Physics 3210

Week 6 clicker questions

In central-force motion, the areal velocity is a constant $= \dfrac{\ell}{2\mu}$

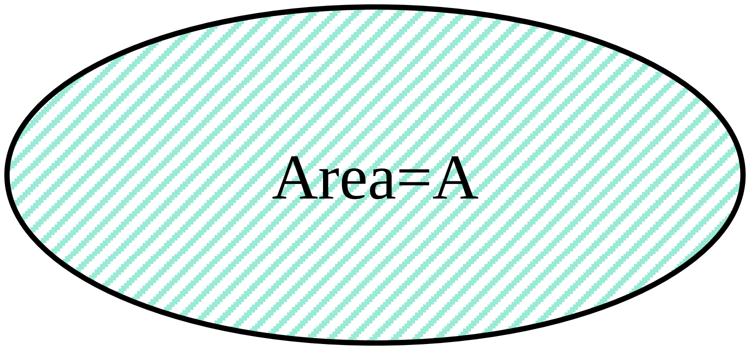
What is the period τ of an elliptical orbit with area A?

A. $\tau = \dfrac{\ell}{\mu} A$

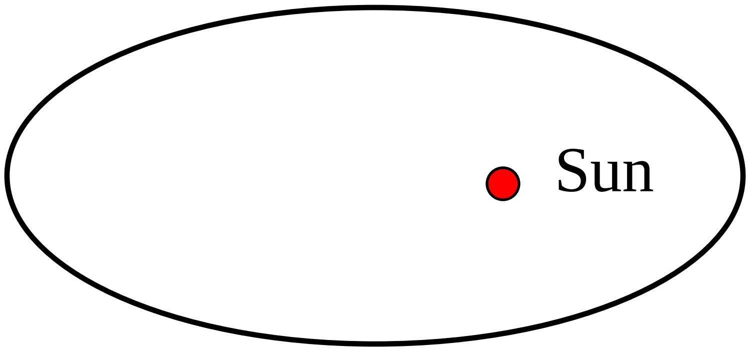
B. $\tau = \dfrac{\ell}{2\mu} A$

C. $\tau = \dfrac{\mu}{\ell} A$

D. $\tau = \dfrac{2\mu}{\ell} A$



Kepler's First Law states that planets move in elliptical orbits with the sun at one focus.



Why is the sun at one focus of the orbit? Because...

A. Otherwise the planets wouldn't all be in the same orbital plane.

B. In two-body central-force motion one mass is always at the focus on the orbit.

C. In two-body central-force motion the center of mass is always at the focus of the orbit, and the center of mass position is approximately given by the position of the sun.

D. The moon is at the other focus.

A system of n particles is described by the masses and positions of each particle: $m_\alpha, \mathbf{r}_\alpha$ $\quad M = \sum_\alpha m_\alpha$

What is the position of the center of mass **R** of the system?

A. $\mathbf{R} = \frac{1}{M} \sum_\alpha \mathbf{r}_\alpha$

B. $\mathbf{R} = \frac{1}{M} \sum_\alpha m_\alpha$

C. $\mathbf{R} = \sum_\alpha m_\alpha \mathbf{r}_\alpha$

D. $\mathbf{R} = \sum_\alpha M \mathbf{r}_\alpha$

E. $\mathbf{R} = \frac{1}{M} \sum_\alpha m_\alpha \mathbf{r}_\alpha$

Consider particles α and β, and the internal force $\mathbf{f}_{\alpha\beta}$=the force on particle α due to particle β.

How does Newton's third law relate the internal forces?

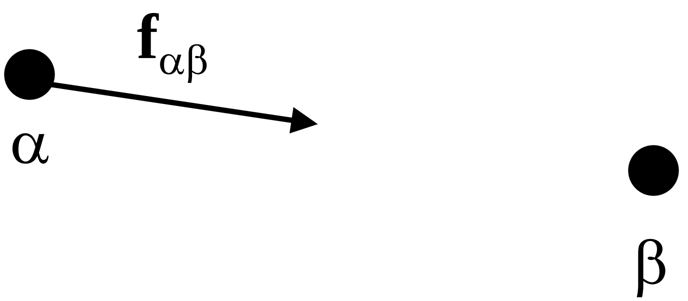
A. $\mathbf{f}_{\alpha\beta} = \mathbf{f}_{\beta\alpha}$

B. $\mathbf{f}_{\alpha\beta} = -\mathbf{f}_{\beta\alpha}$

C. $\mathbf{f}_{\alpha\beta} = -\mathbf{f}_{\alpha\beta}$

D. $\mathbf{f}_{\alpha\beta} = \mathbf{f}_{\beta\alpha} = 0$

E. $\mathbf{f}_{\alpha\beta} + \mathbf{f}_{\beta\alpha} = 1$



Suppose a system of particles experiences only internal forces (no external forces).

What can you say about the momentum of the system?

A. Nothing – having no external forces doesn’t determine the momentum of the system.

B. The momentum of each particle is constant.

C. The momentum of some (but not all) of the particles is constant.

D. The momentum of the center of mass of the system is constant.

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Wednesday clicker questions

A chain with length b and mass density ρ is initially attached at both ends. One end of the chain is cut. After this falling end has moved down a distance x, what is the mass of the right (falling) side of the chain?

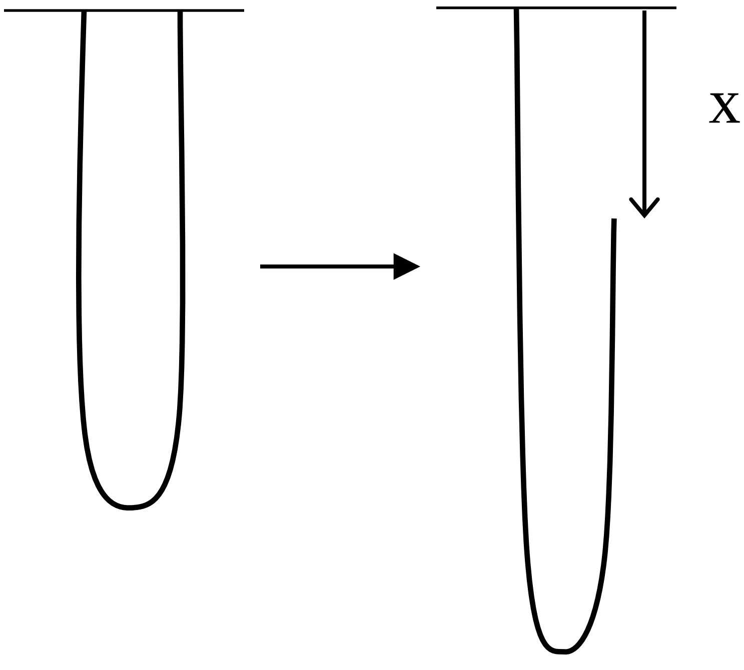
A. $m_{right} = \frac{\rho}{2}(b - x)$

B. $m_{right} = \frac{\rho}{2}(b + x)$

C. $m_{right} = \rho(b + x)$

D. $m_{right} = \rho(b - x)$

E. $m_{right} = \rho b$



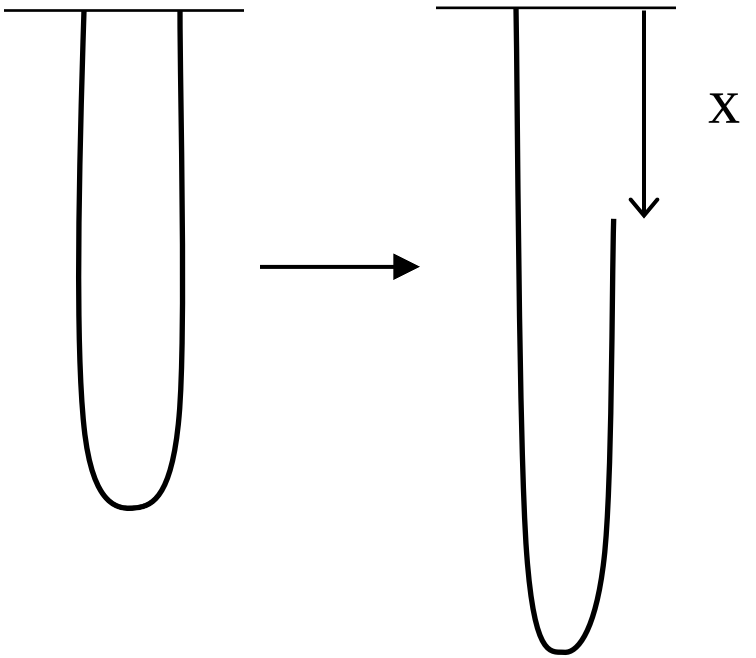
A chain with length b and mass density ρ is initially attached at both ends. One end of the chain is cut; the other end of the chain experiences a tension T. As the chain falls, what is the total external force on the chain (in the x direction)?

A. $F = T$

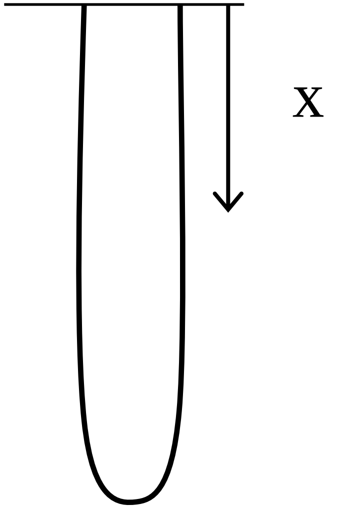
B. $F = Mg$

C. $F = Mg + T$

D. $F = Mg - T$



A chain with length b and mass density ρ is initially attached at both ends. The height is measured by x (increasing down) and the potential energy is zero at the attachment point. What is the total potential energy of the chain?



A. $U = -\rho g b$

B. $U = \rho g b$

C. $U = \frac{-\rho g b^2}{2}$

D. $U = \frac{\rho g b^2}{2}$

E. $U = \frac{-\rho g b^2}{4}$

A system of n particles is described by the masses and positions of each particle, relative to the center of mass: $m_\alpha, \mathbf{r}'_\alpha$

What can you say about the quantity $\sum_\alpha m_\alpha \mathbf{r}'_\alpha$?

A. $\sum_\alpha m_\alpha \mathbf{r}'_\alpha = 0$

B. $\sum_\alpha m_\alpha \mathbf{r}'_\alpha > 0$

C. $\sum_\alpha m_\alpha \mathbf{r}'_\alpha < 0$

D. $\sum_\alpha m_\alpha \mathbf{r}'_\alpha = \text{the position of the CM}$

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Friday clicker questions

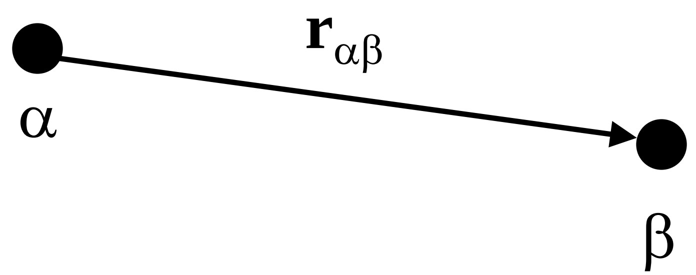
Consider particles α and β; the internal force $\mathbf{f}_{\alpha\beta}$=the force on particle α due to particle β; the position vector $\mathbf{r}_{\alpha\beta}$= the vector from particle α to particle β. If the force between the two particles is central, what can you say about $\mathbf{r}_{\alpha\beta}\times\mathbf{f}_{\alpha\beta}$?

A. Nothing.

B. $\mathbf{r}_{\beta\alpha}\times\mathbf{f}_{\alpha\beta} > 0$

C. $\mathbf{r}_{\beta\alpha}\times\mathbf{f}_{\alpha\beta} = 0$

D. $\mathbf{r}_{\beta\alpha}\times\mathbf{f}_{\alpha\beta} < 0$



A system of n particles is described by the masses and positions of each particle, relative to the center of mass: $m_\alpha, \mathbf{r}'_\alpha$

The squared velocity of each particle is therefore

$$v^2_\alpha = \dot{\mathbf{r}}'^2_\alpha + 2\dot{\mathbf{r}}'_\alpha \cdot \dot{\mathbf{R}} + \dot{\mathbf{R}}^2 = v'^2_\alpha + 2\dot{\mathbf{r}}'_\alpha \cdot \dot{\mathbf{R}} + V^2$$

What is the total kinetic energy of the system?

A. $T = \frac{1}{2}\sum_\alpha m_\alpha v'^2_\alpha + \frac{1}{2}\sum_\alpha m_\alpha v'_\alpha V + \frac{1}{2}MV^2$

B. $T = \frac{1}{2}\sum_\alpha m_\alpha v'^2_\alpha + \sum_\alpha m_\alpha v'_\alpha V + \frac{1}{2}MV^2$

C. $T = \frac{1}{2}\sum_\alpha m_\alpha v'^2_\alpha + \frac{1}{2}MV^2$

D. $T = \frac{1}{2}\sum_\alpha m_\alpha \left(v'_\alpha + V\right)^2$

The work done in unwrapping a rope from a cylinder is given by

$$W = \int_0^{R\theta} \rho g \left[x - R\sin\left(\frac{x}{R}\right) \right] dx$$

What is the total work done?

A. $W = \rho g R \left(\frac{\theta^2}{2} + \cos\theta - 1 \right)$

B. $W = \rho g R^2 \left(\frac{\theta^2}{2} + \cos\theta - 1 \right)$

C. $W = \rho g R^2 \left(\frac{\theta^2}{2} + \cos\theta \right)$

D. $W = \rho g R^2 \left(\frac{\theta^2}{2} + \frac{\cos\theta}{R} - 1 \right)$

What is the total kinetic energy of the rope-cylinder system?

A. $T = \frac{1}{2}\rho R(2\pi - \theta)R^2\dot{\theta}^2 + \frac{1}{2}MR^2\dot{\theta}^2$

B. $T = \frac{1}{2}\rho R(2\pi - \theta)R\dot{\theta}^2 + \frac{1}{2}MR\dot{\theta}^2$

C. $T = \frac{1}{2}(m + M)R\dot{\theta}^2$

D. $T = \frac{1}{2}(m + M)R^2\dot{\theta}^2$