

September 5

Quiz

Momentum

$$\vec{p} = \underset{\uparrow}{\gamma} m \vec{v}, \quad \gamma = \frac{1}{\sqrt{1 - \left(\frac{|\vec{v}|}{c}\right)^2}}$$

$$\uparrow c = 3 \times 10^8 \text{ m/s}$$

γ ?

table 1	calc for	$\frac{ \vec{v} }{c} = 0.25$	$\gamma = 1.03$
" 2	—" —	0.50	$\gamma = 1.15$
3		0.75	$\gamma = 1.51$
4		1.00	$\gamma = ?$
5		1.25	$\gamma = ?$



$|\vec{v}|/c \ll 1$ (or less than ~ 0.5)

Can usually ignore γ

$$\vec{p} \approx m\vec{v}$$

Calculate momentum of electron in TV

$$v \sim 3 \times 10^7 \text{ m/s}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

$$|\vec{p}| = ?$$

$$p = \frac{1}{\sqrt{1-0.1^2}} 9.1 \times 10^{-31} \text{ kg } 3 \times 10^7 \text{ m/s}$$

$$= (1.005) 2.73 \times 10^{-23} \text{ kg m/s}$$

$$= 2.74 \times 10^{-23} \text{ kg m/s}$$

A groups calculate momentum of fast runner
 $70\text{ kg}, 10\text{ m/s}$

B groups calculate momentum of baseball
 $155\text{ g}, 45\text{ m/s}$

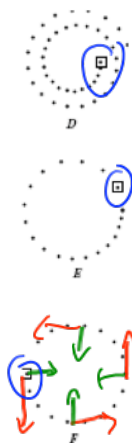
C fastest man-made object
Voyager 1 $\sim 1000\text{ kg}$
 17200 m/s

Momentum Principle

$$\Delta \vec{p} = \vec{F}_{\text{net}} \Delta t \quad \leftarrow \text{memorize}$$

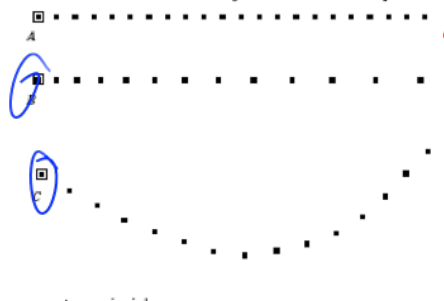
↑ add up all forces to get $\vec{F}_{\text{net}}$

$$\vec{p}_f = \vec{p}_i + \underbrace{\vec{F}_{\text{net}} \Delta t}_{\Delta \vec{p} \text{ impulse}}$$



Newton's first law of motion

RQ 1.6 Moving objects left the traces labelled A - F. The dots were deposited at equal time intervals (for example, one dot each second). Which trajectories show evidence that the moving object was interacting with another object somewhere? In each case the object starts from the square.



← No net force

Momentum Principle $\vec{p}_f = \vec{p}_i + \vec{F}_{\text{net}} \Delta t$

GOAL Protocol

Gather info about problem. How to attack problem (what principles are involved), educated guess about answer,

Organize the information. Write down appropriate principles, definitions
Plan out problem. Write down info that you know, Draw a picture

Analyze Use principles/definitions, Solve for unknowns,
Draw box around the answer

Learn Go back to see if it makes sense
(Correct units, Confirms to educated guess,
why was problem assigned)

3D modeling

most letters Manager

middle recorder

least Skeptre

Lab

least manager

most recorder

middle Skeptre