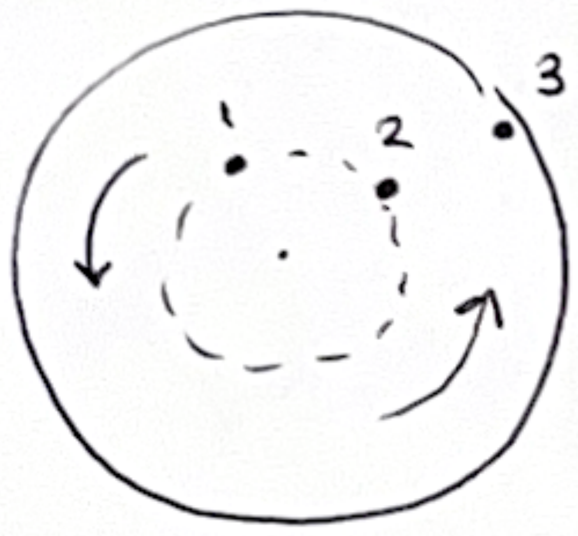
Ch4 p.105 #13, p.106 #24,25,27

(13)



a) $\boxed{\omega_1 = \omega_2 = \omega_3}$

The angular velocity is the rate of charge of angular position. During a certain time interval, each point would rotate through the same angle. Therefore all their angular velocities are equal.

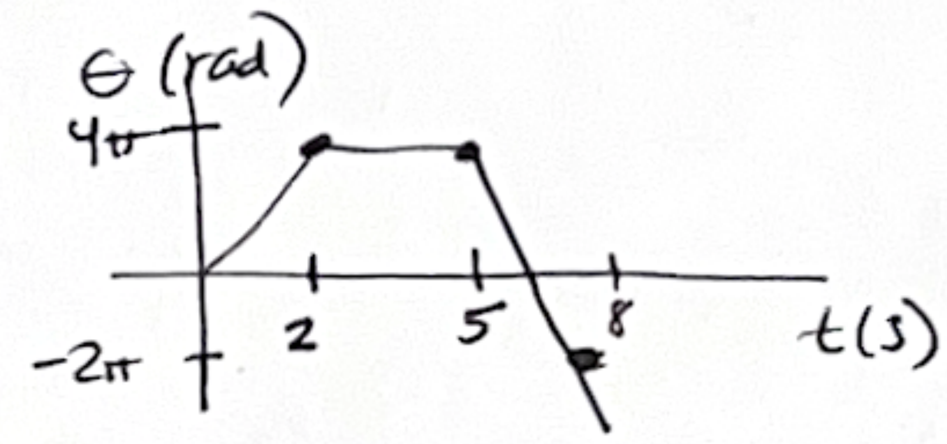
b) Rank the tangential speeds.

Tangential speed ~~is a~~ linear distance per unit time.
Since points 1 and 2 are the same distance from the center, they will travel the same arc length ~~, so~~ in time Δt, so they have the same linear speed. $v_1 = v_2$

But point 3 would travel a greater arc length during the same Δt, so it must have a greater tangential speed.

Thus, $\boxed{v_1 = v_2 < v_3}$

(24)



Find angular velocity at ~~t=1s~~ t=1s, t=4s, t=7s

a) t=1s

$\omega = \frac{\Delta\theta}{\Delta t}$ = slope of θ vs. t graph

$= \frac{+4\pi \text{ rad}}{2\text{ s}}$

$= \boxed{2\pi \text{ rad/s}}$

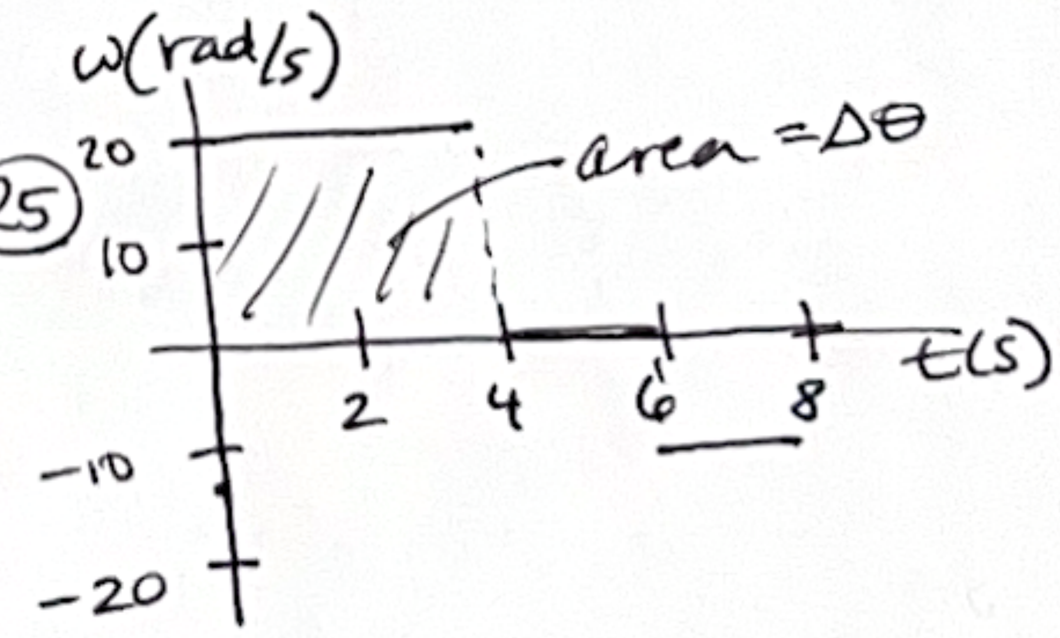
b) t = 4s

$\omega = \frac{\Delta\theta}{\Delta t} = \boxed{0 \text{ rad/s}}$

c) t=7s

$\omega = \frac{\Delta\theta}{\Delta t} = \frac{-6\pi \text{ rad}}{3\text{ s}} = \boxed{-2\pi \frac{\text{rad}}{\text{s}}}$

(25)



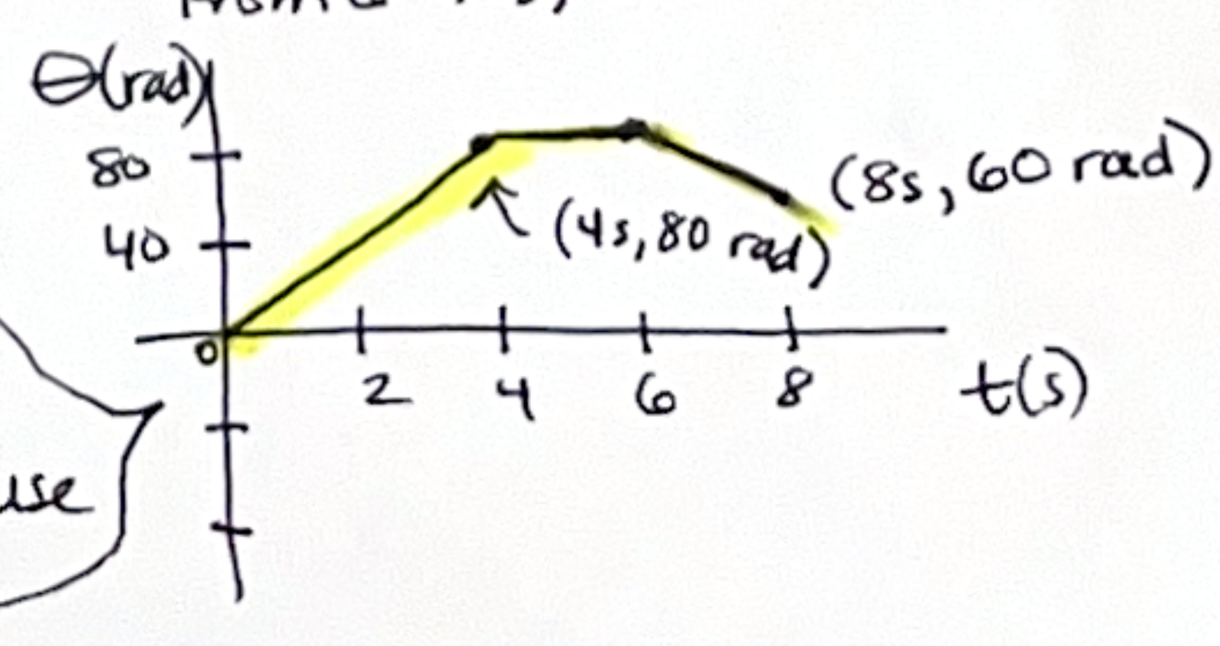
$\omega = \frac{\Delta\theta}{\Delta t}$

area of ω vs t graph is angular displacement, Δθ.

From 0 → 4s, Δθ = area = $(20 \text{ rad/s})(4\text{s})$ = 80 rad

From 4 → 6s, Δθ = area = 0 rad

From 6 → 8s, Δθ = area = $(-10 \text{ rad/s})(2\text{s})$ = −20 rad



You could start at any θ_i on your graph because we don't know θ_i

27) $\omega = 45\,rpm$

a) Find ω in rad/s

$\omega = 45 \frac{\cancel{rev}}{\cancel{min}} \left(\frac{2\pi\, rad}{1\,\cancel{rev}}\right)\left(\frac{1\,\cancel{min}}{60s}\right)$

$= \boxed{4.7\ rad/s}$

This is unit conversions!
You are converting time from minutes to seconds
You are converting angular position from revolutions to radians (1 rev = 2π rad)

b) Find the period of the motion

Period, T, is the time for one rotation, so it is the time for 1 revolution or for 2π radians. There are many ways to get the period

- If it moves 4.7 radians every second, then the time it takes to rotate 1 radian is $\frac{1}{4.7}s = 0.213s$

  then the time to rotate 2π radians is $2\pi(0.213s) = \boxed{1.3s}$

- If it rotates 45 rev in one minute, that means it rotates $\frac{45\,rev}{60s} = 0.75\,rev/s$,

  and the inverse (reciprocal) of this is the seconds per revolution, which is the period, so $T = \frac{1}{0.75\,rev/s} = 1.3\ s/rev = \boxed{1.3s}$

revolutions is similar to radians in that it isn't really a unit, so you can write it when needed to indicate something, or leave it out when something else is carrying the meaning.