Physics 201 - Lecture 11

1. A3
2. Uniform Circular Motion
3. #10, #12

A1, A2, A3

3 questions (10 pts. each)

a) 2 (5)

b) 2 (5)

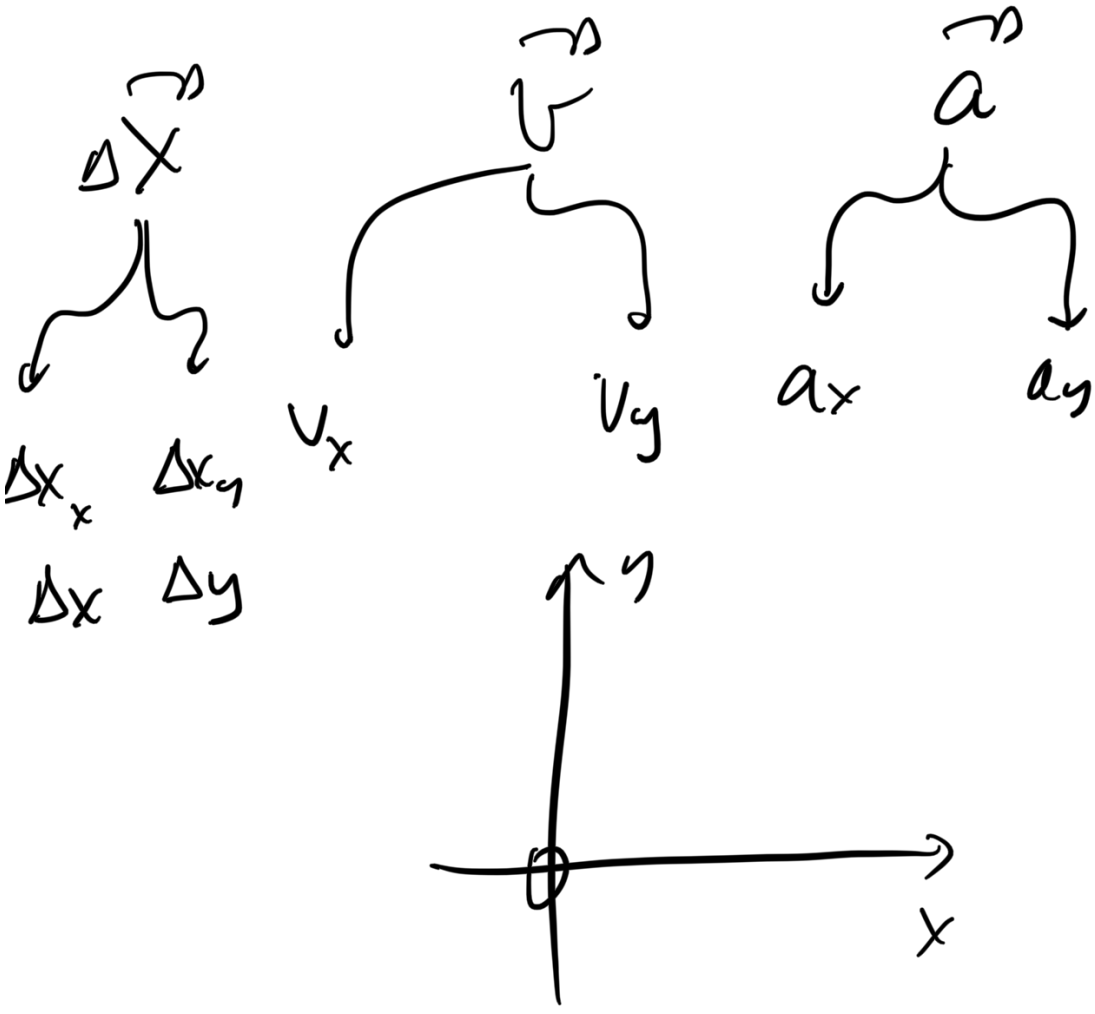
c) 2 (5)

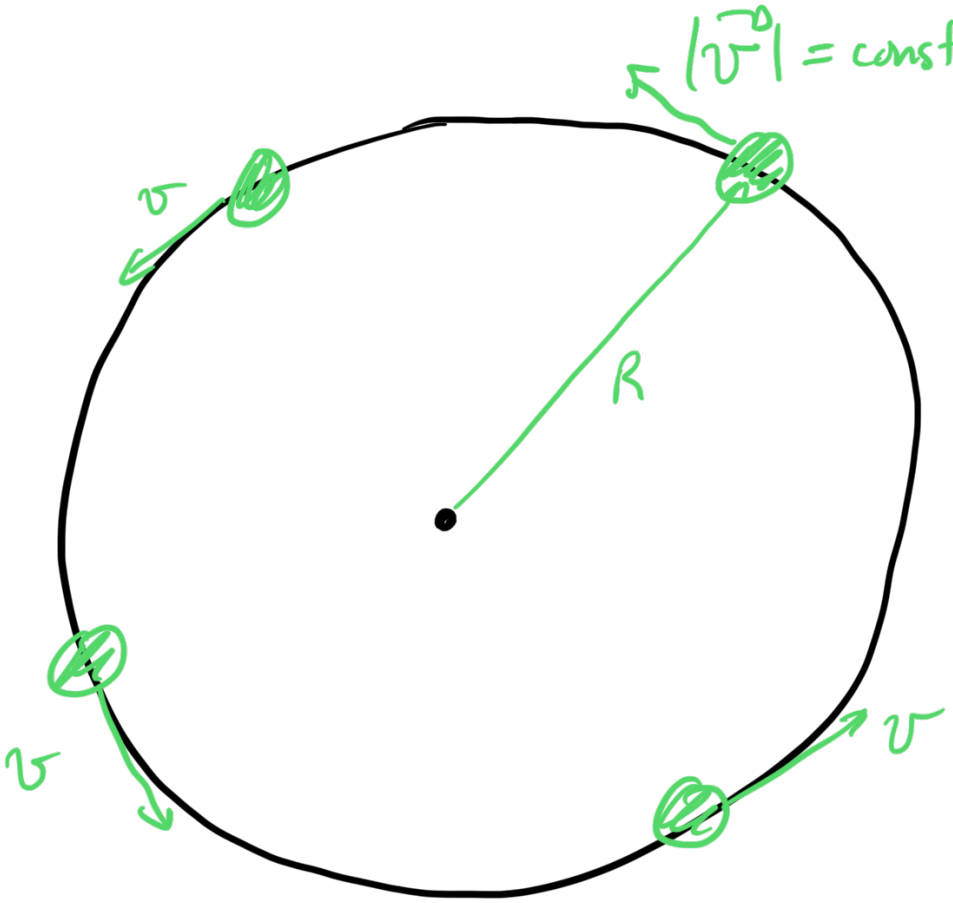
d) 2 (5)

e) 2

5 attempts

Uniform Circular Motion.





Question: Is the acceleration zero?

- constant speed.

NO!

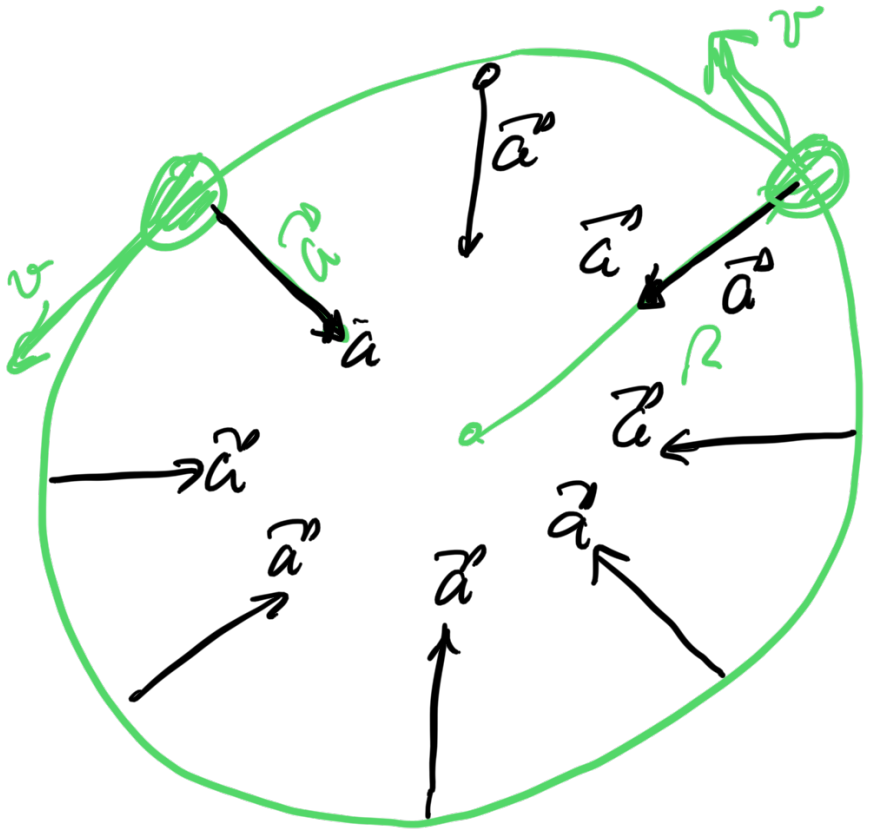
$$\vec{a} = \frac{d\vec{v}}{}$$

$\frac{d\vec{v}}{dt}$

$|\vec{v}|$ = constant

direction is not.

$\vec{v}$ is not constant



What is the acceleration?

$\vec{a}$ → size
→ direction.

→ Calculus !

$$|\vec{a}| = \frac{v^2}{R}$$

towards the center of the circle.

Uniform Circular Motion.

velocity

$|\vec{v}| = v$

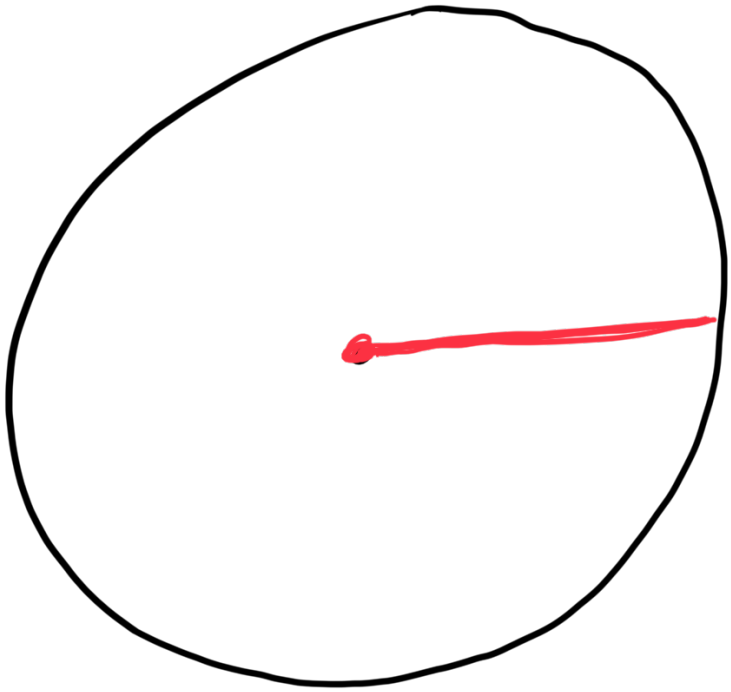
tangential to the circle.

acceleration

$$|\vec{a}| = \frac{v^2}{R}$$

towards the center.

#11



17 rev/s

$$17 \frac{\text{rev}}{\text{s}} \cdot \times 27\ \text{s}$$

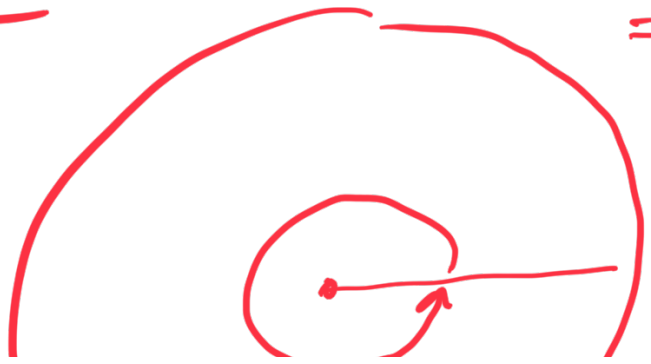
$$= 459 \text{ revolutions.}$$

radians.

1 revolution

$= 360°$

$= 2\pi$ radia

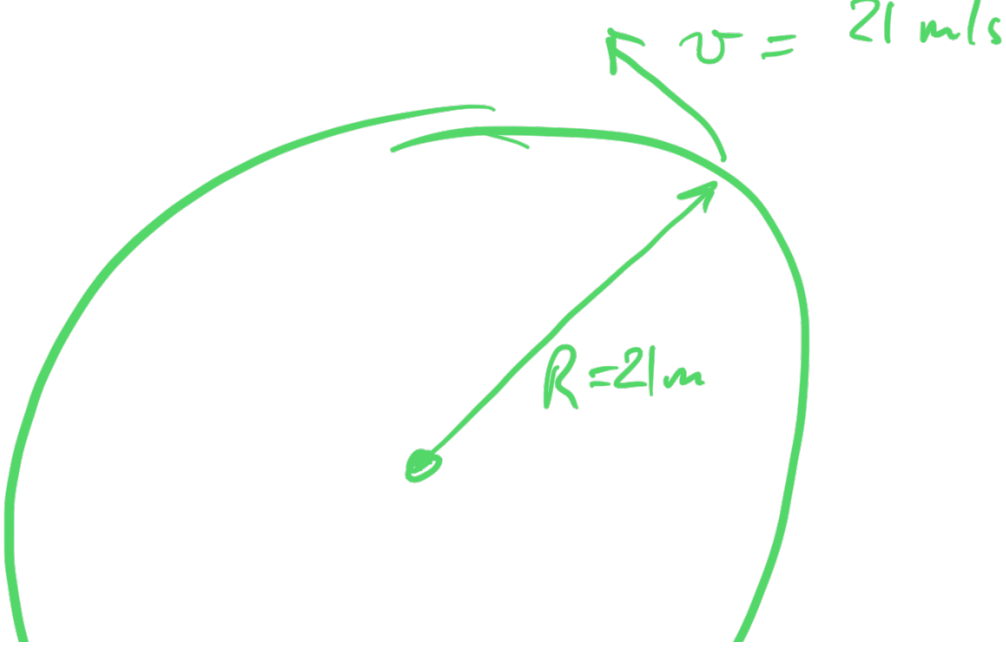


π radians = 180°

2π rad x 459 revolutions

$\Delta\theta = 2884$ rad

↑ angular displacement



$$|\vec{a}| = \frac{v^2}{R} = \frac{(21)^2}{21}$$

$$= 21 \text{ m/s}^2$$

2D Motion (A3)

① Projectile Motion

X	Y
$a_x = 0$	$a_y = -g$
$V_{ix} = ?$	$V_{iy} = ?$
$\Delta x = ?$	$\Delta y = ?$

$t \longleftrightarrow t$

② Relative Motion.

A B, C

3 reference frames ...

$$\vec{v}_{A/B} = \vec{v}_{A/C} + \vec{v}_{C/B}$$

$$\vec{v}_{A/B} = -\vec{v}_{B/A}$$

③ Uniform Circular Motion.

$|\vec{v}| = v$, radius R

$|\vec{a}| = \frac{v^2}{R}$ towards the center

A2 → Motion in 1D with constant acceleration.

5 unknowns $v_i, v_f, a, t, \Delta x$

① $v_f = v_i + at$

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

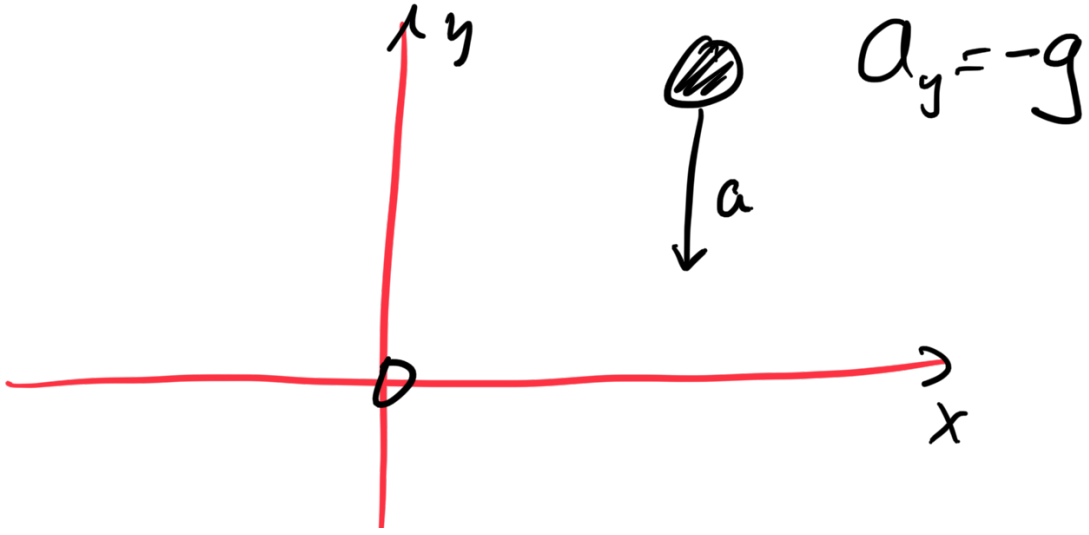
③ $\Delta x = v_f t - \frac{1}{2} a t^2$

④ $\Delta x = \left(\frac{v_i + v_f}{2} \right) t$

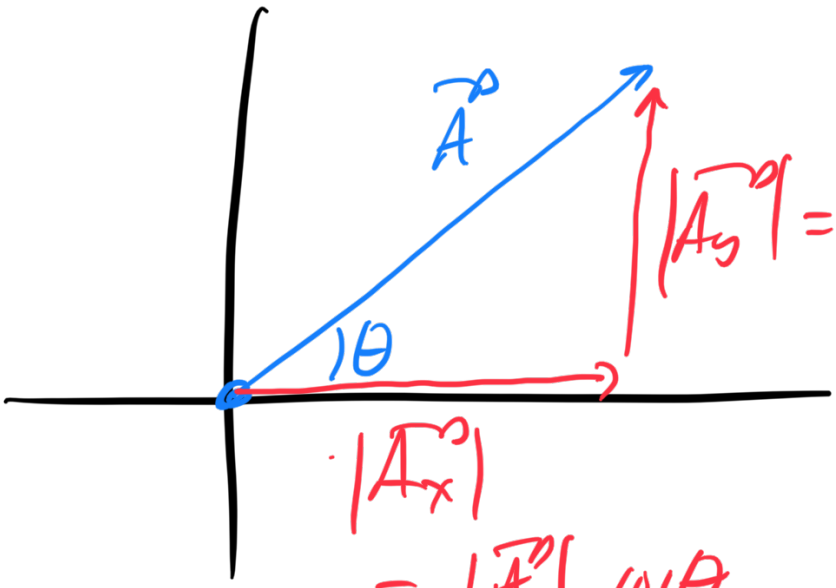
⑤ $v_f^2 = v_i^2 + 2a\Delta x$

Identify (3) unknowns.

Solve for the other two.



A1. Vectors. (x, y, z)



instantaneous

- position $\vec{x}(t)$
- velocity $\vec{v}(t) = \frac{d\vec{x}}{dt}$
- acceleration $\vec{a}(t) = \frac{d\vec{v}}{dt}$

$\Delta\vec{x} = \vec{x}_f - \vec{x}_i$

displacement. $\Delta \vec{x}$

over a time interval. (t_f, t_i)

average velocity

$$\vec{v}_{avg} = \frac{\Delta \vec{x}}{\Delta t}$$

average speed

$$S_{avg} \equiv \frac{\text{Total Distance}}{\text{Total Time}}.$$