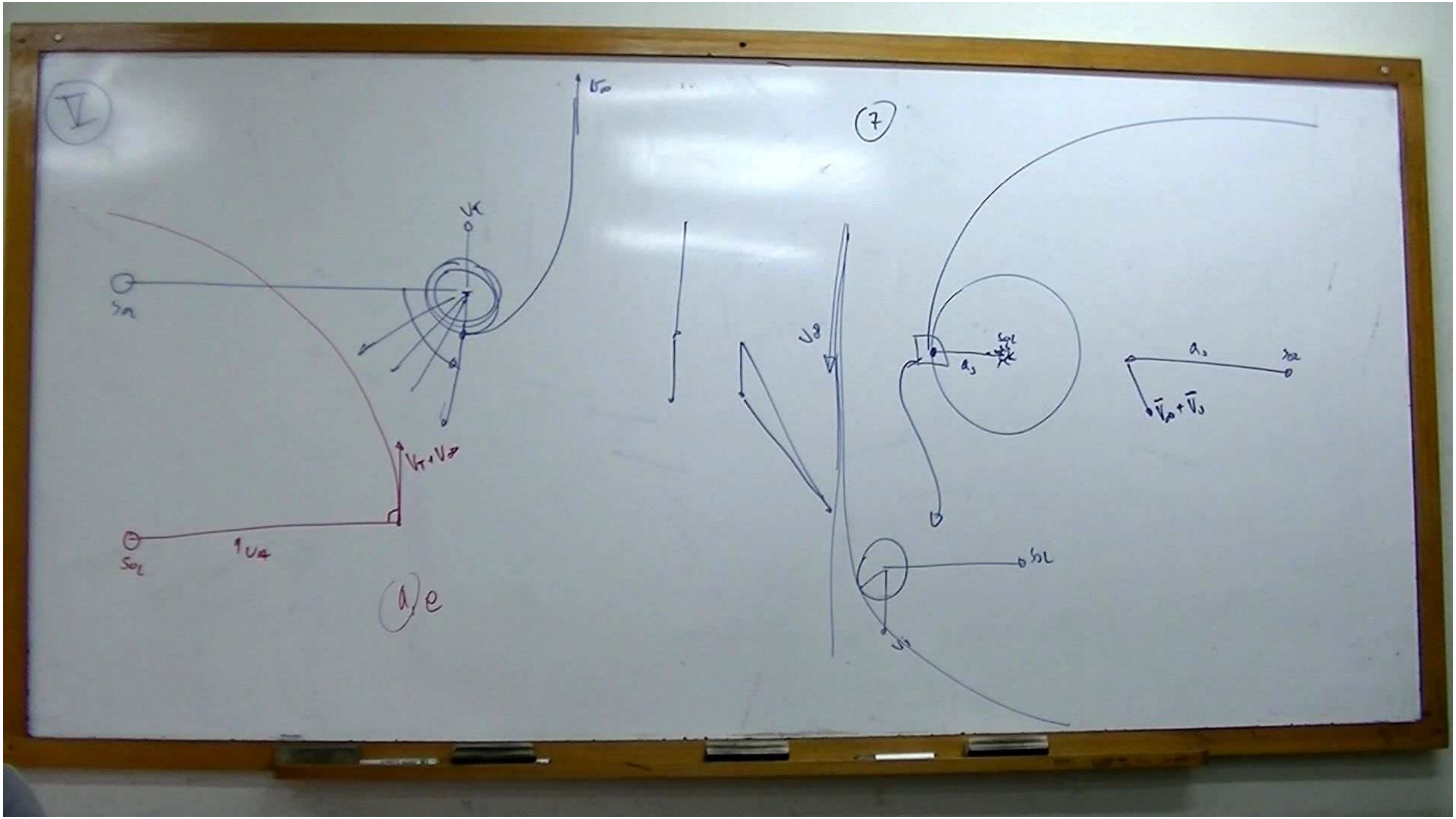

V
V∞
VT
VT+Vp
a, e
S
r = a(1-e²) / 1+e.cos f
CE
M = E - e.sin E
M(Δt)
√(μ/a³)
V
ΔV
5°
V_E
V_AF (TRANSF)
V_F2
ΔV'
5°
V_c = √(μ/r)
②
PLANO ①

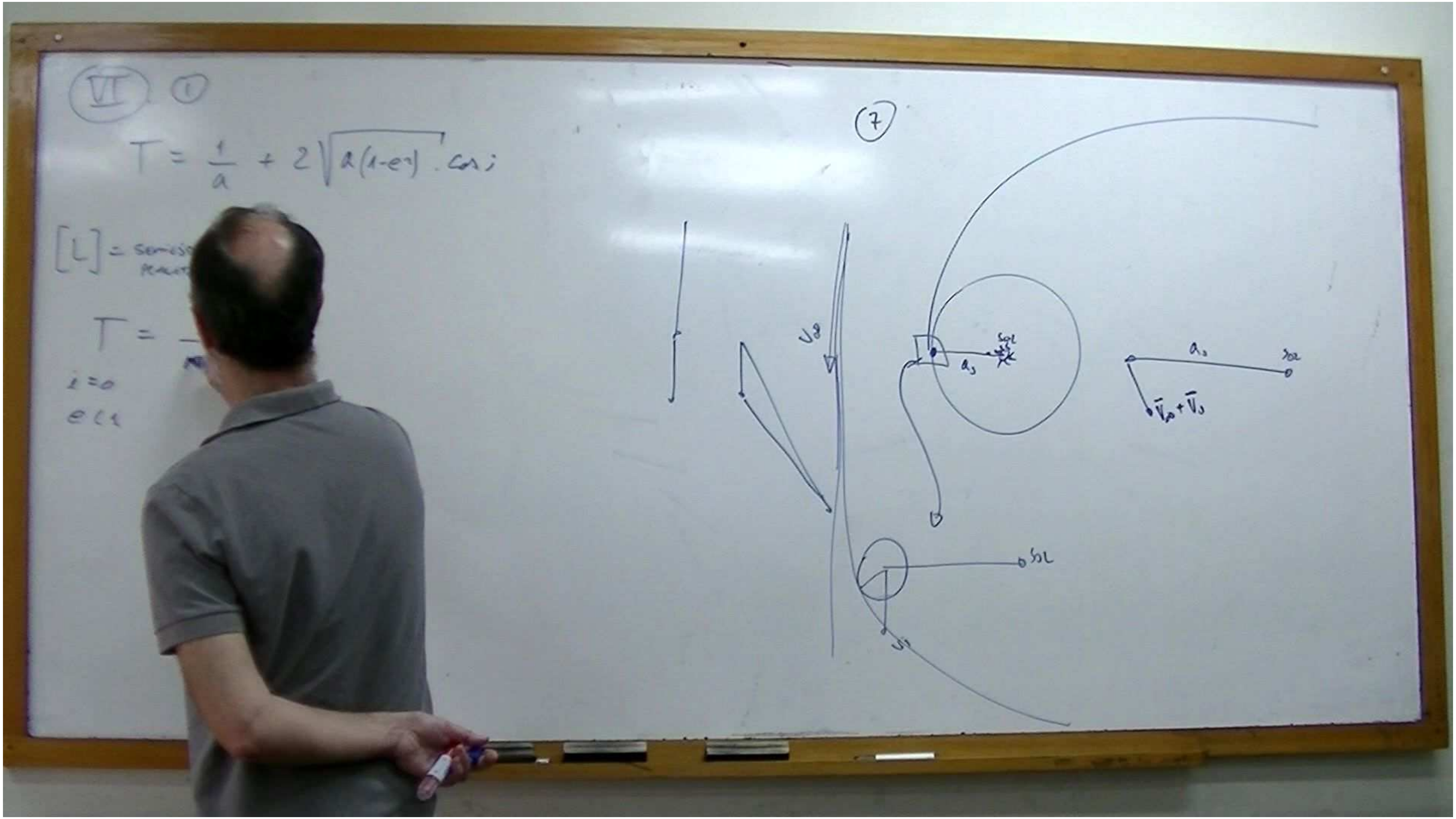

V
V∞
VT
Sol
Sol
1 UA
VT + VP
a, e
s
E
r = a(1-e²) / 1+e cos f
M = E - e sen E
M (Δt)
√(μ/a³)
V
ΔV
5°
V_E
V_AP (TRANSF)
V_E2
5°
ΔV'
V_c = √(μ/r)
(2)
PLANO (1)

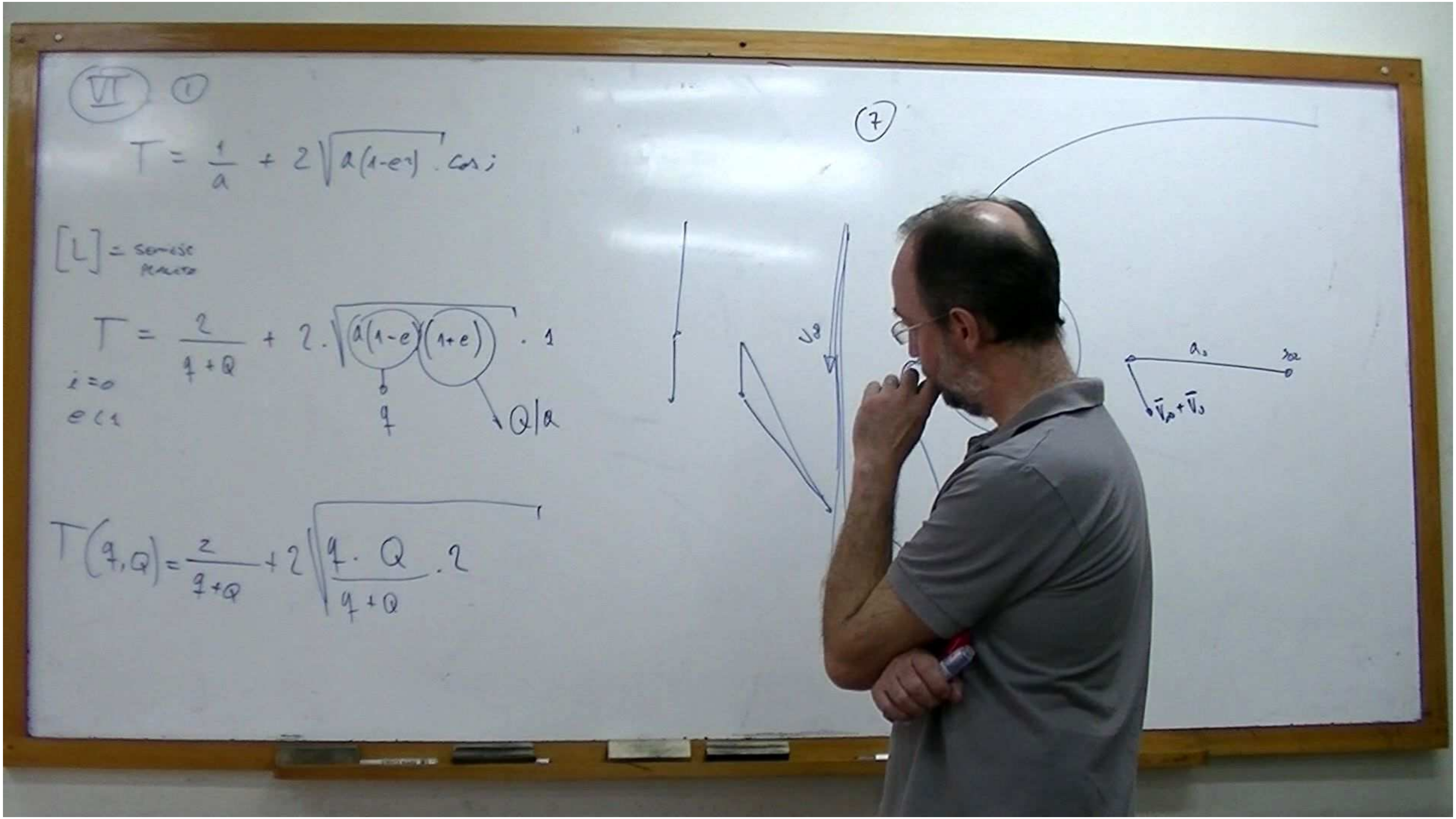

V
V∞
VT
Sol
VT+V∞
1 UA
Sol
a) e
7


V
V∞
VE
Sol
VE+V∞
Sol
1 UA
a, e
7
V∞
Sol
a₀
a₀
Sol
Sol


V
V∞
VK
Sol
V_T + V_P
a_V
Sol
a) e
7
Sol
a_s
a_s
Sol
V_p + V_s


V
V_∞
VK
Sol
$V_T + V_\delta$
Sol
1 UA
a) e
7
V_δ
Sol
a_s
Sol
a_s
Sol
$\bar{V}_\delta + \bar{V}_s$
Sol


VI
1
$T = \frac{1}{a} + 2\sqrt{a(1-e^2)} \cdot \cos i$
[L] = semieje
T =
i = 0
e < 1
7
Sol
a_J
a_0
Sol
$\bar{V}_p + \bar{V}_J$
Sol



VI ①

$$T = \frac{1}{a} + 2\sqrt{a(1-e^2)} \cdot \cos i$$

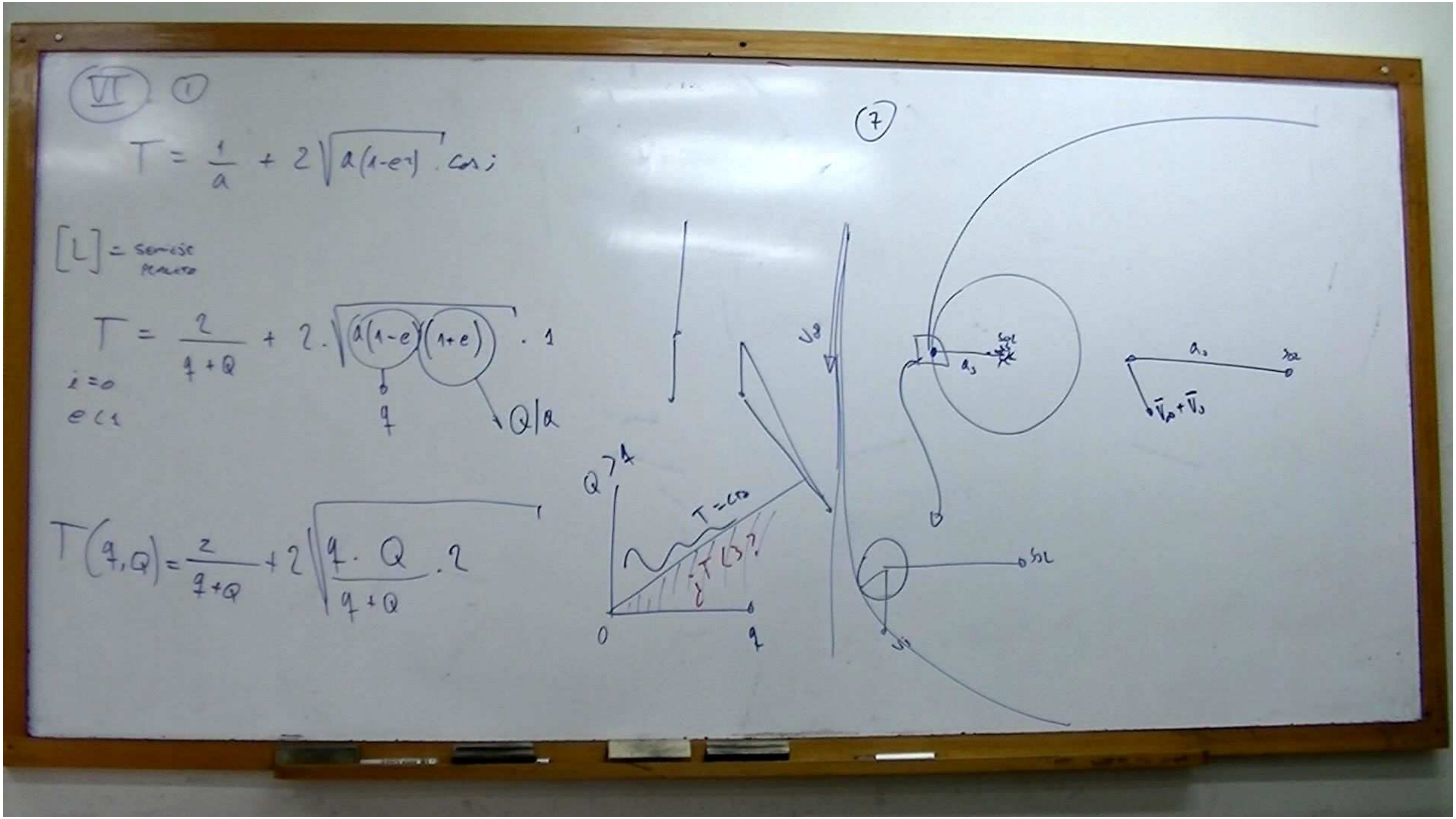
$[L]$ = semieje perihelio

$$T = \frac{2}{q+Q} + 2 \cdot \sqrt{\underbrace{a(1-e)}_{q}\underbrace{(1+e)}_{Q/a}} \cdot 1$$

$i = 0$

$e < 1$

$$T(q,Q) = \frac{2}{q+Q} + 2\sqrt{\frac{q \cdot Q}{q+Q} \cdot 2}$$



VI ①

$$T = \frac{1}{a} + 2\sqrt{a(1-e^2)}\cdot\cos i$$

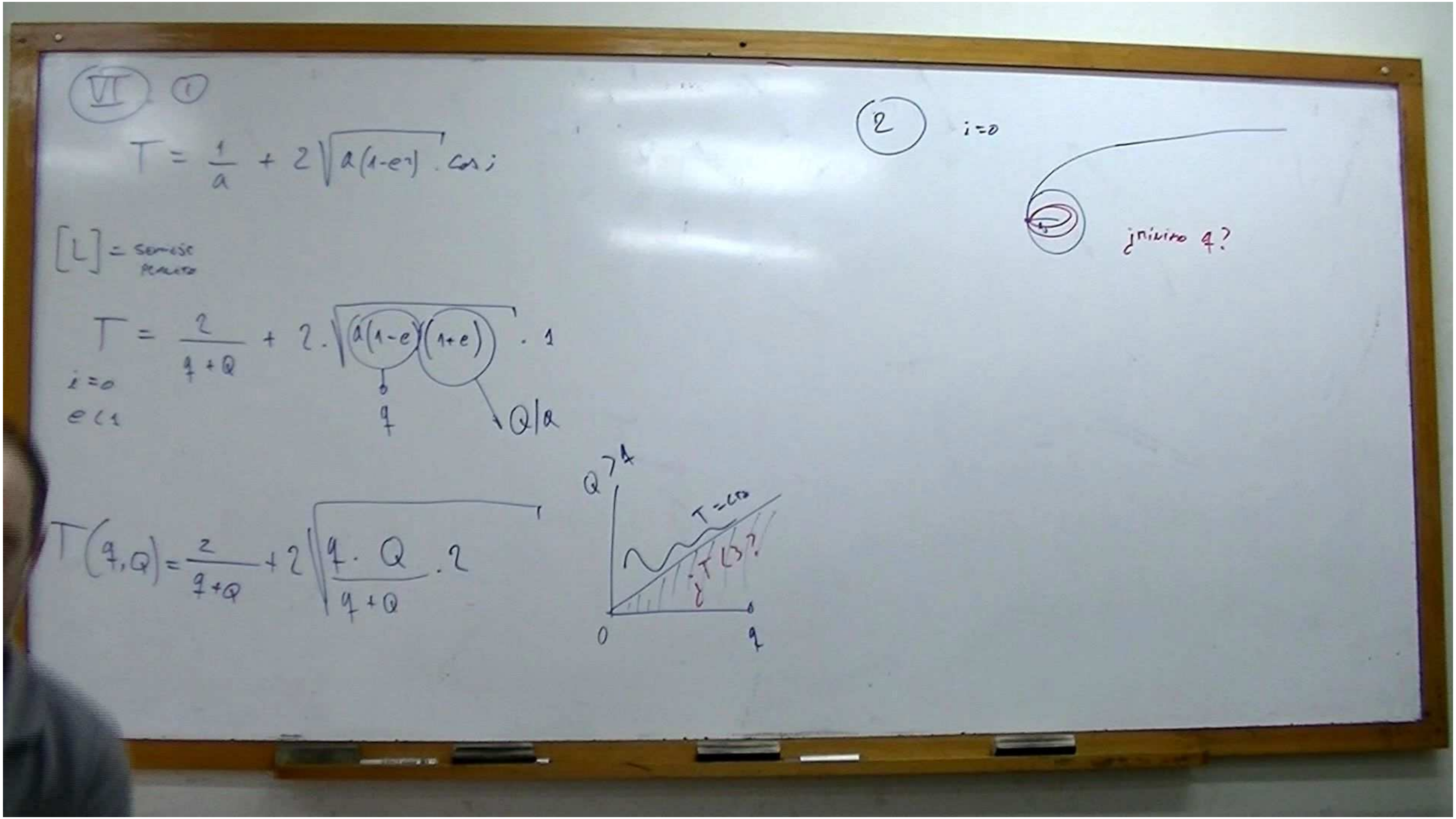
$[L]$ = semieje [illegible]

$$T = \frac{2}{q+Q} + 2\cdot\sqrt{\underbrace{a(1-e)}_{q}\underbrace{(1+e)}_{Q/a}}\cdot 1$$

$i = 0$

$e < 1$

$$T(q,Q) = \frac{2}{q+Q} + 2\sqrt{\frac{q\cdot Q}{q+Q}\cdot 2}$$



Ⓥⅰ ①

$$T = \frac{1}{a} + 2\sqrt{a(1-e^2)}\cdot\cos i$$

[L] = semi-eje perihelio

$$T = \frac{2}{q+Q} + 2\cdot\sqrt{\underbrace{a(1-e)}_{q}\underbrace{(1+e)}_{Q/a}}\cdot 1$$

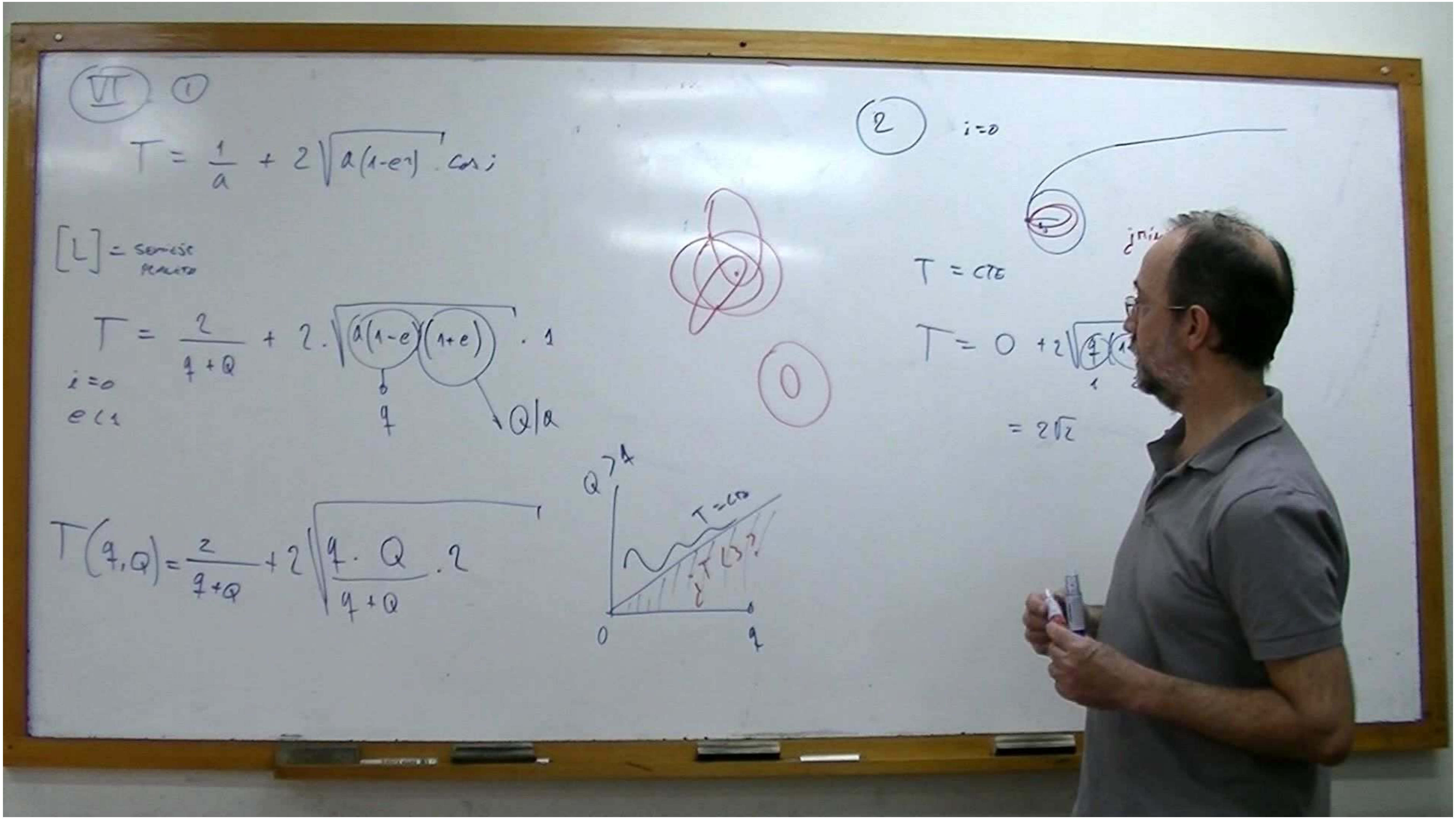
i = 0

e < 1

$$T(q,Q) = \frac{2}{q+Q} + 2\sqrt{\frac{q\cdot Q}{q+Q}\cdot 2}$$

② i = 0

¿mínimo q?



VI ①

$$T = \frac{1}{a} + 2\sqrt{a(1-e^2)}\cos i$$

$[L]$ = semieje recto

$$T = \frac{2}{q+Q} + 2\cdot\sqrt{\underbrace{a(1-e)}_{q}\underbrace{(1+e)}_{Q/a}}\cdot 1$$

$i=0$

$e<1$

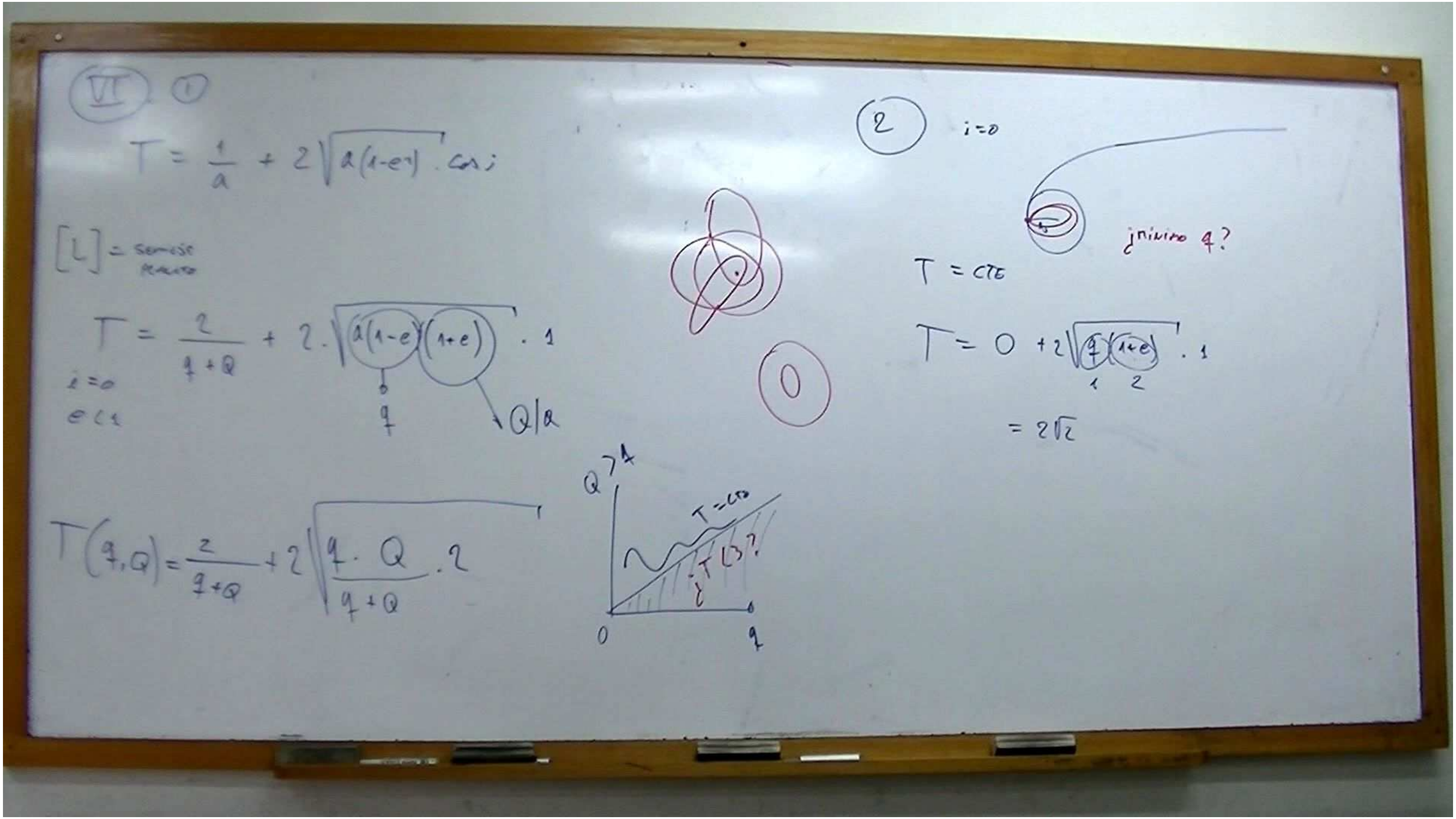
$$T(q,Q) = \frac{2}{q+Q} + 2\sqrt{\frac{q\cdot Q}{q+Q}\cdot 2}$$

② $i=0$

$T = cte$

$$T = 0 + 2\sqrt{q(1}$$

$= 2\sqrt{2}$



VI ①

$$T = \frac{1}{a} + 2\sqrt{a(1-e^2)}\cdot\cos i$$

[L] = semieje mayor

$$T = \frac{2}{q+Q} + 2\cdot\sqrt{\underbrace{a(1-e)}_{q}\underbrace{(1+e)}_{Q/a}}\cdot 1$$

i = 0

e < 1

$$T(q,Q) = \frac{2}{q+Q} + 2\sqrt{\frac{q\cdot Q}{q+Q}\cdot 2}$$

0

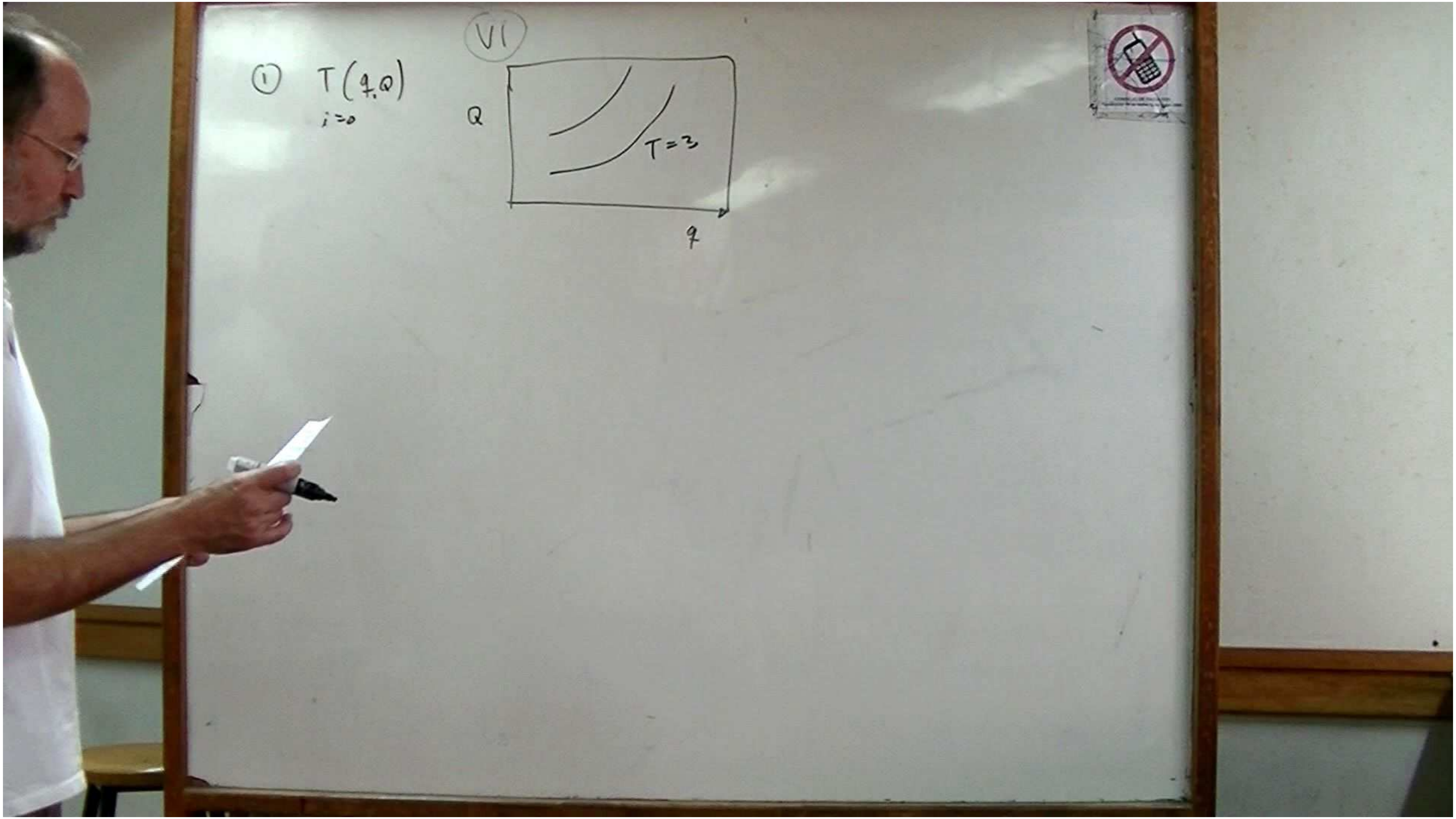
②

i = 0

T = cte

$$T = 0 + 2\sqrt{\underbrace{q}_{1}\underbrace{(1+e)}_{2}}\cdot 1$$

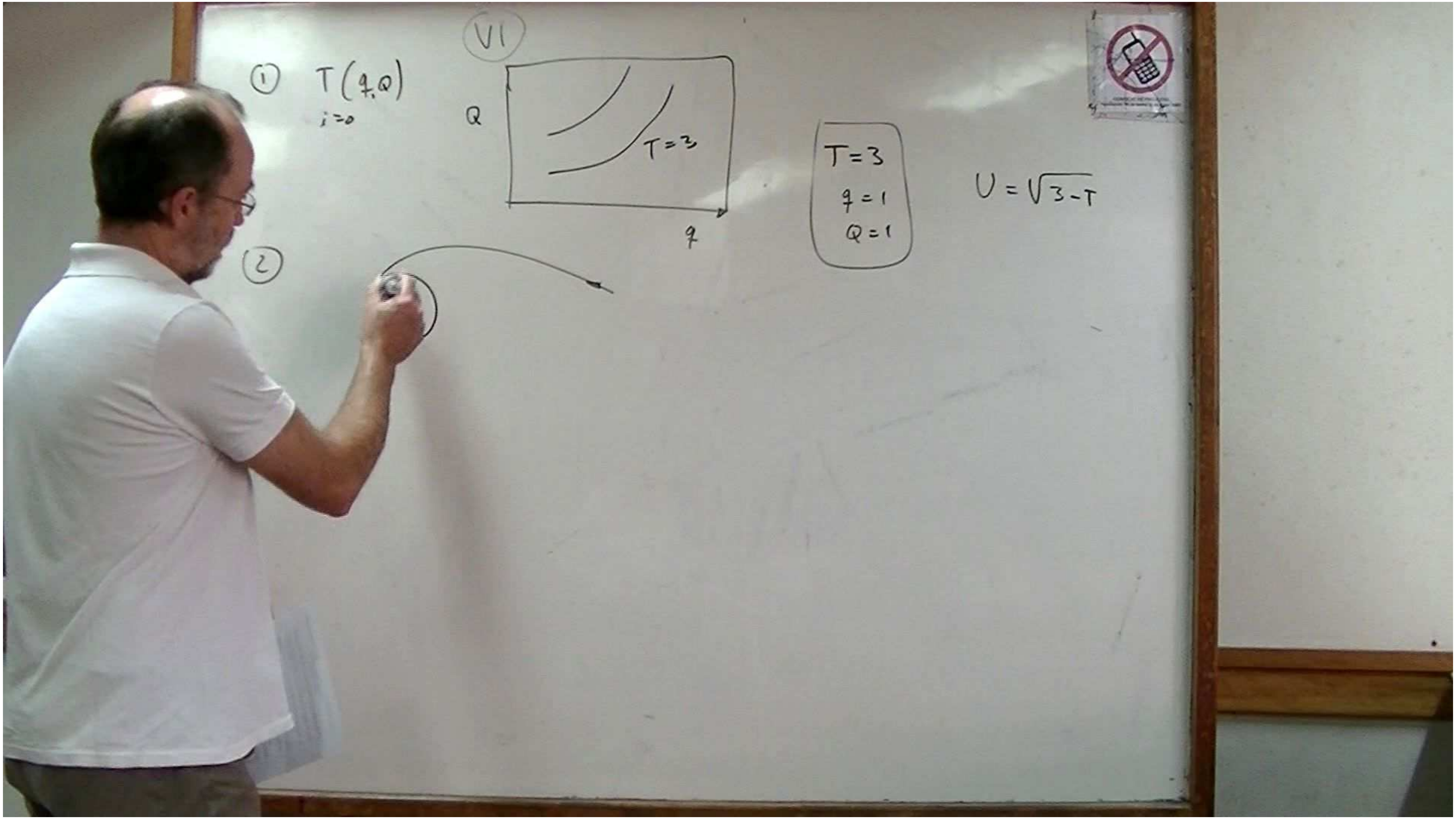
$$= 2\sqrt{2}$$



VI

① $T(q,Q)$

$i=0$



① $T(q,Q)$

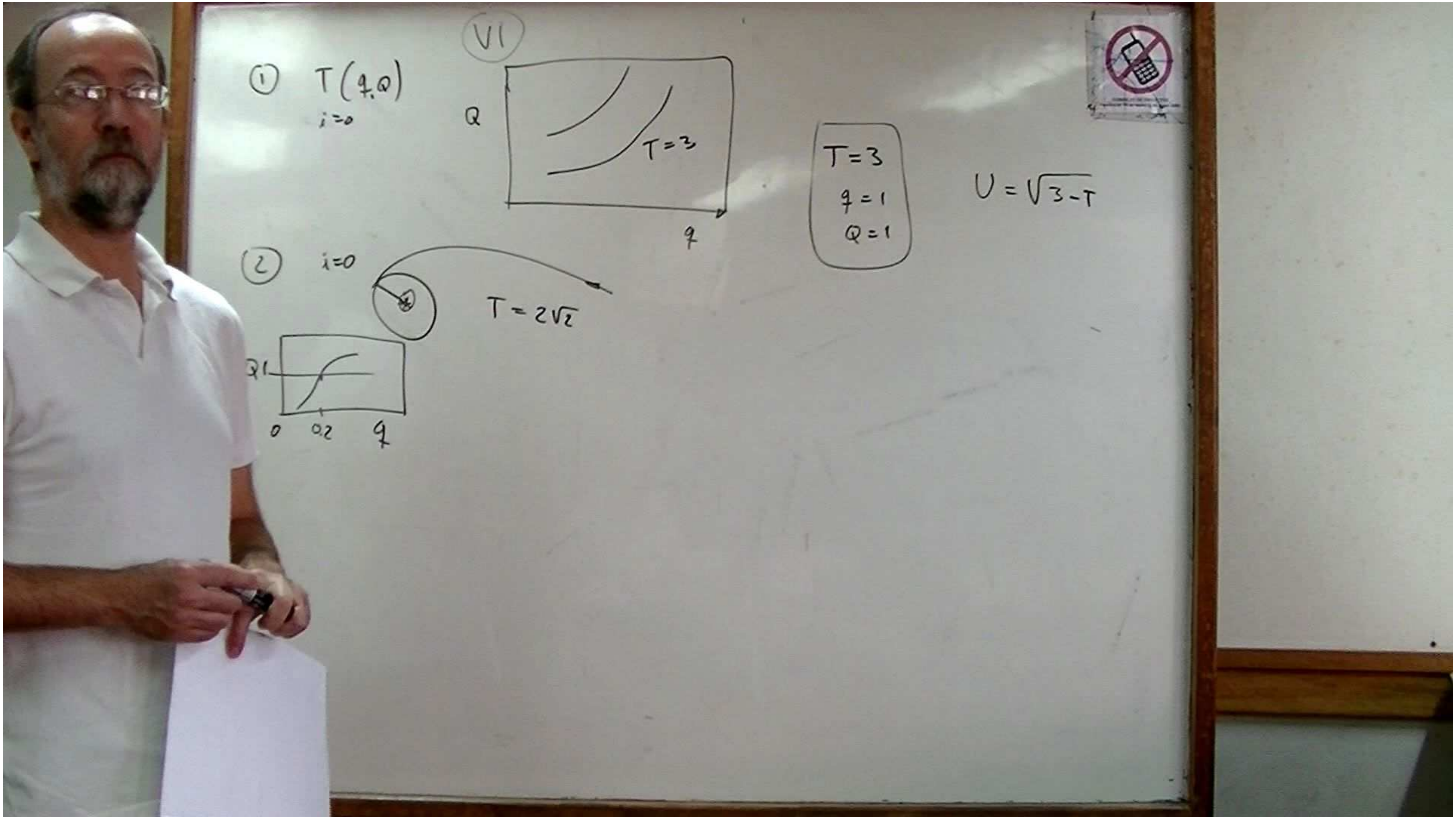
i=0

$T = 3$

$q = 1$

$Q = 1$

$U = \sqrt{3 - T}$



① $T(q,Q)$

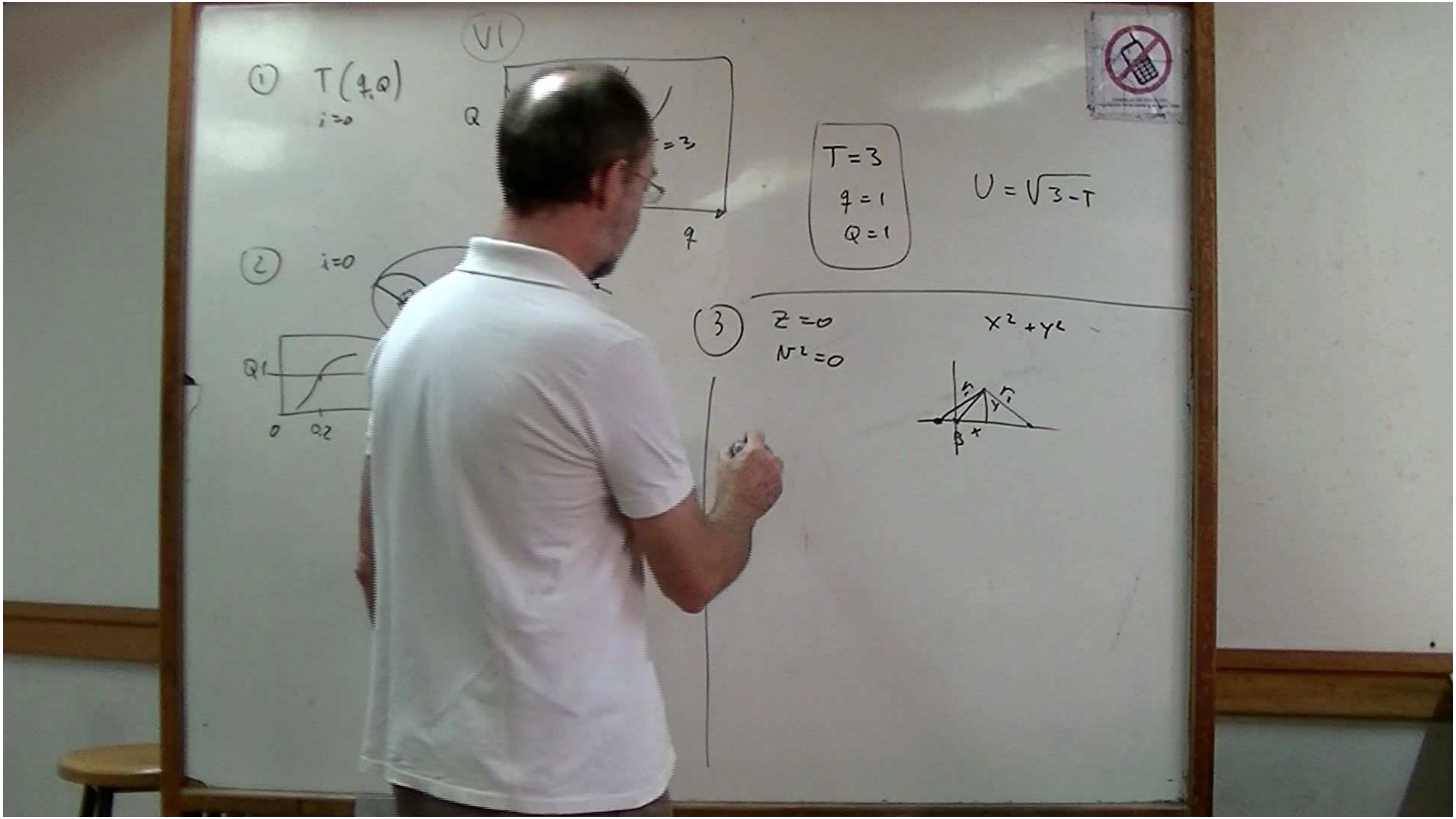
$i=0$

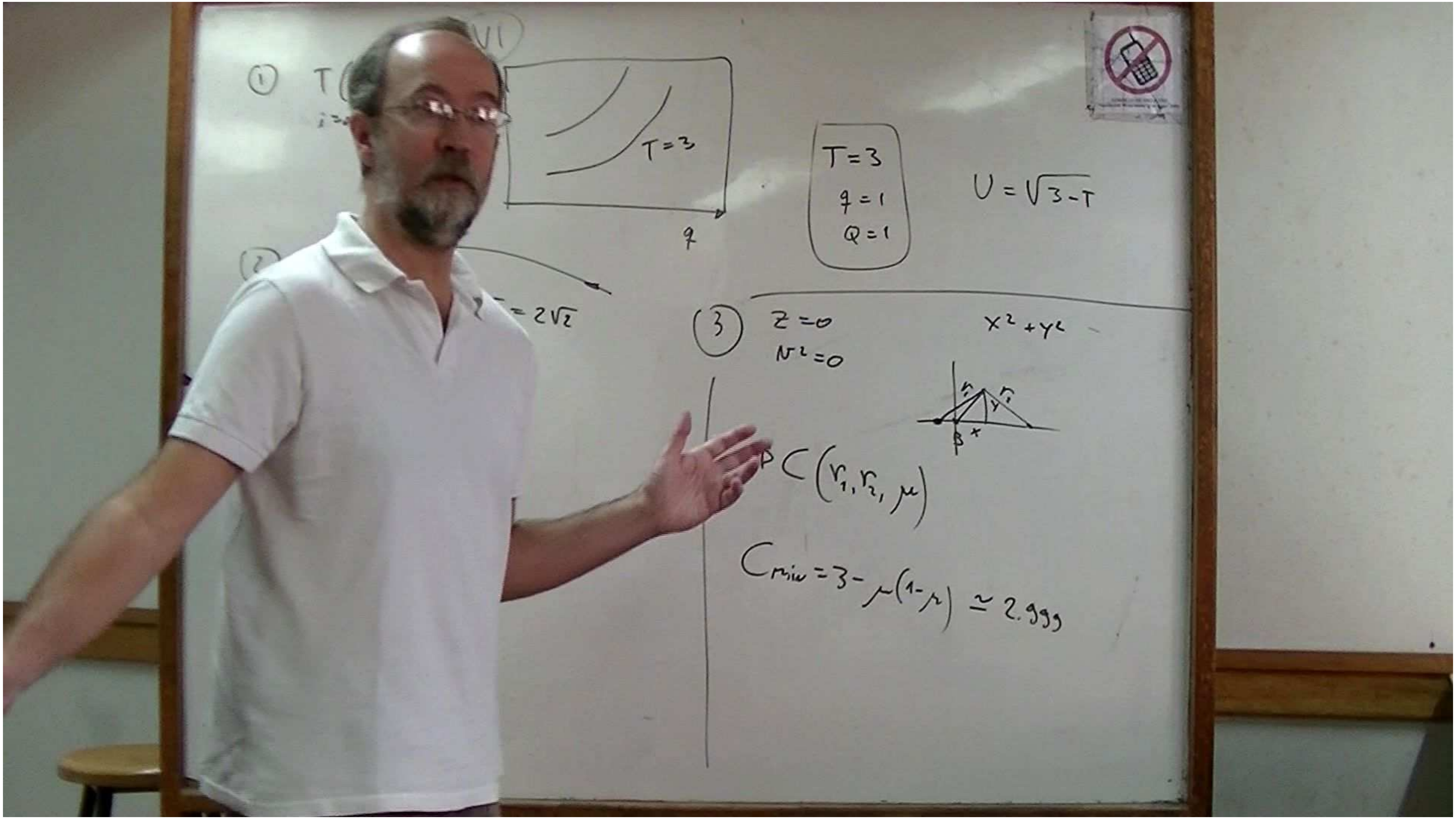
$$\boxed{\begin{array}{c} T=3 \\ q=1 \\ Q=1 \end{array}}$$

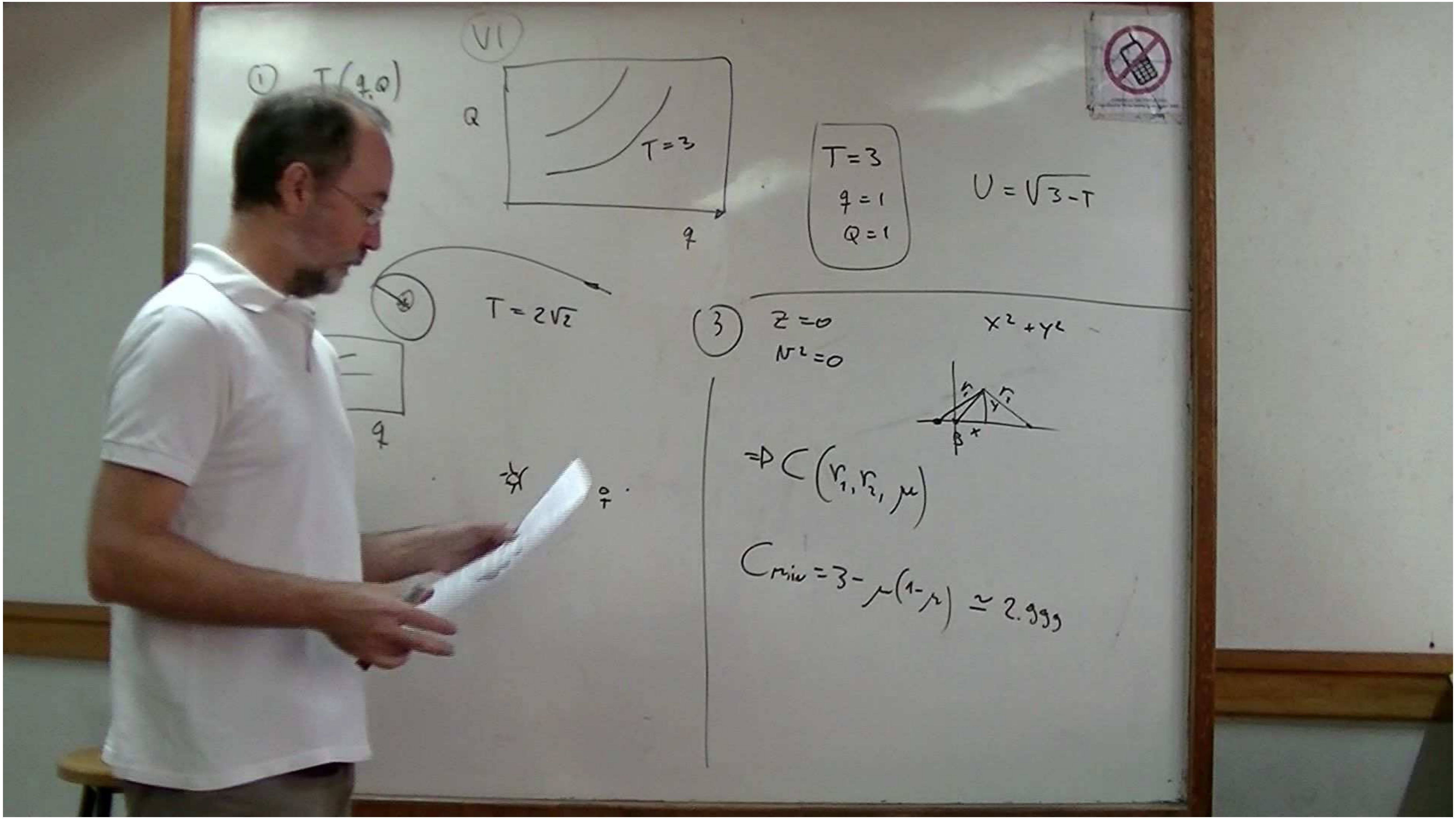
$$U=\sqrt{3-T}$$

② $i=0$

$$T=2\sqrt{2}$$


VI
① T(q,Q)
i=0
Q
=3
q
T=3
q=1
Q=1
U=√3-T
② i=0
Q1
0
0.2
③ Z=0
N²=0
x²+y²
r₁
r₂
y
β
x


VI
①
T(
T = 3
q
T = 3
q = 1
Q = 1
U = √3 - T
②
= 2√2
③
z = 0
v² = 0
x² + y²
r₁
r₂
y
β
x
C(r₁, r₂, μ)
C_min = 3 - μ(1-μ) ≃ 2.999



① $T(q,Q)$

$$\boxed{\begin{matrix} T=3 \\ q=1 \\ Q=1 \end{matrix}}$$

$U = \sqrt{3-T}$

$T = 2\sqrt{2}$

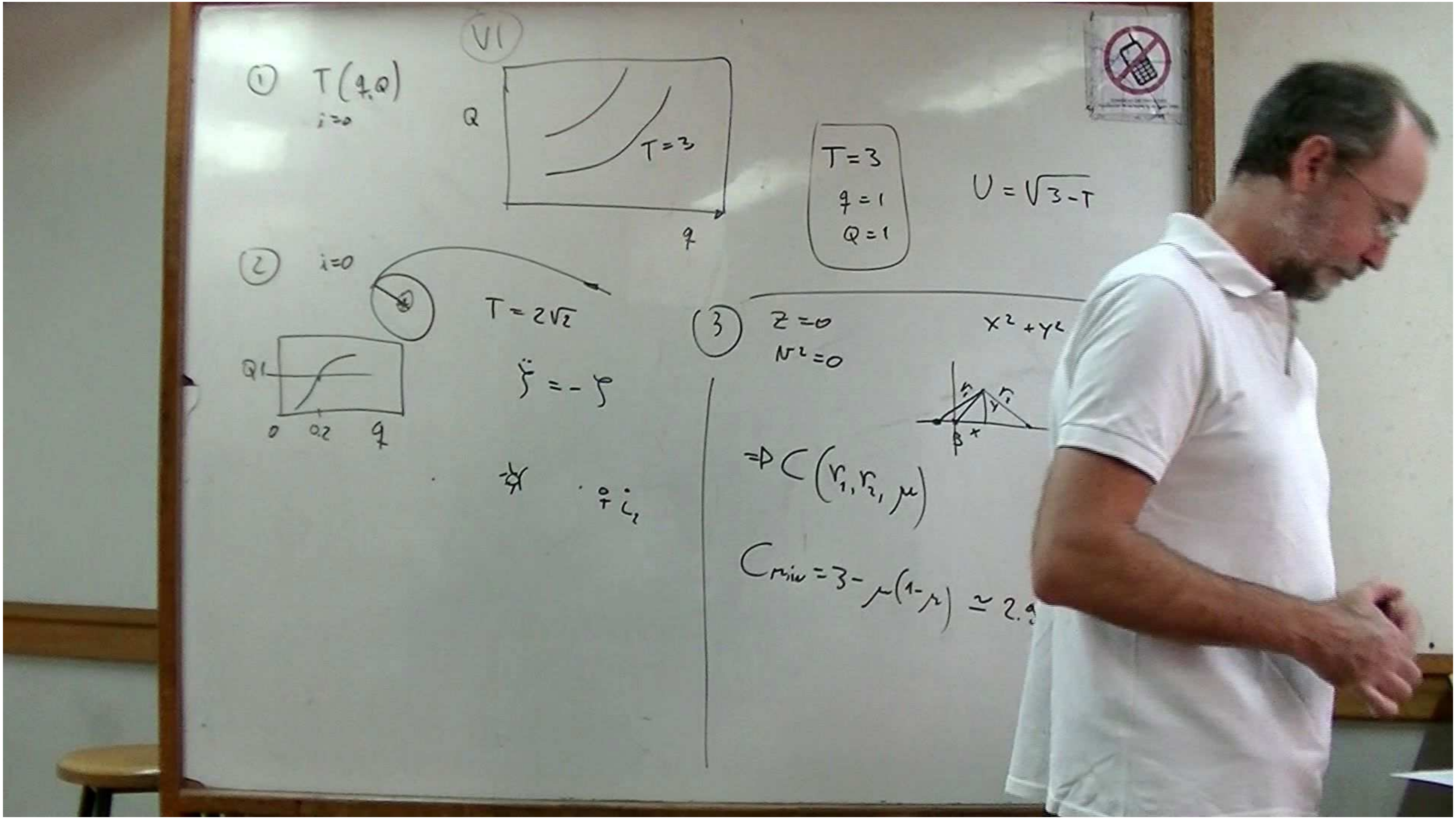
③ $z=0$

$v^2=0$

x^2+y^2

$\Rightarrow C(r_1, r_2, \mu)$

$C_{min} = 3 - \mu(1-\mu) \simeq 2.999$



① $T(q,Q)$

$i=0$

$T=3$

$q=1$

$Q=1$

$U=\sqrt{3-T}$

② $i=0$

$T=2\sqrt{2}$

$\ddot{\xi}=-\xi$

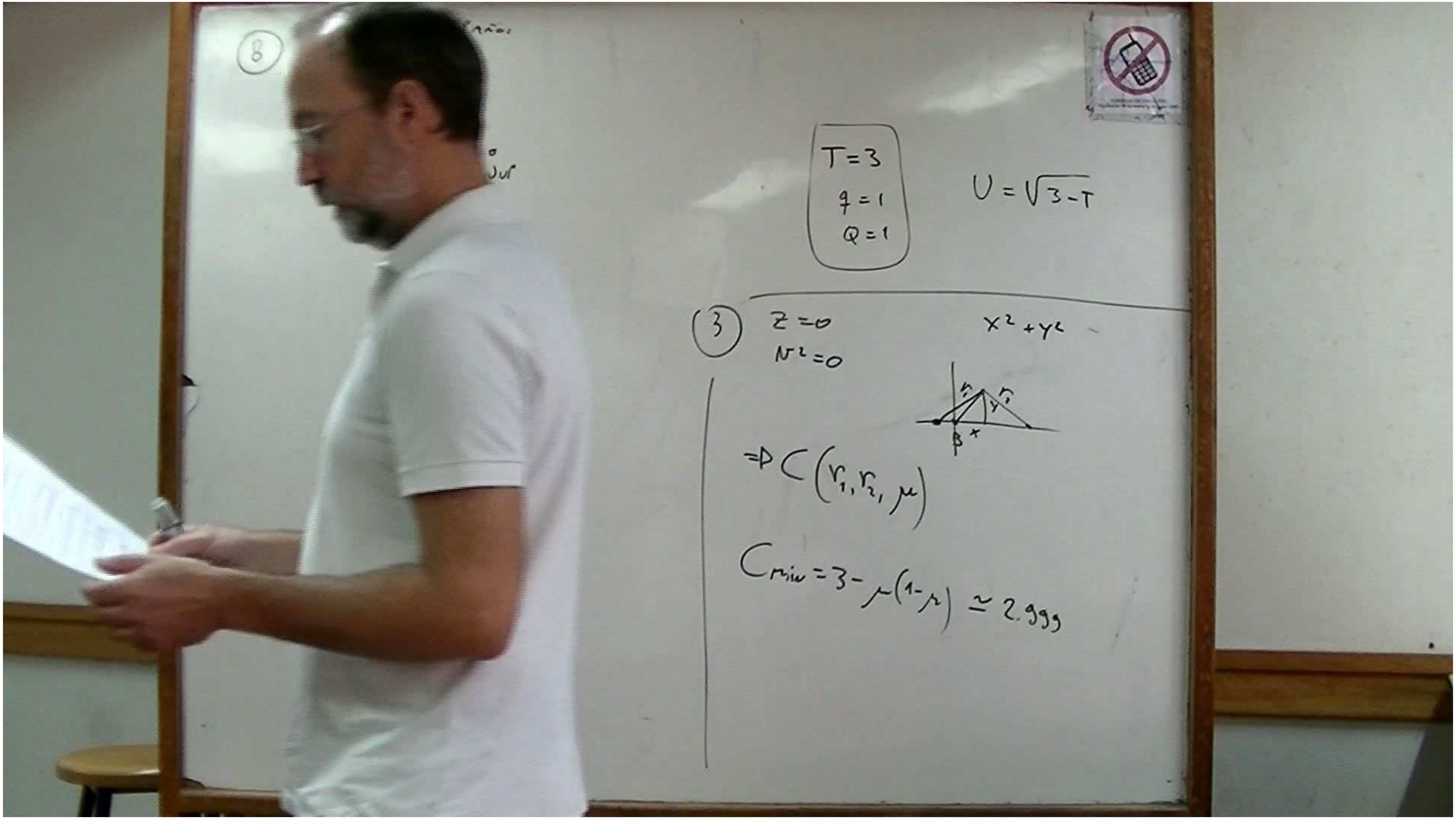
③ $z=0$

$v^2=0$

x^2+y^2

$\Rightarrow C(r_1, r_2, \mu)$

$C_{min}=3-\mu(1-\mu)\simeq 2.9$



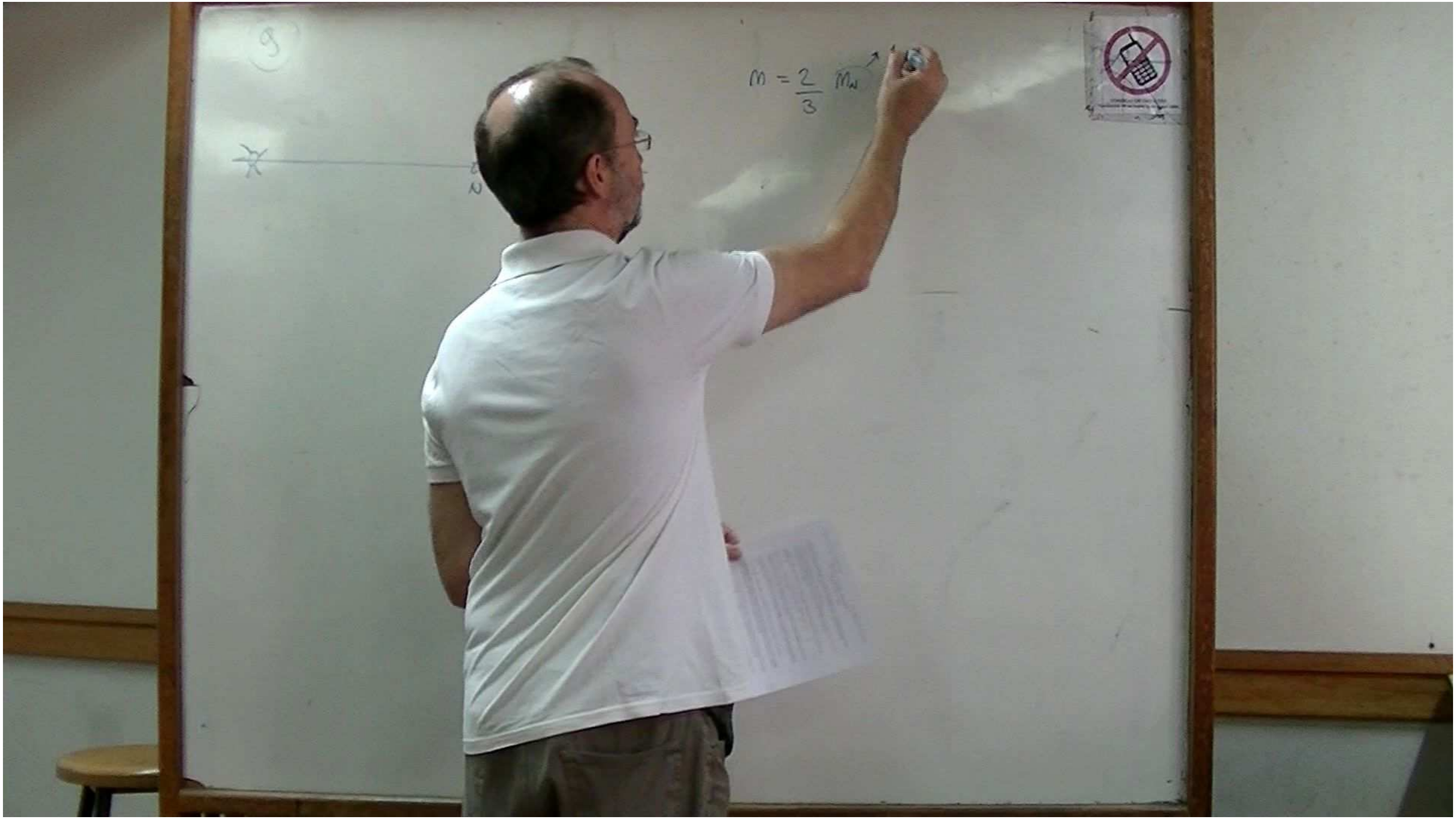
$$\boxed{\begin{array}{c} T=3 \\ q=1 \\ Q=1 \end{array}} \qquad U=\sqrt{3-T}$$

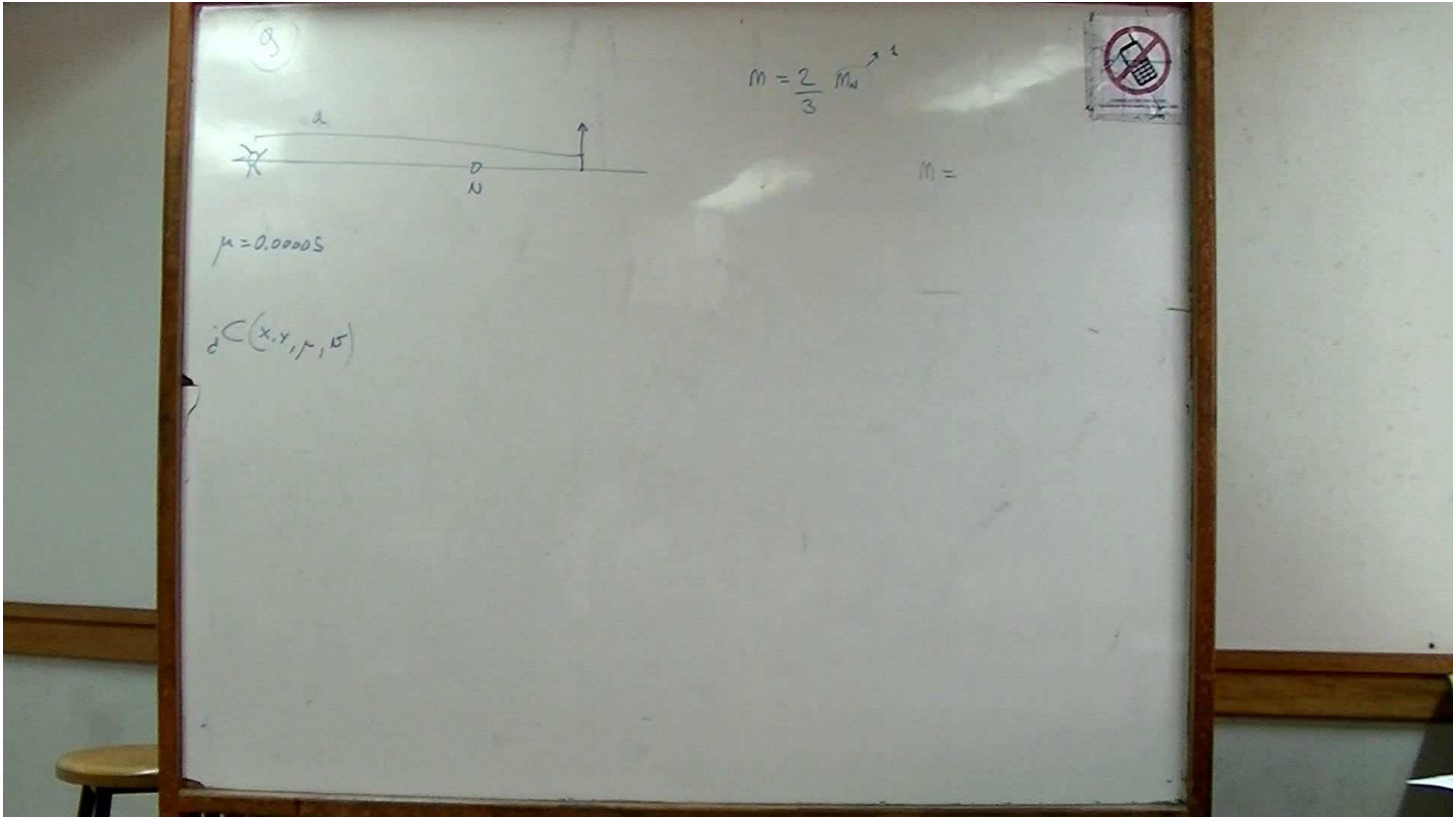
③ $z=0$ $\qquad x^2+y^2$

$v^2=0$

$$\Rightarrow C(r_1, r_2, \mu)$$

$$C_{min} = 3 - \mu(1-\mu) \simeq 2.999$$


9
N
m = 2/3 m_N



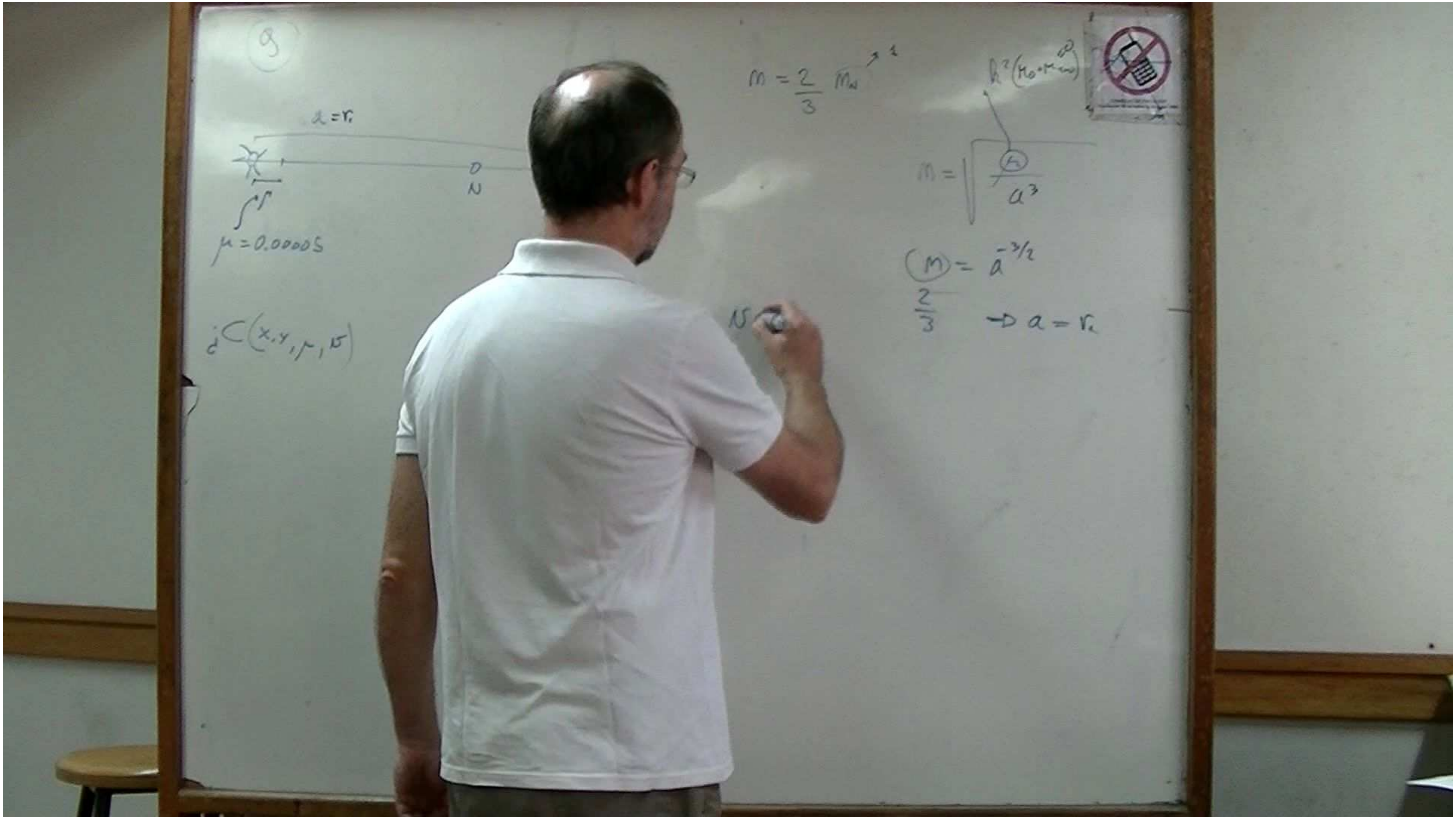
⑨

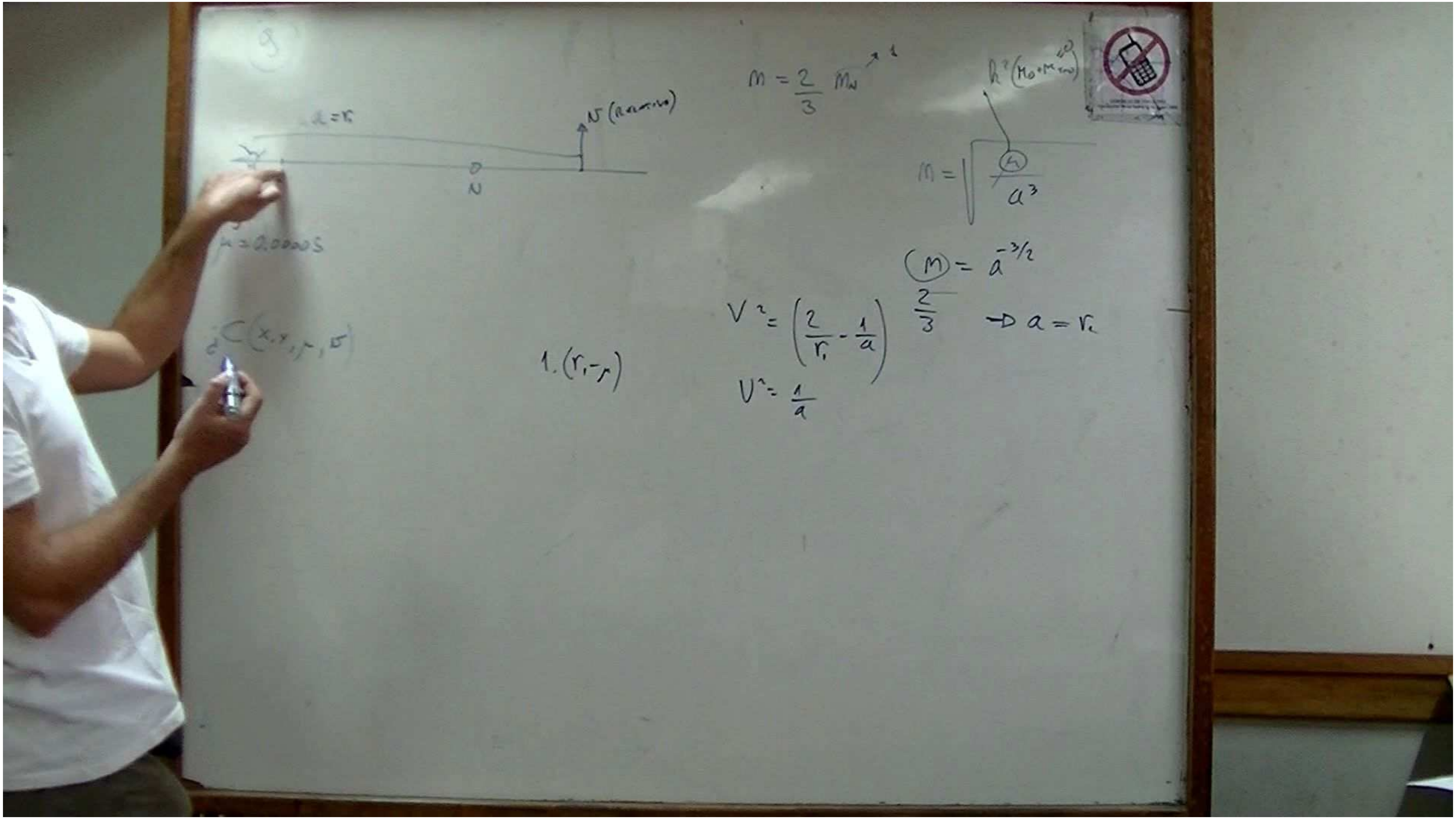
$n = \frac{2}{3} n_N \nearrow 1$

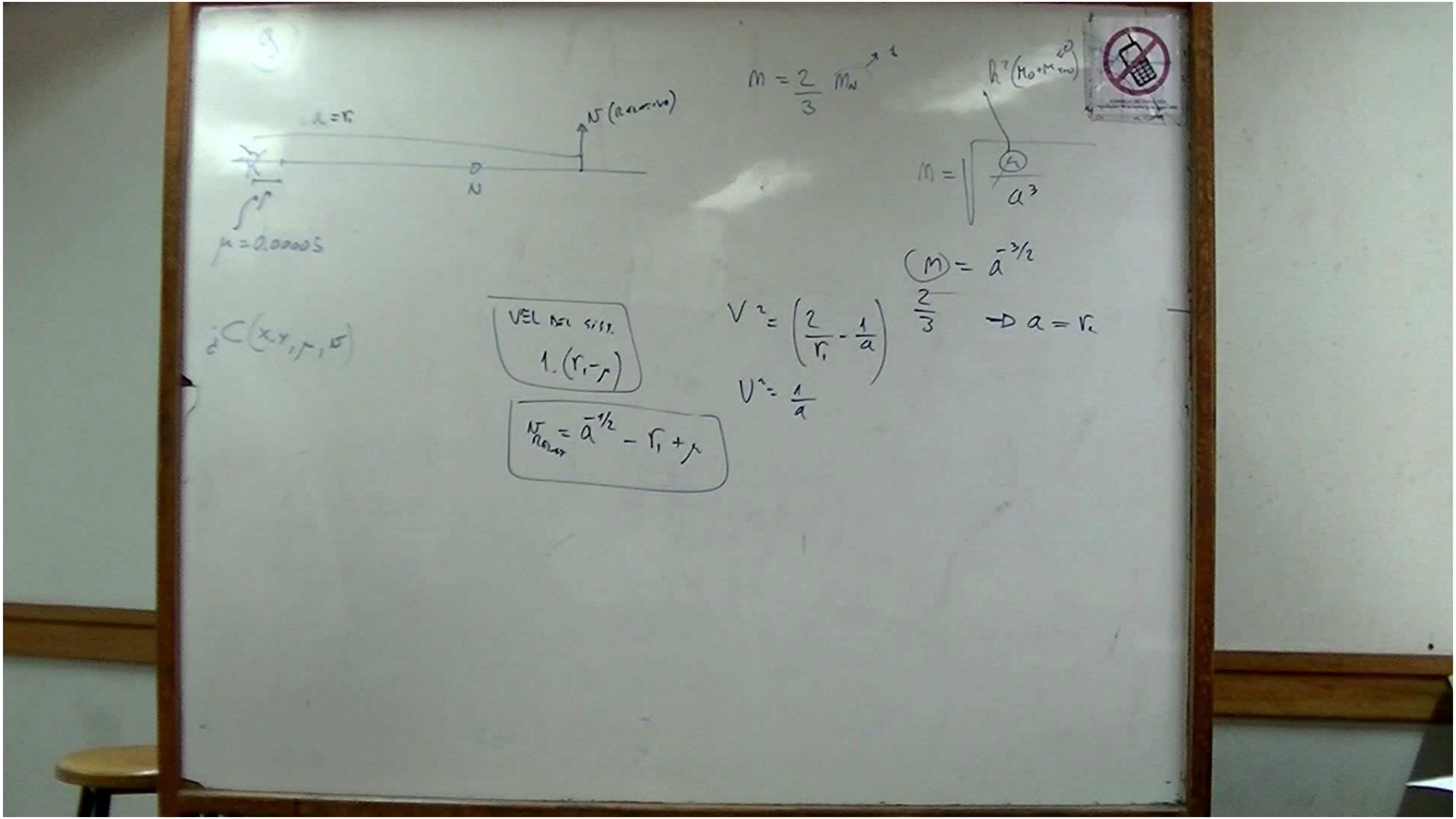
$n =$

$\mu = 0.00005$

¿$C(x, y, \mu, v)$


9
a = r₁
N
μ = 0.00005
¿C(x, y, μ, v)
n = 2/3 n_N
k²(m₀+m…)
n = √(k²/a³)
n = a^{-3/2}
2/3 → a = r₂
N


a = r₁
N (Neptuno)
N
μ = 0.00005
C(x, y, μ, v)
1.(r₁ − μ)
n = 2/3 n_N
h²(M₀+M_Nep)
n = √(μ/a³)
(n) = a^{-3/2}
2/3 → a = r₁
V² = (2/r₁ − 1/a)
V² = 1/a



¿$C(x, y, \mu, v)$

VEL DEL SIST.

$1.(r_1 - \mu)$

$$\boxed{v_{Relat} = a^{-1/2} - r_1 + \mu}$$

$$n = \frac{2}{3}\, n_N \xrightarrow{} 1$$

$$k^2(M_0 + M_{\text{sun}}) \overset{0}{}$$

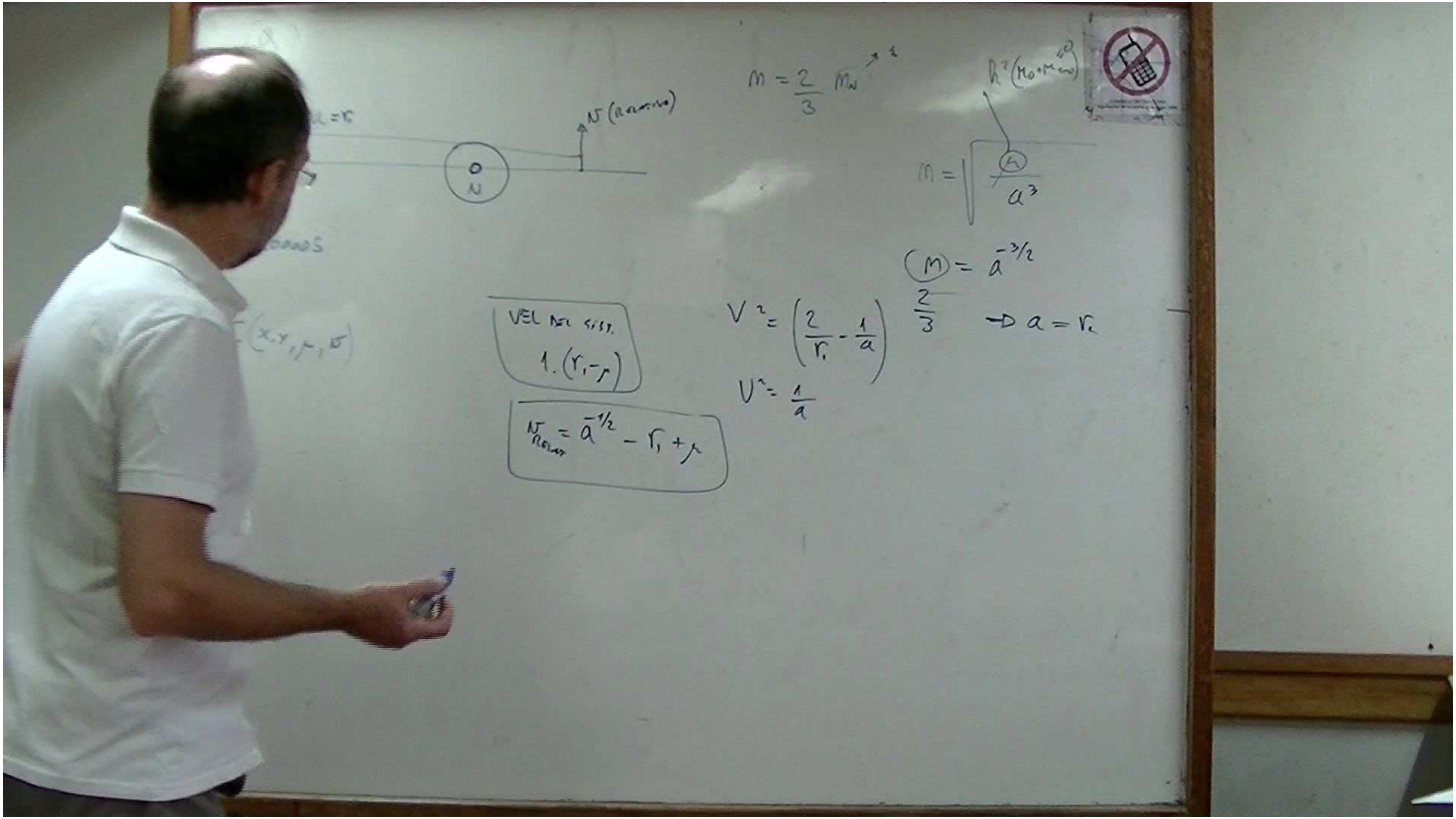
$$n = \sqrt{\frac{\boxed{k}}{a^3}}$$

$$(n) = a^{-3/2}$$

$$\frac{2}{3} \rightarrow a = r_1$$

$$V^2 = \left(\frac{2}{r_1} - \frac{1}{a}\right)$$

$$V^2 = \frac{1}{a}$$



VEL DEL SIST.

$1.(r_1 - \mu)$

$v_{RELAT} = a^{-1/2} - r_1 + \mu$

$n = \frac{2}{3} n_N \to 1$

$k^2(M_0 + M_{\ldots}) \to 0$

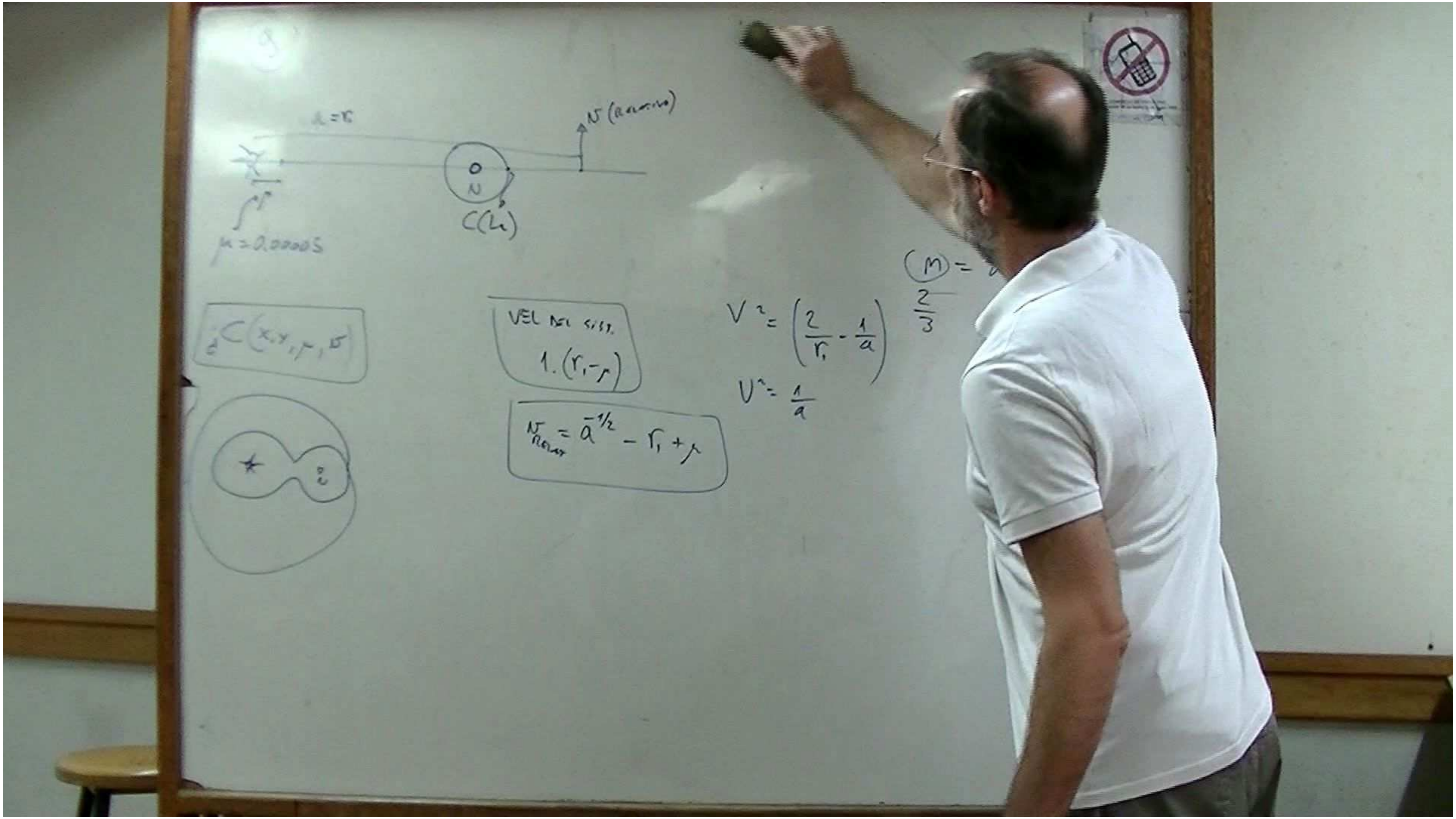
$n = \sqrt{\frac{k}{a^3}}$

$n = a^{-3/2}$

$\frac{2}{3} \to a = r_1$

$V^2 = \left(\frac{2}{r_1} - \frac{1}{a}\right)$

$V^2 = \frac{1}{a}$



$¿C(x, y, \mu, v)$

VEL DEL SIST.

$1.(r_1 - \mu)$

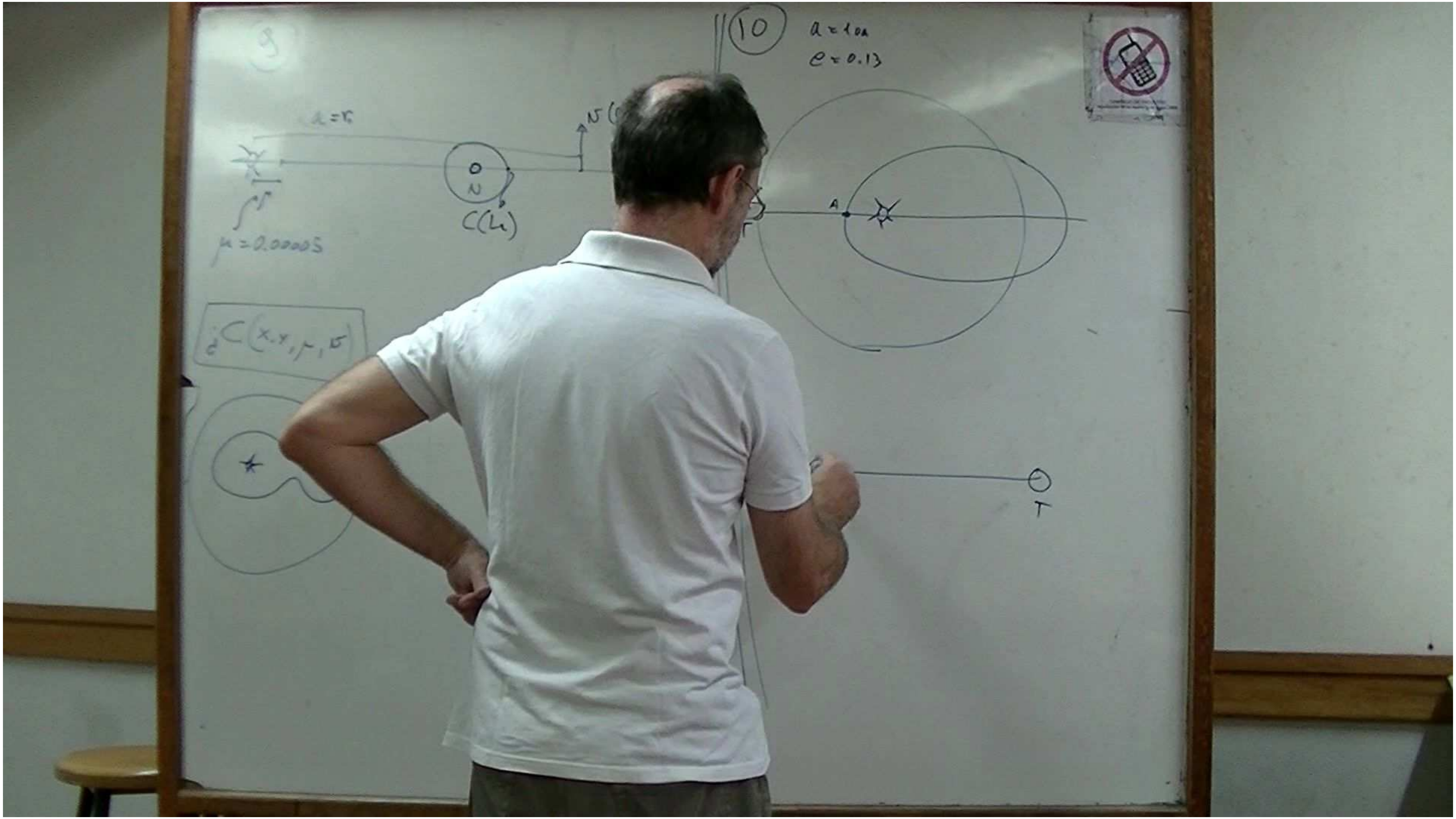
$N_{RELAT} = a^{-1/2} - r_1 + \mu$

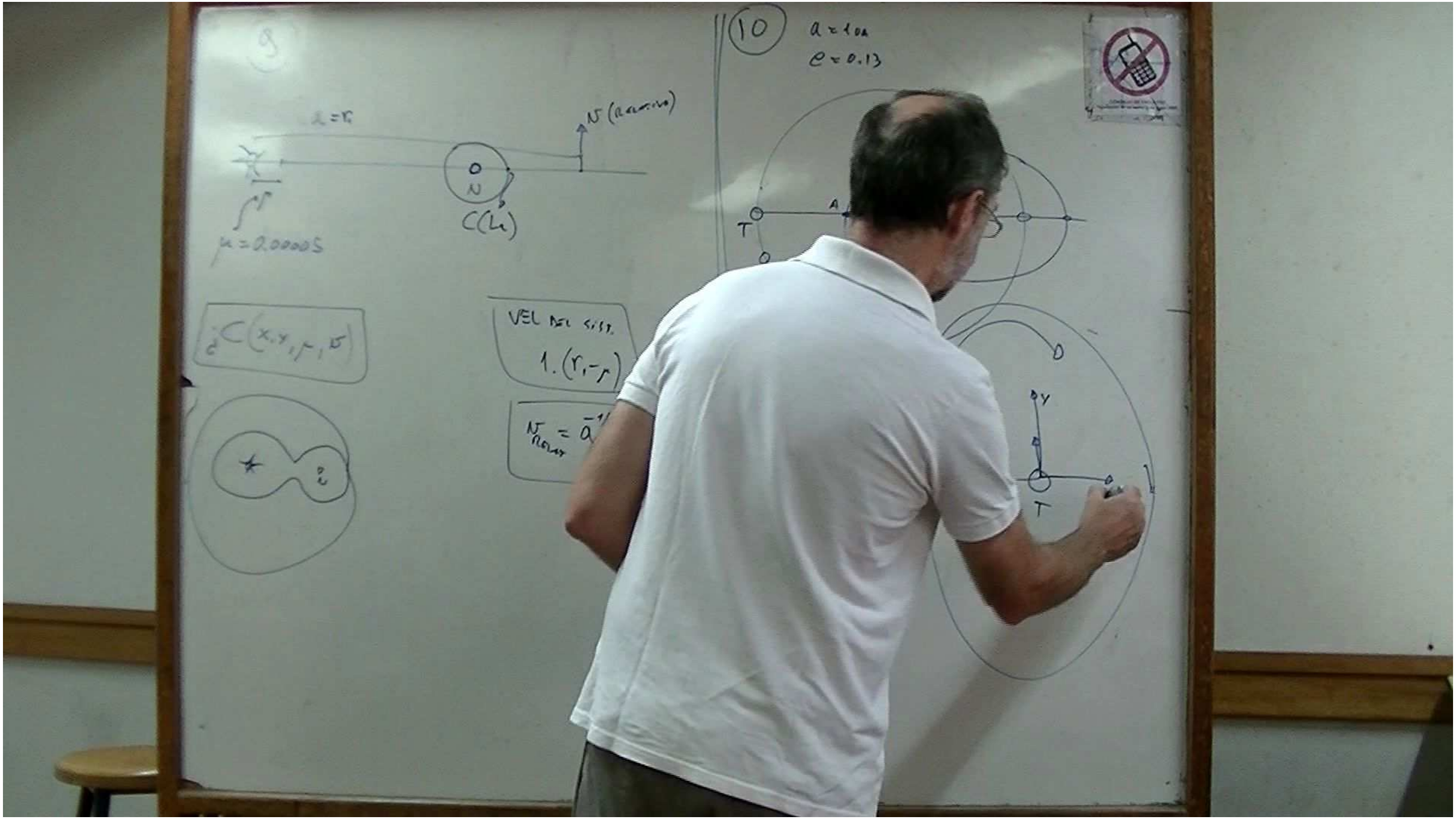
$V^2 = \left(\frac{2}{r_1} - \frac{1}{a}\right)$

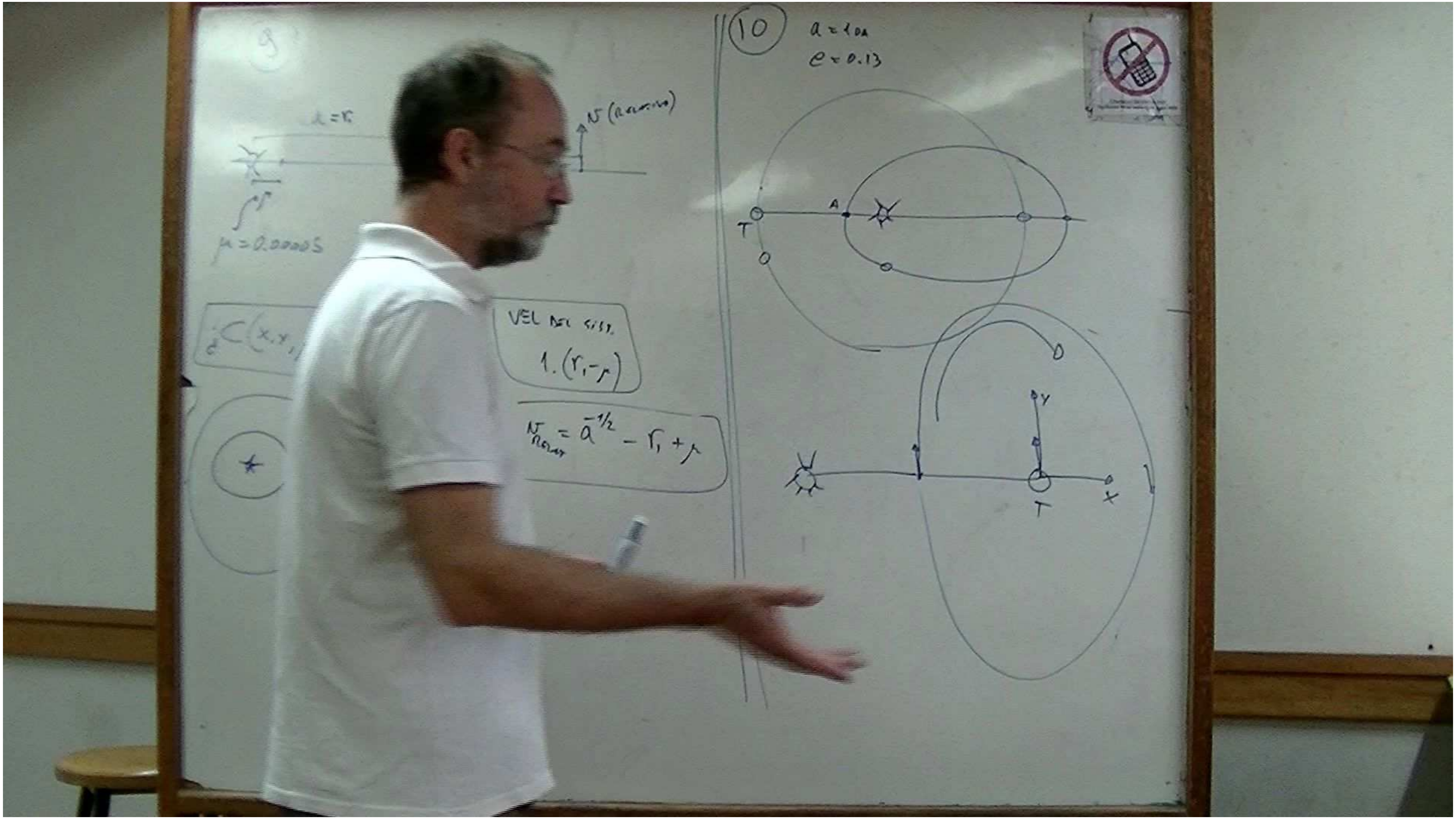
$V^2 = \frac{1}{a}$

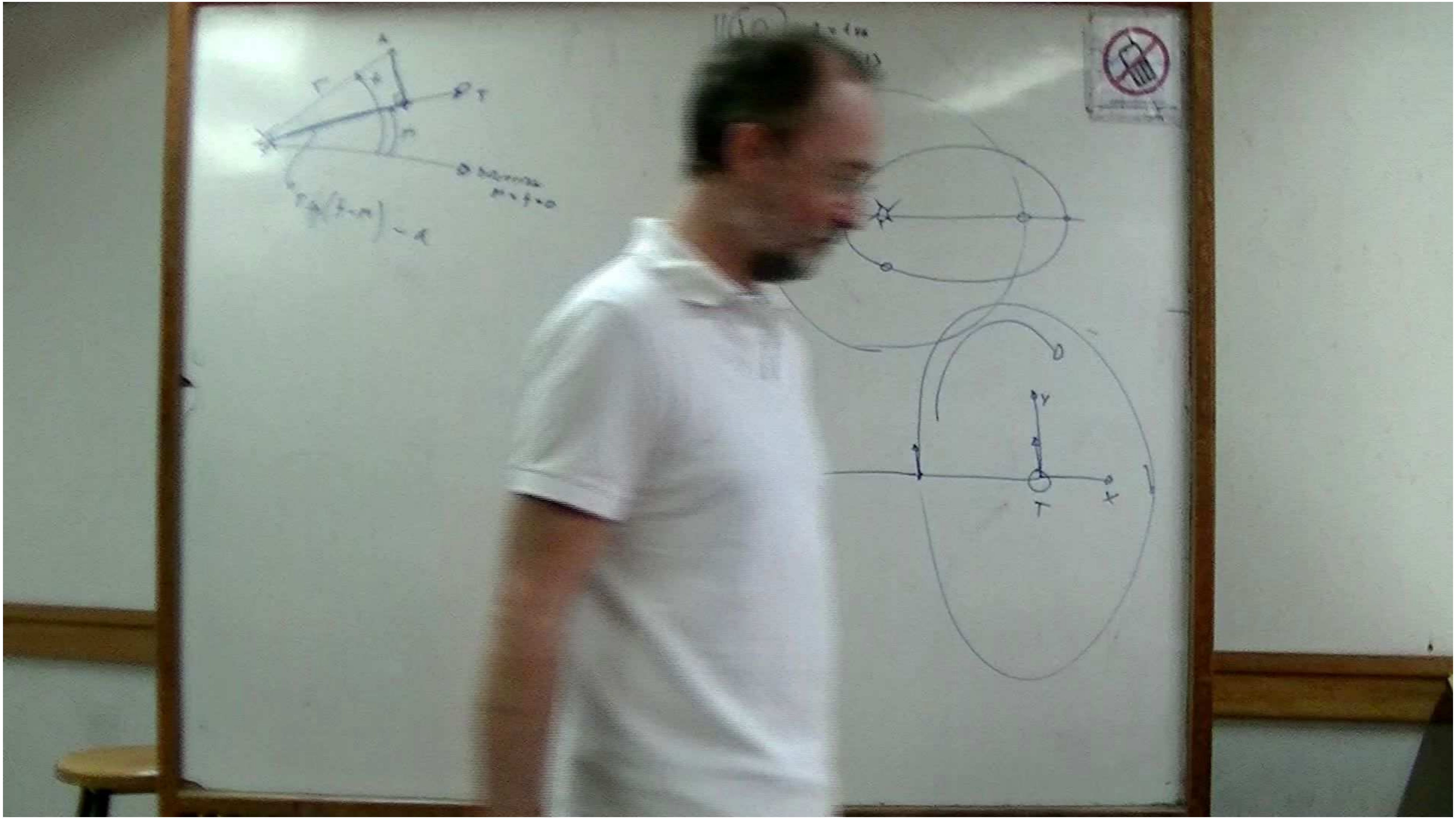
$(M) =$

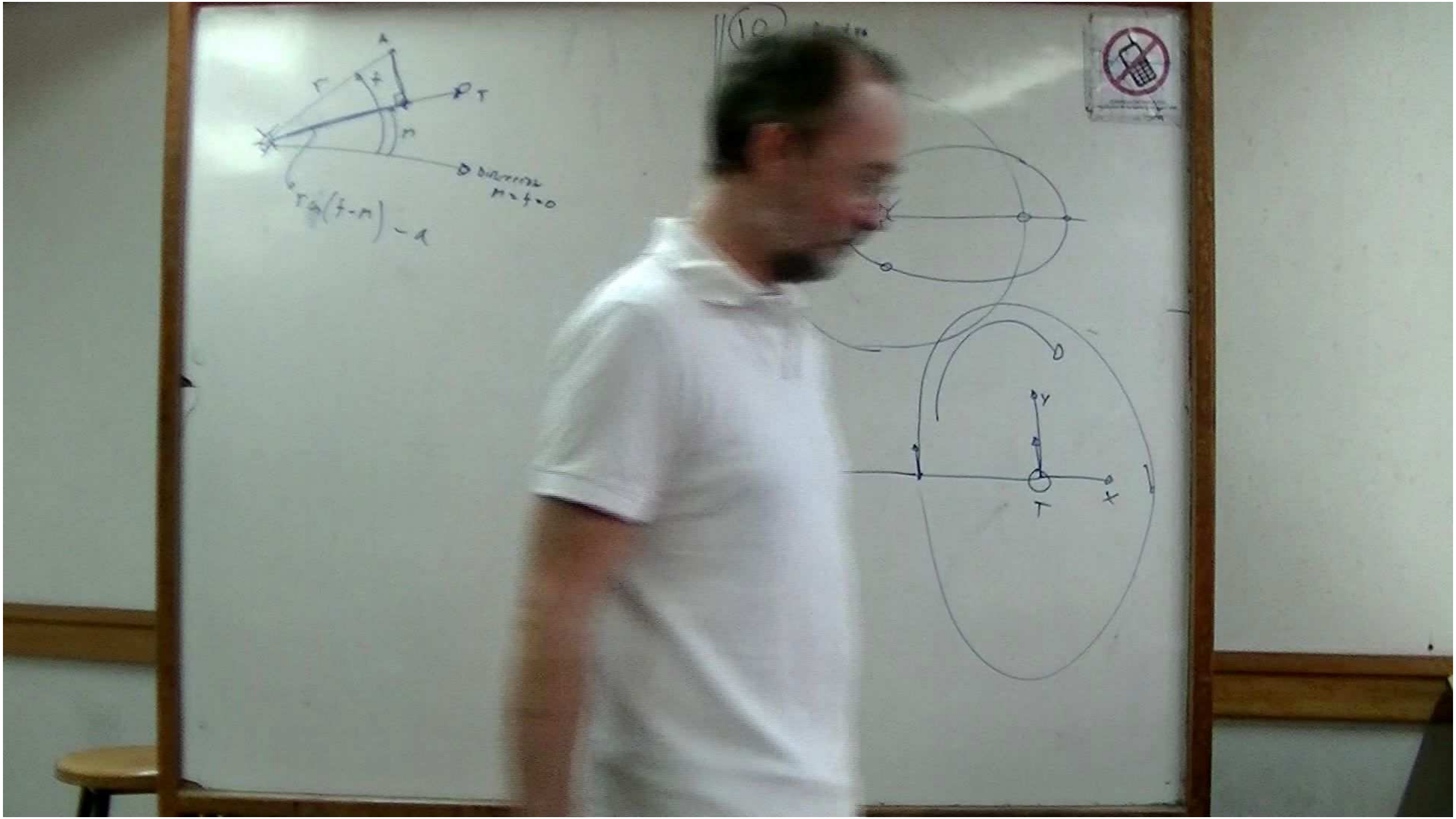
$\frac{2}{3}$

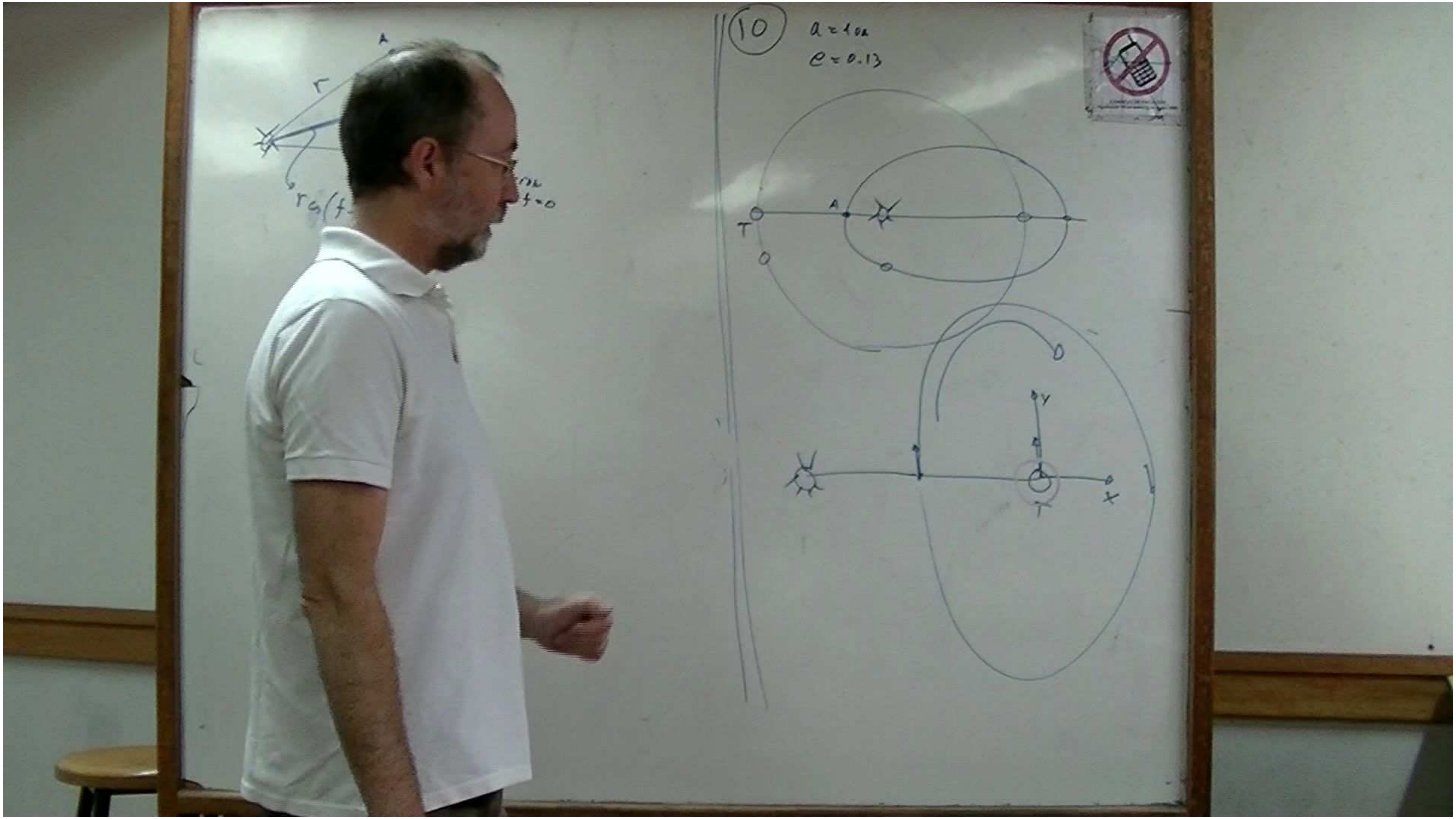

9
a = r₁
N
C(L₁)
μ = 0.00005
¿C(x,y,μ,v)
10
a = 1ua
e = 0.13
A
T

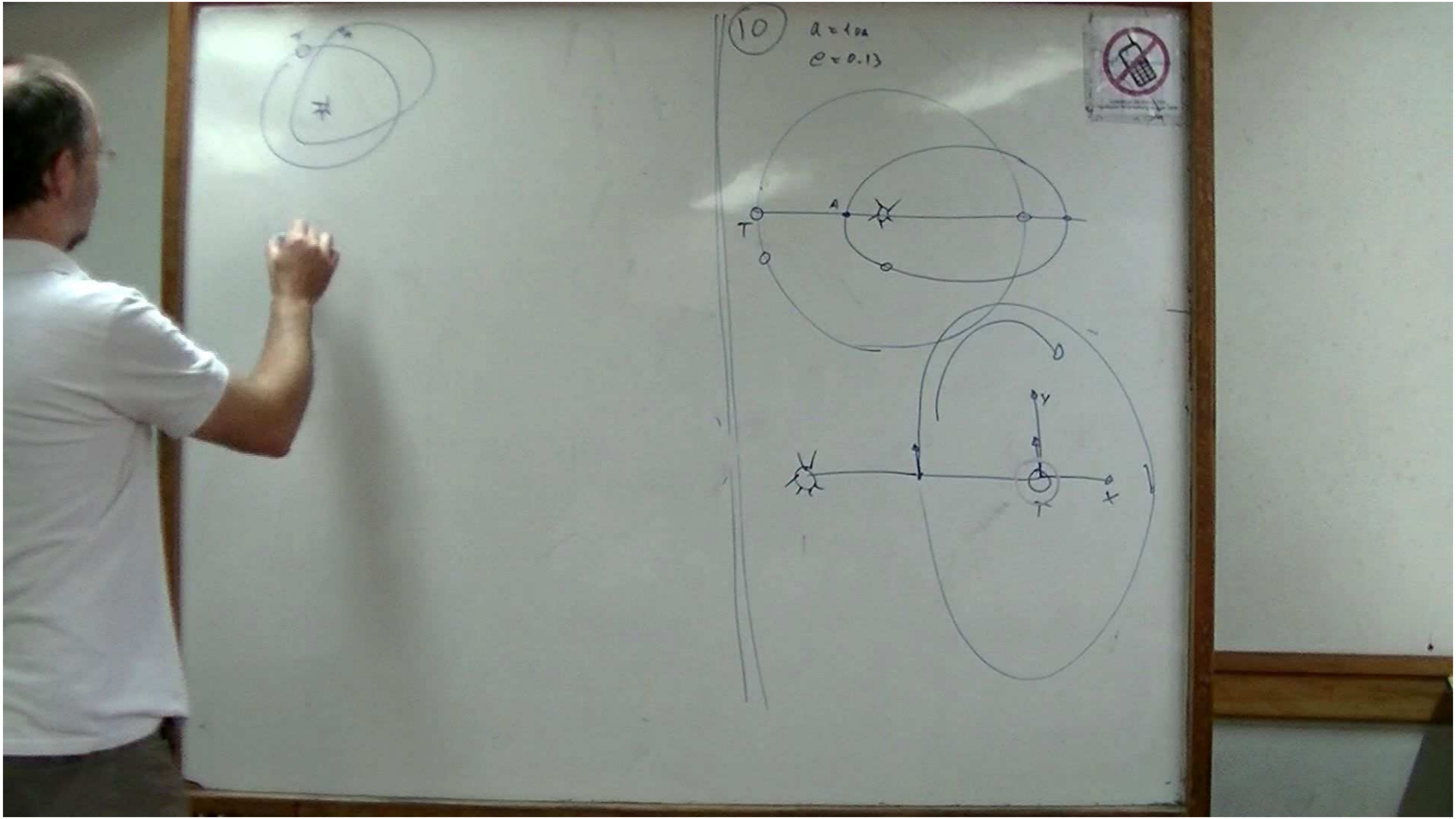

9
a = r₁
V (relativo)
O
N
C(L₁)
μ = 0.00005
¿C(x, y, μ, V)
VEL DEL SIST.
1.(r₁ − μ)
V_RELAT = a⁻¹
10
a = 1 UA
e = 0.13
T
A
Y
T

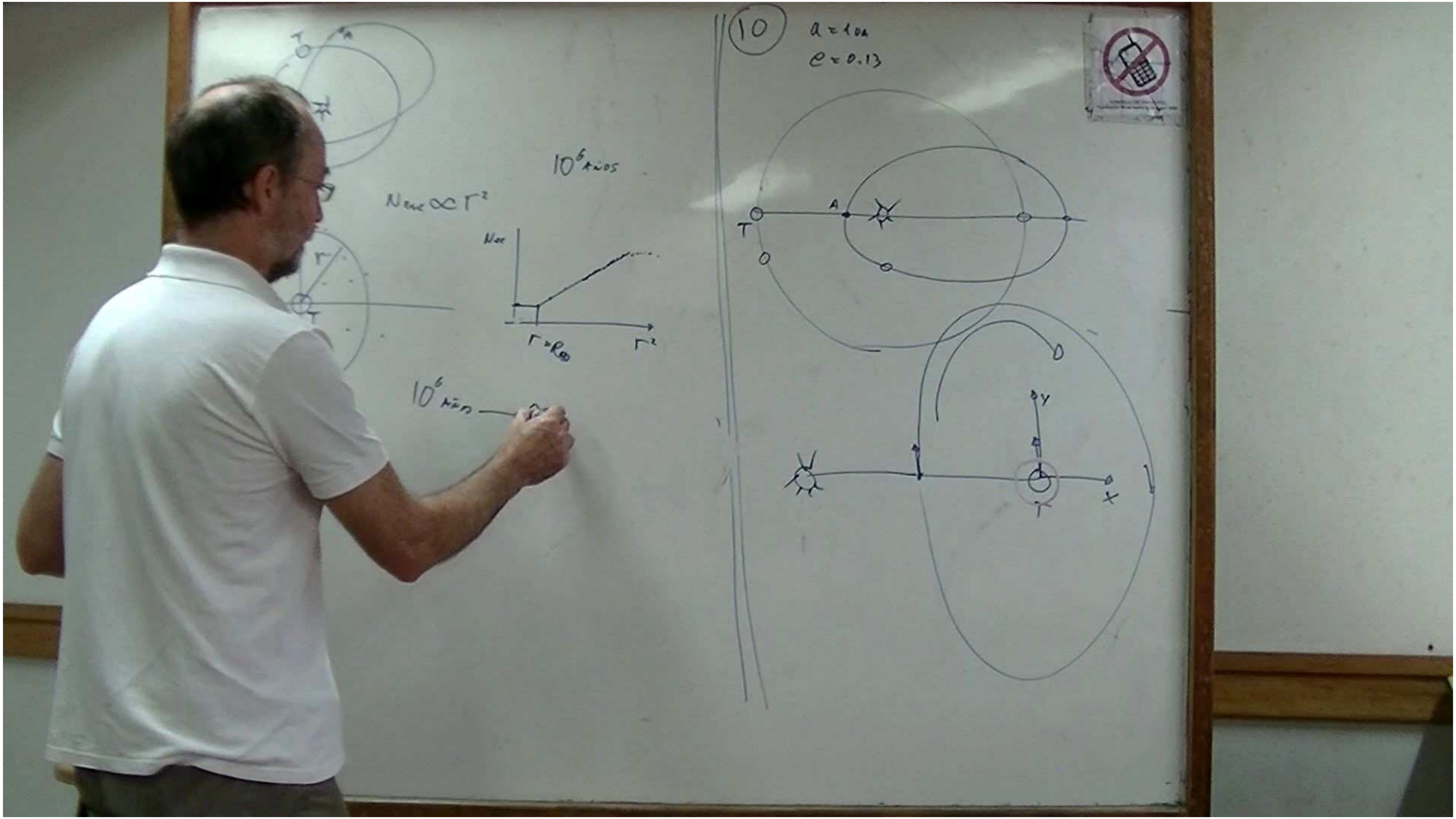

9
a = r₁
v (relativo)
μ = 0.0005
C(x, y,
VEL DEL SIST.
1.(r₁ − μ)
v_Relat = a^{-1/2} − r₁ + μ
10
a = 1 UA
e = 0.13
A
T
Y
T
X

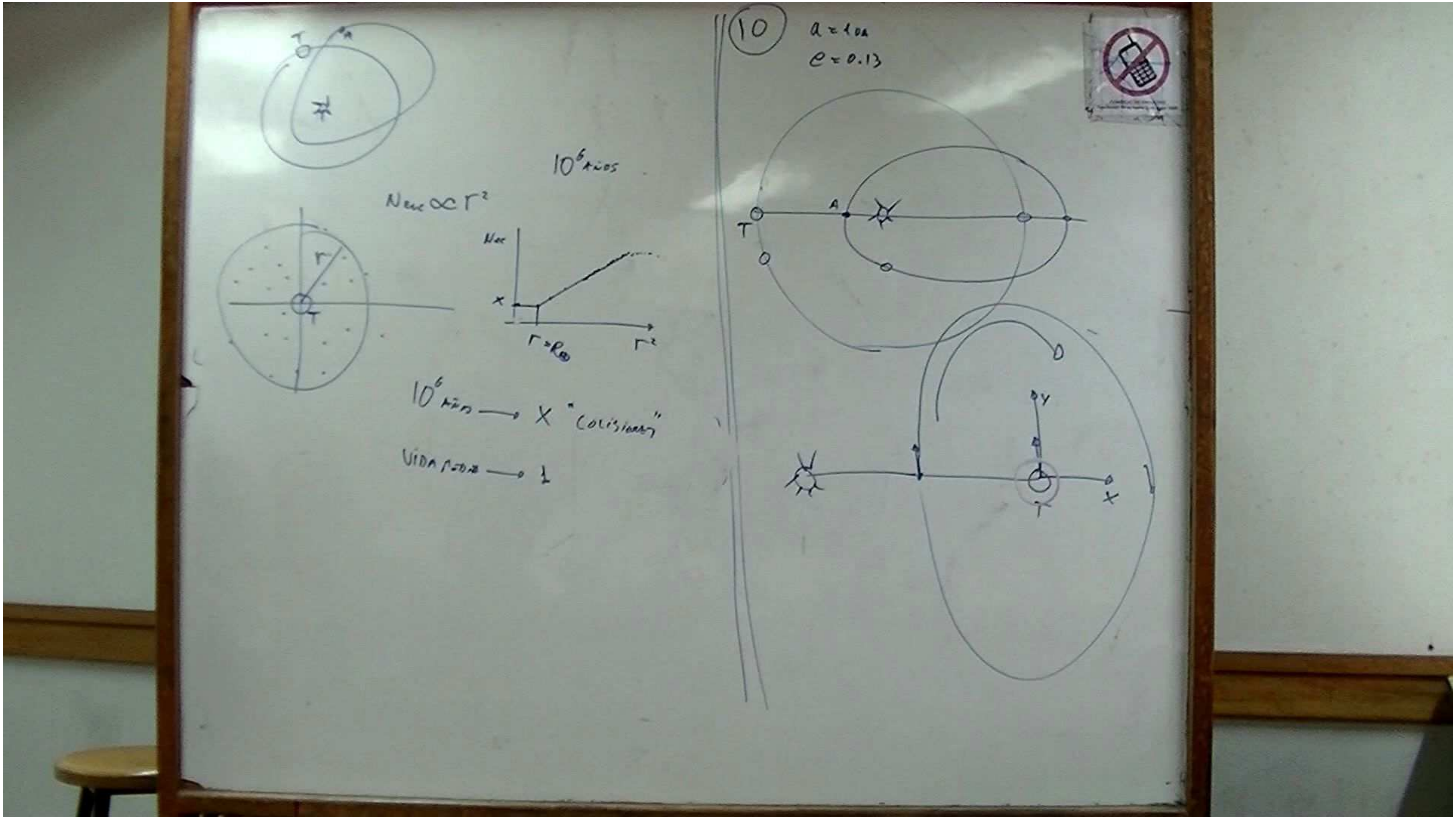

A
r
T
Y
X
T
O


A
r
f
T
m = f = 0
10
Y
X
T

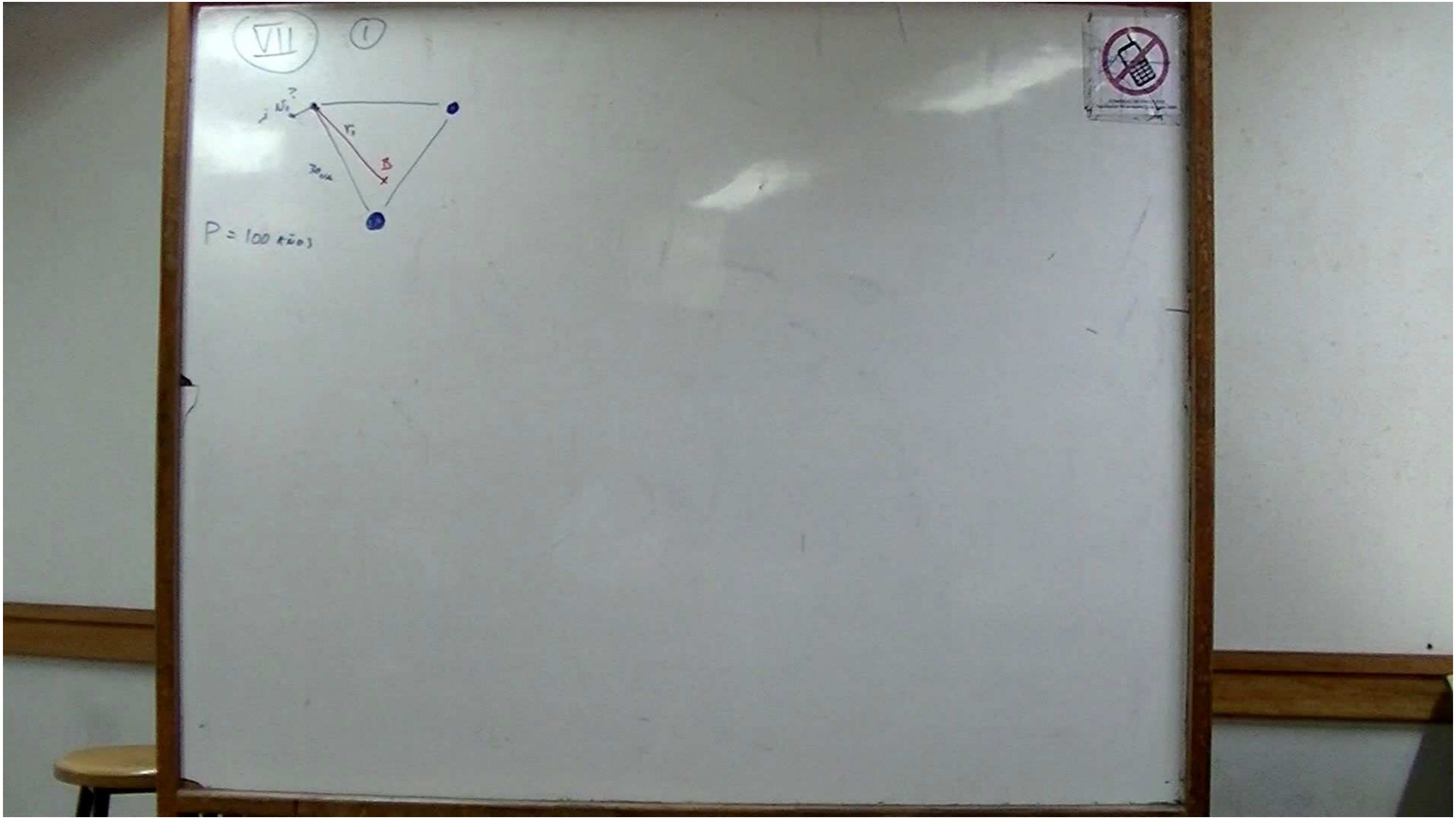

A
r
10
a = 1ua
e = 0.13
T
A
Y
X
T

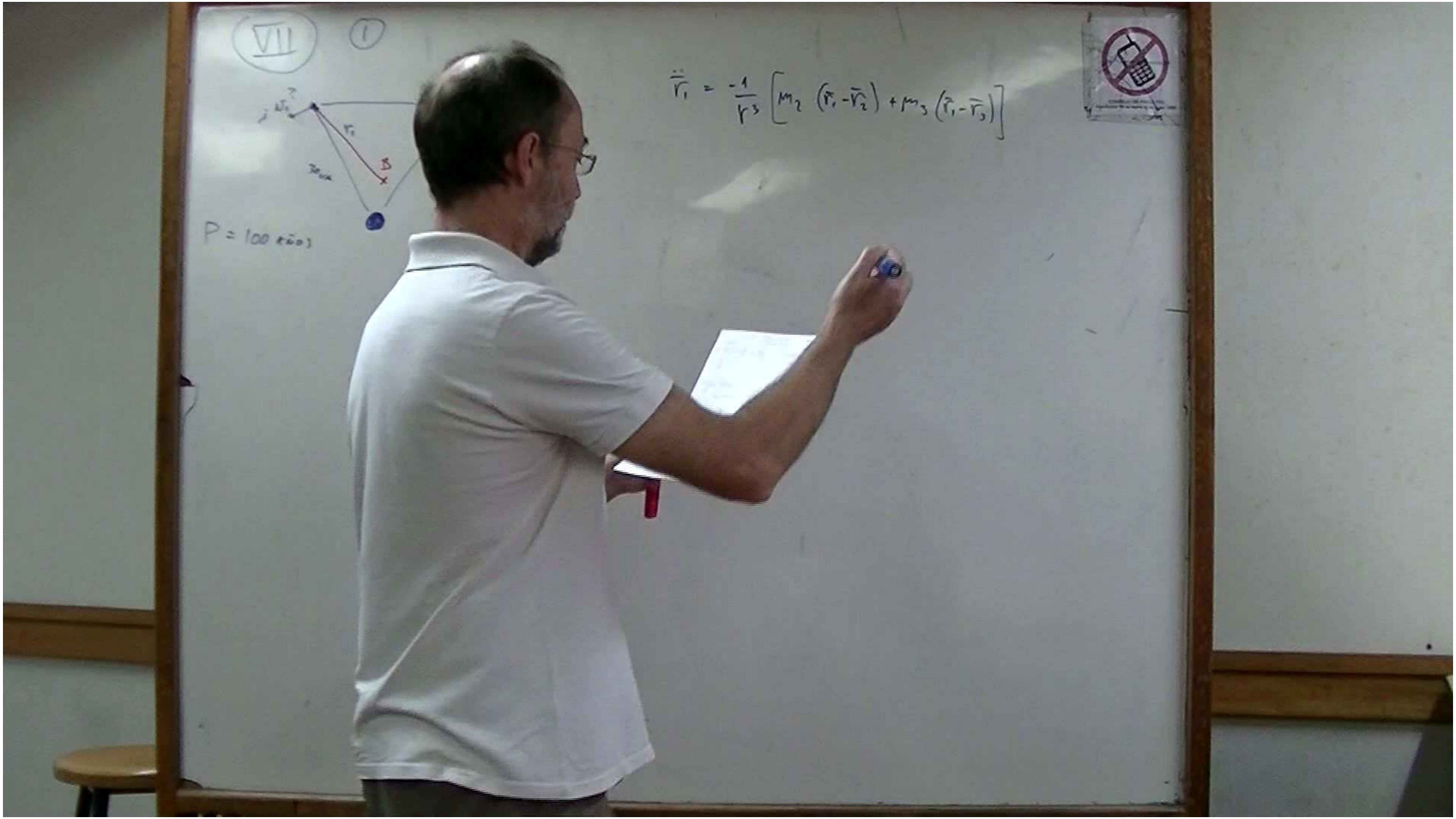

10
a = 1ua
e = 0.13
T
A
Y
X
T


10
a = 1 UA
e = 0.13
T
A
10^6 AÑOS
N_ecc ∝ r^2
N_ecc
r = R⊕
r^2
10^6 AÑOS
Y
X
T

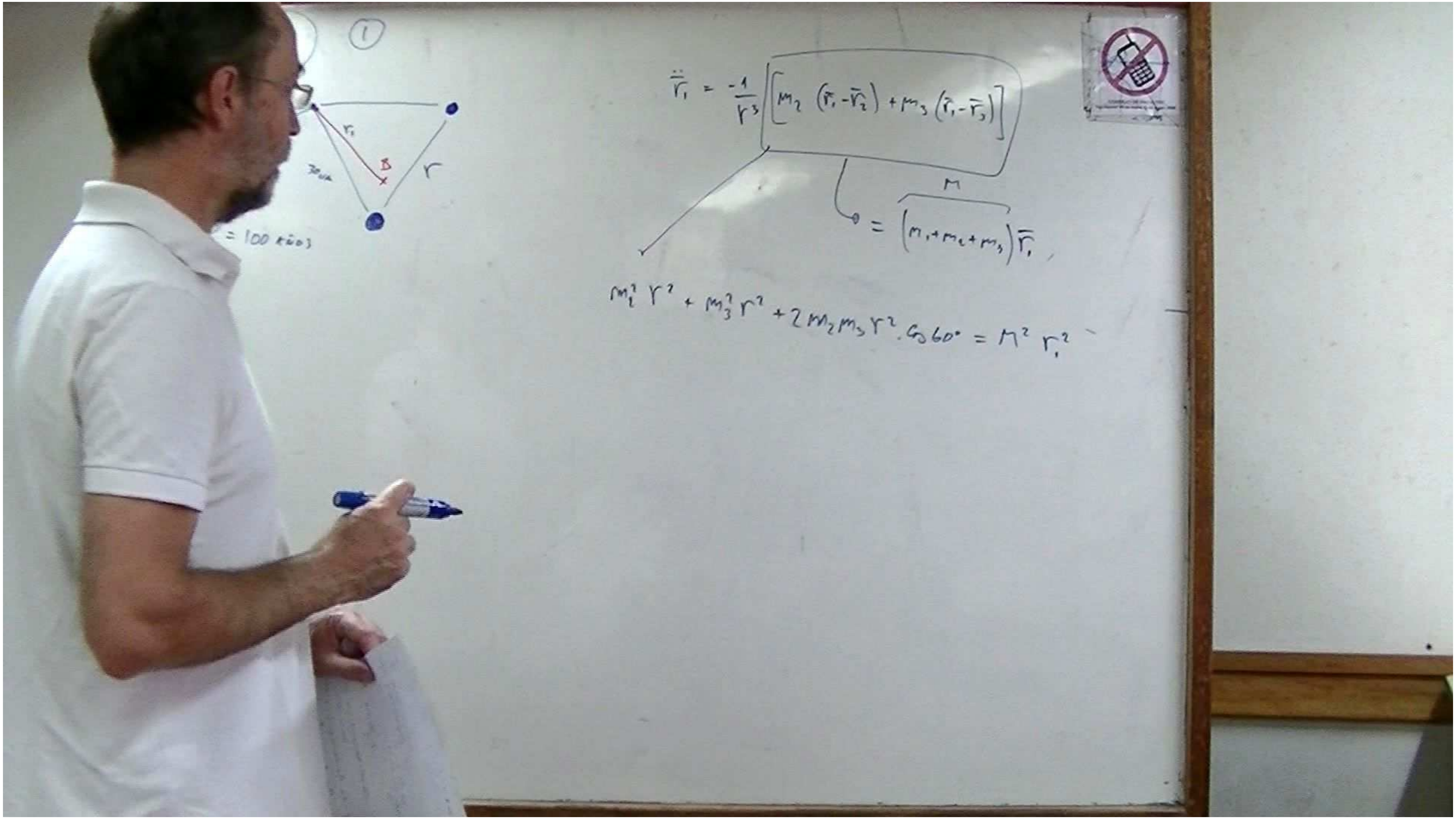

T
A
10^6 AÑOS
$N_{enc} \propto r^2$
r
T
N_{enc}
X
$r = R_\oplus$
r^2
10^6 AÑOS → X "COLISIONES"
VIDA MEDIA → 1
10
a = 1 UA
e = 0.13
A
T
Y
X
T


VII
1
30 ua
B
x


VII
1
?
v_0
r_1
B
30 UA
P = 100 años



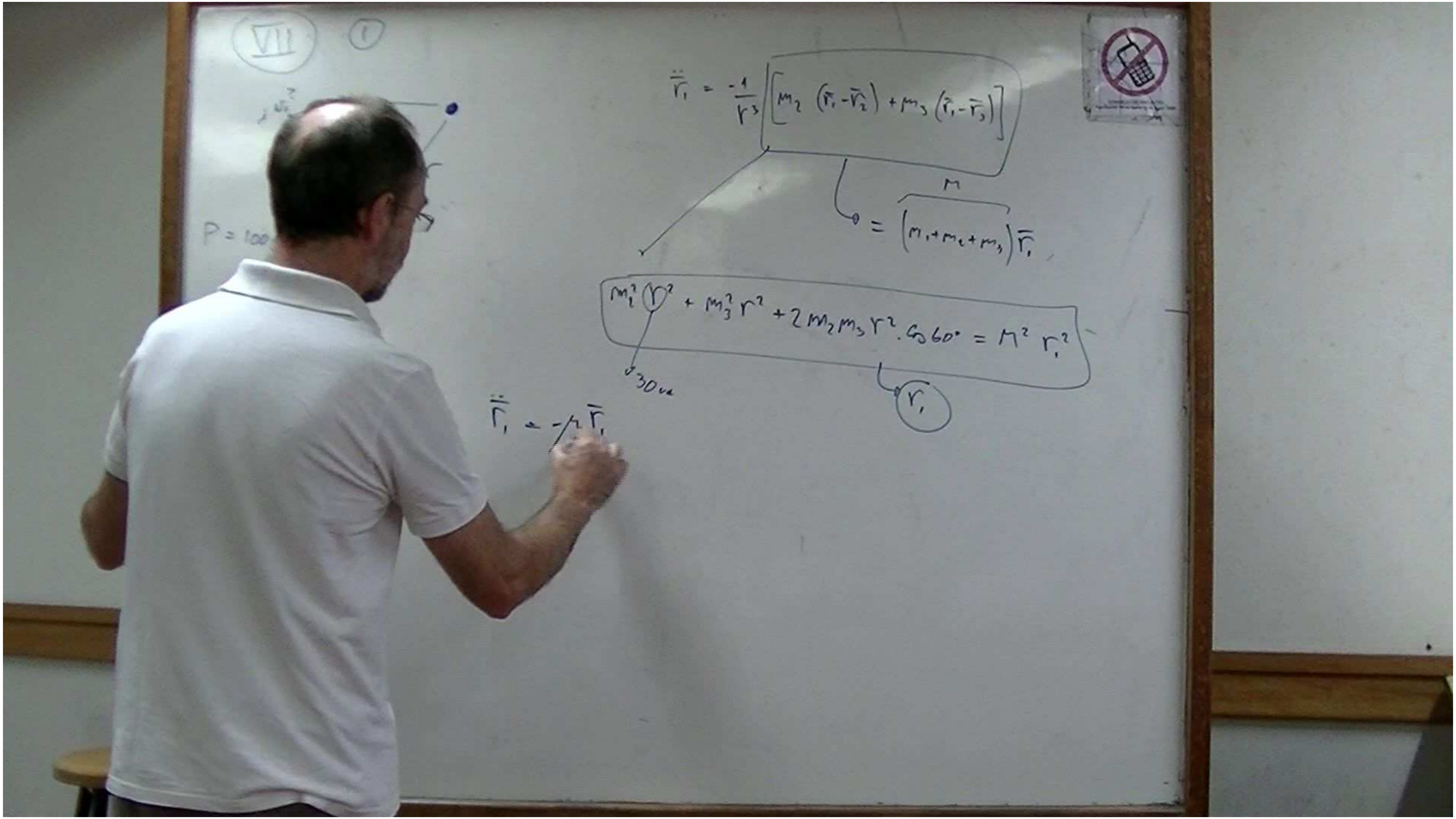
$$\ddot{\vec{r}}_1 = \frac{-1}{r^3}\left[m_2\left(\vec{r}_1-\vec{r}_2\right)+m_3\left(\vec{r}_1-\vec{r}_3\right)\right]$$



$$\ddot{\bar{r}}_1 = -\frac{1}{r^3}\boxed{\left[m_2\left(\bar{r}_1-\bar{r}_2\right)+m_3\left(\bar{r}_1-\bar{r}_3\right)\right]}$$

$$= \overbrace{\left(m_1+m_2+m_3\right)}^{M}\bar{r}_1$$

$$m_2^2\, r^2 + m_3^2\, r^2 + 2\, m_2 m_3\, r^2 . \cos 60° = M^2\, r_1^2$$



$$\ddot{\bar{r}}_1 = \frac{-1}{r^3}\left[m_2\left(\bar{r}_1-\bar{r}_2\right)+m_3\left(\bar{r}_1-\bar{r}_3\right)\right]$$

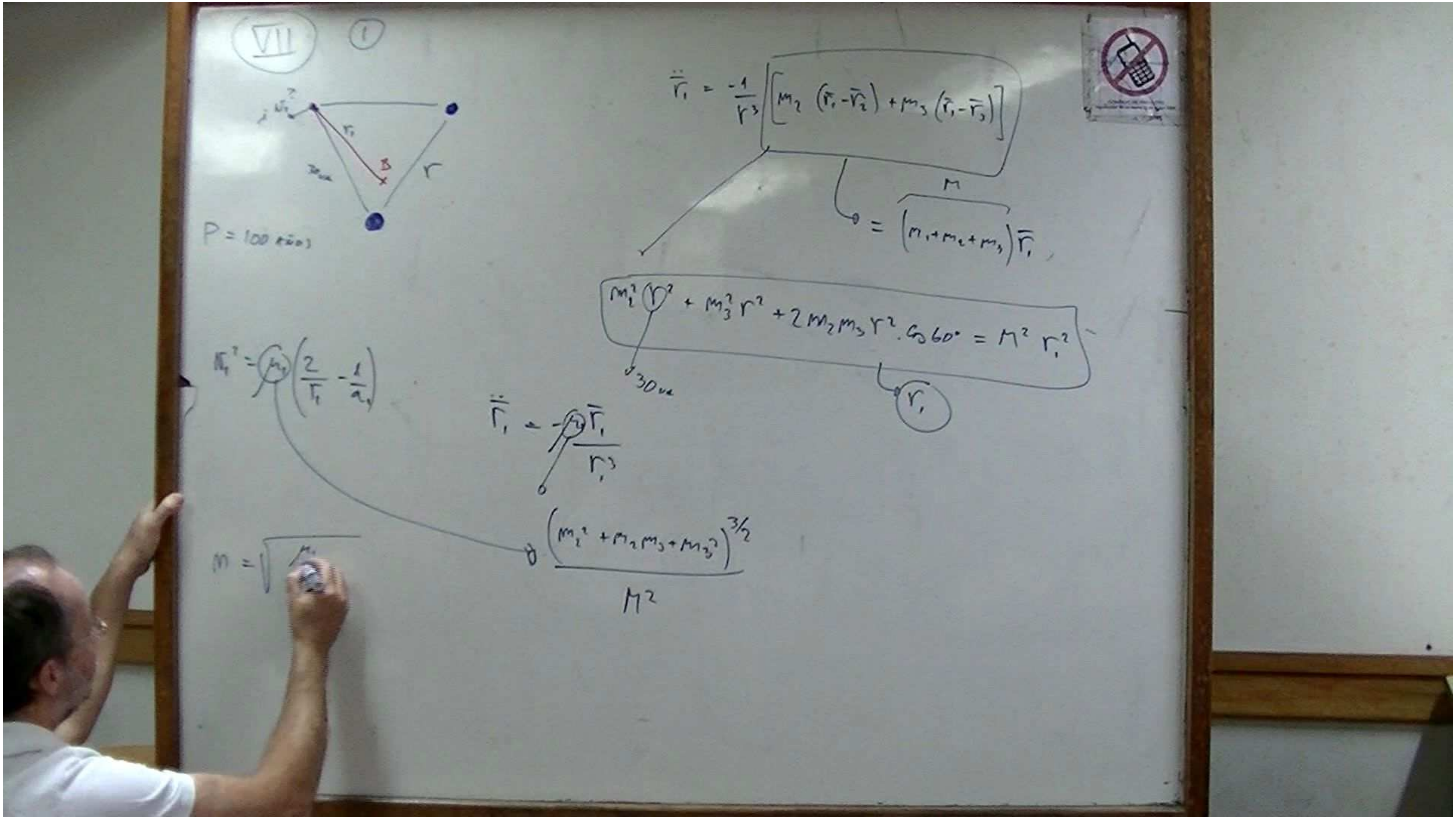
$$= \overbrace{\left(m_1+m_2+m_3\right)}^{M}\bar{r}_1$$

$$m_2^2\,r^2 + m_3^2\,r^2 + 2m_2m_3\,r^2 . \cos 60^\circ = M^2\,r_1^2$$

30 ua

r_1

$\ddot{\bar{r}}_1 = -$ [illegible] $\bar{r}_1$



P = 100 años

$$\ddot{\bar r}_1 = -\frac{1}{r^3}\left[m_2(\bar r_1-\bar r_2)+m_3(\bar r_1-\bar r_3)\right]$$

$$= \overbrace{(m_1+m_2+m_3)}^{M}\bar r_1$$

$$m_2^2 r^2 + m_3^2 r^2 + 2m_2m_3r^2\cdot\cos 60^\circ = M^2 r_1^2$$

30 ua

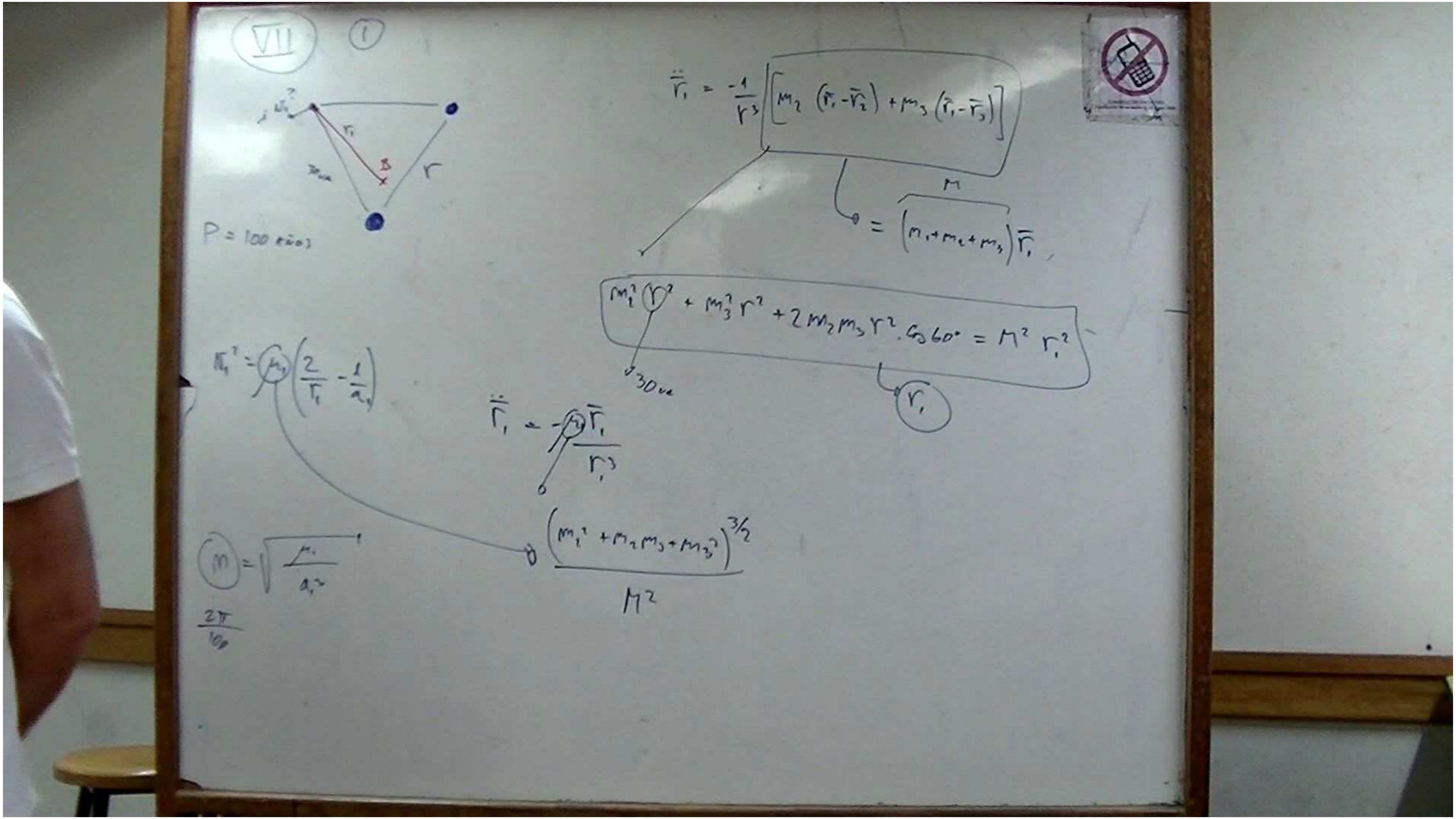
r_1

$$v_1^2 = \mu_1\left(\frac{2}{r_1}-\frac{1}{a_1}\right)$$

$$\ddot{\bar r}_1 = -\mu_1\frac{\bar r_1}{r_1^3}$$

$$\frac{(m_2^2+m_2m_3+m_3^2)^{3/2}}{M^2}$$

$$n = \sqrt{\mu_1}$$



$$\ddot{\bar{r}}_1 = -\frac{1}{r^3}\boxed{\left[m_2(\bar{r}_1-\bar{r}_2)+m_3(\bar{r}_1-\bar{r}_3)\right]}$$

$$= \overbrace{(m_1+m_2+m_3)}^{M}\bar{r}_1$$

$$\boxed{m_2^2 \underset{30ua}{\textcircled{r}}^2 + m_3^2 r^2 + 2 m_2 m_3 r^2 . \cos 60° = M^2 r_1^2} \to \textcircled{r_1}$$

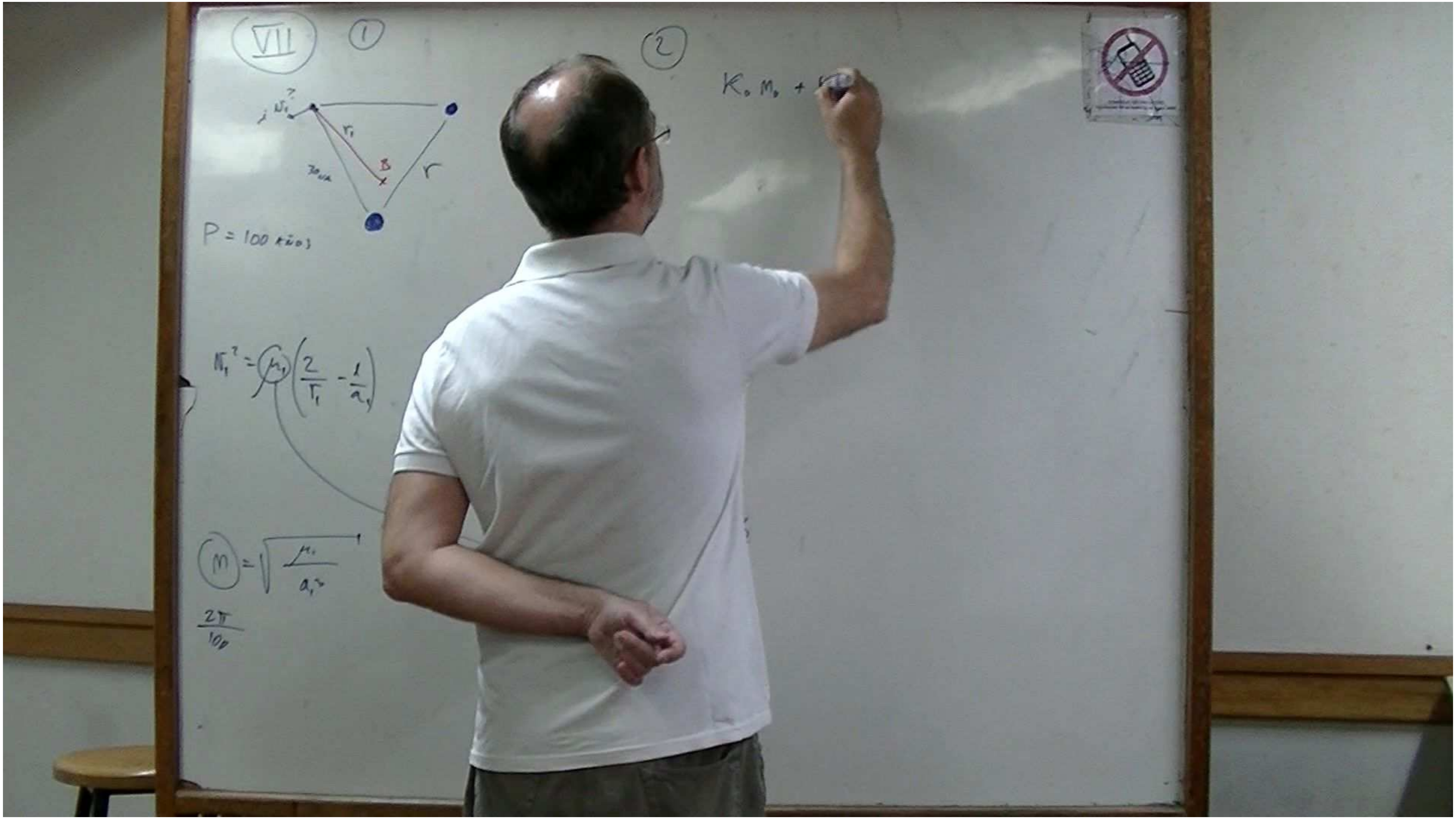
$$v_1^2 = \cancel{\mu_1}\left(\frac{2}{r_1}-\frac{1}{a_1}\right)$$

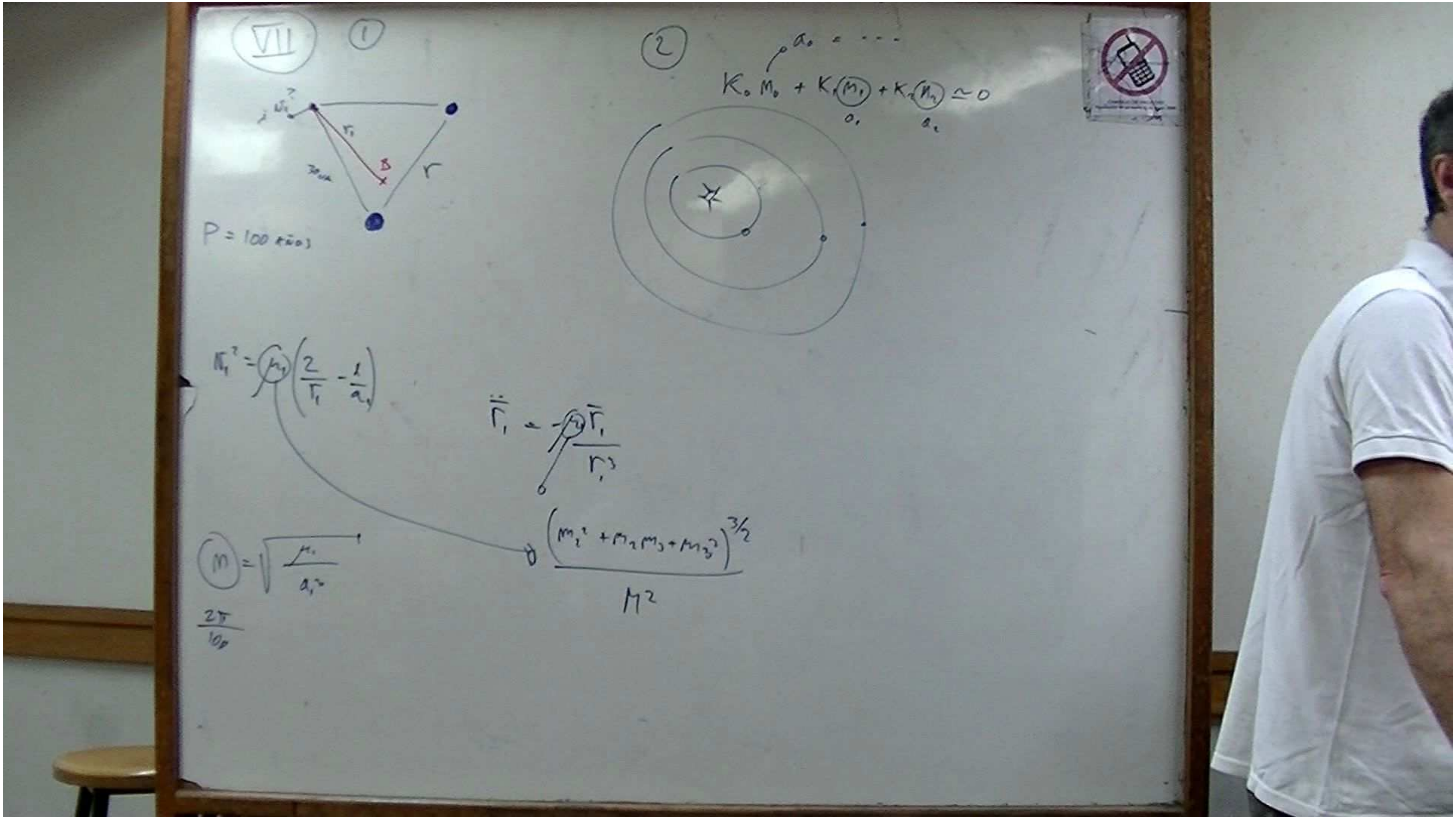
$$\ddot{\bar{r}}_1 = -\cancel{\mu_1}\frac{\bar{r}_1}{r_1^3}$$

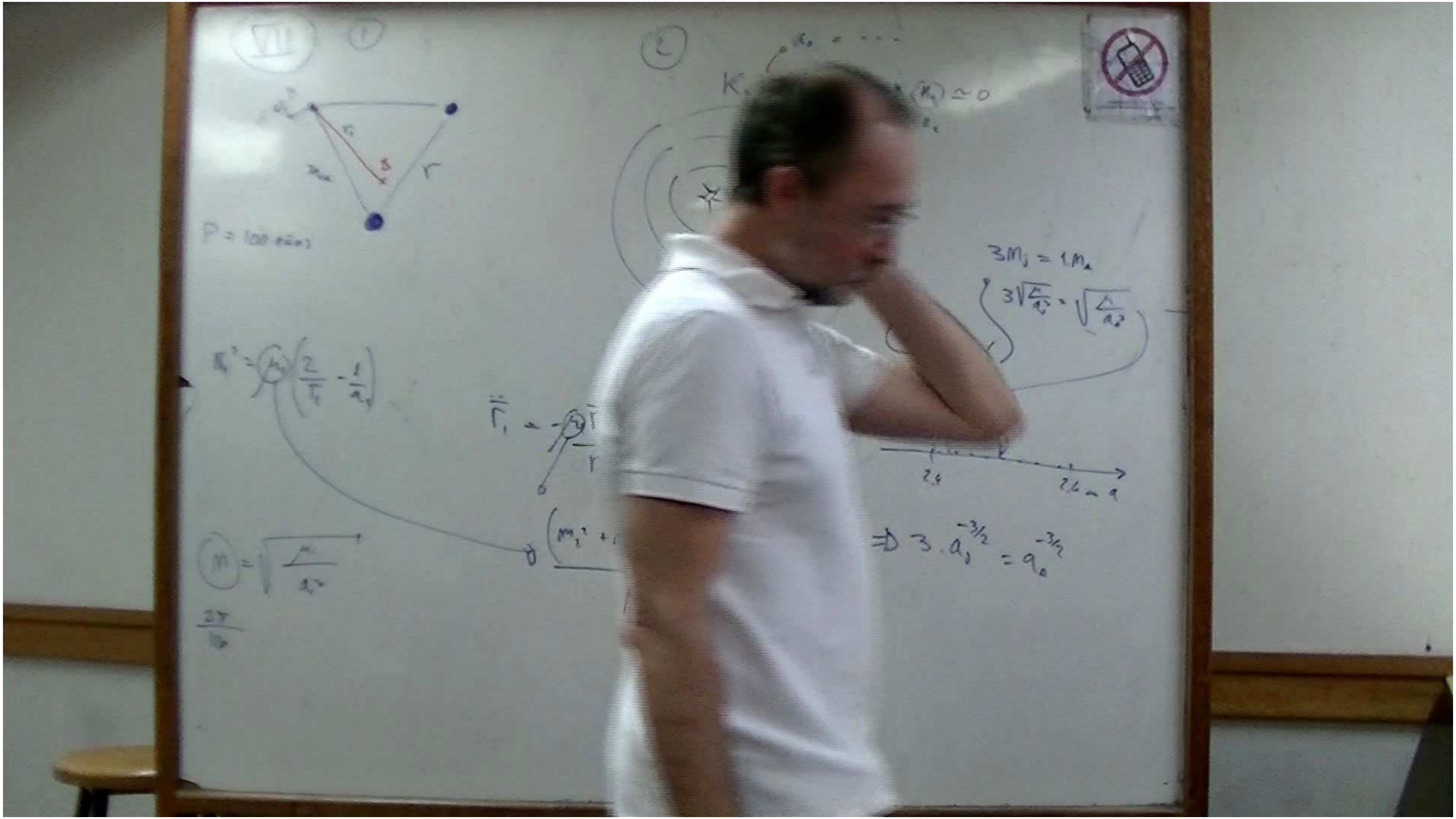
$$\frac{(m_2^2+m_2m_3+m_3^2)^{3/2}}{M^2}$$

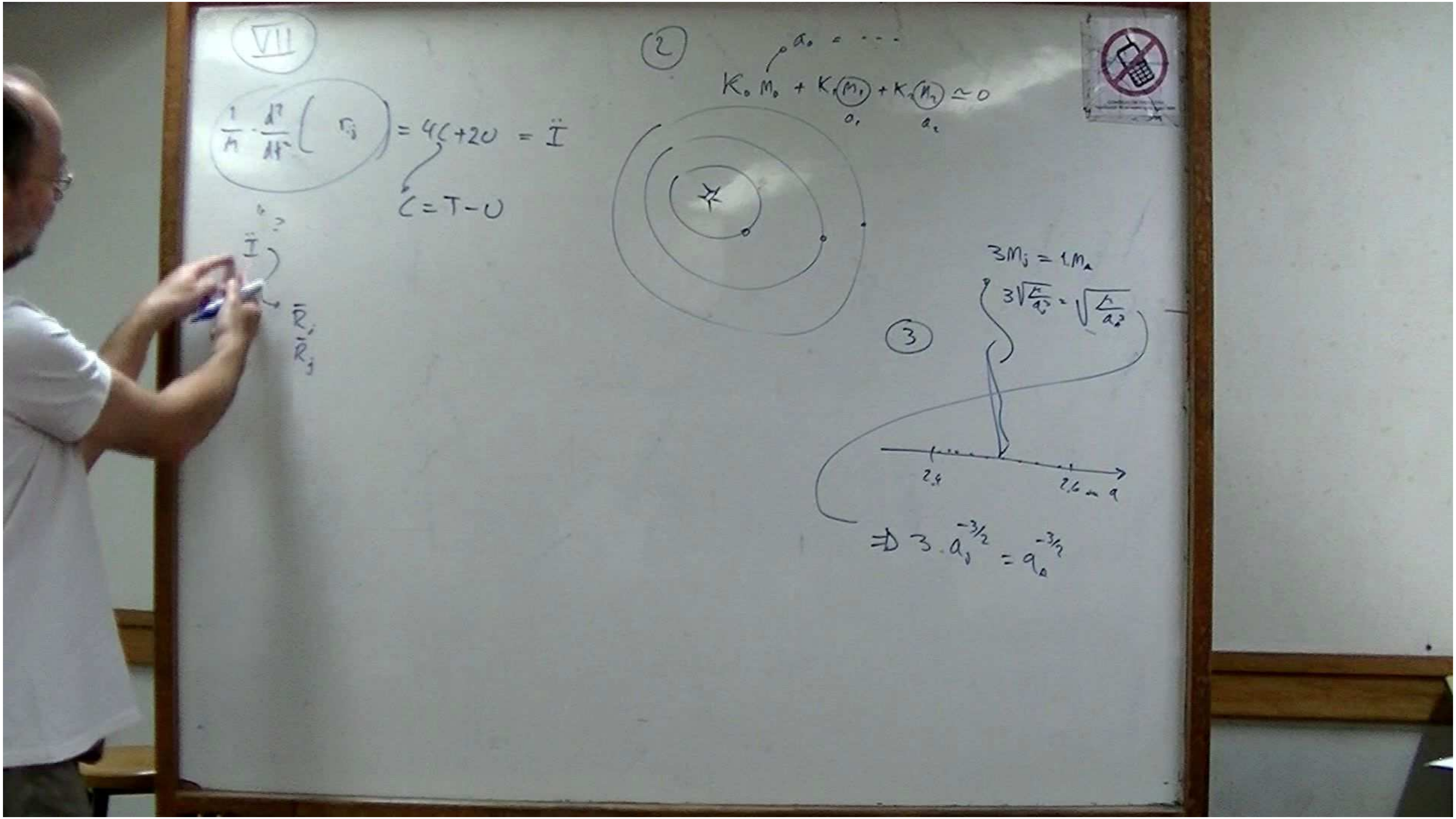
$$\textcircled{n} = \sqrt{\frac{\mu_1}{a_1^3}}$$

$$\frac{2\pi}{100}$$


VII
1
2
¿ v₁ ?
r₁
B
30 UA
r
P = 100 años
v₁² = μ₁ (2/r₁ − 1/a₁)
n = √(μ₁/a₁³)
2π/100
K₀ M₀ +


VII
1
2
r₁
r
δ
30 UA
P = 100 años
a₀ = . . .
K₀ M₀ + K₁ m₁ + K₂ m₂ ≃ 0
a₁
a₂
v₁² = μ₁ (2/r₁ − 1/a₁)
r̈₁ = −μ₁ r₁/r₁³
n = √(μ₁/a₁³)
2π/100
(m₂² + m₂m₃ + m₃²)^{3/2} / M²


VII
1
2
P = 100 años
r
3M_j = 1 M_a
2,4
2,6
a
=> 3 . a_j^-3/2 = a_a^-3/2



VII

$$\frac{1}{M}\cdot\frac{d^2}{dt^2}\left(r_{ij} \right) = 4C+2U = \ddot{I}$$

$$C = T - U$$

$\ddot{I}$? $\bar{R}_i$, $\bar{R}_j$

(2)

$$K_0 M_0 + K_1 M_1 + K_2 M_2 \simeq 0$$

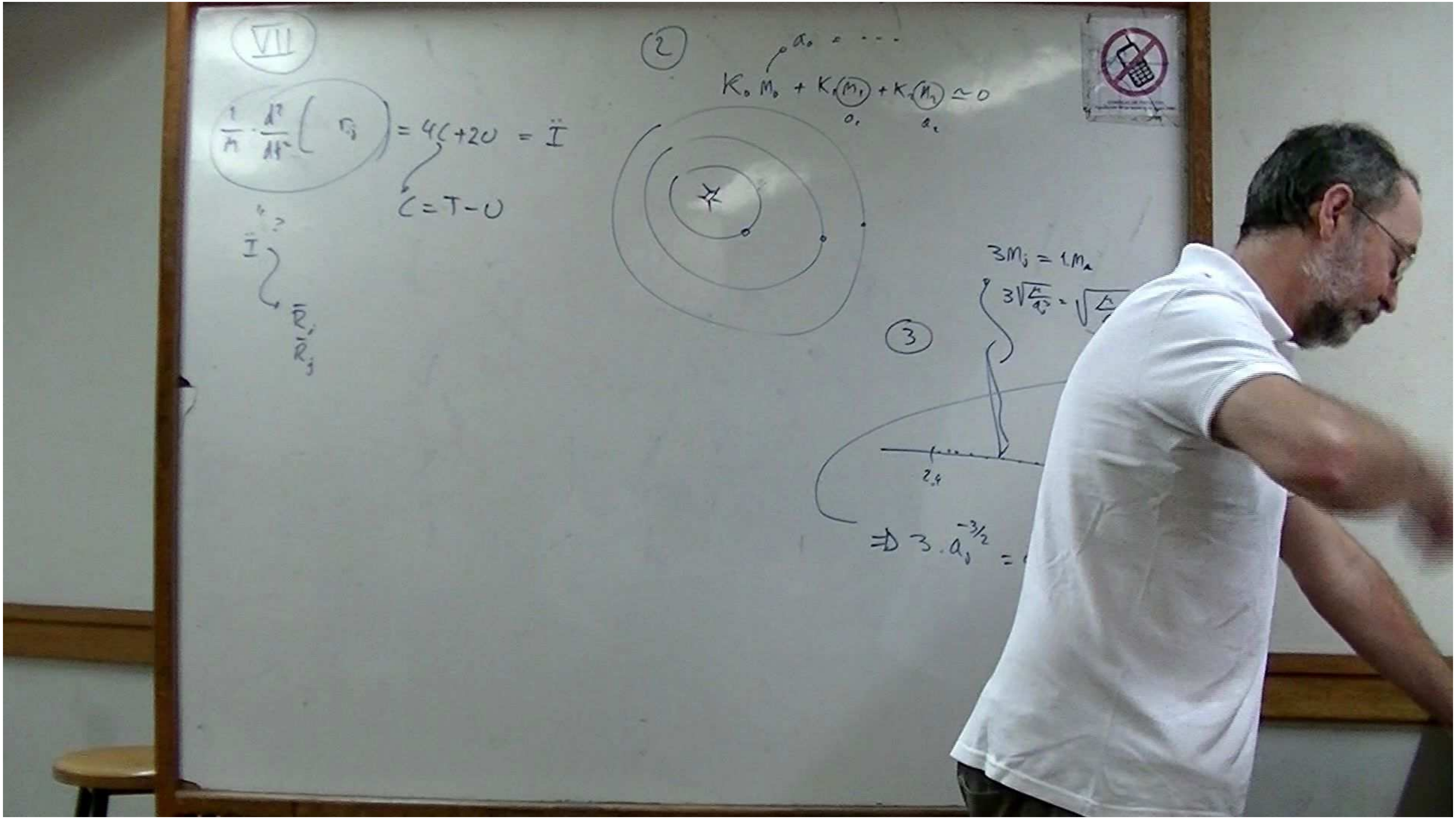
a_0 ... a_1 a_2

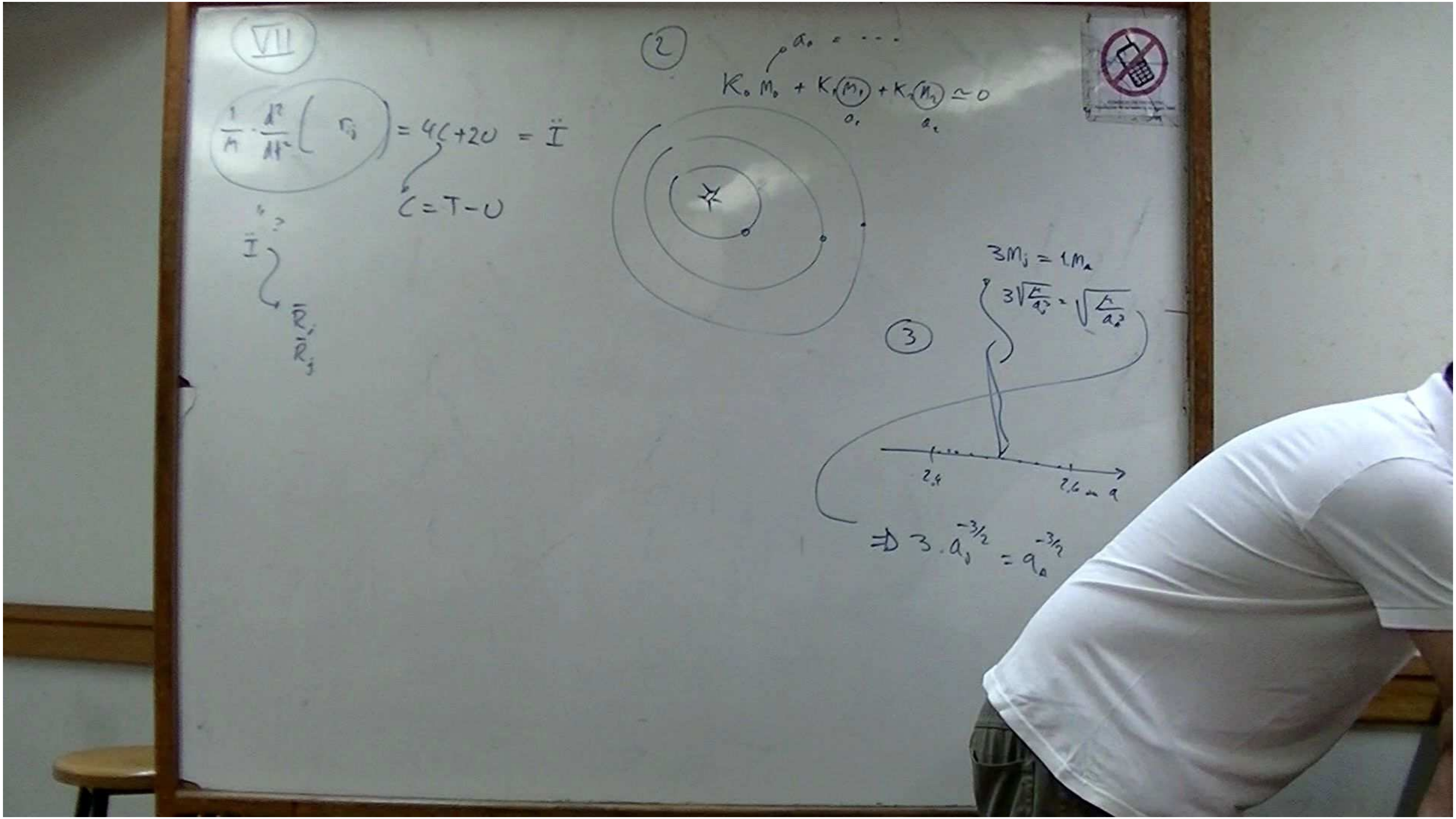
(3)

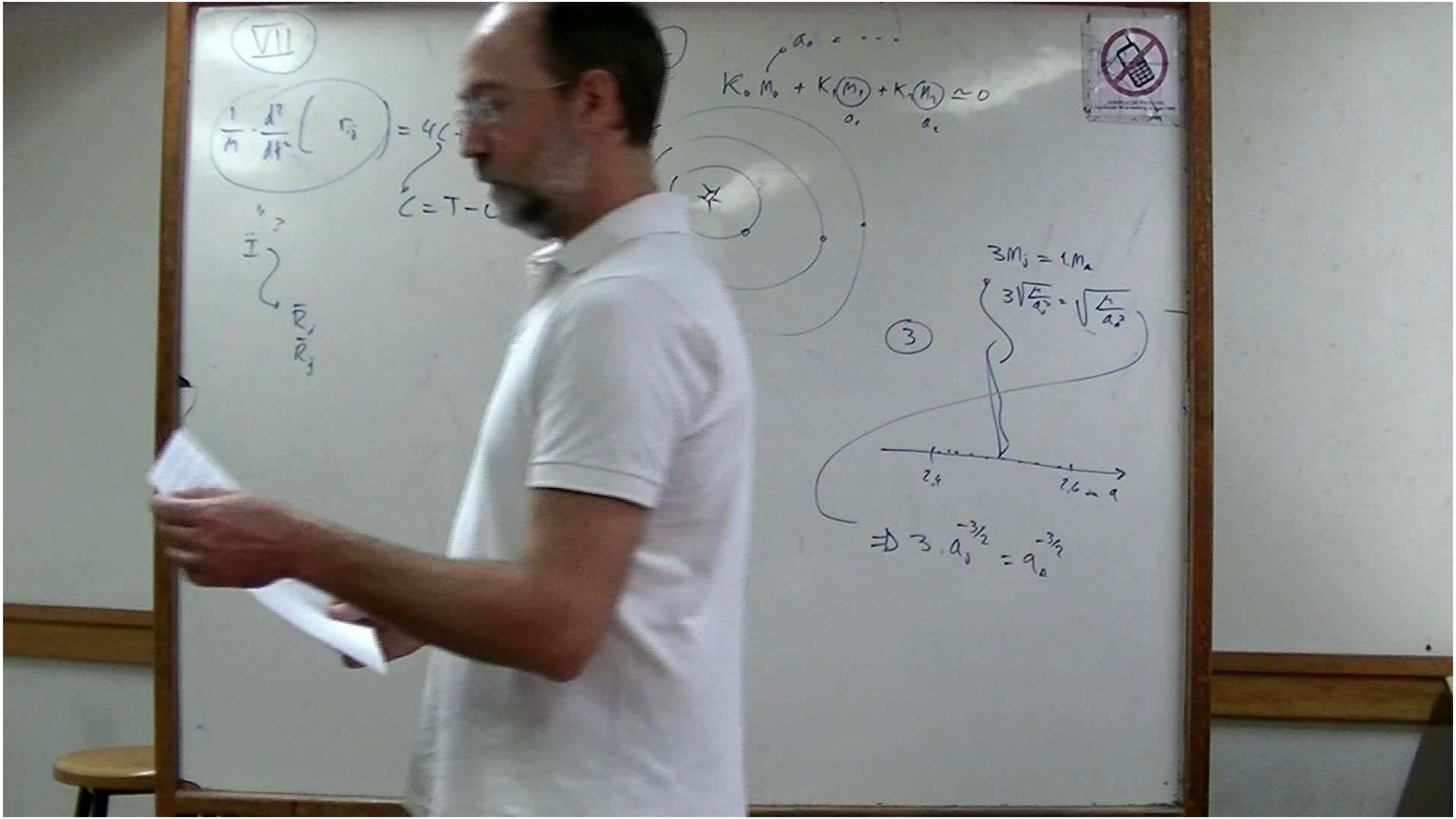
$$3M_j = 1 M_a$$

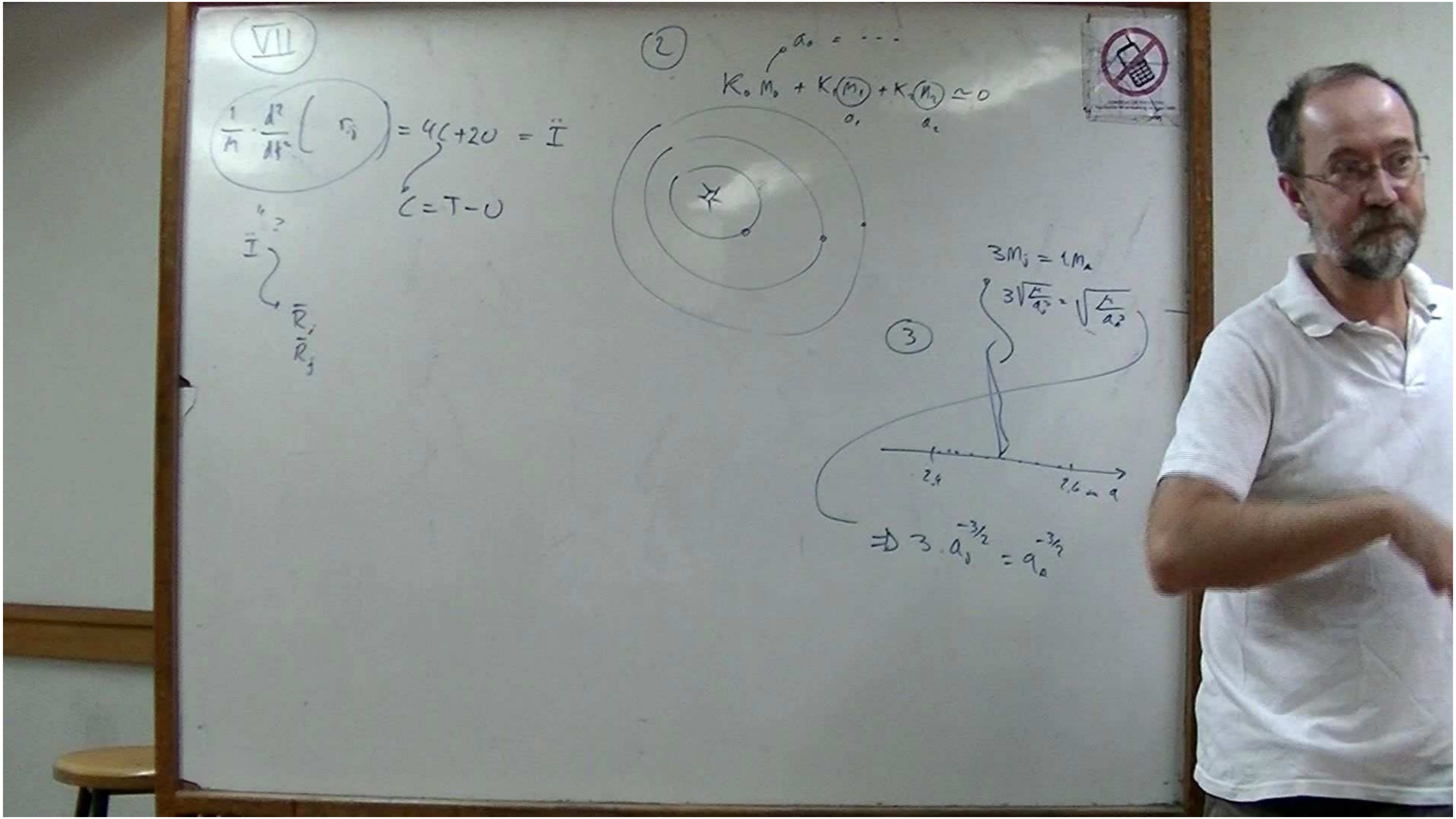
$$3\sqrt{\frac{\mu}{a_j^3}} = \sqrt{\frac{\mu}{a_a^3}}$$

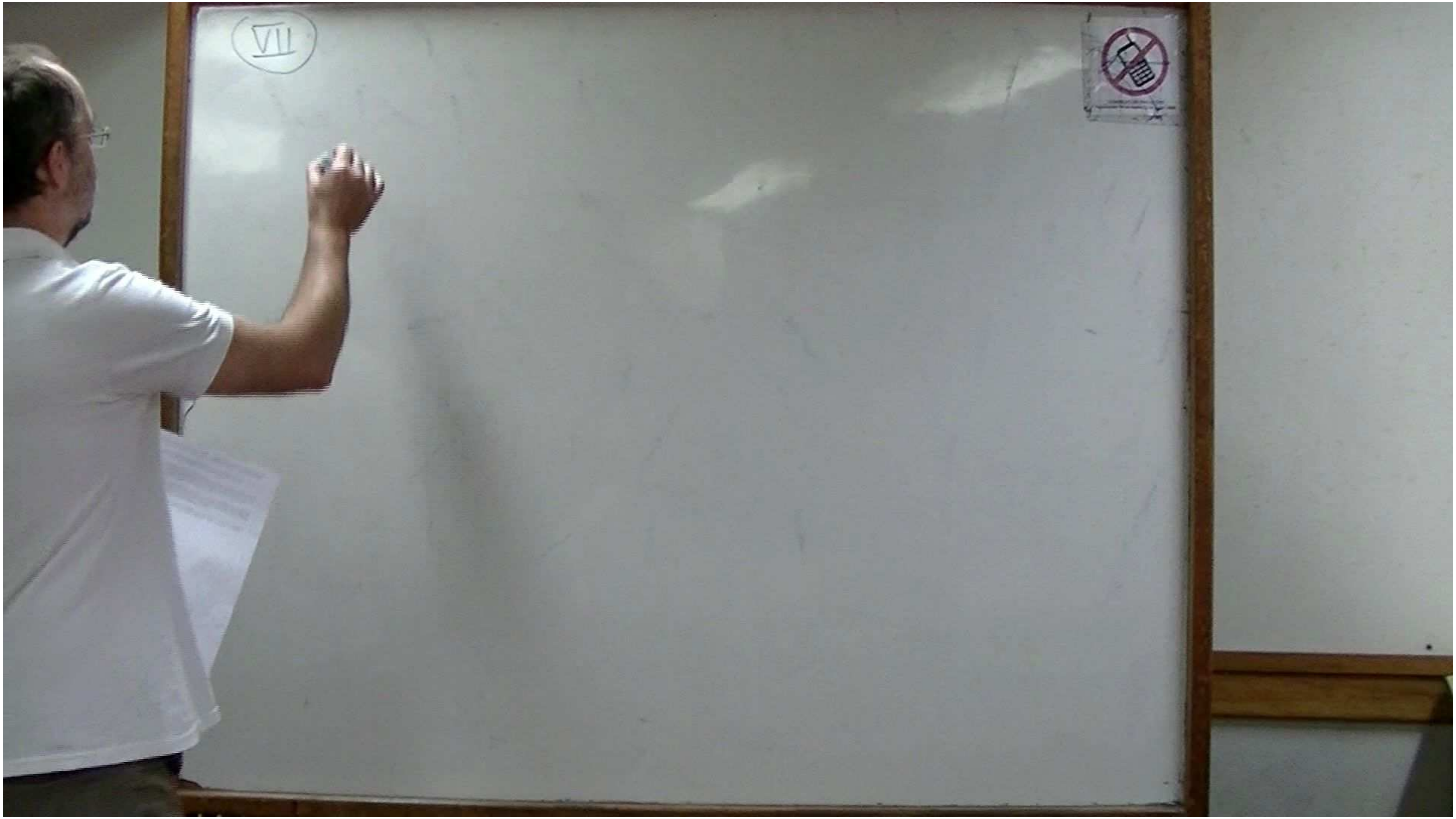
$$\Rightarrow 3 \cdot a_j^{-3/2} = a_a^{-3/2}$$


VII
$\frac{1}{m}\cdot\frac{d^2}{dt^2}\left(r_{ij} \right) = 4C+2U = \ddot{I}$
$C = T - U$
$\ddot{I}$?
$\bar{R}_i$
$\bar{R}_j$
2
$a_0 = \dots$
$K_0 M_0 + K_1 M_1 + K_2 M_2 \simeq 0$
a_1
a_2
$3 M_j = 1 M_a$
3
2,4
$\Rightarrow 3 . a_j^{-3/2} =$

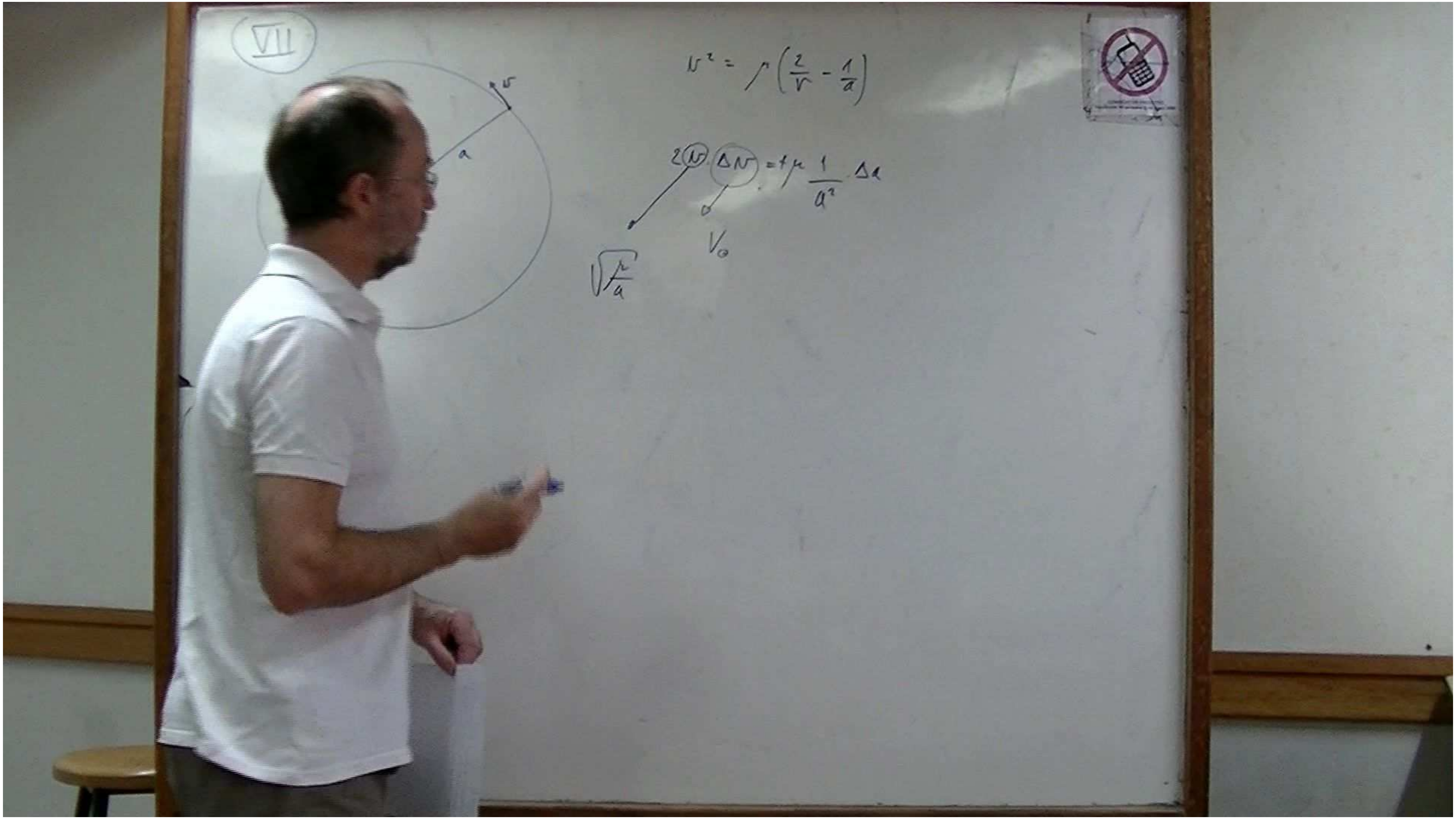

VII
1/m · d²/dt² (r_i) = 4C+2U = Ï
C = T − U
Ï ?
R̄_i
R̄_j
2
a₀ = . . .
K₀ M₀ + K₁ M₁ + K₂ M₂ ≃ 0
a₁
a₂
3
3M_j = 1 M_a
3√(μ/a_j³) = √(μ/a_a³)
2,4
2,6
a
⇒ 3 . a_j^(−3/2) = a_a^(−3/2)


VII
$\frac{1}{m} \cdot \frac{d^2}{dt^2} \left(r_j \right) = 4C$
$C = T - U$
$\ddot{I}$
$\bar{R}_i$
$\bar{R}_j$
$a_0 = \ldots$
$K_0 M_0 + K_1 M_1 + K_2 M_2 \simeq 0$
a_1
a_2
$3M_j = 1 M_a$
$3\sqrt{\frac{\mu}{a_j^3}} = \sqrt{\frac{\mu}{a_a^3}}$
3
2,4
2,6
a
$\Rightarrow 3 \cdot a_j^{-3/2} = a_a^{-3/2}$


VII
$\frac{1}{m} \cdot \frac{d^2}{dt^2}\left(r_i \right) = 4C + 2U = \ddot{I}$
$C = T - U$
$\ddot{I}$?
$\bar{R}_i$
$\bar{R}_j$
2
$a_0 = \dots$
$K_0 m_0 + K_1 m_1 + K_2 m_2 \simeq 0$
a_1
a_2
$3 m_j = 1 m_a$
$3\sqrt{\frac{c}{a_j^3}} = \sqrt{\frac{c}{a_a^3}}$
3
2,4
2,6
a
$\Rightarrow 3 \cdot a_j^{-3/2} = a_a^{-3/2}$

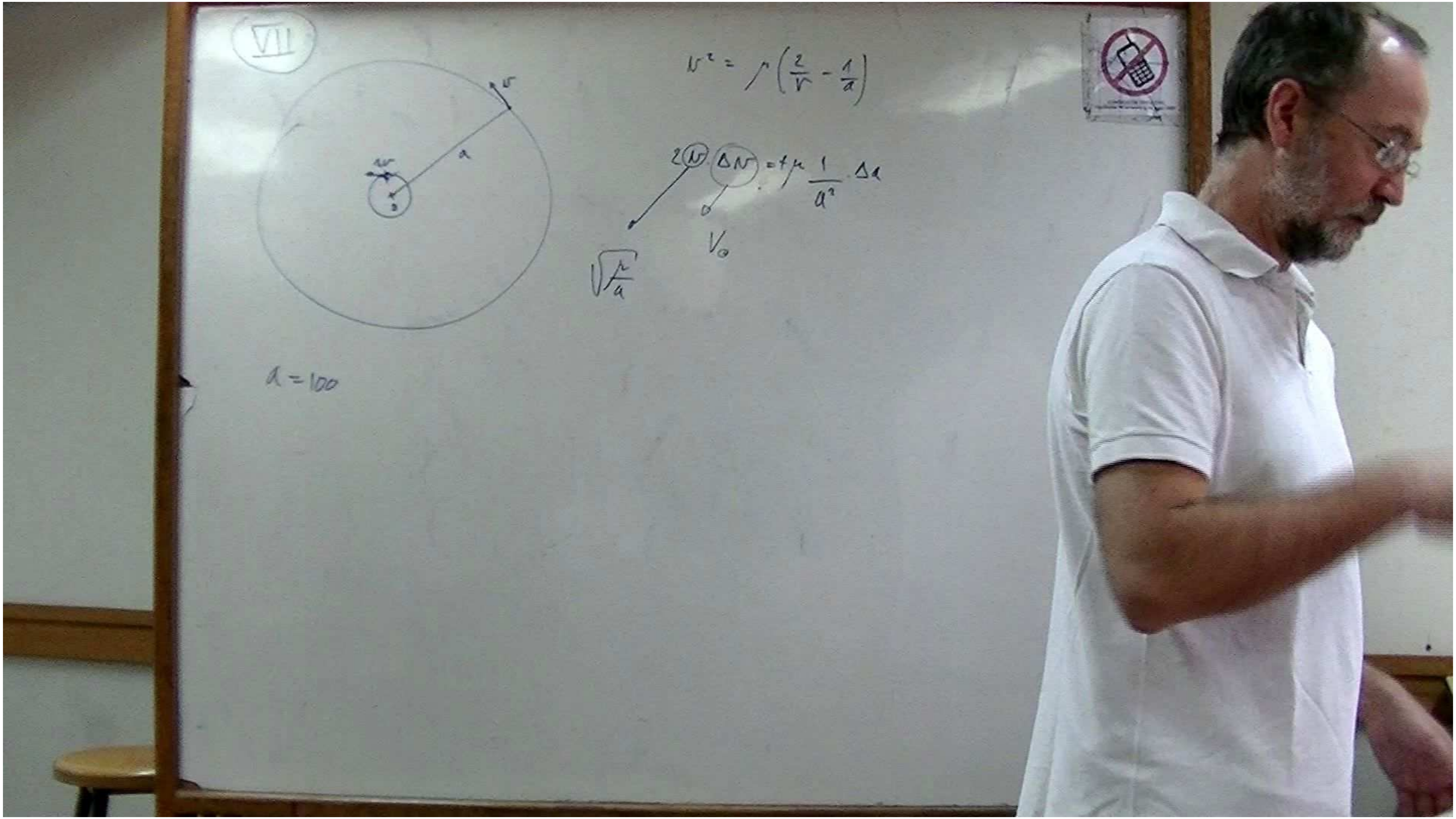

VII


VII
a
v² = μ(2/r − 1/a)
2v . Δv = μ(



$$v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$$

$$2\underbrace{v}_{\sqrt{\frac{\mu}{a}}} \cdot \underbrace{\Delta v}_{V_0} = +\mu \frac{1}{a^2} \cdot \Delta a$$

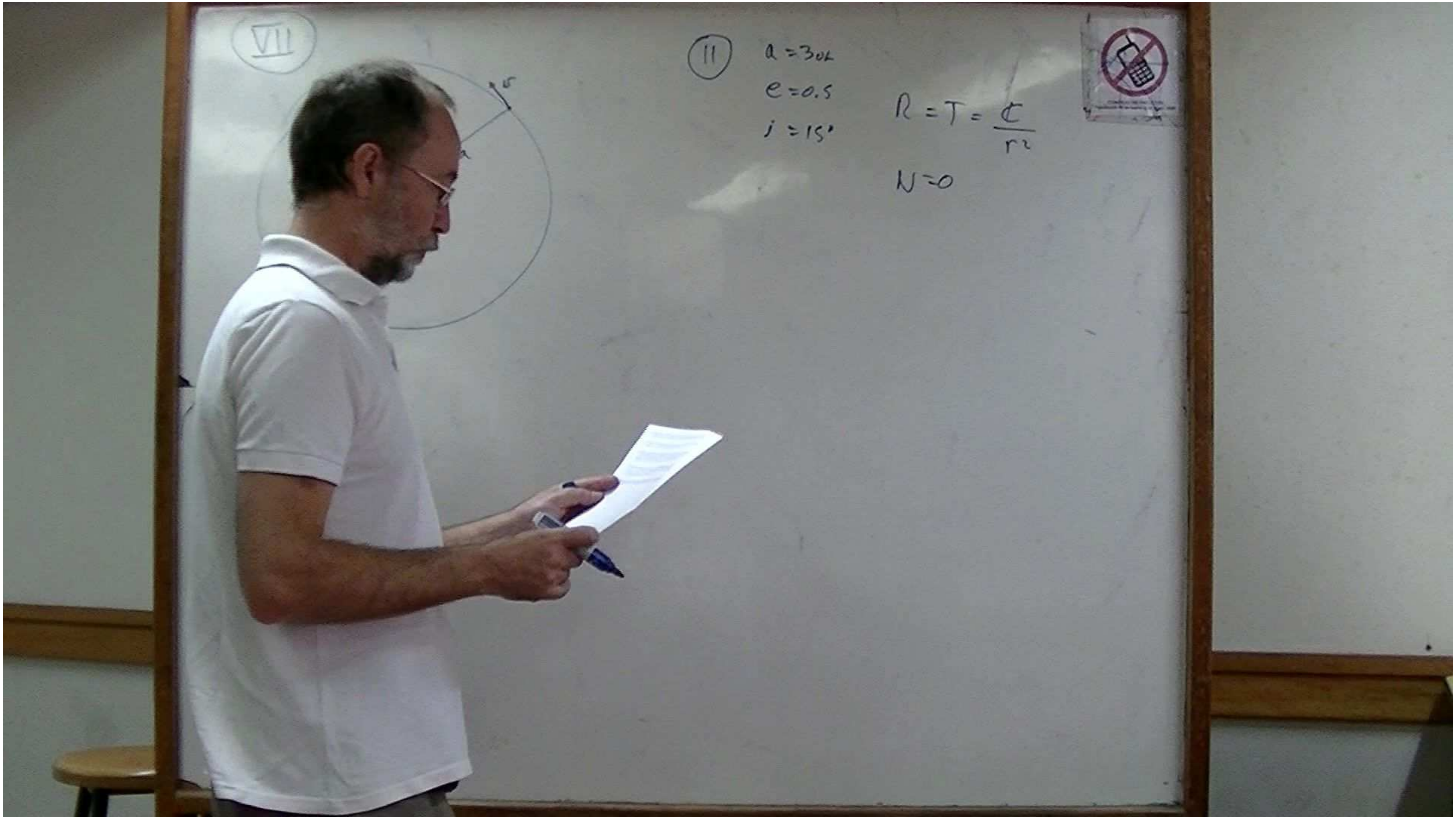


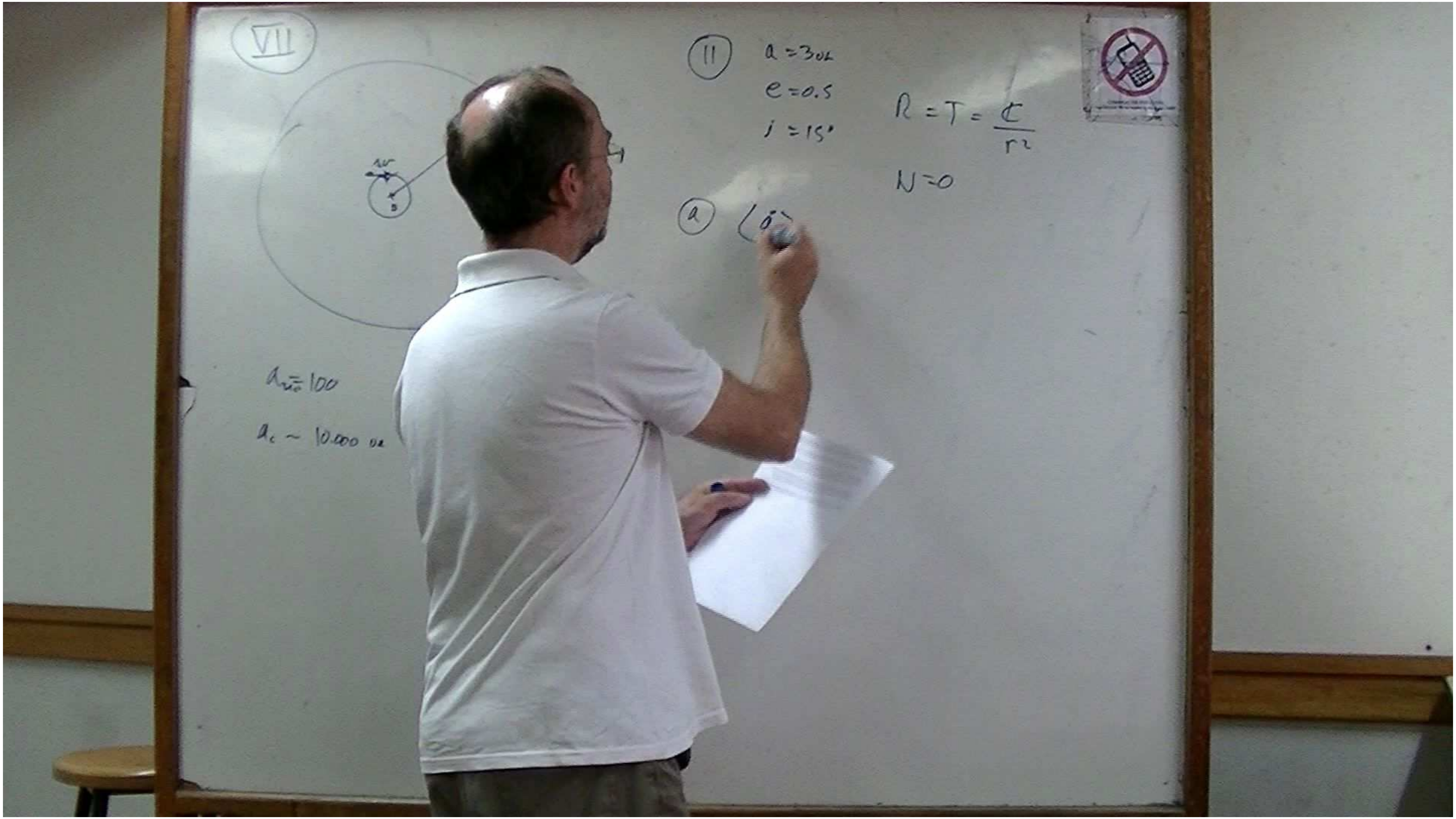
$$v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right)$$

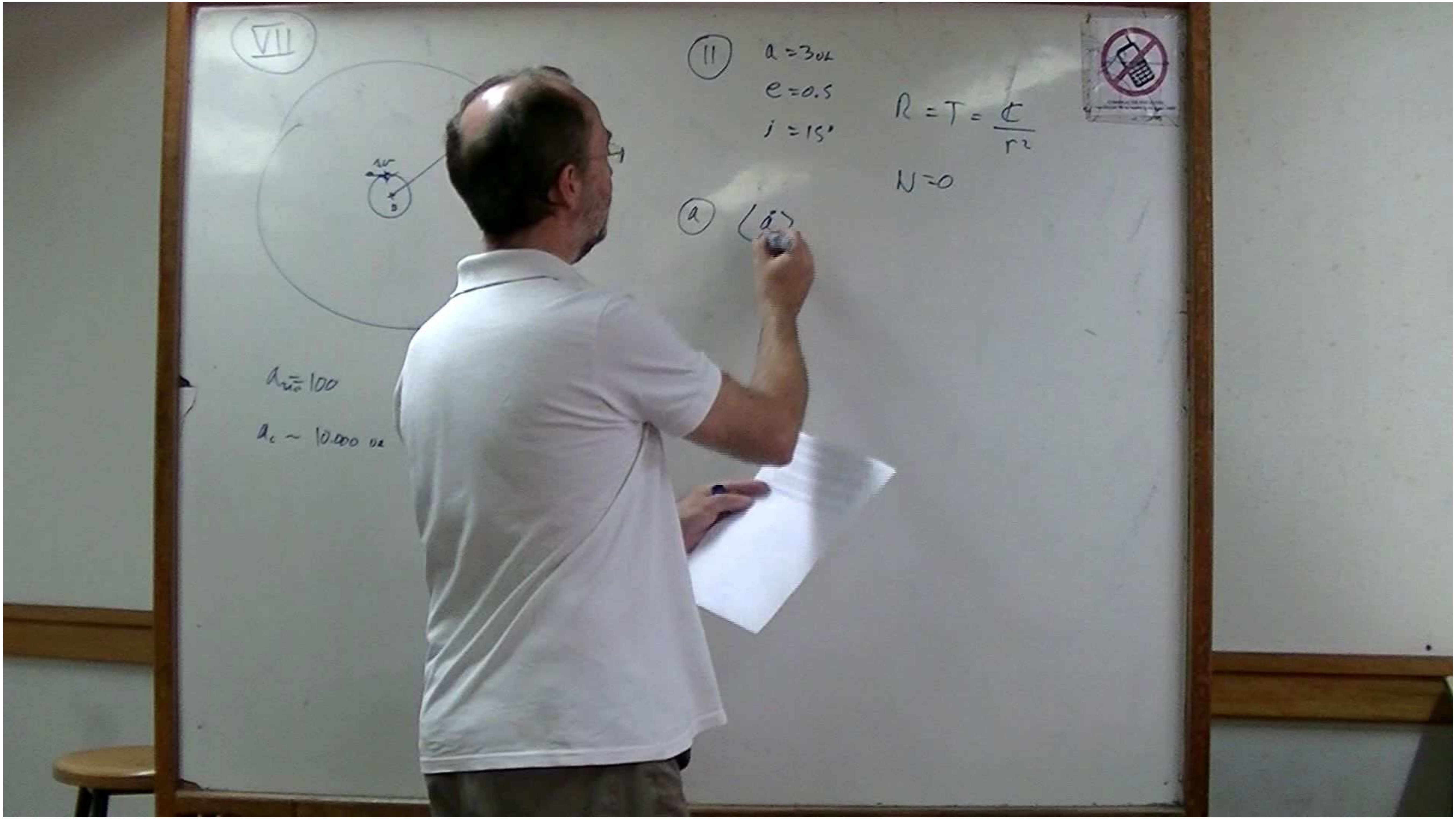
$$2\,\boxed{v} \cdot \boxed{\Delta v} = +\mu \frac{1}{a^2} \cdot \Delta a$$

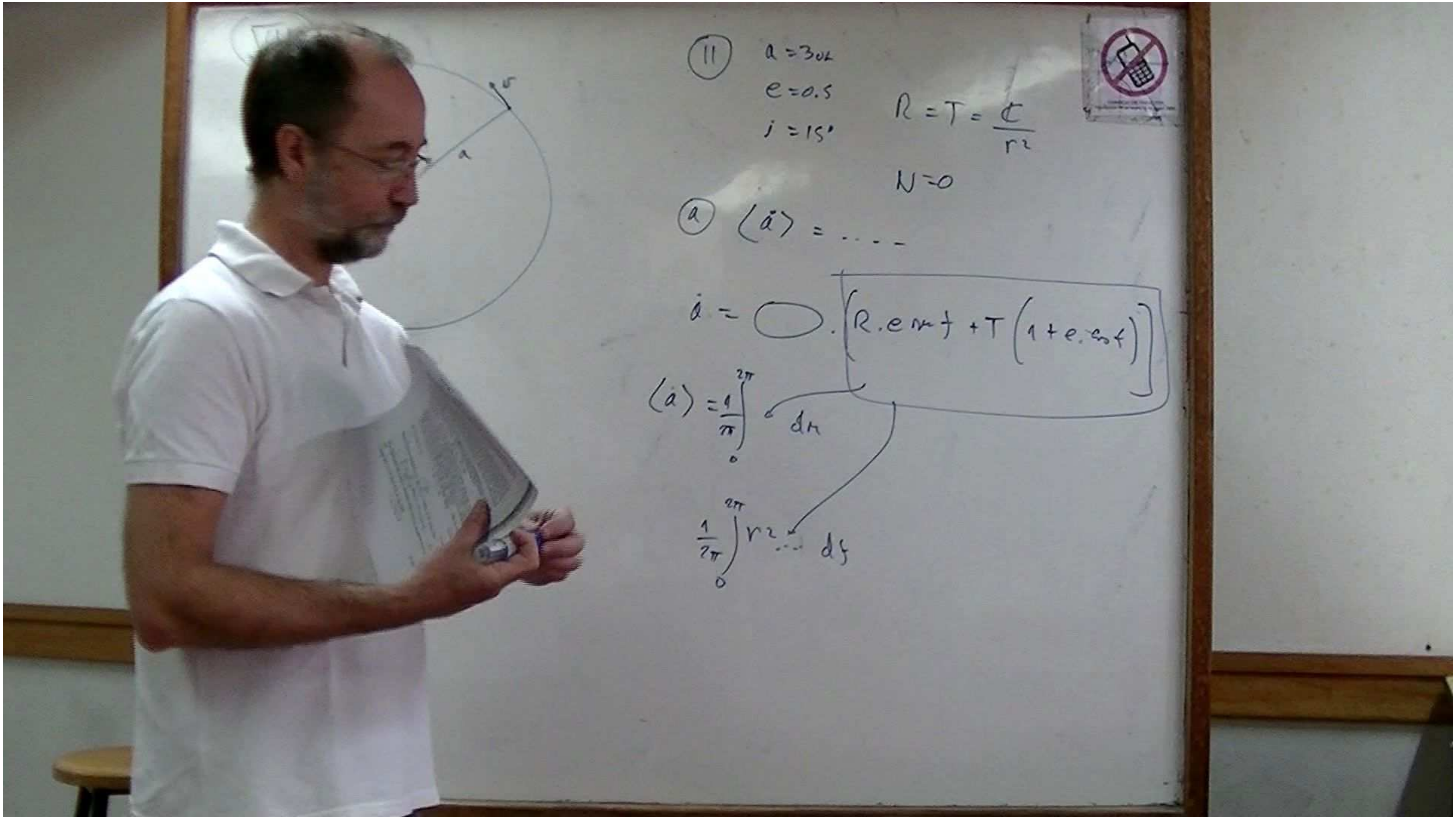
$$\sqrt{\frac{\mu}{a}}$$

$$V_0$$


VII
v
a
11
a = 3ua
e = 0.5
i = 15°
R = T = C/r²
N = 0


VII
11
a = 30 ua
e = 0.5
i = 15°
R = T = C / r²
N = 0
a
⟨ô⟩
a ≈ 100
a_c ~ 10.000 ua


VII
11
a = 30 ua
e = 0.5
i = 15°
R = T = C / r²
N = 0
a ⟨i⟩
NV
D
a ~ 100
a_c ~ 10.000 ua



⑪ $a = 3 ua$

$e = 0.5$

$i = 15°$

$R = T = \frac{C}{r^2}$

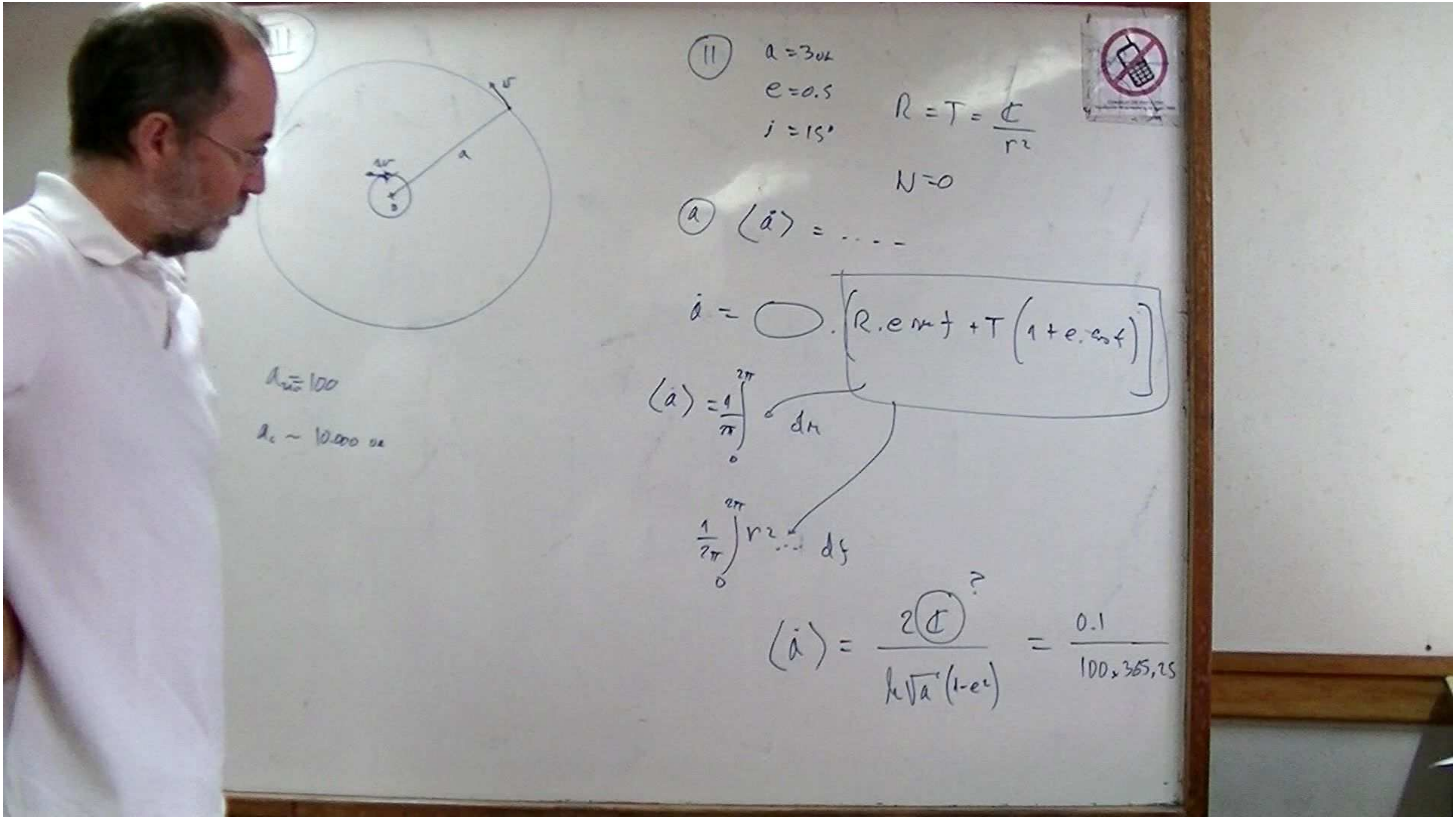
$N = 0$

ⓐ $\langle \ddot{a} \rangle = \dots$

$\dot{a} = \bigcirc \cdot \boxed{\left[R.e \sin f + T \left(1 + e.\cos f \right) \right]}$

$\langle \dot{a} \rangle = \frac{1}{\pi} \int_0^{2\pi} \dots \, dM$

$\frac{1}{2\pi} \int_0^{2\pi} r^2 \dots \, df$



$a_{ni} = 100$

$a_c \sim 10.000$ ua

⑪ $a = 30$ ua

$e = 0.5$

$i = 15°$

$$R = T = \frac{C}{r^2}$$

$$N = 0$$

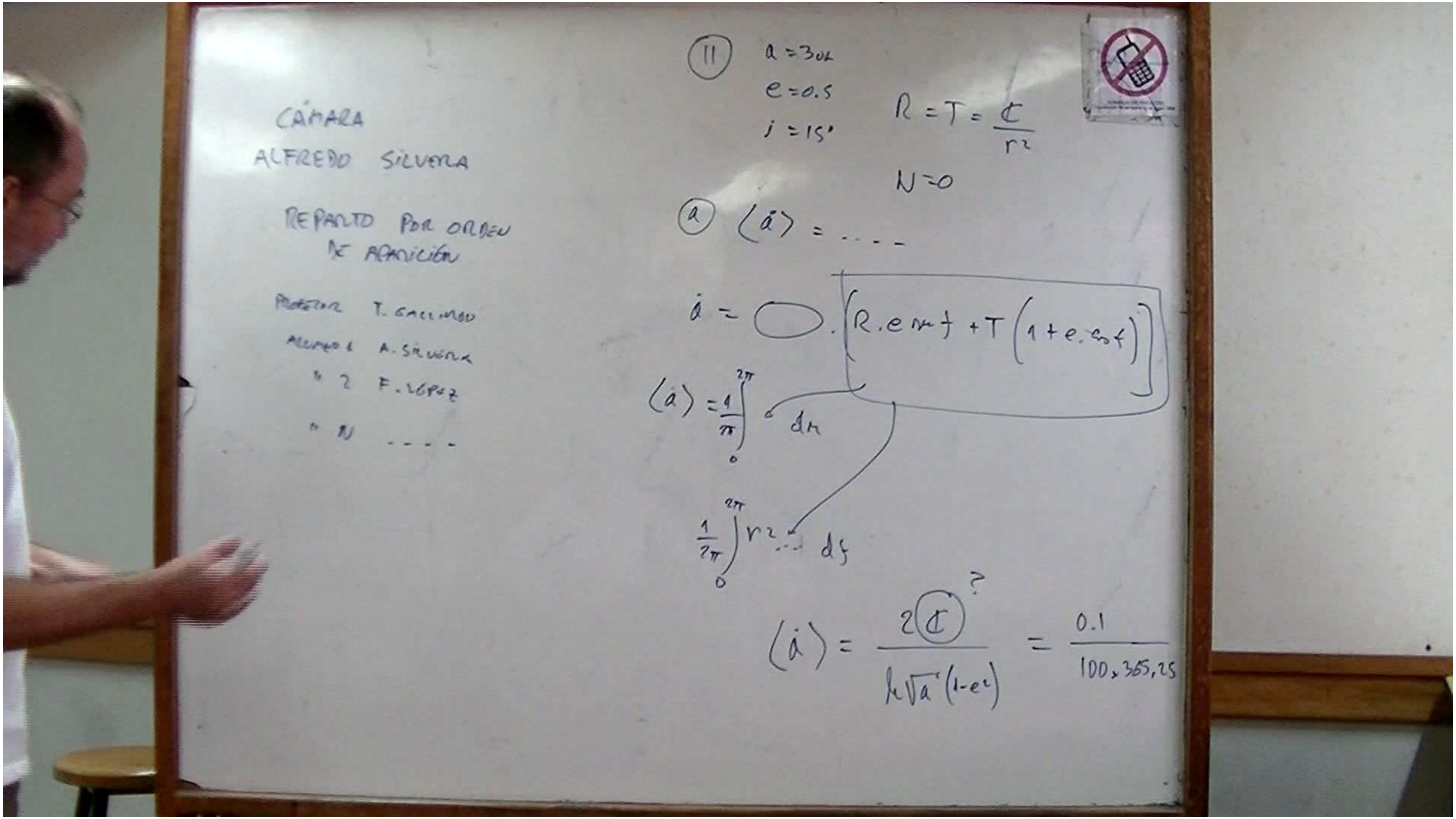
ⓐ $\langle \dot{a} \rangle = \ldots\ldots$

$$\dot{a} = \bigcirc . \boxed{\left[R . e \sin f + T \left(1 + e . \cos f\right)\right]}$$

$$\langle \dot{a} \rangle = \frac{1}{\pi} \int_0^{2\pi} \cdot \, dM$$

$$\frac{1}{2\pi} \int_0^{2\pi} r^2 \ldots \, df$$

$$\langle \dot{a} \rangle = \frac{2 \overset{?}{\textcircled{C}}}{k \sqrt{a} (1-e^2)} = \frac{0.1}{100 \times 365,25}$$



CÁMARA
ALFREDO SILVERA

REPARTO POR ORDEN DE APARICIÓN

PROFESOR T. GALLARDO
ALUMNO 1 A. SILVERA
" 2 F. LÓPEZ
" N - - - -

⑪ $a = 30L$
$e = 0.5$
$i = 15°$

$R = T = \frac{C}{r^2}$

$N = 0$

ⓐ $\langle \dot{a} \rangle = \ldots -$

$$\dot{a} = \bigcirc \cdot \boxed{\left[R \cdot e \sin f + T \left(1 + e \cdot \cos f \right) \right]}$$

$$\langle \dot{a} \rangle = \frac{1}{\pi} \int_0^{2\pi} \ldots \, dM$$

$$\frac{1}{2\pi} \int_0^{2\pi} r^2 \ldots \, df$$

$$\langle \dot{a} \rangle = \frac{2 \textcircled{C}^{?}}{k \sqrt{a} \left(1 - e^2 \right)} = \frac{0.1}{100 \times 365,25}$$