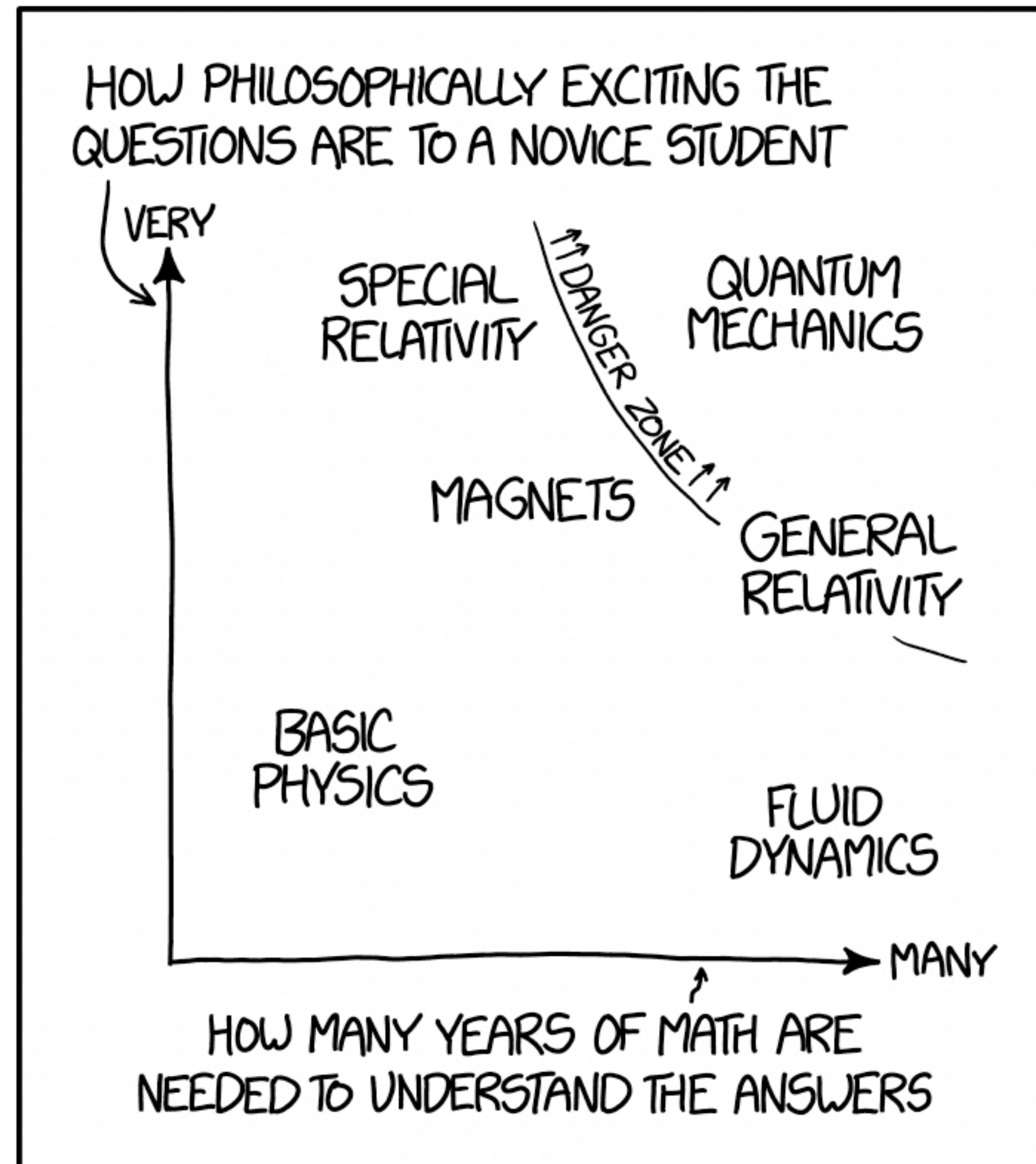


General Physics: Mechanics

PHYS-101(en)
Lecture 14b: Review

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Conceptual question

Which one of the following physical quantities is **not** a *vector*?

~~A.~~ Position

$$\vec{r} = x\hat{x} + y\hat{y} + z\hat{z}$$

$$\vec{r} = \vec{r}(t) = x(t)\hat{x} + y(t)\hat{y} + z(t)\hat{z}$$

~~B.~~ Impulse

$$\vec{I} = \Delta\vec{p} = \vec{p}(t_f) - \vec{p}(t_0) \quad \text{where } t_f > t_0$$

~~C.~~ Torque

$$\vec{\tau} = \vec{r} \times \vec{F}$$

D. Work

$$W = \int_C \vec{F} \cdot d\vec{l}$$

~~E.~~ Displacement

$$\Delta\vec{r} = \vec{r}(t_f) - \vec{r}(t_0)$$

Conceptual question

Which one of the following *scalar* quantities **can** be negative?

A. Mass $m > 0$

B. Moment of inertia $I = \int r^2 dm$

C. Work $W = \int_C \vec{F} \cdot d\vec{l}$

D. Kinetic energy $K = \frac{1}{2}mv^2$

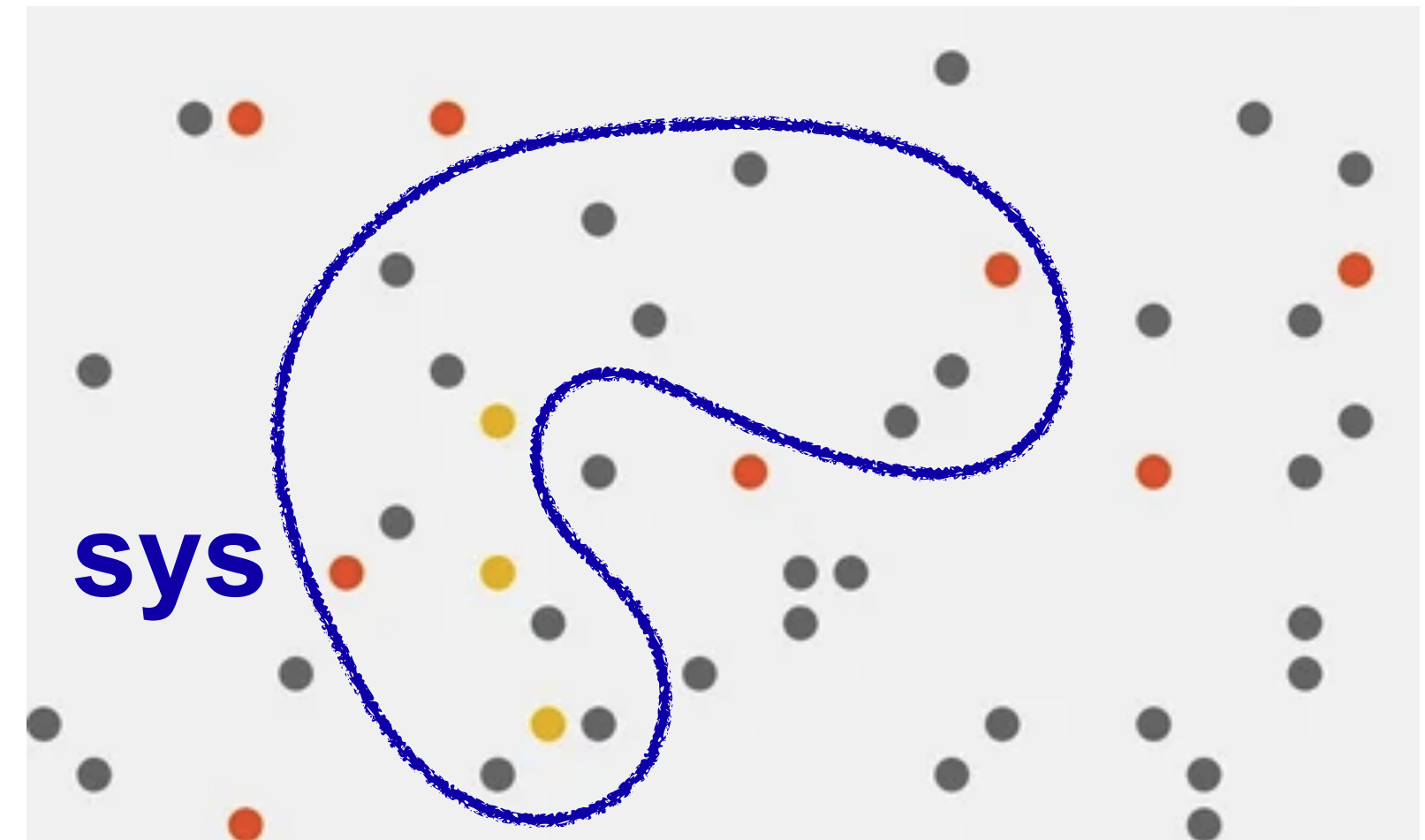
E. Spring constant $k > 0$

$$\vec{F} \cdot d\vec{l} = F dl \cos(\theta) < 0 \quad \text{if} \quad \frac{\pi}{2} < \theta < \frac{3\pi}{2}$$

Conceptual question

The net *force* acting on sys (the physical system on the right) is

- ~~A.~~ The largest force exerted on any point anywhere
- ~~B.~~ The largest force exerted on any point in sys
- ~~C.~~ Zero
- ~~D.~~ The sum of all forces internal to sys } This always zero
- E. The sum of all forces exerted by points **not** in sys on points in sys



(Lecture 6a)

$$\begin{aligned}
 \vec{F}_{net} &= \sum_{i \in sys} \sum_j \vec{F}_{ji} \\
 &= \sum_{i \in sys} \left[\sum_{j \in sys} \vec{F}_{ji} + \sum_{j \notin sys} \vec{F}_{ji} \right] \\
 &= \sum_{i \in sys} \sum_{j \in sys} \vec{F}_{ji} + \sum_{i \in sys} \sum_{j \notin sys} \vec{F}_{ji}
 \end{aligned}$$

Conceptual question

We look at sys from an inertial reference frame and see that $\vec{F}_{net}^{ext} = 0$. There is no matter exchange with the outside. Which one of the following statements is **not** true?

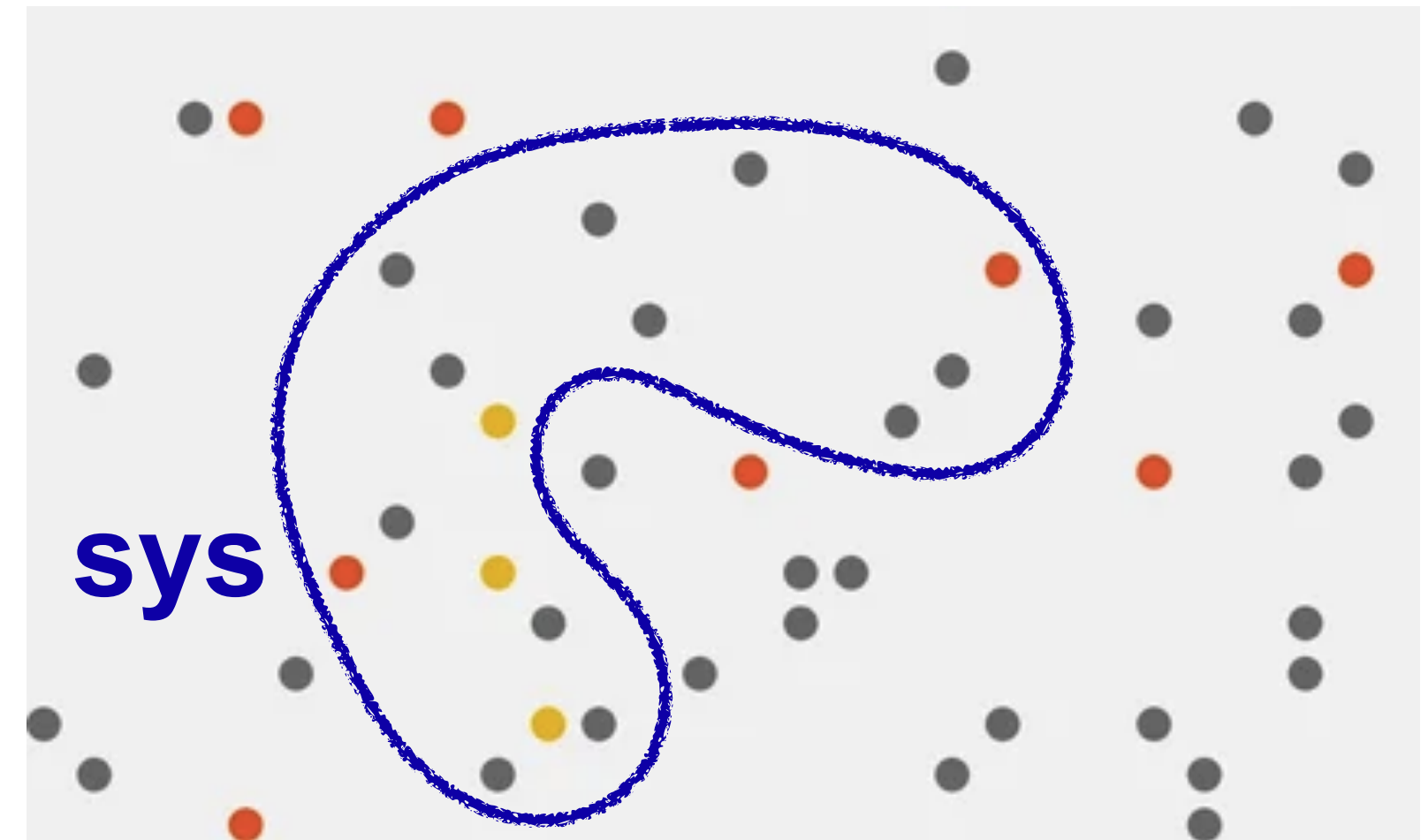
- ~~A.~~ The internal forces add up to zero
- ~~B.~~ The total momentum of sys is conserved
- C. The momentum of each individual particle is guaranteed to stay constant
- ~~D.~~ The position of the center-of-mass (CM) is well defined
- ~~E.~~ The velocity of the CM is constant

Always true by 3rd law

$\Delta \vec{p}_{tot} = 0$ for isolated system

$$\vec{r}_{CM} = \frac{\sum \vec{r}_i \cdot m_i}{\sum m_i}$$

$$0 = \vec{F}_{net}^{ext} = M \vec{A}_{CM} \Rightarrow \vec{A}_{CM} = 0$$



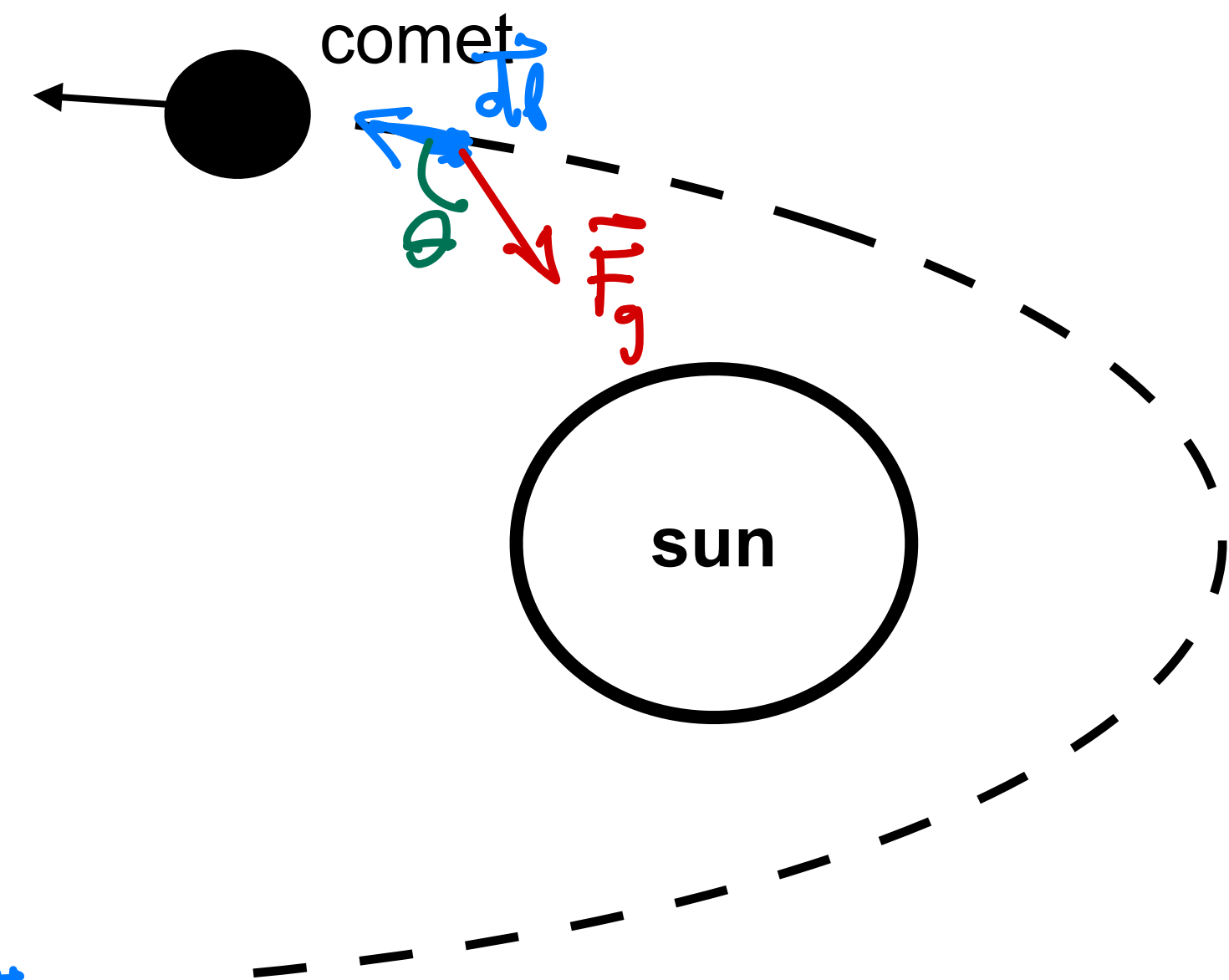
Conceptual question

A comet is on a hyperbolic orbit around the Sun. While the comet is moving away from the Sun, the work done by the Sun on the comet is...

- A. positive.
- B. zero.
- C. negative.

$$\vec{F}_g \cdot d\vec{l} = F_g dl \cos(\theta)$$

< 0 because $\frac{\pi}{2} < \theta < \frac{3\pi}{2}$



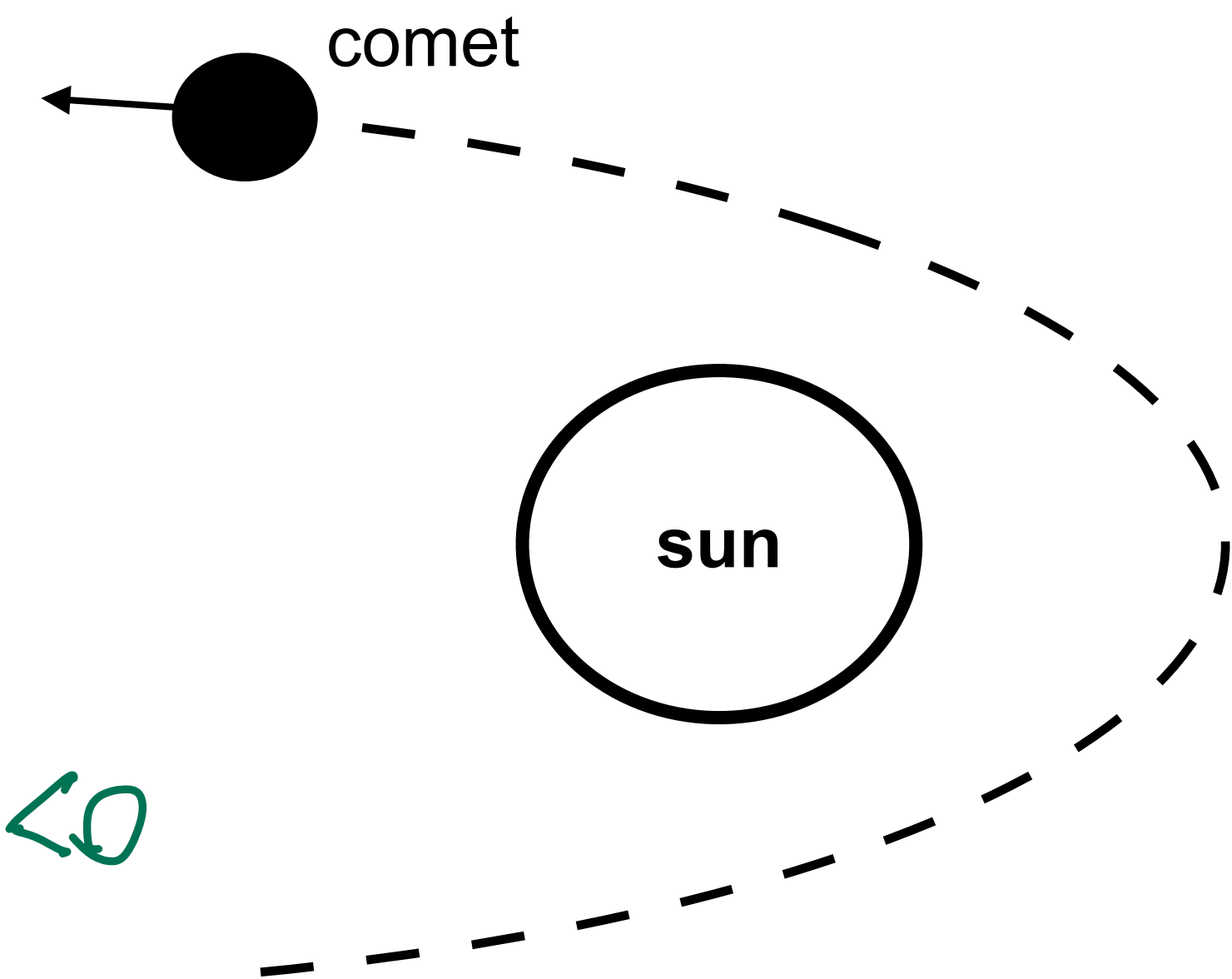
Conceptual question

A comet is on a hyperbolic orbit around the Sun. While the comet is moving away from the Sun, what happens with its speed?

- A. It increases
- B. It stays the same
- C. It decreases
- D. There is not enough info

$$\Delta K = W_g < 0 \Rightarrow \Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 < 0$$

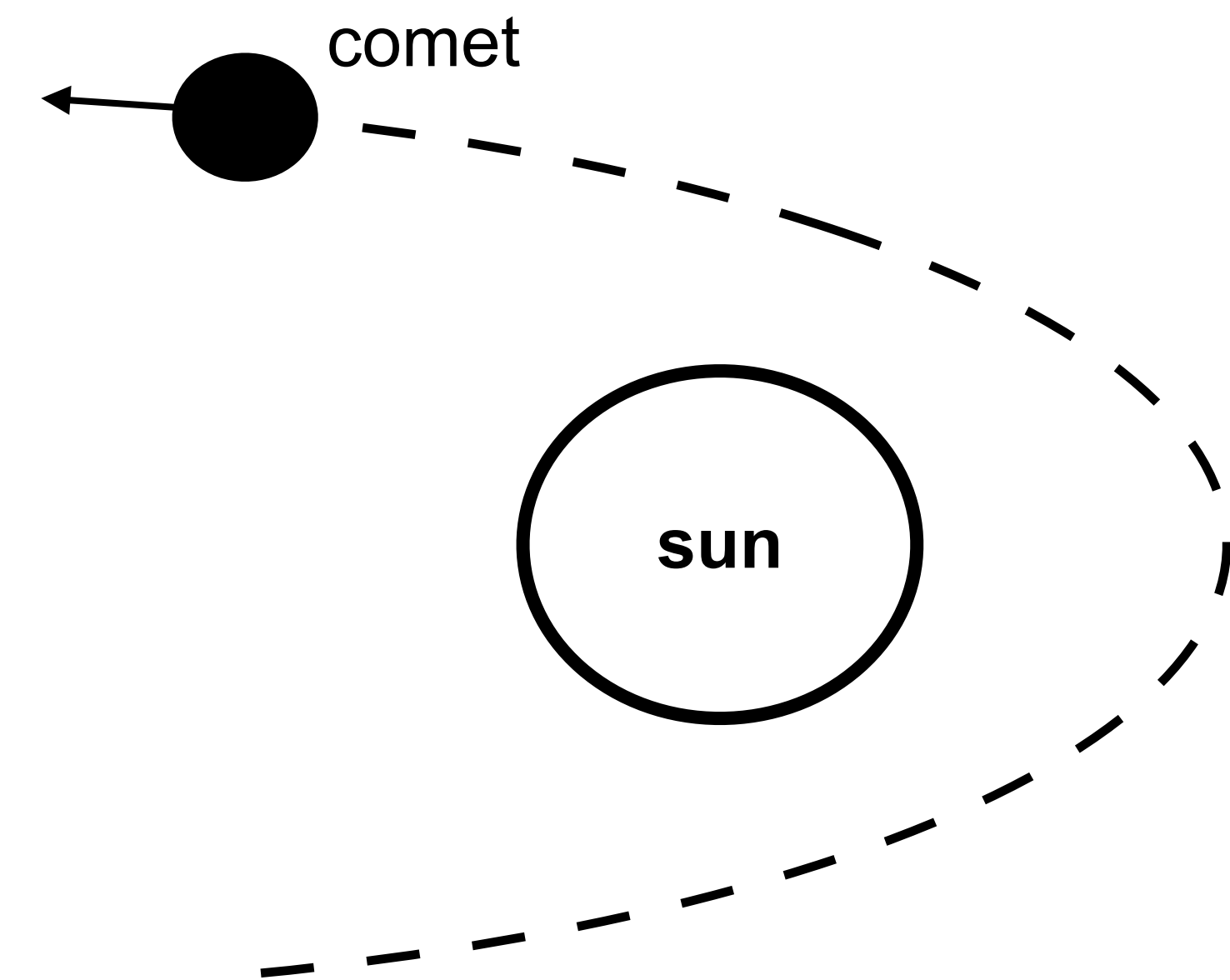
$$\Rightarrow v_f^2 < v_i^2$$



Conceptual question

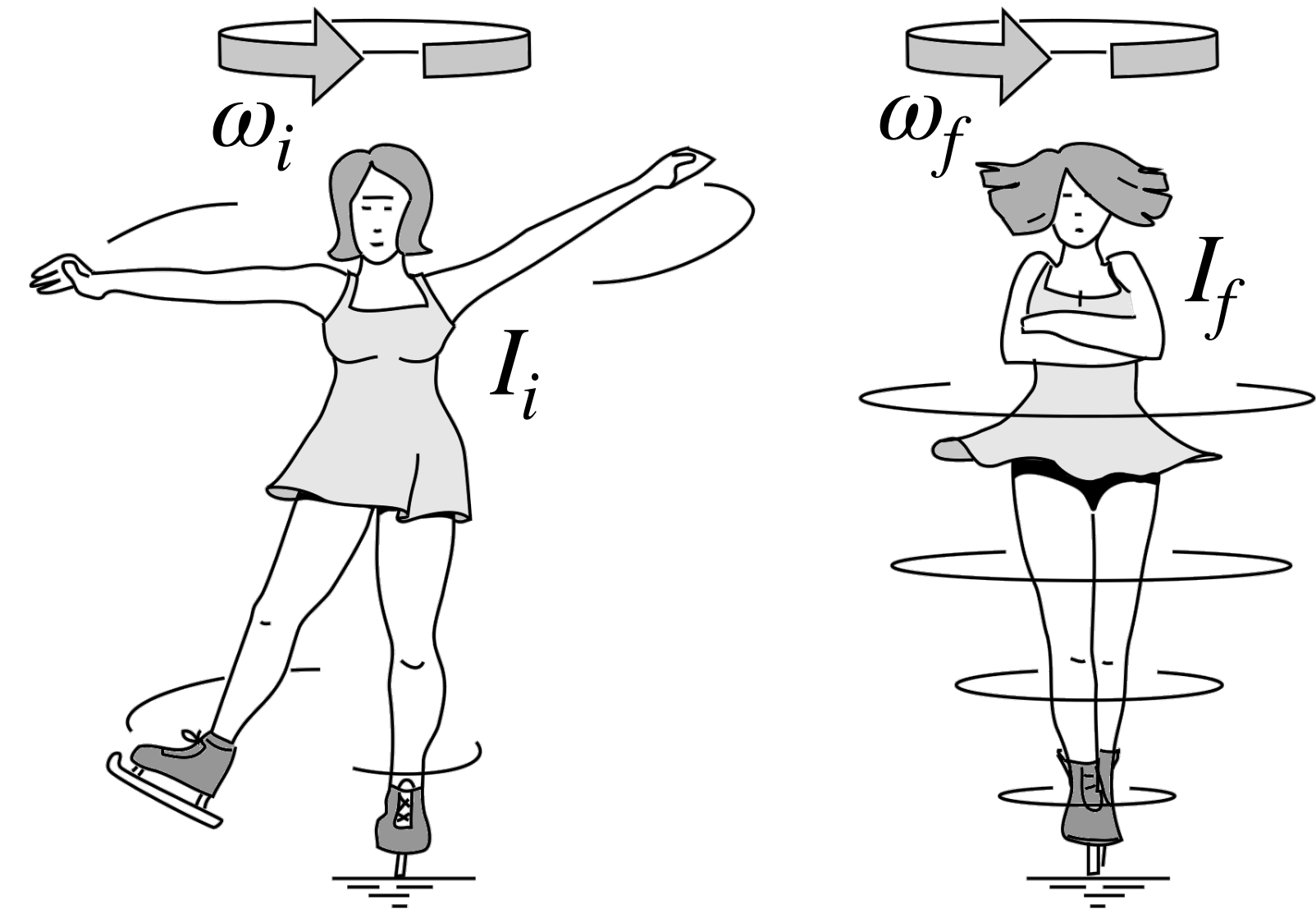
A comet is on a hyperbolic orbit around the Sun. While the comet is moving away from the Sun, what happens with its gravitational potential energy?

- A. It increases $\Delta U_g = -W_g > 0$ (because $W_g < 0$)
- B. It stays the same
- C. It decreases
- D. There is not enough info



Conceptual question

A figure skater stands on one spot on the ice (assumed frictionless) and spins around with her arms extended. When she pulls her arms in, she reduces her moment of inertia and her angular speed increases. Compared to her initial **angular momentum**, her **angular momentum** after she has pulled her arms in must be...



- A. the same.
- B. larger.
- C. smaller.

No net external torque
 $\Rightarrow \Delta \vec{L}_{\text{tot}} = 0$

Happy holidays and good luck in the Final Exam!

(Do not forget to check the Moodle for the rooms of the
Review sessions)