Physics 3210

Week 7 clicker questions

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

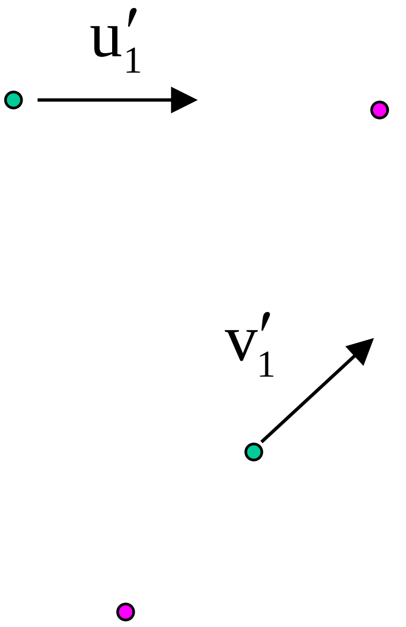
By combining momentum and energy conservation in the center-of-mass frame, what can you conclude about the initial and final speeds of particle 1?

A. nothing

B. $u_1' < v_1'$

C. $u_1' = v_1'$

D. $u_1' > v_1'$



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Wednesday clicker questions

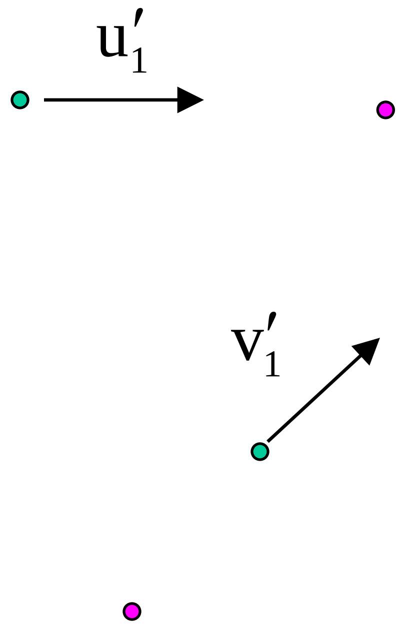
By combining momentum and energy conservation in the center-of-mass frame, what can you conclude about the initial and final speeds of particle 1?

A. nothing

B. $u_1' < v_1'$

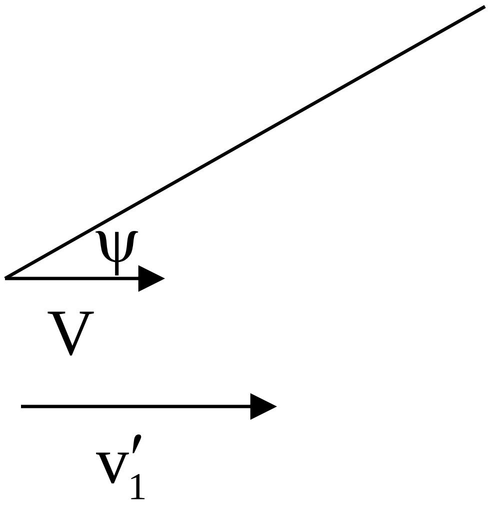
C. $u_1' = v_1'$

D. $u_1' > v_1'$



Suppose we know ψ, V, and v'_1(magnitude, but not direction) and that $V<v'_1$.

Note that the direction of the initial and final velocities are not known. How many CM scattering angles are possible?



A. It can’t be determined.

B. None.

C. 1.

D. 2.

E. 3.

Suppose we know ψ, V, and v'_1 (magnitude, not direction), and that $V > v'_1$.

Note that the direction of the initial and final velocities are not known. How many CM scattering angles are possible?

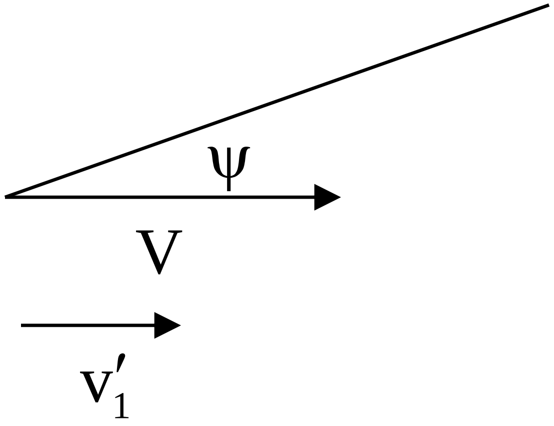
A. It can't be determined.

B. None.

C. 1.

D. 2.

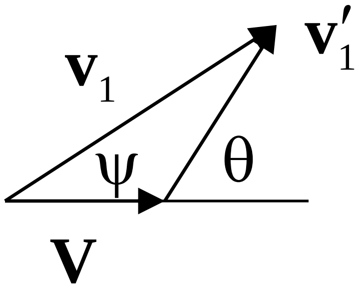
E. 3.



We derived that if $m_1=m_2$, then

$$\tan\psi = \tan\frac{\theta}{2}$$

What does this imply about the maximum scattering angle in the lab frame?



A. nothing

B. $\psi_{max} = \pi$

C. $\psi_{max} = \frac{\pi}{2}$

D. $\psi_{max} = \frac{\pi}{4}$

E. $\psi_{max} = 0$

What are the CM kinetic energies of particles 1 and 2 after the collision, in the limit $m_1 << m_2$?

A. $T_1' = T_0; \quad T_2' = T_0$

B. $T_1' = \frac{1}{2} T_0; \quad T_2' = \frac{1}{2} T_0$

C. $T_1' = 0; \quad T_2' = T_0$

D. $T_1' = T_0; \quad T_2' = 0$

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Friday clicker questions

What are the lab frame kinetic energies of particles 1 and 2 after the collision, in the limit $m_1=m_2$?

A. $\frac{T_1}{T_0}=\cos^2\psi;\qquad \frac{T_2}{T_0}=\sin^2\psi$

B. $\frac{T_1}{T_0}=\sin^2\psi;\qquad \frac{T_2}{T_0}=\cos^2\psi$

C. $\frac{T_1}{T_0}=\cos^2\psi;\qquad \frac{T_2}{T_0}=1$

D. $\frac{T_1}{T_0}=\sin^2\psi;\qquad \frac{T_2}{T_0}=1$

In a homework problem, you derived that a comet scattering off the sun undergoes a deflection

$$\tan\frac{\theta}{2} = \frac{k}{mv_0^2 b}$$

What happens to the scattering angle if gravity is repulsive instead of attractive?

A. The angle increases.

B. The angle decreases.

C. The angle stays the same.

D. The magnitude of the angle stays the same, but its sign changes.

E. The change in the angle depends on the mass of the comet.

What is the integral of the solid angle increment $d\Omega = \sin\theta \, d\theta \, d\varphi$ all possible solid angles (that is, over the surface of a sphere)?

A. $\int d\Omega = 0$

B. $\int d\Omega = 2$

C. $\int d\Omega = 2\pi$

D. $\int d\Omega = 4$

E. $\int d\Omega = 4\pi$

For a beam with area A and total number of particles N, what is the total number of particles dN that passes through the segment between b and b+db and between φ and φ+dφ?

A. $dN = N\, db\, d\varphi$

B. $dN = N\, b\, db\, d\varphi$

C. $dN = \frac{N}{A}\, db\, d\varphi$

D. $dN = \frac{N}{A}\, b\, db\, d\varphi$

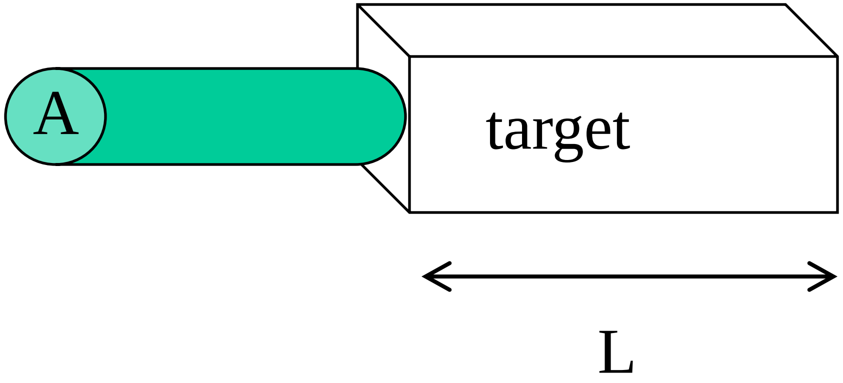
A beam with area A passes through a target of length L and number density of particles n. Assume the target is larger in cross-sectional area than the beam (as sketched). What is the total number of target particles in the beam?

A. AL

B. nL

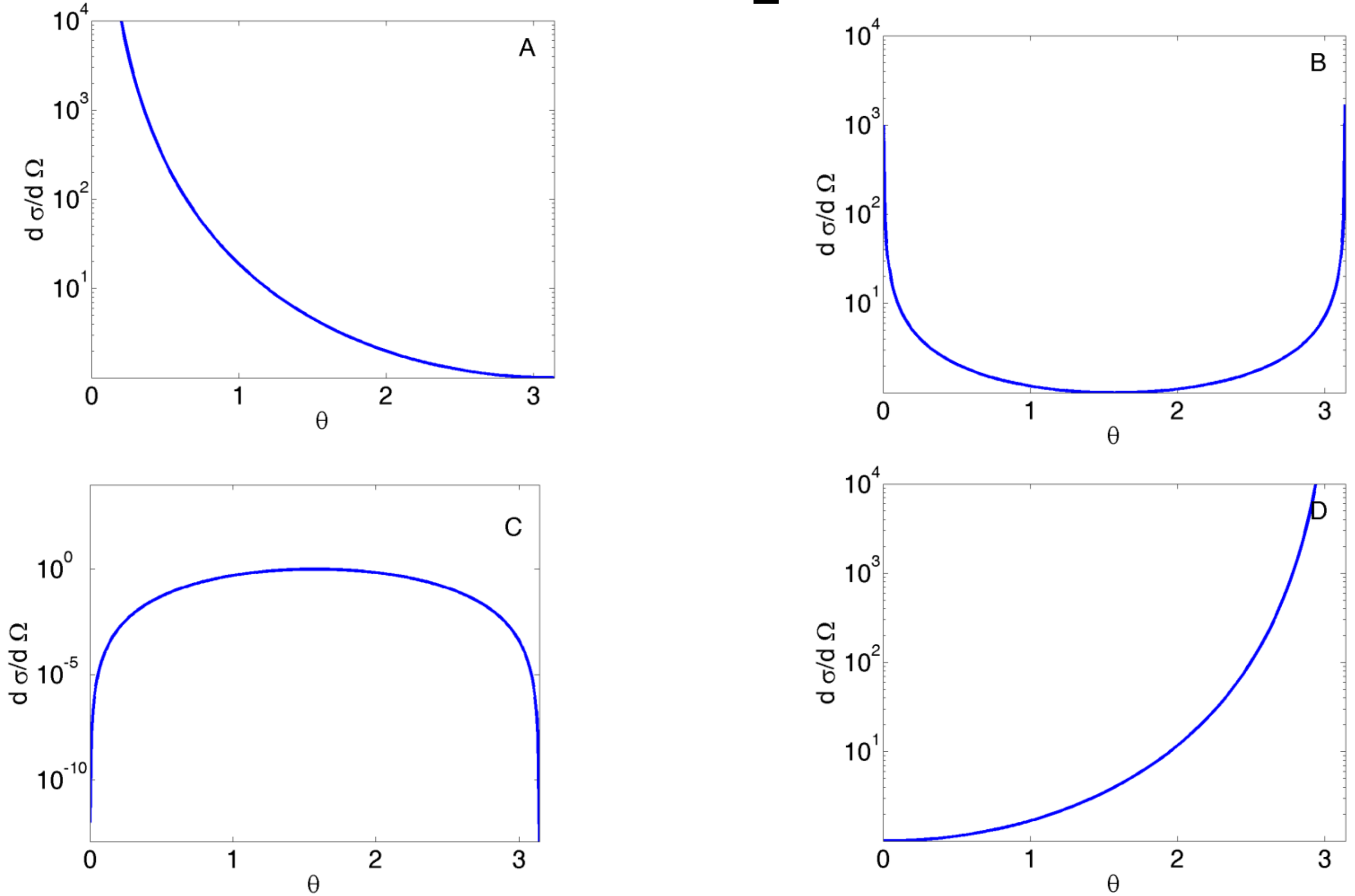
C. nA

D. nAL



Which of the following is a plot of the Rutherford scattering cross section?

$$\frac{d\sigma}{d\Omega} = \frac{q_1^2 q_2^2}{16E^2} \frac{1}{\sin^4 \frac{\theta}{2}}$$



What is the total cross section for Rutherford scattering?

A. $\sigma = \int \frac{d\sigma}{d\Omega} d\Omega = 0$

B. $\sigma = \int \frac{d\sigma}{d\Omega} d\Omega = \infty$

C. $\sigma = \int \frac{d\sigma}{d\Omega} d\Omega = -\infty$