Physics 201 - Lecture 26

① Welcome to guests!

② Test on $\boxed{\text{Friday}}$

→ A4, A5, A6

→ 3 questions

→ In addition to "calculations", there will also be boxes that you will write in, to provide explanations and also to test concepts.

I will grade these by hand

③ Rotational Motion and Assignment?

Question 1:

$$\begin{cases} \boxed{\alpha} = 2.5\ rad/s^2 \\ \boxed{\Delta\theta} = 200\ rad \\ \boxed{\omega_i} = 0 \\ \omega_f = ? \end{cases}$$

(= 11,459 degrees,

("from rest")

a) $\omega_f^2 = \cancel{\omega_i^2}^{\,0} + 2\alpha\Delta\theta$

$\omega_f^2 = 2(2.5)(200) = 1000$

$\omega_f = 31.6\ rad/s$

$y = b + mx$

b) $\boxed{\omega_f = \omega_i + \alpha t}$

$\therefore\ t = \dfrac{\omega_f - \cancel{\omega_i}^{\,0}}{\alpha}$

$= \dfrac{31.6}{2.5} = 12.6\ s$

$\alpha.5$

Question 2 :

① $\omega_i = 200 \frac{rev}{min}$

② $\omega_f = 1450 \frac{rev}{min}$

③ $t = 110\ s$

$\alpha = ?$

$\Delta\theta = ?$

→ Seems easy, but we need to convert ω_i, ω_f to rad/s !

$$1 \frac{\cancel{rev}}{\cancel{min}} \times \boxed{\frac{2\pi\ rad}{\cancel{rev}}} \times \boxed{\frac{1\ \cancel{min}}{60\ s}}$$

1 rev = $\boxed{0.1047}$ rad/s

min

$\therefore \quad \omega_i = 200\,(.1047) = \underline{20.9\ \text{rad/s}}$

$\omega_f = 1450\,(.1047) = \underline{151.8\ \text{rad/s}}$

a) $\omega_f = \omega_i + \alpha t$

$$\therefore \quad \alpha = \frac{\omega_f - \omega_i}{t}$$

$$= \frac{151.8 - 20.9}{110}$$

$$\boxed{\alpha = 1.19\ \text{rad/s}^2}$$

$\Delta x = v_i t + \frac{1}{2} a t^2$

b) $\Delta \theta = \omega_i t + \frac{1}{2} \alpha t^2$

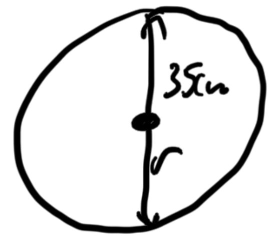
$$= (20.9)(110) + \frac{1}{2}(1.19)(110)^2$$

9105 rad

$\boxed{\Delta\theta = 4441}$

Question 3 :

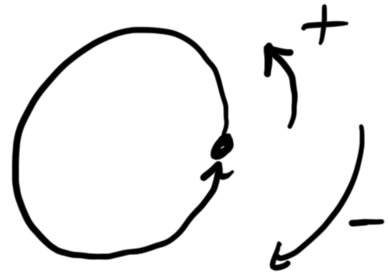
$$r = \frac{0.35\ m}{2} = 0.175\ m$$



$\omega_i = 0$

$\alpha = 7.2\ rad/s^2$

" counterclockwise "



positive

$t = 11\ s$

a) $\Delta\theta = \cancel{\omega_i t}^{\,0} + \frac{1}{2}\alpha t^2$

$= \frac{1}{2}(7.2)(11)^2$

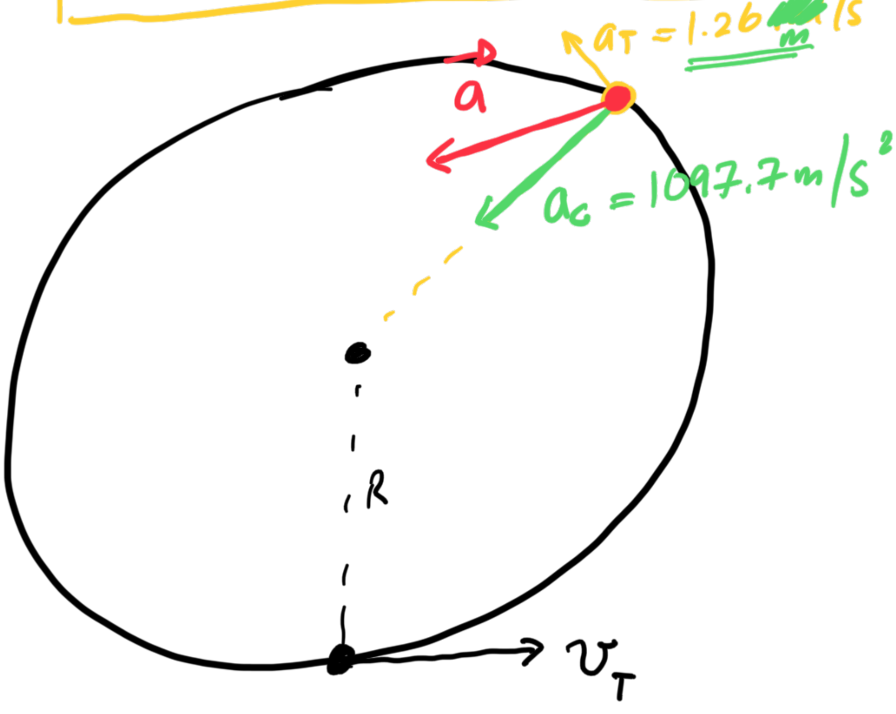
$= 435.6\ rad$

$= 435.6\ rad \times \boxed{\frac{180^\circ}{\pi\ rad}}$

$$\boxed{\Delta\theta = 24{,}958^\circ}$$

b) What is the "linear acceleration"?

$$\boxed{\begin{aligned} a_T &= R \cdot \alpha \\ &= (0.175)(7.2) \\ &= 1.26\ m/s^2 \end{aligned}}$$



$$\boxed{v_T = R \cdot \omega_f}$$

$$\omega_f = \cancel{\omega_i^{\,0}} + \alpha t$$

$$= (7.2)(11) = \boxed{79.2 \text{ rad/s}}$$

$$v_T = R \cdot \omega_f = (0.175)(79.2)$$

$$= \boxed{13.86 \text{ m/s}}$$

$$|\vec{a}_c| = \boxed{\frac{v^2}{R}} = \frac{(13.86)^2}{0.175} = \underline{1097.7} \text{ m/s}$$

$$|\vec{a}| = \sqrt{a_T^2 + a_c^2}$$

$$\boxed{|\vec{a}| = \underline{1097.8} \text{ m/s}^2}$$

Question 4 :

① $\omega_i = 0$

② $\omega_f = 100\,000 \ \frac{rev}{min} \times 0.1047$

$= 10470 \ rad/s$

③ $t = 3.5 \, min \times \frac{60 \, s}{min} = 210 \ s$

a) $\omega_f = \cancel{\omega_i}^{0} + \alpha t$

$\alpha = \frac{\omega_f}{t} = \frac{10470}{210} = 49.9 \ rad/s$

b) $\boxed{a_T = R \cdot \alpha}$

$= (0.06)(49.9) = 2.99 \ m/s$

c) $a_c = \frac{v_f^2}{R} = \frac{(R\,\omega_f)^2}{R} = \frac{\omega_f^2 R^2}{\cancel{R}}$

$\boxed{a_c = \omega_f^2 \cdot R}$

$$a_c = (10470)^2(0.06)$$

$$= \underline{6.58 \times 10^6 \text{ rad/s}^2}$$

(as a multiple of g : divide by 9.8 m/s²)

$$a_c = \frac{6.58 \times 10^6}{9.8} = \underline{\underline{6.71 \times 10^5}}\ g$$

d) $$\underline{\Delta\theta} = \cancel{\omega_i t}^{\,0} + \frac{1}{2}\alpha t^2$$

$$= \frac{1}{2}(49.9)(210)^2$$

$$= \underline{1.100 \times 10^6 \text{ rad}}$$

$$\Delta S = \overset{(.06)}{R} \cdot \Delta\theta$$

$$\boxed{\Delta S = \underline{\underline{66018}} \text{ m}}$$

$$v_T = R \cdot \omega_f$$

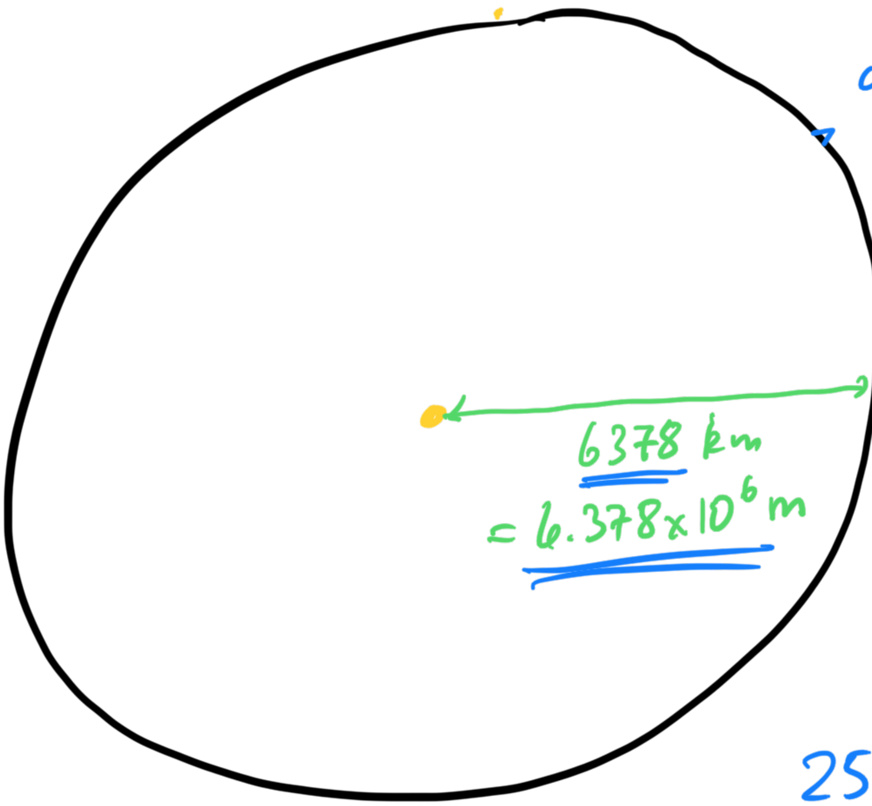
$$a_T = R \cdot \alpha$$

$$\Delta\theta = R \cdot \Delta\theta$$

$$\boxed{a_c = R \cdot \omega_f^2}$$

Question 5:

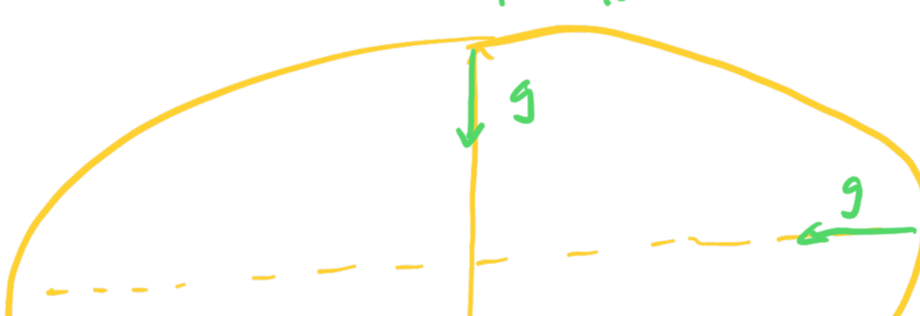
~ 1 part = 1000



254 mi

~ 400 km

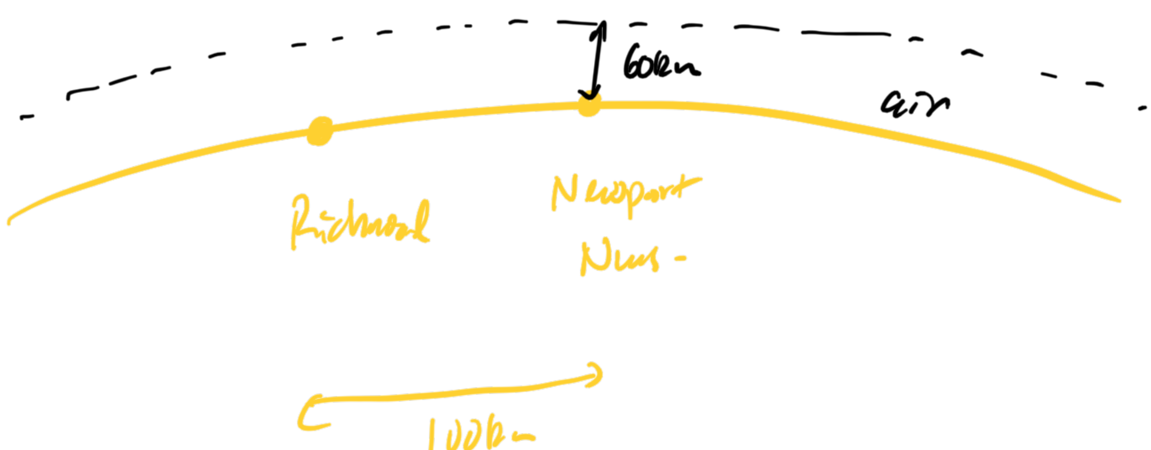
→ earth is not a sphere.

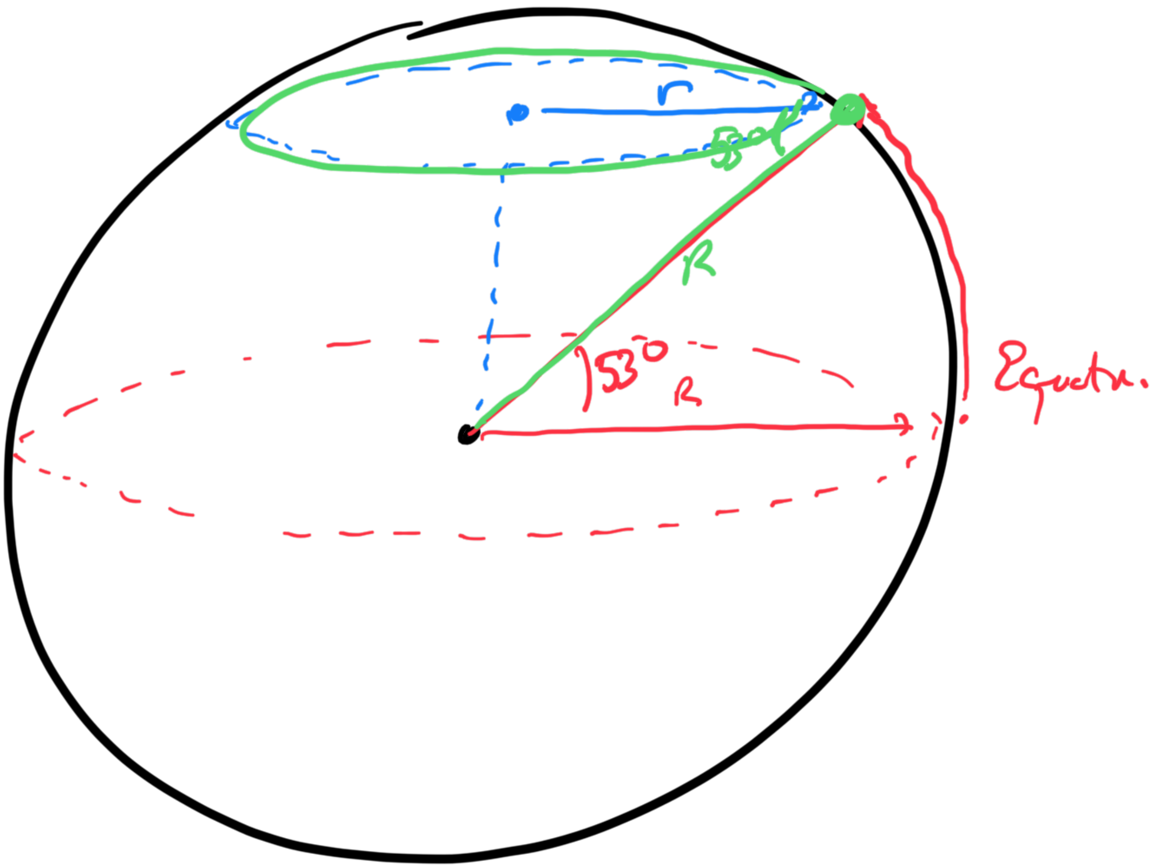


oblate spheroid.

Mt. Everest : 29,032 ft.

~ 9000 m





$R = 6.378 \times 10^{6}$ m

$r = R \cdot \cos 53° = 3.838 \times 10^{6}$ m

pt. rotates around once per day.

$24 \times 60 \times 60$ s $\rightarrow$ 86,400 s

$L = 2\pi r = 2\pi (3.838 \times 10^{6})$

$d = 2\pi$ …

$= 2.412 \times 10^{7}$ m

b) $v_T = \dfrac{d}{t} = \dfrac{2.412 \times 10^{7} \text{ m}}{86{,}400 \text{ s}}$

$= \underline{\underline{279 \text{ m/s}}}$

$\boxed{v_T = r \cdot \omega_f}$

a) $\omega_f = \dfrac{v_T}{r} = \underline{7.27 \times 10^{-5} \text{ rad/s}}$

$= \dfrac{2\pi \text{ rad}}{\text{day}}$

Constant

$\dfrac{2\pi \text{ rad}}{86{,}400 \text{ s}}$

$v_T = 92$

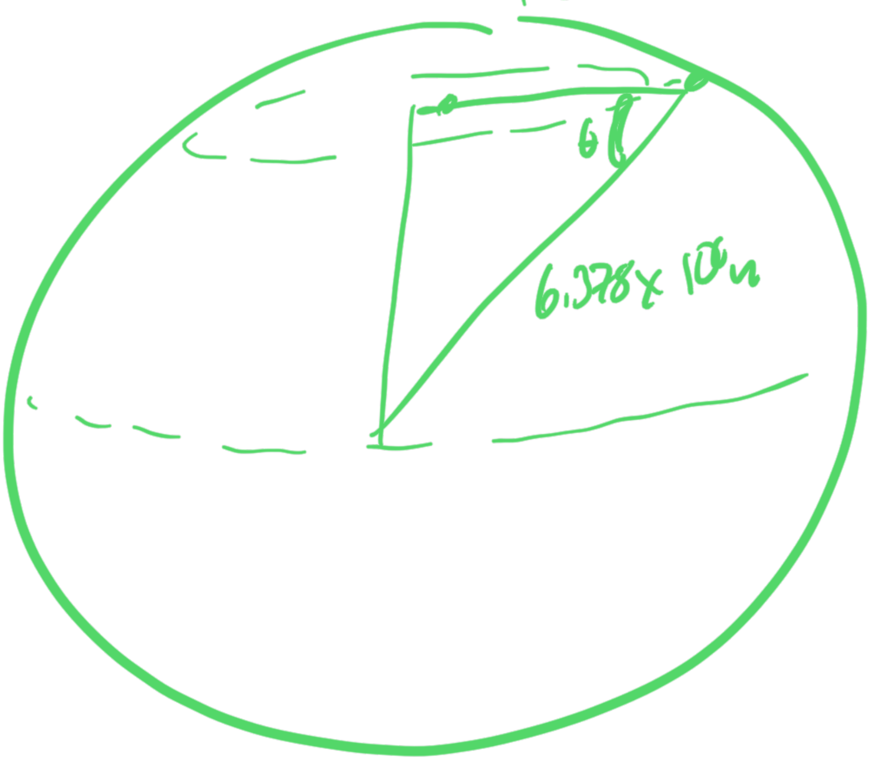
$\omega_f = 7.27 \times 10^{-5}$ rad/s

$\omega_f = \ldots$

$$v_T = R \cdot \omega_f$$

$$R = \frac{v_T}{\omega_f} = \boxed{\frac{92}{7.27 \times 10^{-5}}}$$

$$= 1.265 \times 10^{6} \text{ m}$$



$$R_{earth} \cdot \cos(\theta) = R$$

$$\cos(\theta) = \frac{R}{R_{earth}}$$

$$= \frac{1.265 \times 10^{6}}{6.378 \times 10^{6}}$$

$$\cos(\theta) = 0.1983$$

$$\theta = 78.56^{\circ}$$