Uniform Circular Motion: WS 1

1) a. i. False: velocity is a vector quantity, so as the direction changes, velocity changes

ii. False; $\vec{a}$ is vector

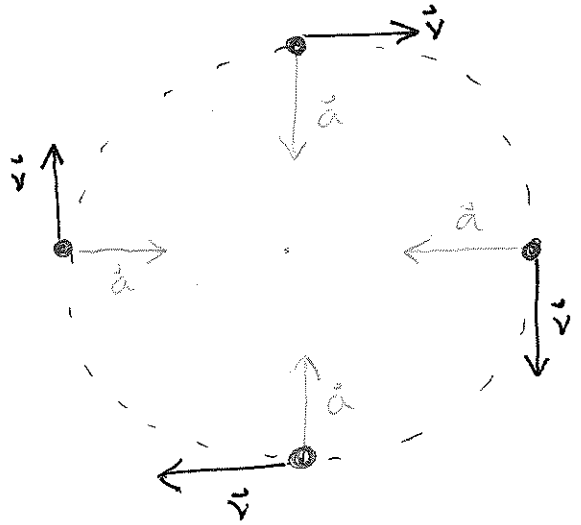
iii. False: The acceleration is not zero, the mass is not zero $\Rightarrow \sum \vec{F} = m\vec{a} \neq 0$

iv. False: $\vec{v}$ and $\vec{a}$ are $\perp$.

v. False: T is constant if v is constant

vi. True: $a = \frac{v^2}{r}$; speed is constant, radius is constant

b.



i. North
ii. East
iii. South
iv. West
v. South
vi. West

c. const speed so...

i. $v = \frac{d}{t} = \frac{2\pi r}{t} = \frac{2\pi r}{3.14s}$

$v = 4.0\ m/s$

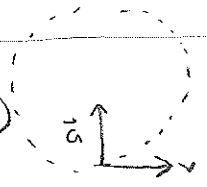
ii. $a = \frac{v^2}{r}$

$v = \sqrt{ar} = \sqrt{(8.0\ m/s^2)(2.0\ m)}$

$v = 4.0\ m/s$

2) $\frac{(m/s)^2}{m} = \frac{m^2/s^2}{m} = \frac{m^2}{ms^2} = m/s^2$ which is appropriate for acceleration

OR $\frac{(L/T)^2}{L} = \frac{L^2/T^2}{L} = \frac{L^2}{LT^2} = \frac{L}{T^2}$ " " " "

3) 

a. $a = \frac{v^2}{r} = \frac{(8.0\ m/s)^2}{16m} = 4.0\ m/s^2$; $\vec{a} = 4.0\ m/s^2$ east

b. $\vec{a} = 4.0\ m/s^2$ south

c. $\sum \vec{F} = m\vec{a} = 4.0 \times 10^3\ N$ west

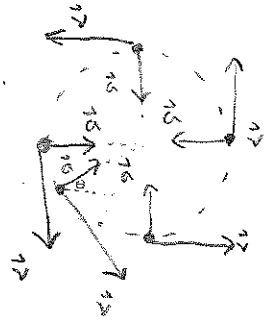
(4) a. $f = 30\frac{1}{min} \times \frac{1\,min}{60\,s} = 0.500\frac{1}{s} = 0.500\,Hz$

b. $T = \frac{1}{f} = 2.00\,s$

c. $v = \frac{d}{t} = \frac{C}{T} = \frac{2\pi r}{T} \Rightarrow r = \frac{vT}{2\pi} = 0.0200\,m$ (2.00 cm)

d. $a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2} = 0.2\ m/s^2$

(5) a. $a = \frac{v^2}{r} \Rightarrow v = \sqrt{ar} = \sqrt{4.5\ m/s^2 (200\,m)} = \sqrt{900\ m^2/s^2} = 30.0\ m/s$

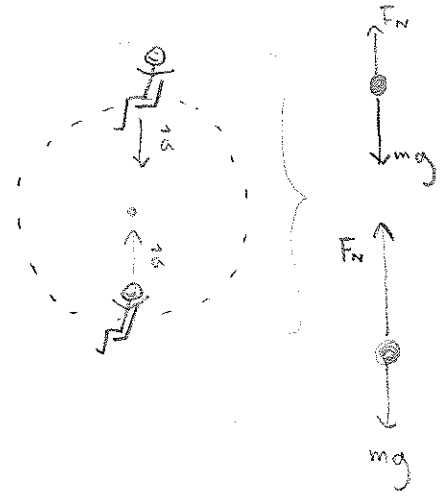


b. $4.50\ m/s^2$ south

c. $4.50\ m/s^2$ north

d. $4.50\ m/s^2$ [30.0° North of East]

6.



a. 100 N down

b. $2\ m/s^2$ down

c. 600 N up

d. $4.0\ m/s$

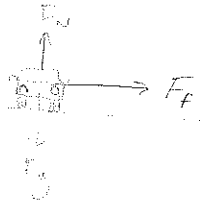
(7) $v = 72\ km/h = 20\ m/s$

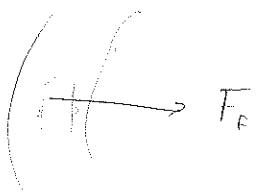
$\sum \vec{F} = m\vec{a}$

$F_f = \frac{mv^2}{r}$

$\mu F_N = \frac{mv^2}{r}$

$\mu mg = \frac{mv^2}{r}$





$\mu = \frac{v^2}{rg} = \frac{20^2}{80(10)} = 0.5$

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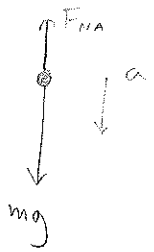
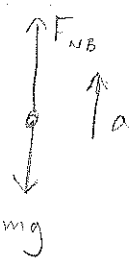
(8) o. i. equal to
ii. less than
iii. equal to

(9) A.





$a_A = a_B$

$mg - F_{NA} = ma_A$ $\qquad$ $F_{NB} - mg = ma_B$

$mg - F_{NA} = F_{NB} - mg$

$F_{NB} = 2mg - F_{NA}$

$F_{NB} = 19\,600 - 8800$

$\vec{F}_{NB} = 10\,800\ N$ up

(10) Same turntable $\Rightarrow$ same T (or f)

$r_2 = 2r_1 \quad \therefore \quad a_2 = 2a_1$

$a_2 = 2.0\ m/s^2$

$a = \frac{v^2}{r} = \frac{\left(\frac{2\pi r}{T}\right)^2}{r} = \frac{\frac{4\pi^2 r^2}{T^2}}{r} = \frac{4\pi^2 r}{T^2}$

$\Rightarrow \quad a \propto r \quad$ (if T is constant)

(11) same speed, $a = \frac{v^2}{r} \Rightarrow a \propto \frac{1}{r}$

$r_2 = 2r_1$

$\Rightarrow a_2 = \frac{1}{2} a_1$ $\quad a_2 = 5.00\ m/s^2$

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(12) same turntable $\Rightarrow$ same T

$v = \frac{2\pi r}{T} \Rightarrow v \propto r$

$r_2 = 2r_1$

$v_2 = 2v_1$

$v_2 = 2.0\ m/s$