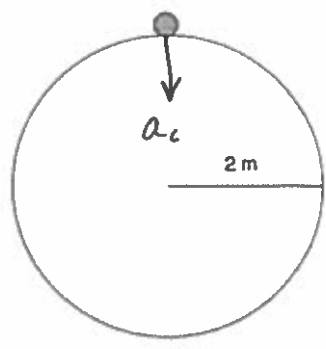


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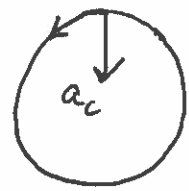
AP Physics 1: 5.4 Frequency and Period (Groups)

- 1) A person runs laps around the track to the right at a pace of 12 seconds/lap.
  - a) What velocity does the person run, in m/s? (1.04 m/s)

$$v = \frac{x}{t} = \frac{2\pi r}{t} = \frac{2\pi(2)}{12} = 1.04 \text{ m/s}$$



- b) The person is running in a counterclockwise direction, sketch a line representing the centripetal acceleration at the point at the top of the track. Label correctly.



- c) How many laps does the person run every minute? (5 laps/min)

$$f = \frac{60}{12} = 5 \frac{\text{laps}}{\text{min}}$$

We call the variable you solved for in part c, frequency. We measure frequency in many different forms, rotations/minute (rpm)(which you did above), rotations/hour, and rotations/second (Hz) and we use the variable  $f$  to denote frequency.

- d) Calculate the frequency in rotations/hour. (300 laps/hr)

$$f = 5 \frac{\text{laps}}{\text{min}} \cdot \frac{60 \text{ min}}{1 \text{ hr}} = 300 \frac{\text{laps}}{\text{hr}}$$

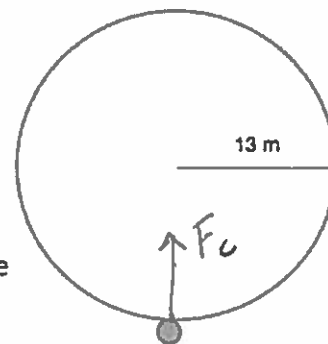
- e) Calculate the frequency in rotations/second (Hz). Hint: This will be a decimal. (0.083 laps/sec)

$$f = \frac{300}{60 \cdot 60} = .083 \frac{\text{laps}}{\text{sec}}$$

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- 2) An object moves around the track to the right at 3 Hz (rotations/second).  
a) Calculate how much time it takes an object to travel around the track once. (.33 sec)

$$\frac{1}{3} = .33 \text{ sec}$$



We call the variable you solved for in part a, period. We normally measure period in seconds and denote period with the variable T.

- b) Create a formula for calculating the period using only frequency.

$$T = \frac{1}{f}$$

- c) Calculate the velocity of the object as it moves around the track, in m/s. (m/s)

$$v = \frac{2\pi(13)}{.33} = \boxed{247.5 \text{ m/s}}$$

- d) Create a formula for switching from frequency to velocity.

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

- e) Sketch and label the centripetal force of the object at the bottom on the track where the point is located.

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- 3) Earth has a radius of  $5.98 \times 10^24$  m. A photon of light has a frequency of 8 Hz around the Earth.

- a) Calculate the velocity of a photon of light. ( $3.01 \times 10^{26}$  m/s)

$$v = \frac{2\pi r}{T} = \frac{2\pi (5.98 \times 10^{24})}{(\frac{1}{8})} = 3.01 \times 10^{26} \text{ m/s}$$

$$T = \frac{1}{f} = \frac{1}{8}$$

- b) Calculate the period of a photon of light. (0.13 sec)

$$T = \frac{1}{8} = .13 \text{ sec}$$

- c) As the photon travels around the Earth two forces act on it. Name the two forces and explain in what direction they are pointed.

gravitational pull (weight) and Centripetal Force  
both directed towards the center of the  
earth.

- 4) Explain what frequency is in your own words so anyone could understand.

How many rotations an object has every  
second.

- 5) Explain what period is in your own words so anyone could understand.

How much time it takes to complete  
one rotation.

- 6) Explain what centripetal acceleration is in your own words so anyone could understand.

acceleration towards the center of a circle  
when turning.

- 7) Explain what centripetal force is in your own words so anyone could understand.

a Force directed towards the center of  
a circle when turning.