DIALOGO
DI
GALILEO GALILEI LINCEO
MATEMATICO SOPRAORDINARIO
DELLO STVDIO DI PISA.
E Filosofo, e Matematico primario del
SERENISSIMO
GR. DVCA DI TOSCANA.

Doue ne i congressi di quattro giornate si discorre sopra i due

MASSIMI SISTEMI DEL MONDO
TOLEMAICO, E COPERNICANO;

Proponendo indeterminatamente le ragioni Filosofiche, e Naturali tanto per l'una, quanto per l'altra parte.

CON PRI VILEGI.

IN FIORENZA, Per Gio: Batista Landini MDCXXXII.

CON LICENZA DE' SVPERIORI.

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SIMPLICIO: But isn't math different? Isn't math a language of its own, with all sorts of symbols that have to be learned before you can use it?

SALVIATI: Not at all. Mathematics is not a language, it's an adventure. Do musicians "speak another language" simply because they choose to abbreviate their ideas with little black dots? If so, it's no obstacle to the toddler and her song. Yes, a certain amount of mathematical shorthand has evolved over the centuries, but it is in no way essential. Most mathematics is done with a friend over a cup of coffee, with a diagram scribbled on a napkin. Mathematics is and always has been about ideas, and a valuable idea transcends the symbols with which you choose to represent it. As Gauss once remarked, "What we need are *notions*, not notations."

SIMPLICIO: But isn't one of the purposes of mathematics education to help students think in a more precise and logical way, and to develop their "quantitative reasoning skills?" Don't all of these definitions and formulas sharpen the minds of our students?

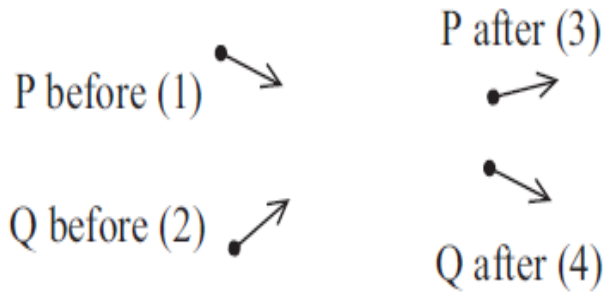
SALVIATI: No they don't. If anything, the current system has the opposite effect of dulling the mind. Mental acuity of any kind comes from solving problems yourself, not from being told how to solve them.

SIMPLICIO: Fair enough. But what about those students who are interested in pursuing a career in science or engineering? Don't they need the training that the traditional curriculum provides? Isn't that why we teach mathematics in school?

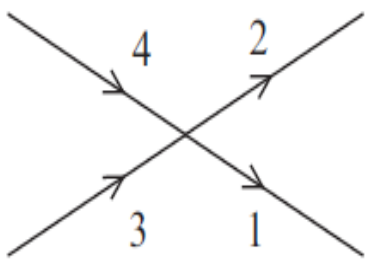
SALVIATI: How many students taking literature classes will one day be writers? That is not why we teach literature, nor why students take it. We teach to enlighten everyone, not to train only the future professionals. In any case, the most valuable skill for a scientist or engineer is being able to think creatively and independently. The last thing anyone needs is to be *trained*.

Advanced level physics question.

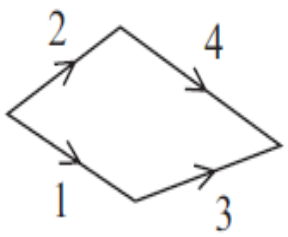
2 The diagram represents the collision between two sub-atomic particles P and Q moving with momenta 1 and 2 respectively. After the collision they have momenta 3 and 4 respectively.



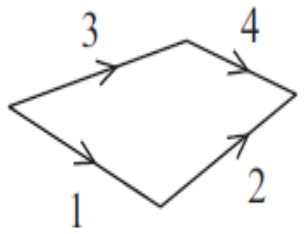
Which vector diagram best shows the correct relationship for the momenta of P and Q?



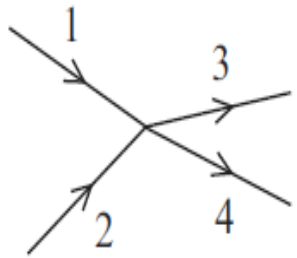
A



B

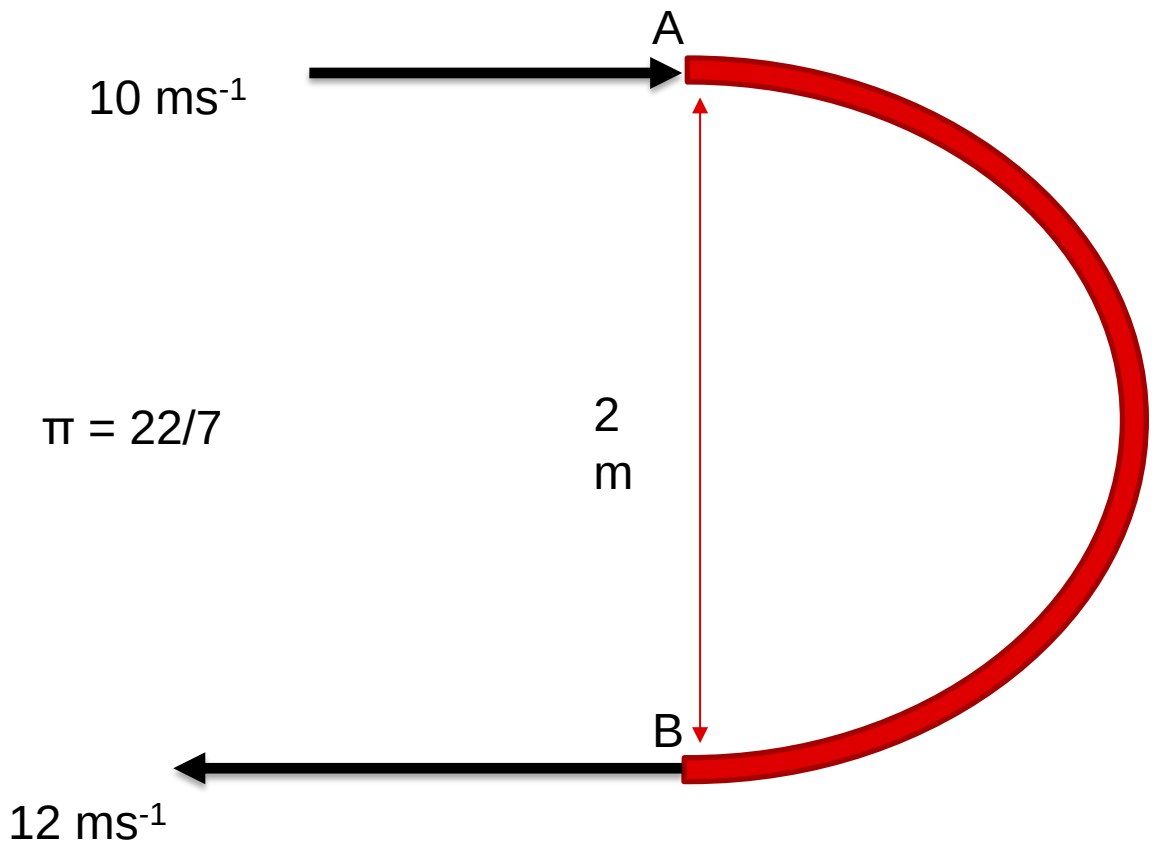


C



D

From John Warren

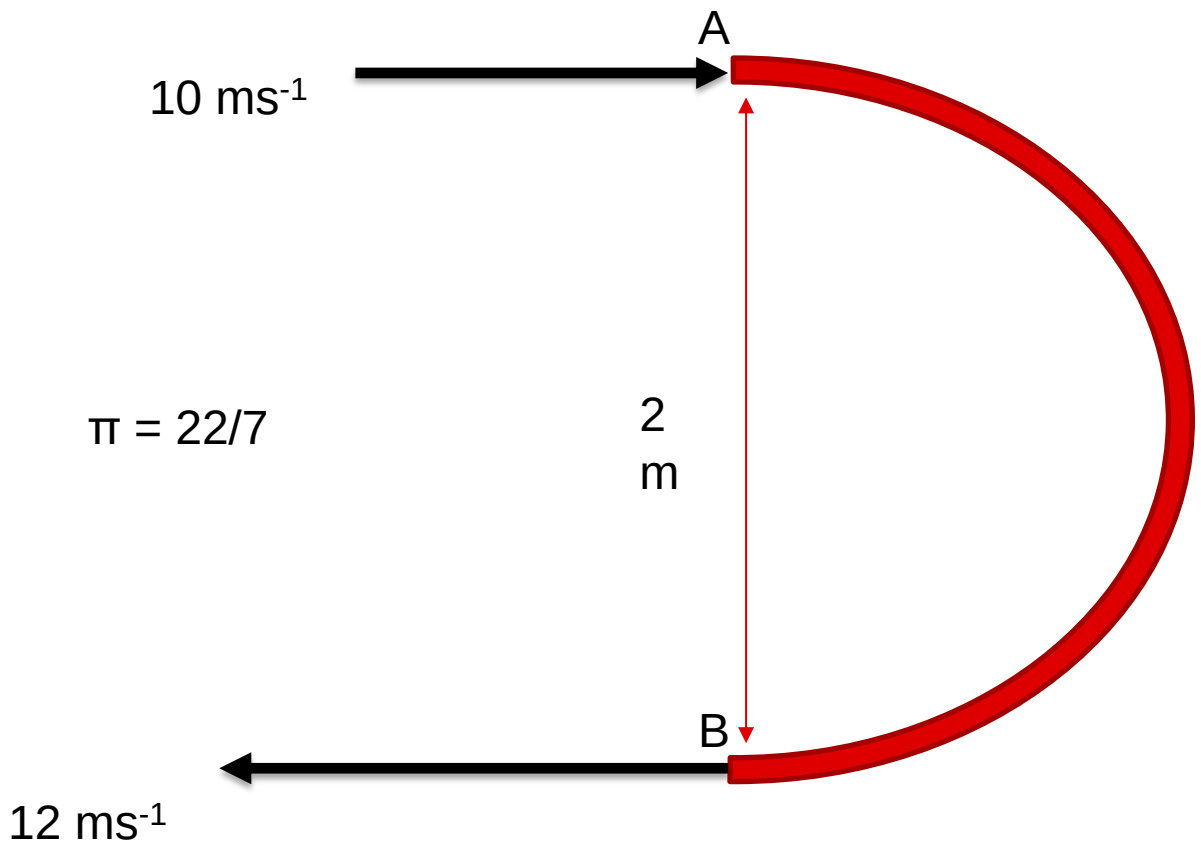


This task was given to his undergraduate physics students

What is the average velocity from A to B ?

What is the average acceleration from A to B?

From John Warren



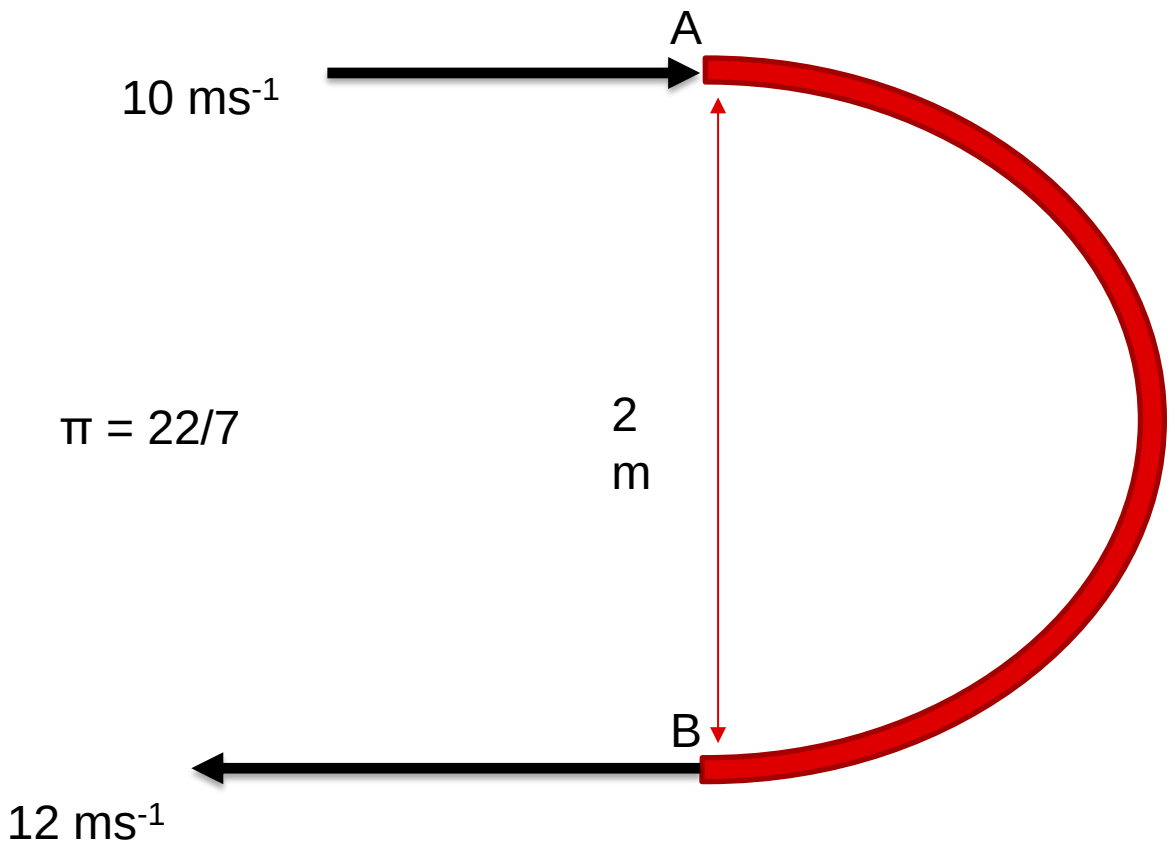
What is the average velocity from A to B ?

Average velocity= $\frac{\text{displacement}}{\text{time taken}}$

= 2/((22/7)/11) ms^{-1}

= 7 ms^{-1}

From John Warren



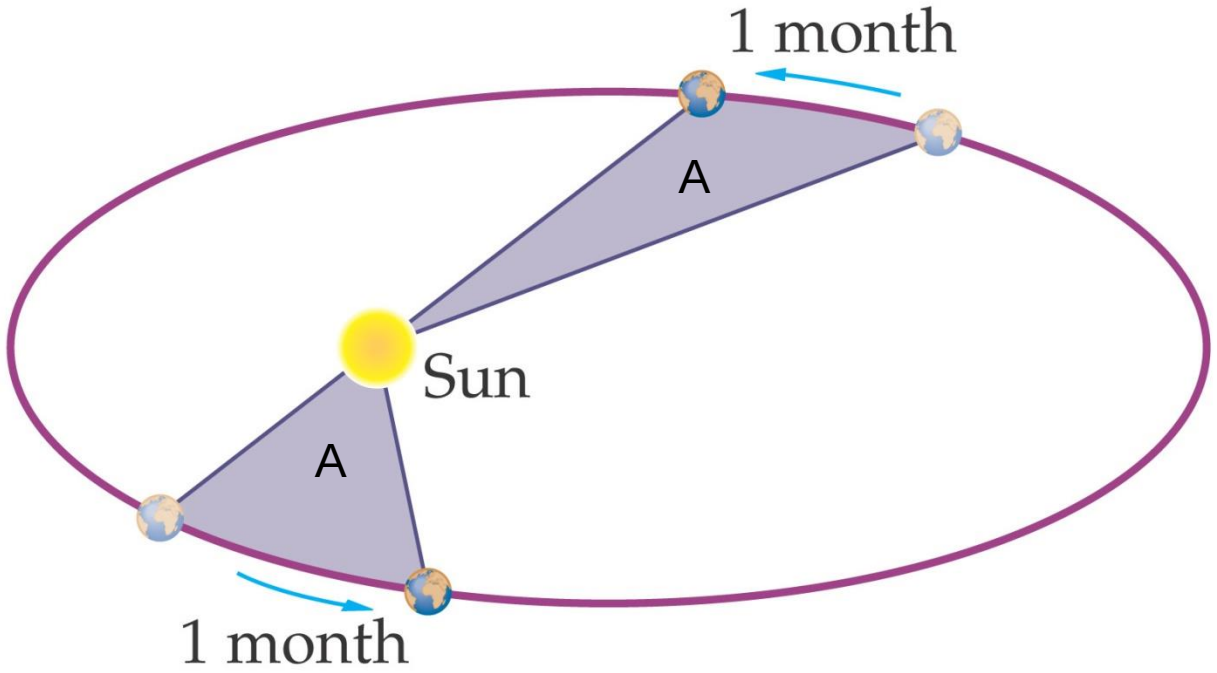
What is the average acceleration from A to B?

Average acc= $\frac{\text{Change in velocity}}{\text{time taken}}$

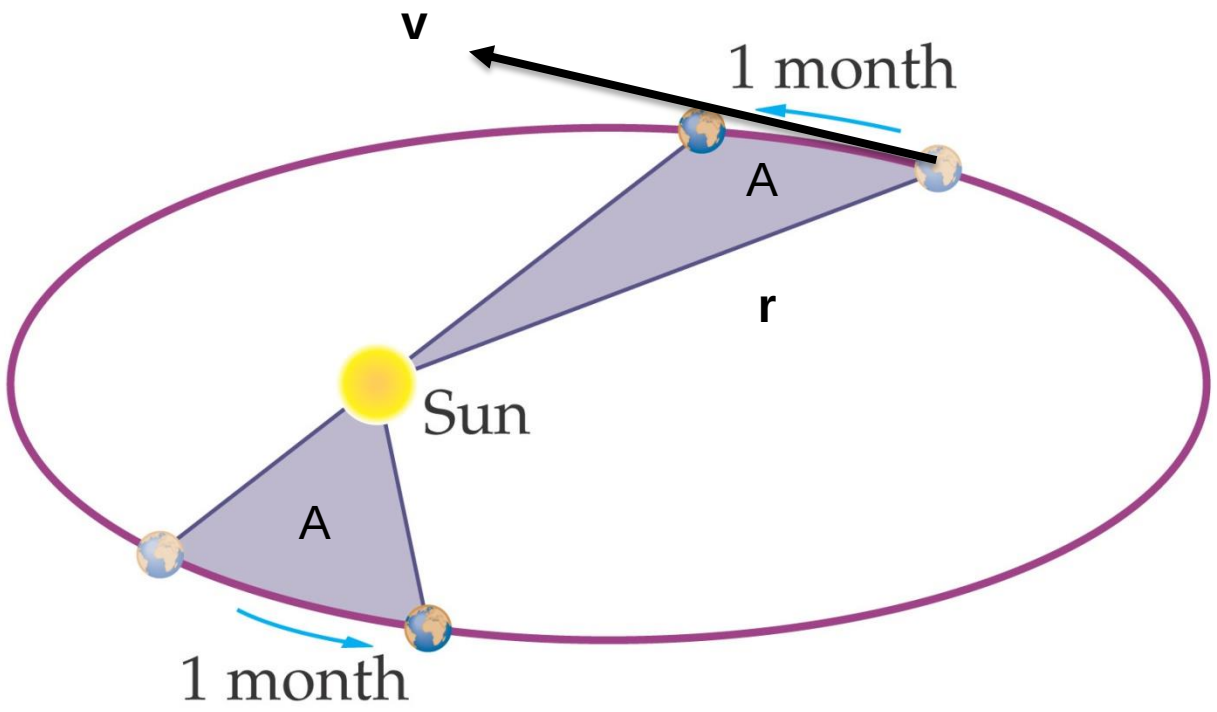
= 22/ (2/7) ms^{-2}

= 77 ms^{-2} ⟵

Kepler's Second Law 1609



Kepler's Second Law 1609



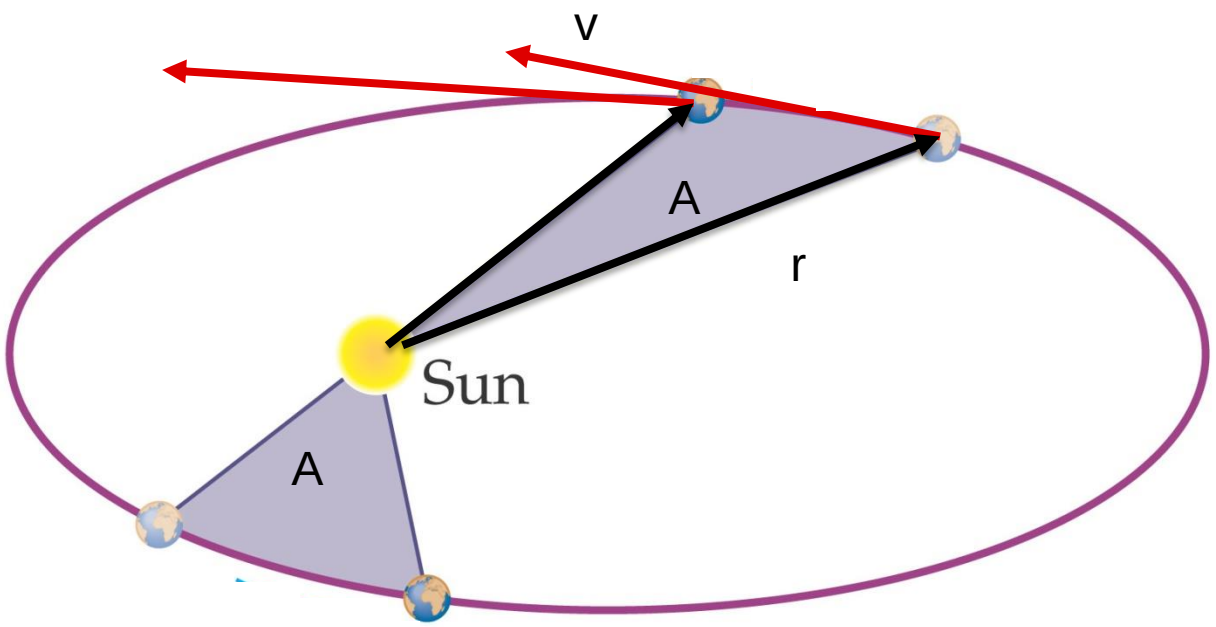
The instantaneous velocity **v** of the planet is the rate of change of the radius vector **r**

The area A is that area which is swept out by the radius vector which has an instantaneous velocity of **v**

The rate of change of area is constant.

The rate of change of the rate of change of area is zero!

From Richard Feynman 1965



$$\dot{\boldsymbol{A}} = \boldsymbol{r} \times \dot{\boldsymbol{r}}$$

$$\ddot{\boldsymbol{A}} = \dot{\boldsymbol{r}} \times \dot{\boldsymbol{r}} + \boldsymbol{r} \times \ddot{\boldsymbol{r}}$$ applying product rule

$$\ddot{\boldsymbol{A}} = \boldsymbol{r} \times \ddot{\boldsymbol{r}}$$ since $\dot{\boldsymbol{r}} \times \dot{\boldsymbol{r}} = 0$

$$\ddot{\boldsymbol{A}} = \boldsymbol{r} \times \boldsymbol{F}/m$$ since $\ddot{\boldsymbol{r}} = \boldsymbol{F}/m$

But $\ddot{\boldsymbol{A}} = 0$

implies that ***F*** and ***r*** are parallel and in opposite directions.

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