



Least Action Lab



COMPLETE TO COLLECT

Tumbled Jade

Level 2 · 4 Glints

COMPARE WHOLE MOTIONS

Physicists call a complete motion from start to finish a **history**. Each history has a number called **action**.

A nearly friction-free puck starts at (0, 2) and must finish at (6, 2) exactly 3 seconds later. Four candidate histories show where it could be after each second.

FOR EACH 1-SECOND STEP

$$A_{\text{step}} = (\Delta x)^2 + (\Delta y)^2$$

Total action is the sum of the three step actions.

READ ONE STEP BEFORE COMPARING WHOLE HISTORIES

1 · Find the change

Subtract coordinates to get $(\Delta x, \Delta y)$.

2 · Score the step

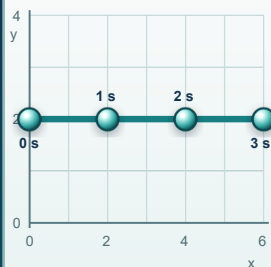
Square both changes and add them.

3 · Score the history

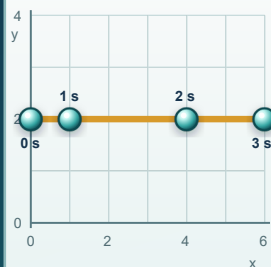
Add its three step actions only after each step is clear.

For example, moving from (1, 2) to (3, 3) gives $(\Delta x, \Delta y) = (2, 1)$, so the step action is $2^2 + 1^2 = 5$.

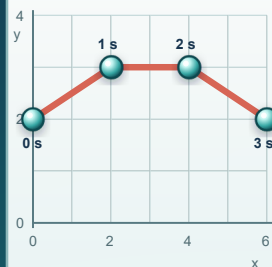
A equal steps



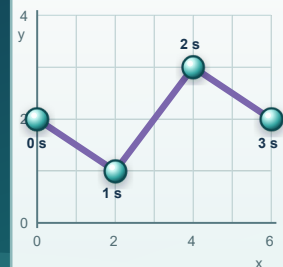
B uneven timing



C one bend



D zigzag



The dots are the puck's positions at 0, 1, 2, and 3 seconds.



- Complete the table. Each ordered pair is **(horizontal change, vertical change)**. Write each step action and each total, then circle the history with the least total action.

History	0–1 s	1–2 s	2–3 s	Total
A	(2, 0) _____	(2, 0) _____	(2, 0) _____	_____
B	(1, 0) _____	(3, 0) _____	(2, 0) _____	_____
C	(2, 1) _____	(2, 0) _____	(2, –1) _____	_____
D	(2, –1) _____	(2, 2) _____	(2, –1) _____	_____

- Two histories have the same total action even though one stays straight and the other bends. Name them. Use their three step actions to explain the tie.
- Describe the motion of the least-action history. Use its time marks and step actions as evidence. Then write one sentence describing the **principle of least action** in this puck model.

Physics note: In this free-puck model, the action is truly least. In more advanced systems, the precise idea is *stationary action*, which need not be the absolute smallest action.

