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p113f09 | **Section 3**
Due Thr, Nov 5, 2009 at 08:00 | Set 9
Physics 113: General Physics I | CAPA ID 9556

1. [2pt] A turntable rotates at 33 rev/min. Calculate the angular velocity of the turntable.

2. [2pt] A particle on the turntable is located 0.16 m from the center of the rotating turntable. What is the speed of the particle?

3. [2pt] The flywheel of a steam engine begins to rotate from rest with a constant angular acceleration of 1.45 rad/s^2. It accelerates for 30.7 s, then maintains a constant angular velocity. Calculate the total angle through which the wheel has turned 66.1 s after it begins rotating.

4. [2pt] The flywheel of a steam engine runs with a constant angular speed of 167 rev/min. When steam is shut off, the friction of the bearings and the air brings the wheel to rest in 1.9 h. What is the magnitude of the constant angular acceleration of the wheel?

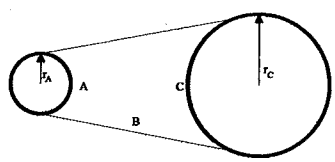
5. [2pt] How many rotations does the wheel make before coming to rest?

6. [2pt] A Ferris wheel rotates at an angular velocity of $0.291 rad/s$. Starting from rest, it reaches its operating speed with an average angular acceleration of $0.0289 rad/s^2$. How long does it take the wheel to come up to operating speed?

7. [2pt] A gymnast is performing a floor routine. In a tumbling run she spins through the air, increasing her angular velocity from 2.84 to $5.06 rev/s$ while rotating through one-half of a revolution. How much time does this maneuver take?

8. [2pt] A dentist causes the bit of a high-speed drill to accelerate from an angular speed of $1.23 \times 10^4 rad/s$ to an angular speed of $3.01 \times 10^4 rad/s$. In the process, the bit turns through $1.75 \times 10^4 rad$. Assuming a constant angular acceleration, how long would it take the bit to reach its maximum speed of $7.77 \times 10^4 rad/s$, starting from rest?

9. [2pt] Wheel A of radius $r_a = 9.3\ cm$ is coupled by belt B to wheel C of radius $r_c = 34.8\ cm$. Wheel A increases its angular speed from rest at time $t = 0\ s$ at a uniform rate of 7.2 rad/s^2. At what time will wheel C reach a rotational speed of 135.9 rev/min, assuming the belt does not slip?



10. [2pt] During normal operation, a computer's hard disk spins at 5400 rpm. If it takes the hard disk 8.0 s to reach this angular velocity starting from rest, what is the average angular acceleration of the hard disk in rad/s^2?

11. [2pt] A ceiling fan has two different angular speed settings: $\omega_1 = 460$ revolutions per minute and $\omega_2 = 112$ revolutions per minute. What is the ratio a_1/a_2 of the centripetal accelerations of a given point on a fan blade?

12. [2pt] A bicycle with 52.80 cm diameter wheels is traveling at 15.00 km/hr. At what angular speed do the wheels turn?

13. [3pt] How much time is required for a wheel to complete one revolution?

14. [2pt] Suppose you are riding a stationary exercise bicycle, and the electronic meter indicates that the wheel is rotating at $9.57 rad/s$. The wheel has a radius of $0.472m$. If you ride the bike for $34.5 min$, how far would you have gone if the bike could move?

15. [3pt] A ball of radius $0.194m$ rolls along a horizontal table top with a constant linear speed of $3.62 m/s$. The ball rolls off the edge and falls a vertical distance of $2.20m$ before hitting the floor. What is the angular displacement of the ball while it is in the air?

16. [2pt] A train is rounding a circular curve whose radius is $2.11 \times 10^2 m$. At one instant, the train has an angular acceleration of $1.55 \times 10^{-3} rad/s^2$ and an angular speed of $0.0539 rad/s$. Find the magnitude of the centripetal acceleration of the train.

17. [2pt] Find the magnitude of the total acceleration (centripetal plus tangential) of the train.

18. [2pt] Two people start at the same place and walk around a circular lake in opposite directions. One has an angular speed of $1.58 \times 10^{-3} rad/s$, while the other has an angular speed of $3.45 \times 10^{-3} rad/s$. How long will it be before they meet?

19. [2pt] The front and rear sprockets on a bicycle have radii of 8.76 and $5.50 cm$, respectively. The angular speed of the front sprocket is $9.68 rad/s$. Calculate the linear speed (in cm/s) of the chain as it moves between the sprockets.

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General Physics HW 9

① Given:

$\omega = 33$ rev/min

$$\omega = \left(\frac{33\,\text{rev}}{\text{min}}\right)\left(\frac{2\pi\,\text{rad}}{\text{rev}}\right)\left(\frac{1\,\text{min}}{60\,\text{s}}\right)$$

$\omega =$

② $r = 0.16\,\text{m}$

$\boxed{V = r\omega}$ remember ω must be in rad/s.

③ Given:

$\alpha_1 = 1.45\,\text{rad/s}^2 \quad \alpha_2 = 0\,\text{rad/s}^2$

$\Delta t_1 = 30.7\,\text{s}$

$\Delta t_{tot} = 66.1\,\text{s}$

for the first period of time

$\theta_i = 0$

$\theta_f = ?$

$\omega_i = 0$

$\omega_f = ?$

$\alpha = \alpha_1$

$\Delta t = \Delta t_1$

$$\theta_f = \theta_i + \omega_i \Delta t + \frac{1}{2}\alpha \Delta t^2$$

$$\theta_f = \frac{1}{2}\alpha_1 \Delta t_1^2$$

$$\omega_f = \omega_i + \alpha \Delta t$$

$$\omega_f = \alpha_1 \Delta t_1$$

for the second part

$\theta_i = \frac{1}{2}\alpha_1 \Delta t_1^2$

$\theta_f = ?$

$\omega_i = \alpha_1 \Delta t_1$

$\Delta t_2 = \Delta t_{tot} - \Delta t_1$

$\alpha = 0$

$$\theta_f = \theta_i + \omega_i \Delta t + \frac{1}{2}\alpha \Delta t^2$$

$$\theta_f = \frac{1}{2}\alpha_1 \Delta t_1^2 + \alpha_1 \Delta t_1 (\Delta t_{tot} - \Delta t_1)$$

$$\theta_f = \frac{1}{2}\alpha_1 \Delta t_1^2 + \alpha_1 \Delta t_1 \Delta t_{tot} - \alpha_1 \Delta t_1^2$$

$$\boxed{\theta_f = \alpha_1 \Delta t_1 \left(\Delta t_{tot} - \frac{1}{2}\Delta t_1\right)}$$

(4) Given,

$\omega_i = 167$ rev/min → convert to rad/s

$\omega_f = 0$

$\Delta t = 1.9$ hr → convert to ~~rad/s~~ s

$\omega_f = \omega_i + \alpha \Delta t$

$\alpha = \frac{\omega_f - \omega_i}{\Delta t} = \boxed{\frac{-\omega_i}{\Delta t}}$

(5) $\theta_f = \theta_i + \frac{1}{2}(\omega_i + \omega_f)\Delta t$

$\boxed{\theta_f = \frac{1}{2}\omega_i \Delta t}$

(6) Given: $\omega_f = 0.291$ rad/s

$\omega_0 = 0$

$\alpha = 0.0289$ rad/s^2

$\omega_f = \omega_i + \alpha \Delta t$

$\Delta t = \frac{\omega_f - \omega_i}{\alpha} = \boxed{\frac{\omega_f}{\alpha}}$

(7) Given: $\omega_i = 2.84$ rev/s

$\omega_f = 5.06$ rev/s

$\theta_f = 1/2$ rev

$\theta_i = 0$

$\theta_f = \theta_i + \frac{1}{2}(\omega_i + \omega_f)\Delta t$

$\boxed{\Delta t = \frac{2(\theta_f - \theta_i)}{\omega_i + \omega_f}}$

(8) Given: First

$\omega_i = 1.23 \times 10^4$ rad/s

$\omega_f = 3.01 \times 10^4$ rad/s

$\theta_i = 0$

$\theta_{f1} = 1.75 \times 0^4$ rads

find α

$\omega_f^2 = \omega_i^2 + 2\alpha(\theta_f - \theta_i)$

$\alpha = \dfrac{\omega_f^2 - \omega_i^2}{2\theta_f}$

Second

$\theta_i = 0$

$\theta_f = ?$

$\omega_0 = 0$

$\omega_{f2} = 7.77 \times 10^4$ rad/s

$\alpha = \dfrac{\omega_f^2 - \omega_i^2}{2\theta_{f1}}$

$\omega_{f2} = \omega_0 + \alpha \Delta t$

$\Delta t = \dfrac{\omega_{f2}}{\alpha} = \boxed{\dfrac{2\omega_{f2}\theta_{f1}}{\omega_f^2 - \omega_i^2}}$

(9) Given: $r_a = 9.3$ cm $r_c = 34.8$ cm

(10) Given

$\omega_i = 0$

$\omega_f = 5400 \text{ rpm}$ Beware units $5400 \text{ rpm}\left(\frac{2\pi \text{ rad}}{\text{rev}}\right)\left(\frac{1 \text{ min}}{60 \text{ s}}\right) =$

$\Delta t = 8.0 \text{ s}$

$\omega_f = \omega_i + \alpha \Delta t$

$\alpha = \frac{\omega_f - \omega_i}{\Delta t}$ ($\omega_i \to 0$)

$$\boxed{\alpha = \frac{\omega_f}{\Delta t}}$$

(11) Given

$\omega_1 = 460 \text{ rev/min}$

$\omega_2 = 112 \text{ rev/min}$

$a_c = R\omega^2$

$$\frac{a_1}{a_2} = \frac{R\omega_1^2}{R\omega_2^2} = \boxed{\frac{\omega_1^2}{\omega_2^2}}$$

(12) Given

$D = 52.8 \text{ cm}$ beware the units!

$v = 15.0 \text{ km/hr}$

$$\omega = \frac{V}{R} = \frac{V}{(D/2)} = \boxed{\frac{2V}{D}}$$

(13) $$T = \frac{2\pi}{\omega} = \frac{2\pi}{(2V/D)} = \boxed{\frac{\pi D}{V}}$$

14 Given:

$\omega = 9.57 \text{ rad/s}$
$R = 0.472 \text{ m}$
$\Delta t = 34.5 \text{ min}$
} Beware units

$v = R\omega$

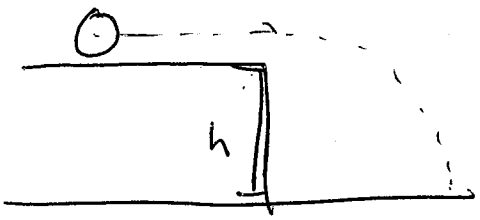
$v_{ave} = \frac{\Delta x}{\Delta t}$

$\Delta x = v\Delta t = \boxed{R\omega\Delta t}$

15 $R = 0.194$

$v_{roll} = 3.62 \text{ m/s}$

$h = 2.20 \text{ m}$



$\omega = \frac{v_{roll}}{R}$

Given
$\theta_i = 0$
$\theta_f = ?$
$\omega = \frac{v_{roll}}{R}$
$\alpha = 0$
$\Delta t = ?$

$\theta_f = \theta_i + \omega\Delta t + \frac{1}{2}\cancel{\alpha}^{0}\Delta t^2$

$\boxed{\theta_f = \frac{v_{roll}}{R}\sqrt{2gh}}$

Given
$y_i = h$
$y_f = 0$
$v_{iy} = 0$
$a = -g$
$\Delta t = ?$

$y_f = y_i + \cancel{v_{iy}}^{0}\Delta t + \frac{1}{2}at^2$

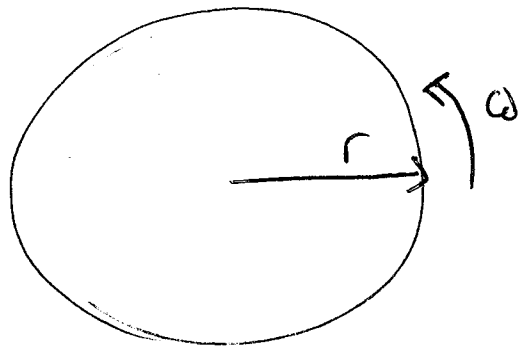
$0 = h - \frac{1}{2}g\Delta t^2$

$\Delta t = \sqrt{2gh}$

16 $R = 2.11 \times 10^{2}\ m$

$\alpha = 1.55 \times 10^{-3}\ rad/s^2$

$\omega = 0.0539\ rad/s$



$$a_c = R\omega^2$$

17 $a_t = R\alpha$

$$a = \sqrt{a_c^2 + a_t^2}$$

$$a = \sqrt{(R\omega^2)^2 + (R\alpha)^2}$$

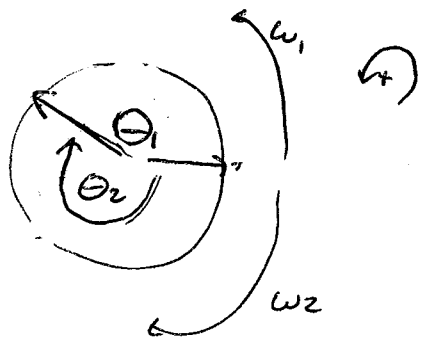
$$a = R\sqrt{\omega^4 + \alpha^2}$$

18

Given

$\omega_1 = 1.58 \times 10^{-3}\ rad/s$

$\omega_2 = 3.45 \times 10^{-3}\ rad/s$



Notice

They move in opposite directions

so

ω_2 and θ_2 must be negative

They meet when

$$\theta_1 - \theta_2 = 360^\circ = 2\pi\ rad$$

$\theta_1 = \omega_1 t$ $\qquad$ $\theta_2 = \omega_2 t$

$$\omega_1 t + \omega_2 t = 2\pi$$

$$(\omega_1 + \omega_2)t = 2\pi$$

$$t = \frac{2\pi}{\omega_1 + \omega_2}$$

(19) Given:

$R_F = 8.76\,cm$

$R_B = 5.50\,cm$

$\omega_F = 9.88\,rad/s$

The chain moves tangentially on the front wheel

so

$$\boxed{V_c = R_F \omega_F}$$