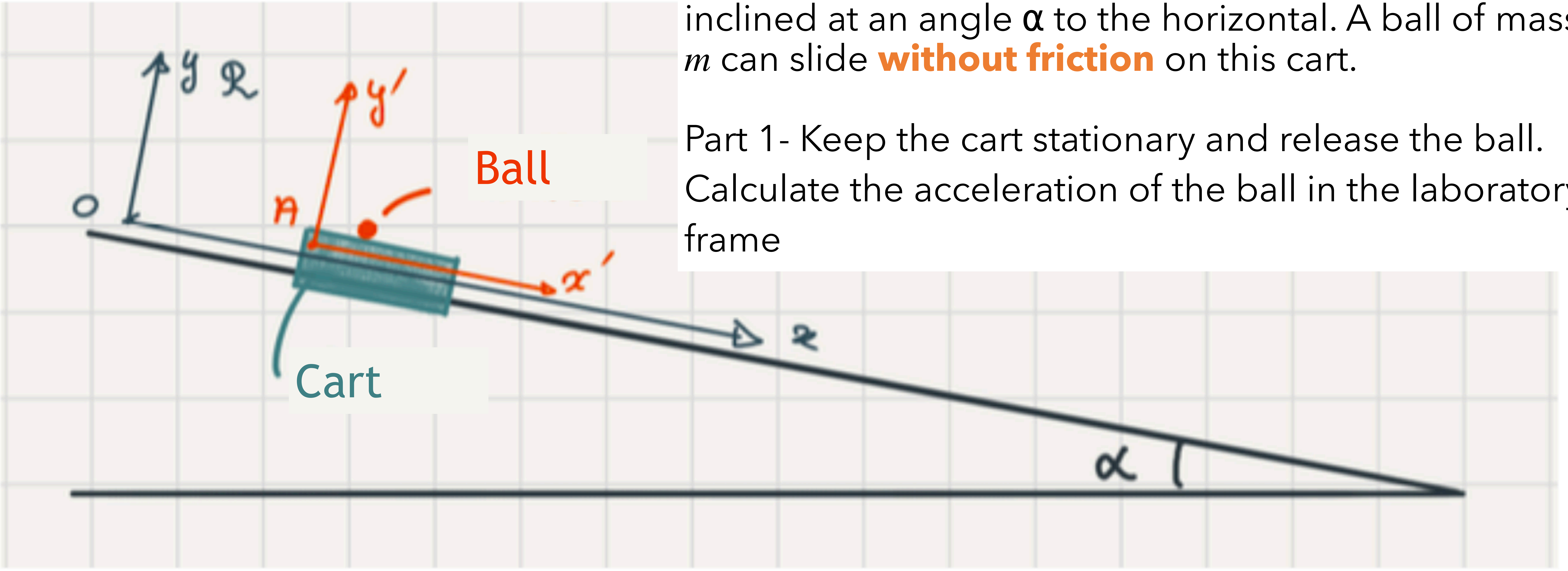


A rectangular cart of mass M is placed on an air track inclined at an angle α to the horizontal. A ball of mass m can slide **without friction** on this cart.

Part 1- Keep the cart stationary and release the ball. Calculate the acceleration of the ball in the laboratory frame

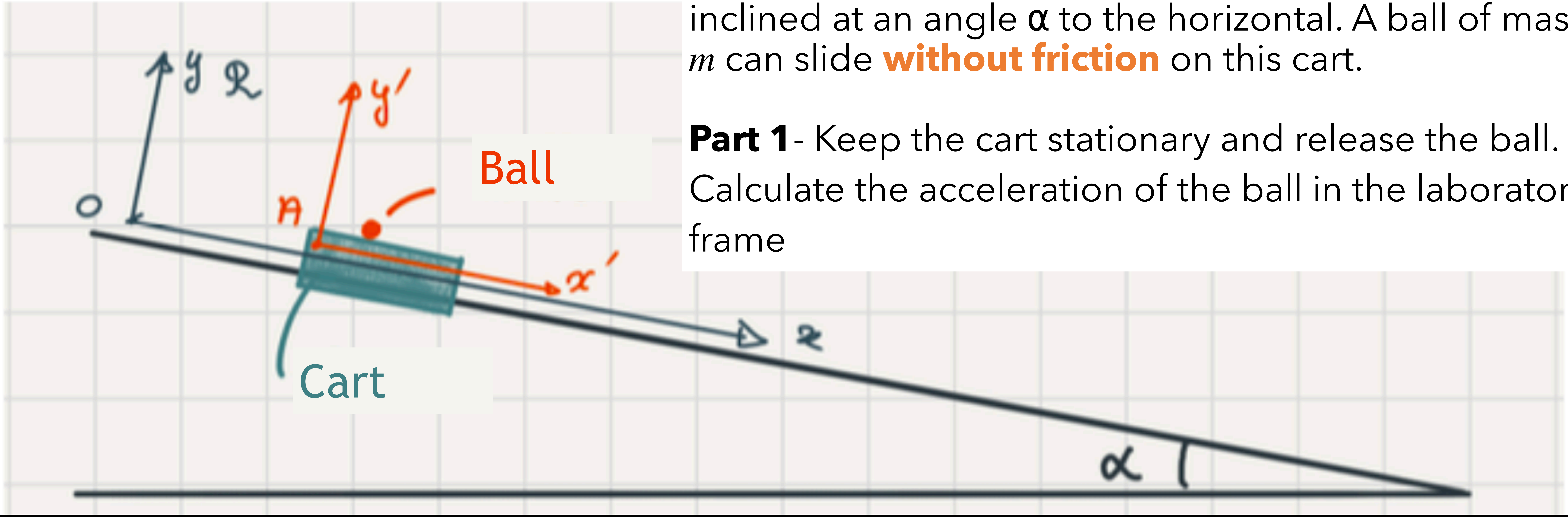
PHYS-101 WEEK 5

EPFL

Physique générale : mécanique (classe inversée en anglais)

Prof. Emma Tolley, 6 October 2025

EXERCISE: BALL ON A CART, PART 1



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QUIZ: BALL ON A CART

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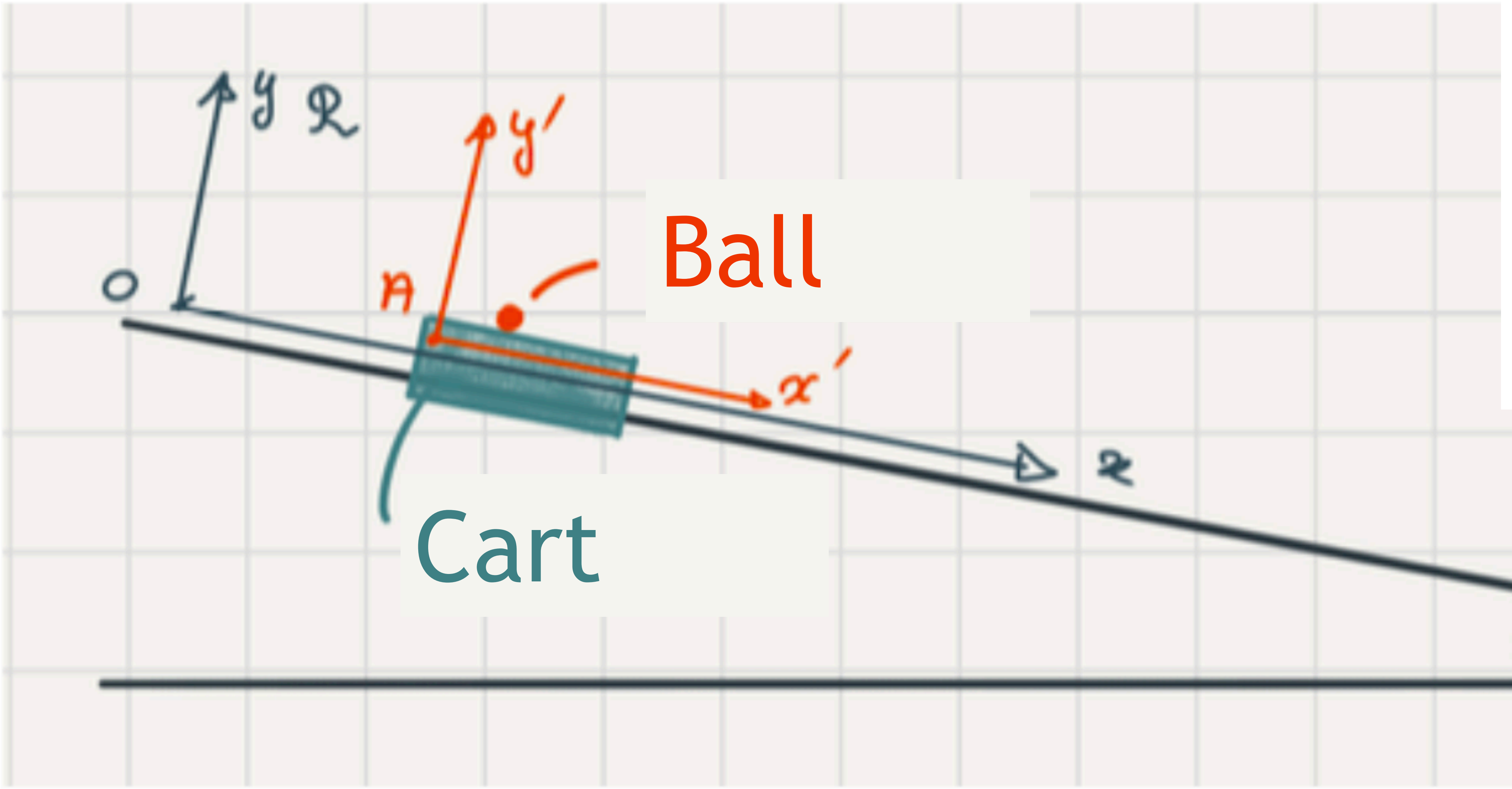


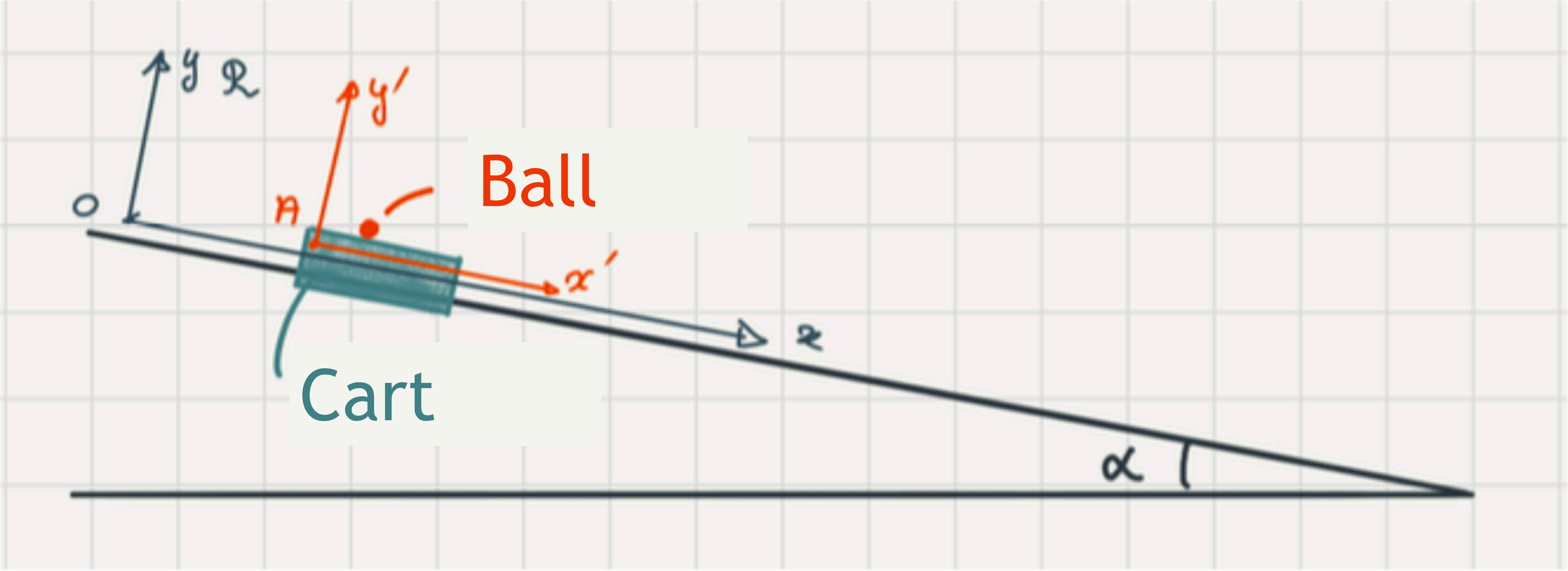
What happens to the ball if we release the ball and the cart at the same time?

- The ball will go backward, towards the top of the cart — 0%
- The ball will go forward, towards the bottom of the cart — 0%
- The ball will remain stationary relative to the cart — 0%

EXERCISE: BALL ON A CART, PART 2

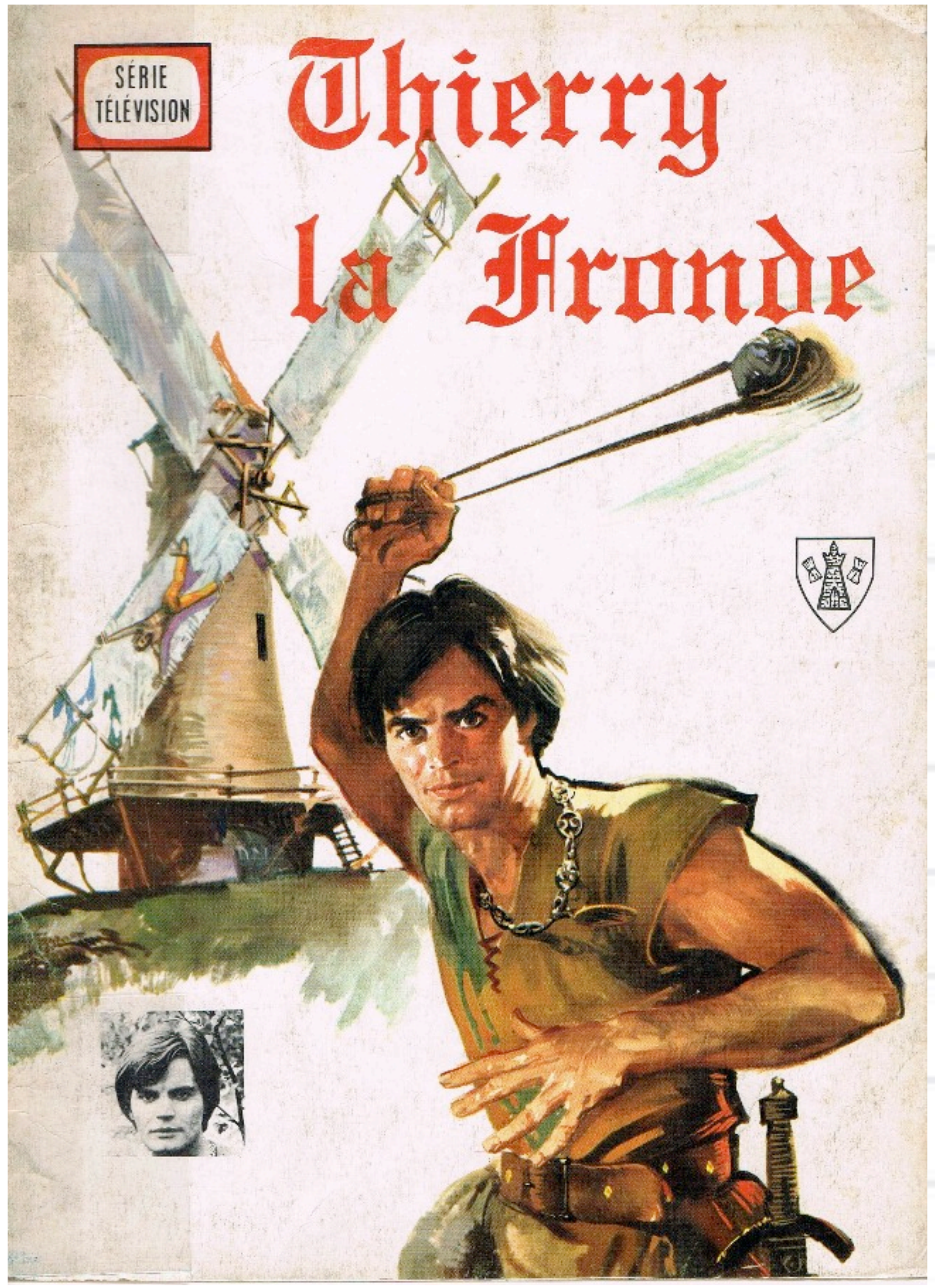
A rectangular cart of mass M is placed on an air track inclined at an angle α to the horizontal. A ball of mass m can slide **without friction** on this cart.

Part 2 – We release the ball and the cart at the same time.

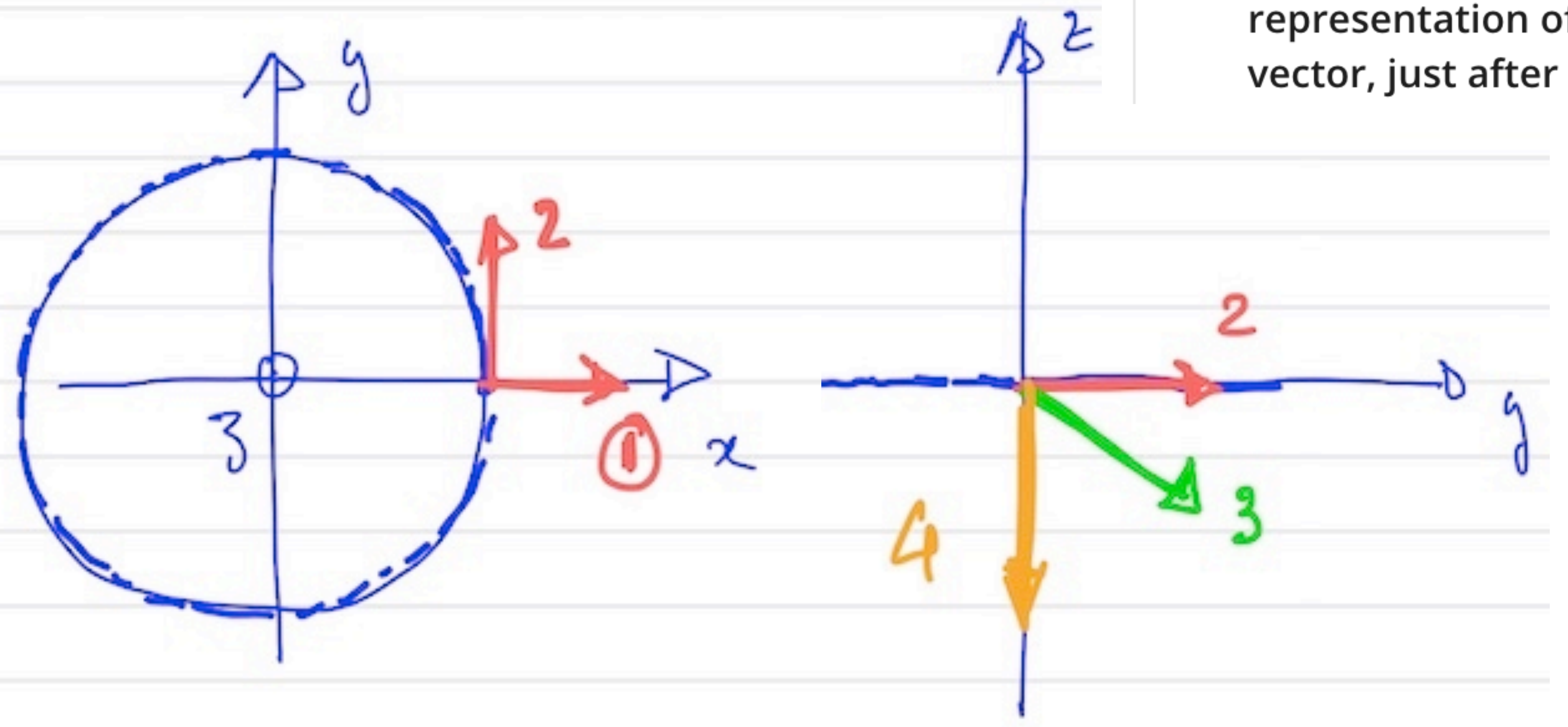


- Calculate the acceleration of the cart in the laboratory frame.
- Calculate the acceleration of the ball in the cart frame.
- What will be the motion of the ball relative to the cart?

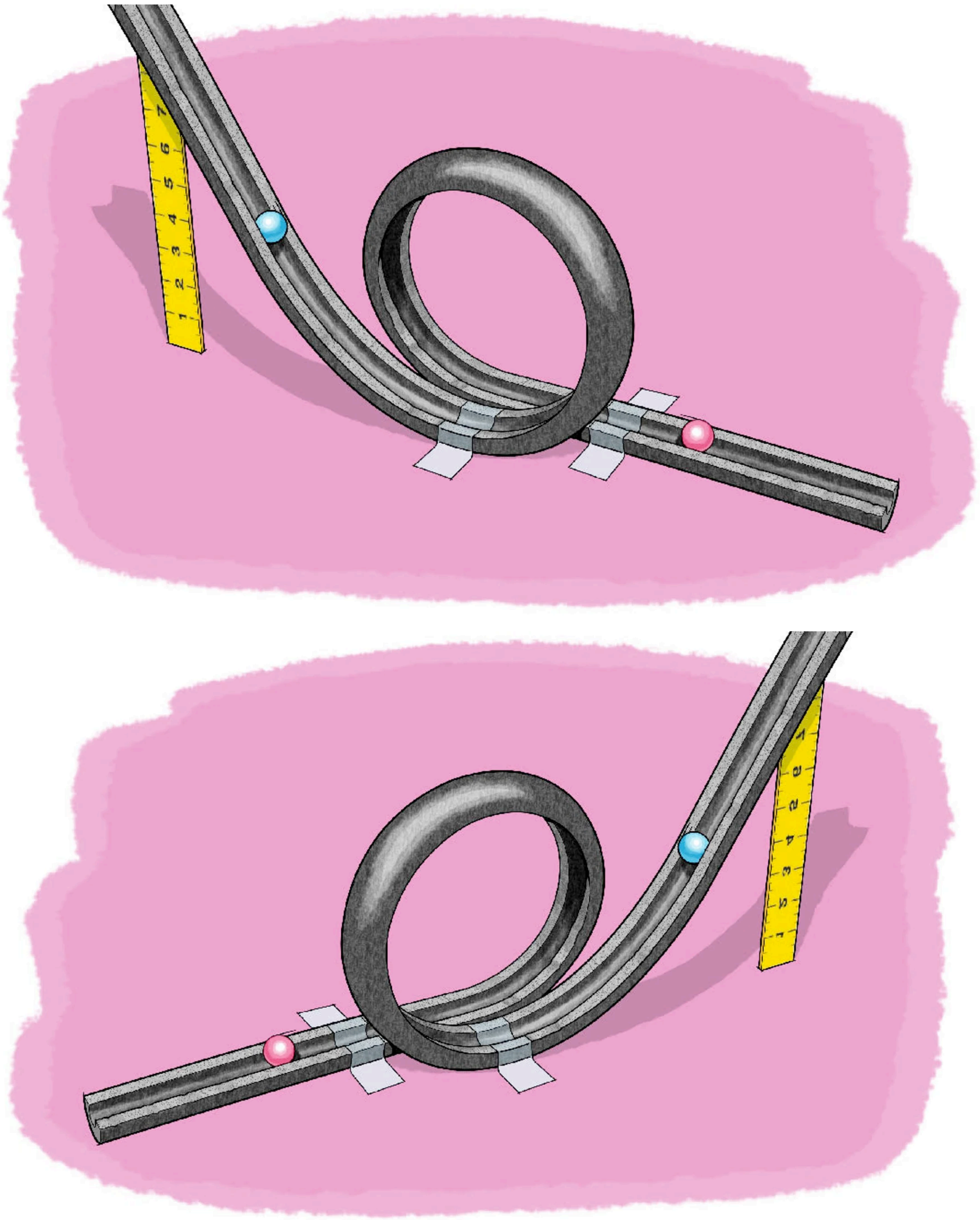
QUIZ: THIERRY LA FRONDE

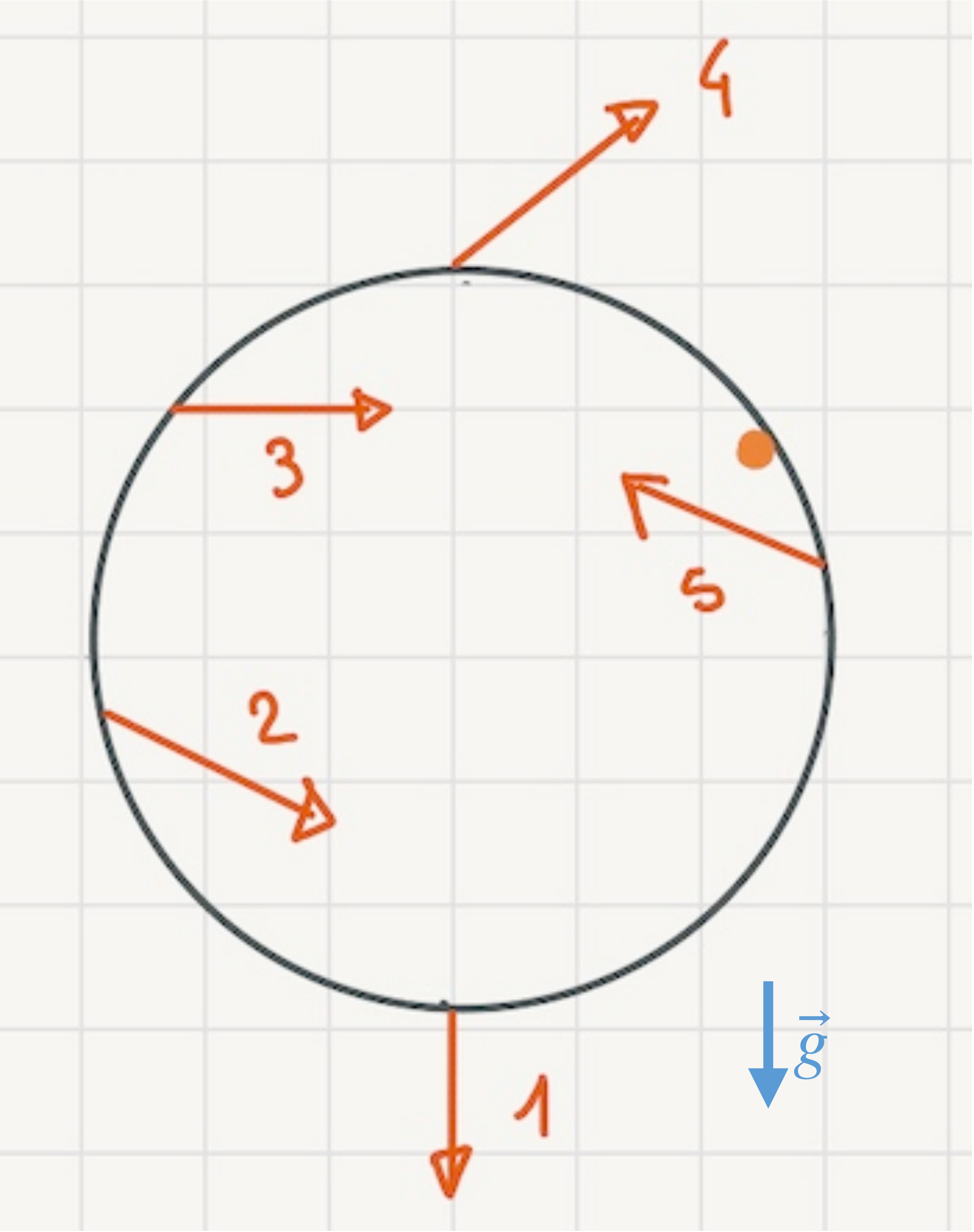


Thierry la Fronde spins his slingshot above his head in a horizontal plane, in a uniform circular motion. Suddenly, the string breaks. We represent the situation with z-axis vertically upwards. What is the correct representation of the stone's velocity vector, just after the string breaks?



QUIZ: MARBLE IN A LOOP





A marble is thrown into a vertical loop where it moves without friction, and with sufficient speed to complete the turn. At what point(s) does the plotted vector represent a *possible* acceleration for the marble?

- [ ] 1 — 0%
- [ ] 2 — 0%
- [ ] 3 — 0%
- [ ] 4 — 0%
- [ ] 5 — 0%

STATIC & DYNAMIC DRY FRICTION

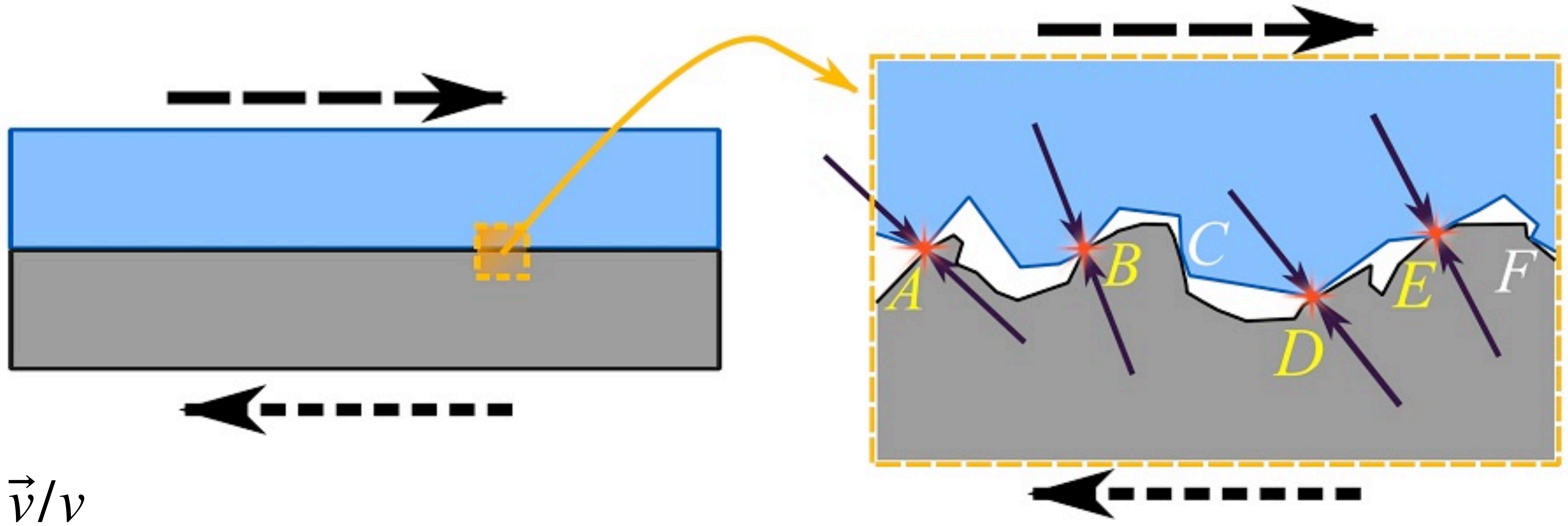
Static friction:

$\overrightarrow{F}_F$ such that $\sum \overrightarrow{F} = 0, \quad F_F \leq \mu_s N$

Dynamic/kinetic friction:

$\overrightarrow{F}_F$ such that $F_F = \mu_c N$ and $\overrightarrow{F}_F / F_F = -\vec{v}/v$

for Normal force $\overrightarrow{N}$ and velocity $\vec{v}$



STATIC & DYNAMIC DRY FRICTION

Static friction:

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Dynamic/kinetic friction:

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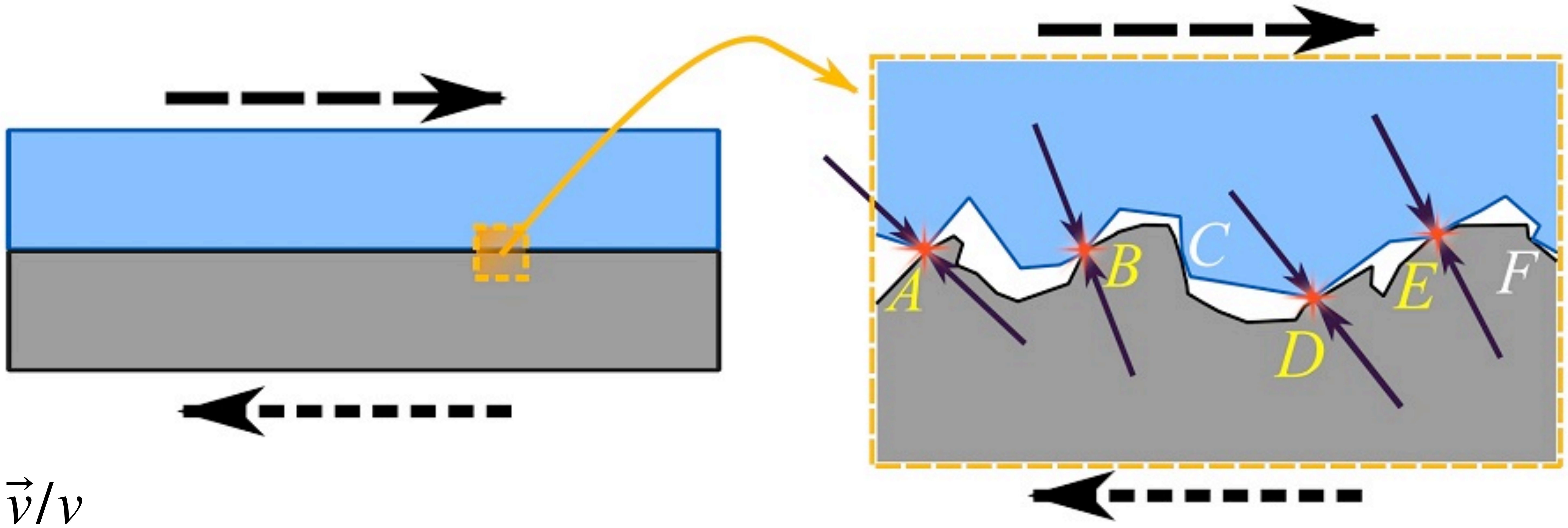

ELSEVIER
Tribology International
Volume 34, Issue 9, September 2001, Pages 585-591

The significance and use of the friction coefficient ☆

Peter J Blau

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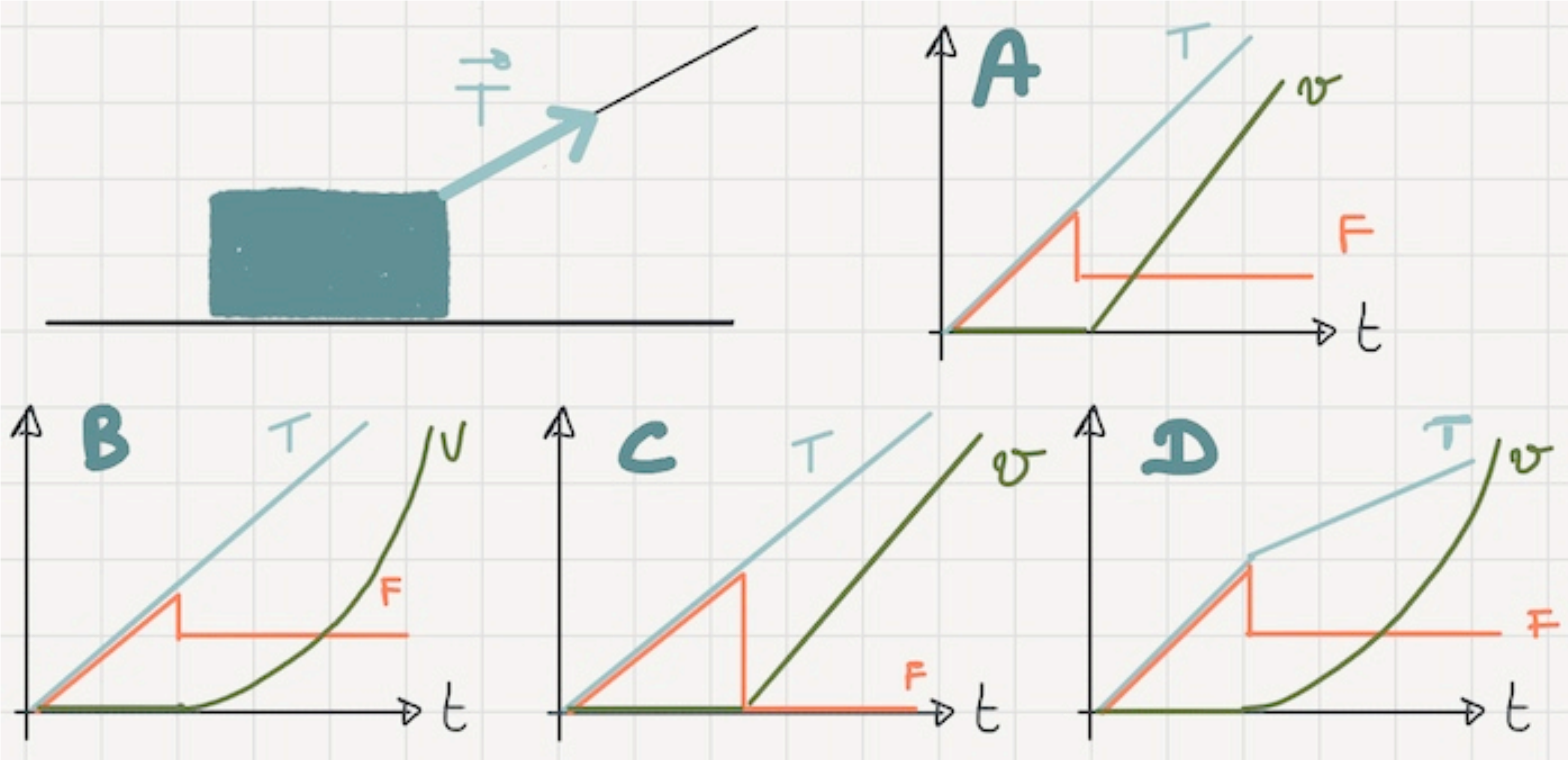
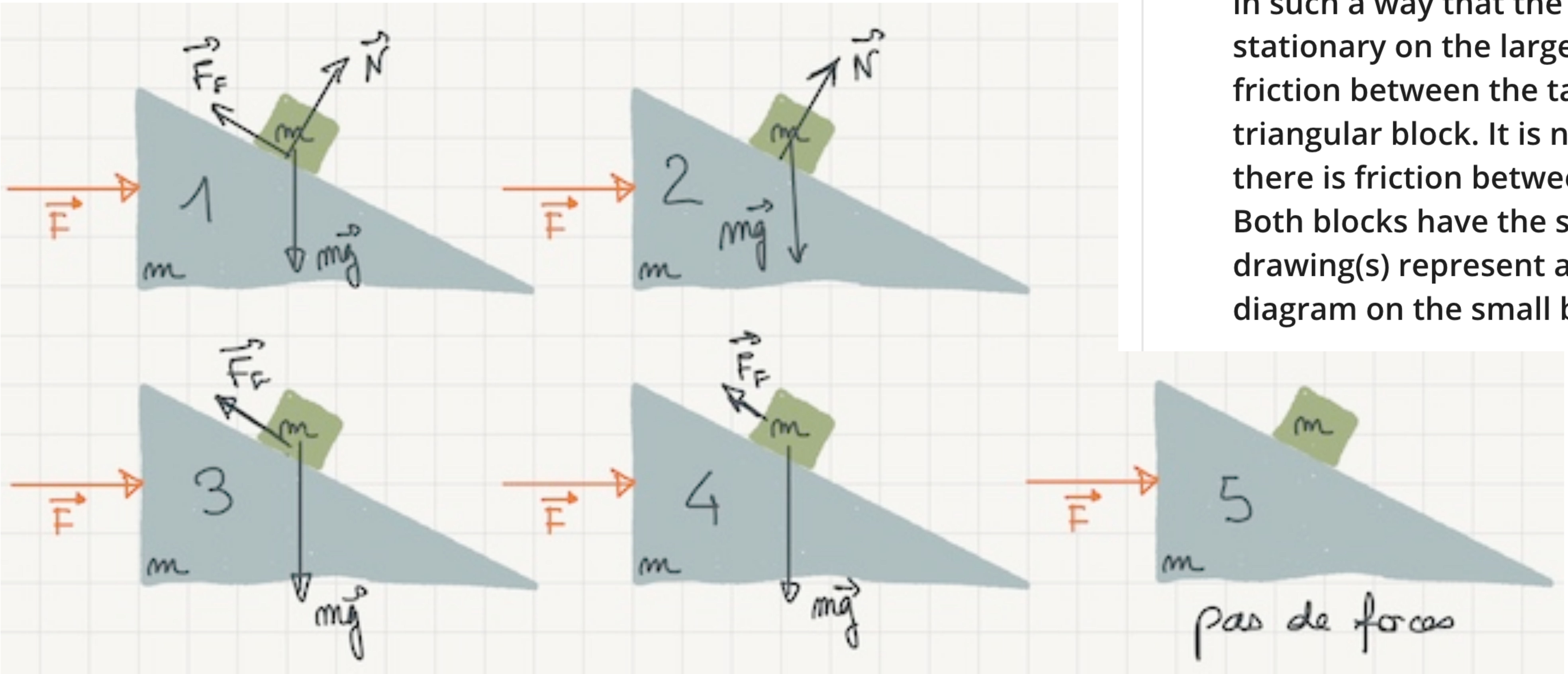
Despite the fact that both static and kinetic friction coefficients can be measured with little difficulty under laboratory conditions, the time- and condition-dependent characteristics of friction coefficients associated with both clean and lubricated surfaces have proven exceedingly difficult to predict a priori from first principles.

QUIZ: FRICTION

I pull on a rope connected to a box placed on the ground, applying a tension that increases linearly with time. We assume $\mu_s > \mu_c$. We sketch the curves as a function of time: the speed of the box v, the tension in the rope T and the friction force F. Which graph corresponds to the situation described?



QUIZ: BLOCK & PLANE



A force $\vec{F}$ is exerted on the triangular block in such a way that the small block remains stationary on the large one. There is no friction between the table and the triangular block. It is not known whether there is friction between the two blocks. Both blocks have the same mass. Which drawing(s) represent a *plausible* force diagram on the small block?