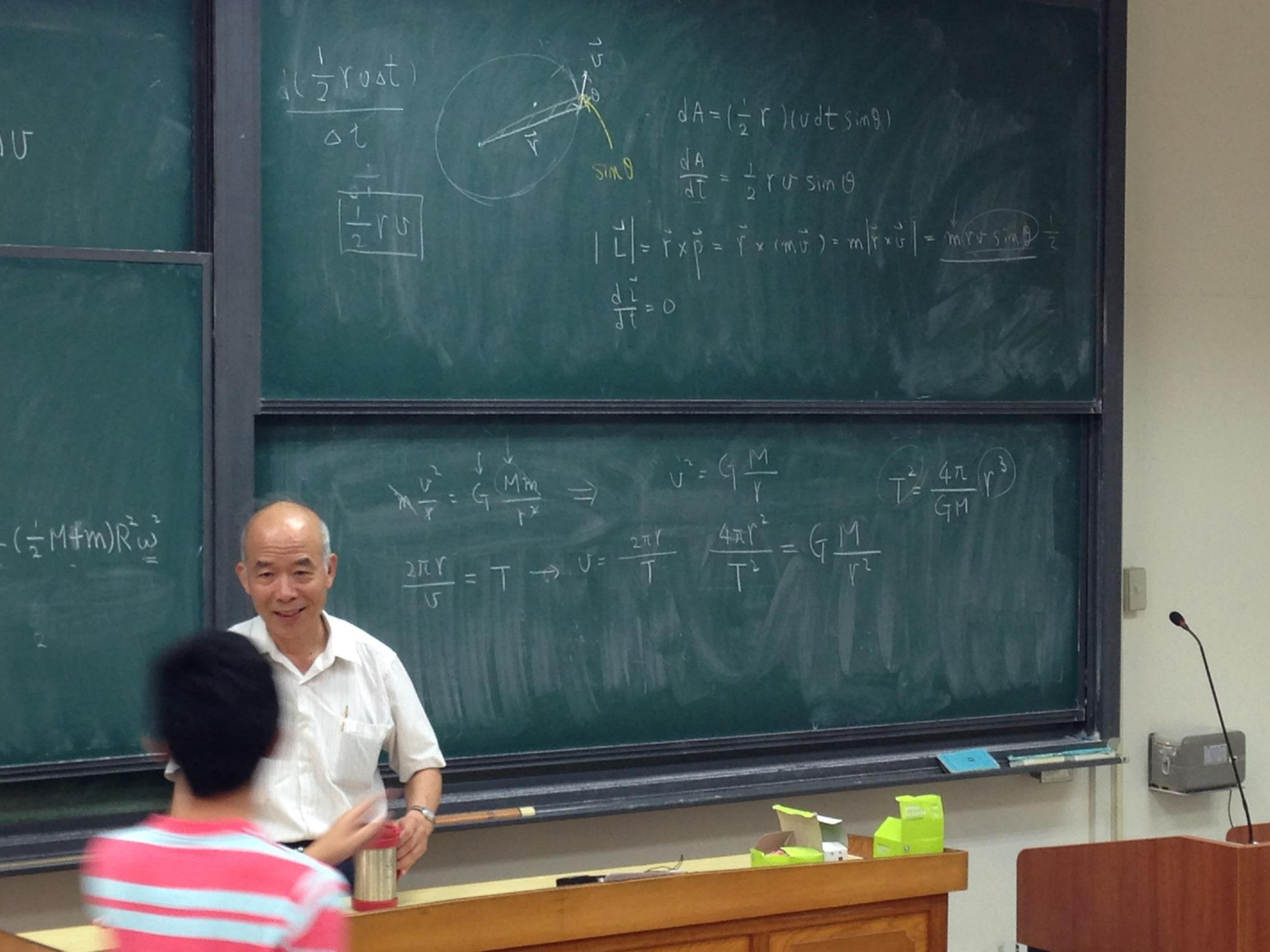
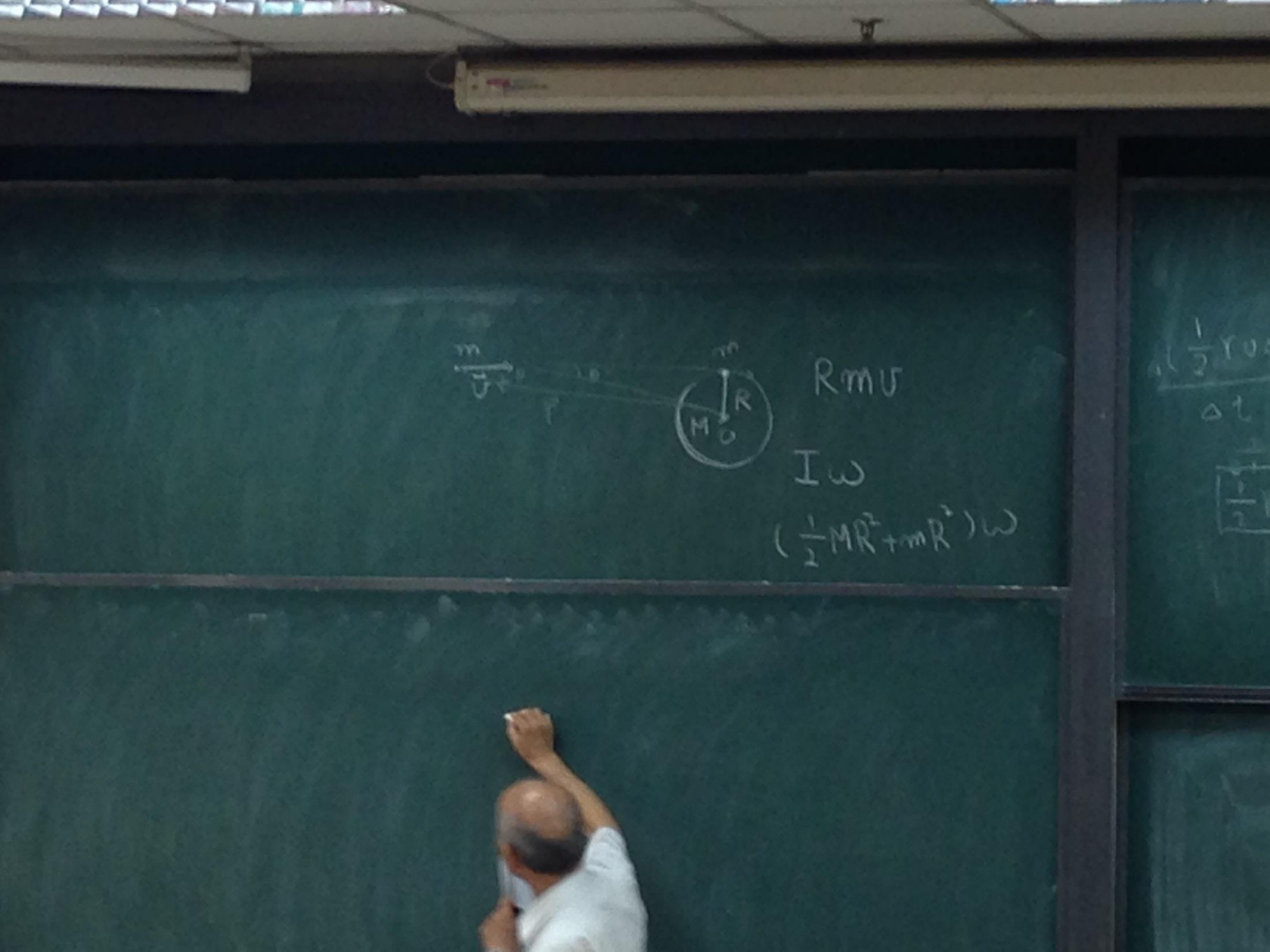
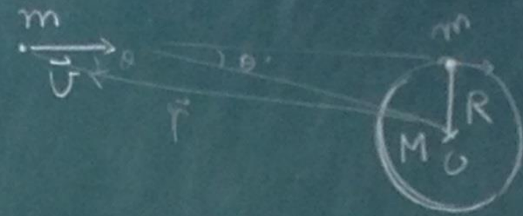


d(1/2 r v Δt) / Δt
1/2 r v
sin θ
dA = (1/2 r)(v dt sin θ)
dA/dt = 1/2 r v sin θ
|L| = r × p = r × (m v) = m|r × v| = m r v sin θ 1/2
dL/dt = 0
m v²/r = G Mm/r² ⟹ v² = G M/r
T² = 4π/GM r³
2πr/v = T → v = 2πr/T
4π r²/T² = G M/r²
(1/2 M + m)R² ω²


m
v
m
R
M
Rmv
Iω
(1/2 MR² + mR²)ω



Rmv

$I\omega$

$$\cancel{R} m v = \left(\tfrac{1}{2}M + m\right) R^{\cancel{2}} \omega$$

$$\omega = \frac{m}{\frac{1}{2}M + m}\, v$$

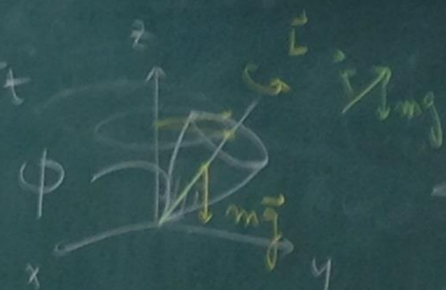
$$K_i - K_f = \frac{1}{2} m v^2 - \frac{1}{2} I \omega^2 = \frac{1}{2} m v^2 - \frac{1}{2}\left(\tfrac{1}{2}M + m\right) R^2 \omega^2$$

$$= \frac{mM}{2M + 4m}\, v^2$$

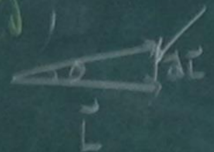
$$\Omega = \frac{d\theta}{dt} = \frac{dL}{L\sin\phi\, dt}$$

$$L\sin\phi\, d\theta = dL$$

$$\Omega =$$



$$\vec{r} \times \vec{F}$$



$$dL \rightarrow \vec{\tau}\, dt$$

$$mgr\sin\phi$$

$$R m v = \left(\tfrac{1}{2}M + m\right) R^2 \omega$$

$$\omega = \frac{m}{\tfrac{1}{2}M + m}\, v$$

$$K_i - K_f = \tfrac{1}{2} m v^2 - \tfrac{1}{2} I \omega^2 = \tfrac{1}{2} m v^2 - \tfrac{1}{2}\left(\tfrac{1}{2}M + m\right) R^2 \omega^2$$

$$m\frac{v^2}{r} = G\frac{Mm}{r^2} \Rightarrow v^2 = G\frac{M}{r}$$

$$T^2 = \frac{4\pi}{GM} r^3$$

$$\frac{2\pi r}{v} = T \rightarrow v = \frac{2\pi r}{T} \qquad \frac{4\pi r^2}{T^2} = G\frac{M}{r^2}$$

t

ϕ

$R^2\omega^2$