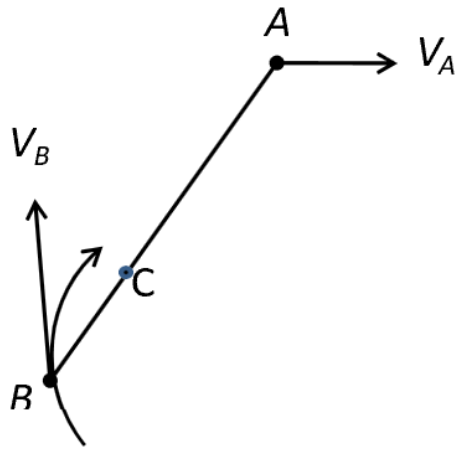
Velocity analysis

Velocity Vector Diagram – VVD

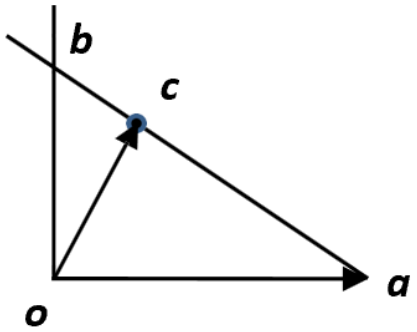
Relative velocity method

Velocity of any point on a link

- Consider a link *AB* where the directions of motion of its ends are shown.
- The velocity vectors are.
  - ***oa*** – velocity of the end *A*
  - ***ob***- velocity of the end *B*
  - ***ab***- velocity of B with respect to *A*



$$v_{ba} = v_b - v_a$$

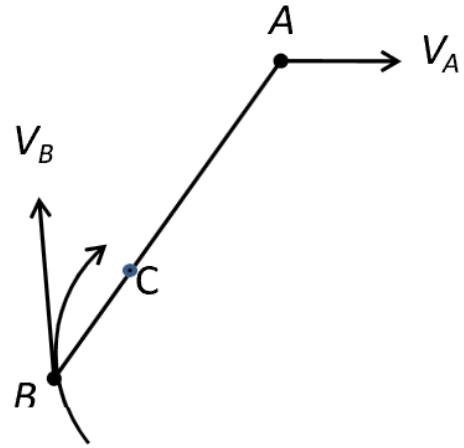


- Velocity of any point *C* on the link can be determined by dividing the vector ***ab*** at ***c*** such that

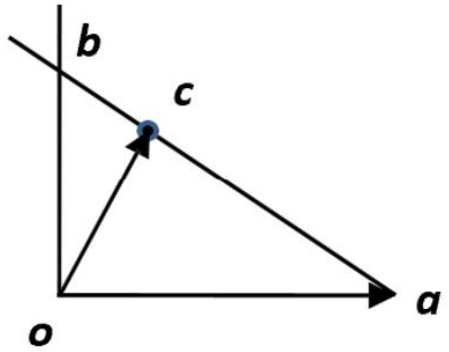
$$\frac{ab}{AB} = \frac{ac}{AC}$$

- Then, the velocity of *C* with respect to *A*

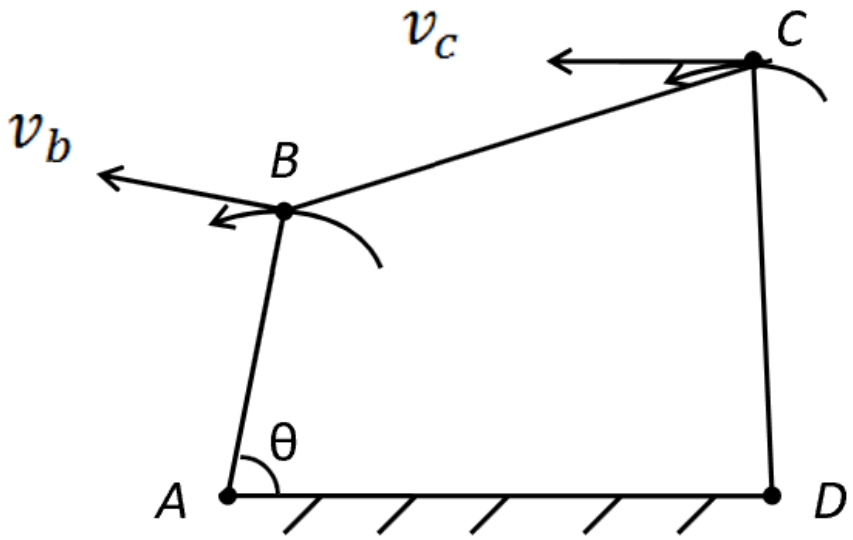
$$v_{ca} = v_c - v_a$$



- Hence, the vector ***oc*** represents the velocity of point *C*.



Velocity diagram for four bar chain

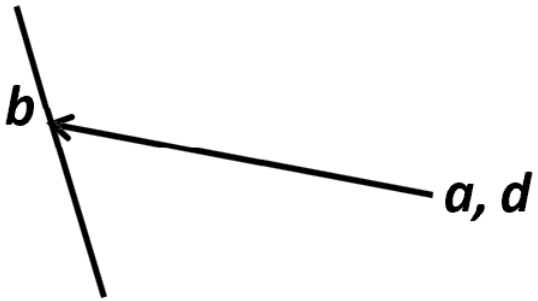


Given the dimensions of all the links, angular velocity of crank AB and position of the crank.

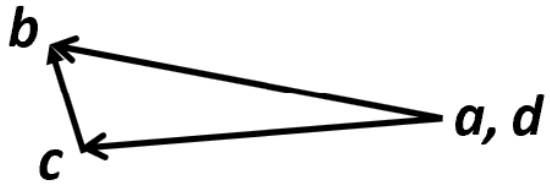
Draw the velocity vector diagram.

1. Draw a vector ***ab*** perpendicular to link *AB* of length *AB x ω* (to a suitable scale).

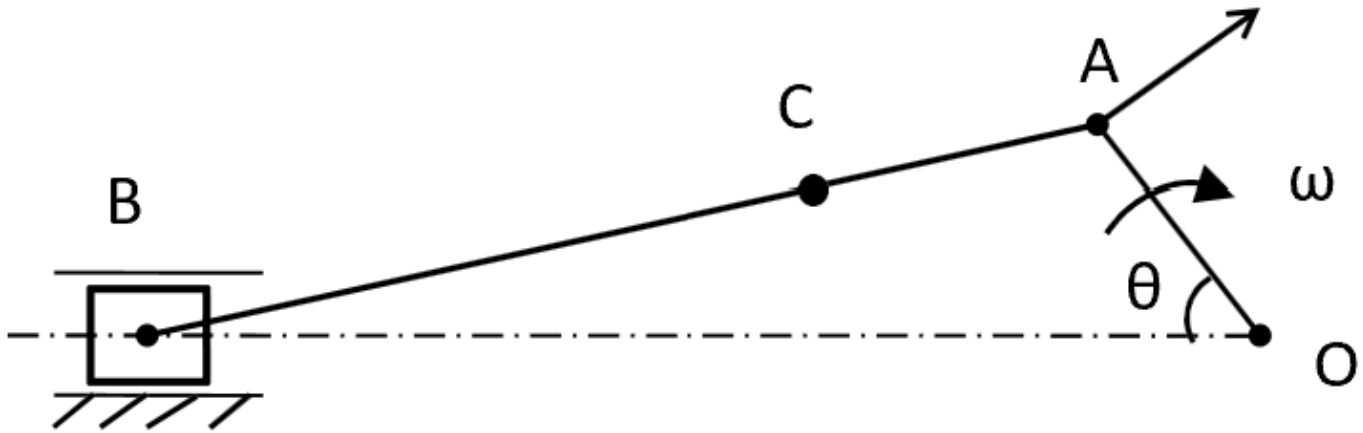
2. Draw a vector line through ***b*** in direction perpendicular to the link *BC*.



3. Draw a vector through **d** in a direction perpendicular to the link ***CD.*** This will intersect the vector **bc** in ***c***.



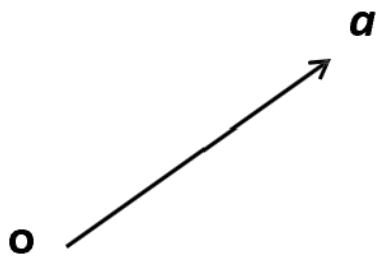
Slider crank chain



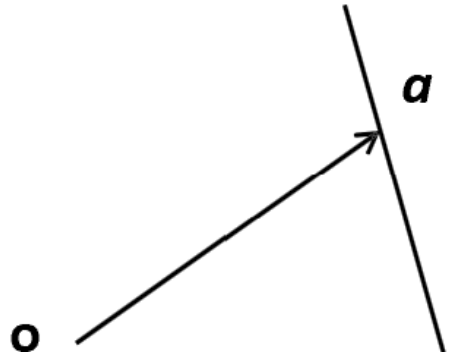
Given the dimensions of all the links, angular velocity of the crank OA and position of the crank.

i. Draw VVD.
ii. Find the velocity of point C on link AB.

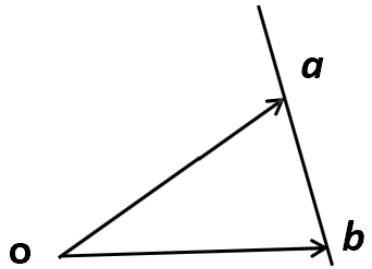
1. Draw a vector ***oa*** of length $OA \times \omega$ (taking a suitable scale) in a direction perpendicular to *OA*.



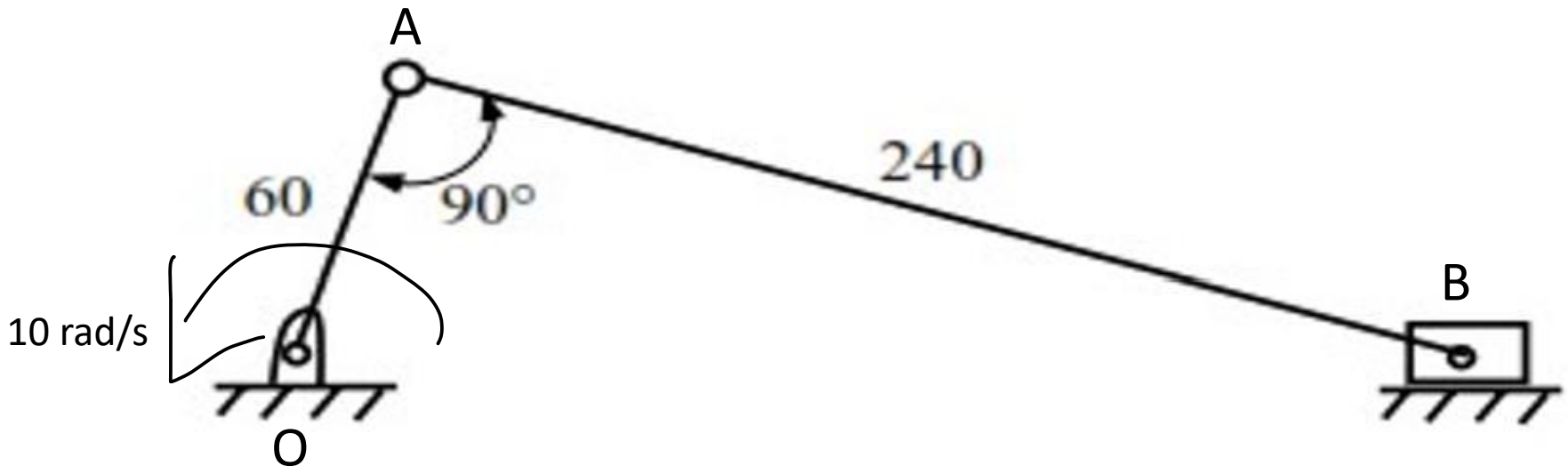
2. Draw a vector line through **a** in a direction perpendicular to the link ***AB***. (draw some length on either side of ***a***.)



3. Draw the vector **ob** parallel to *OB* to intersect the vector ***ab*** at ***b***.

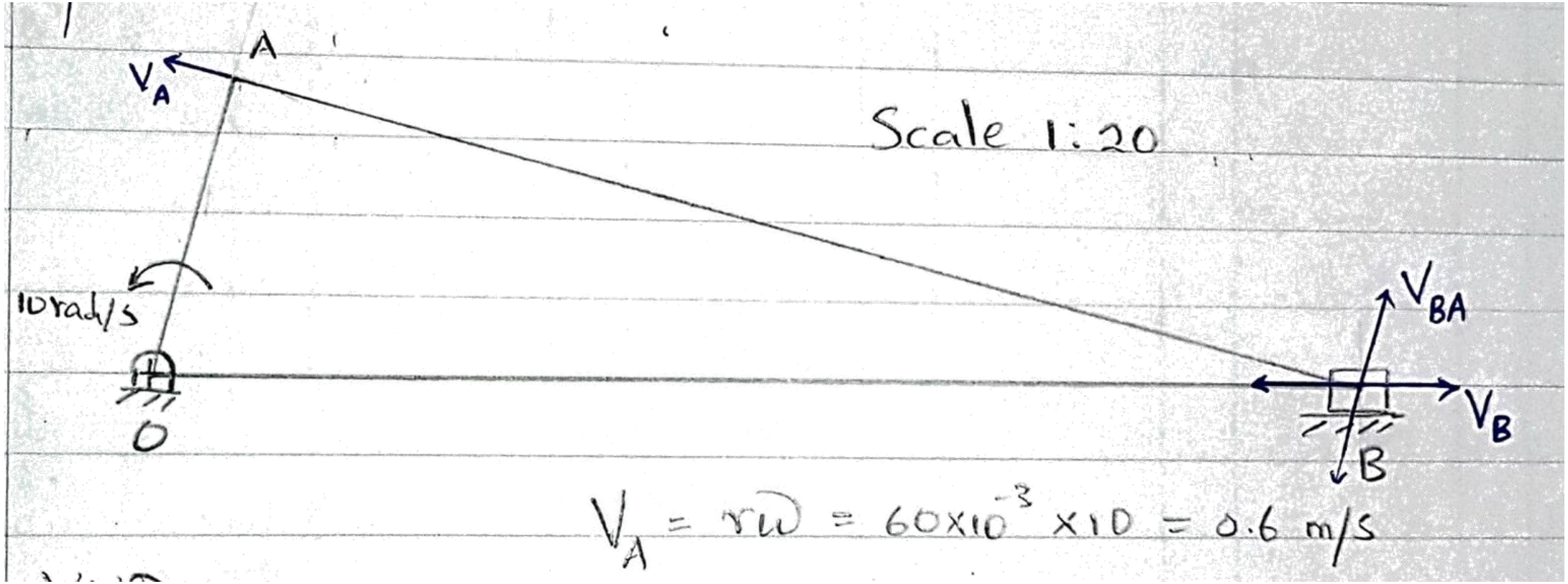


A slider-crank mechanism with crank radius, OA 60 mm and connecting rod, AB length 240 mm is shown in figure. The crank is rotating with a uniform angular speed of 10 rad/s in counter clockwise direction. For the given configuration, find the velocity of the slider.



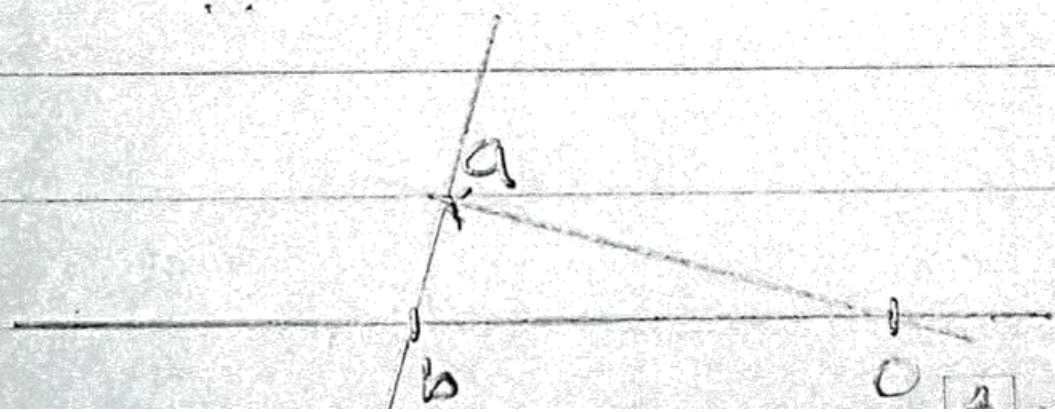
Scale
Space diagram 1:20
VVD 1cm : 0.2 m/s

Space diagram



VVD

Scale 1cm : 0.2m/s



$ob = 3.1\,cm$

$\overleftarrow{V_B} = 0.62\ m/s$

In the slider crank mechanism, the crank OA rotates with a uniform velocity of 600 rev/min in clockwise direction. For the given configuration;

i. draw space diagram, velocity vector diagram

and determine;

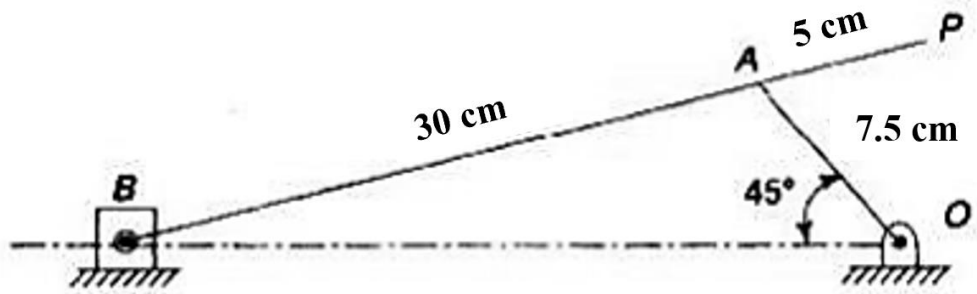
ii. velocity of the slider B

iii. velocity of point P located on the extended connecting rod

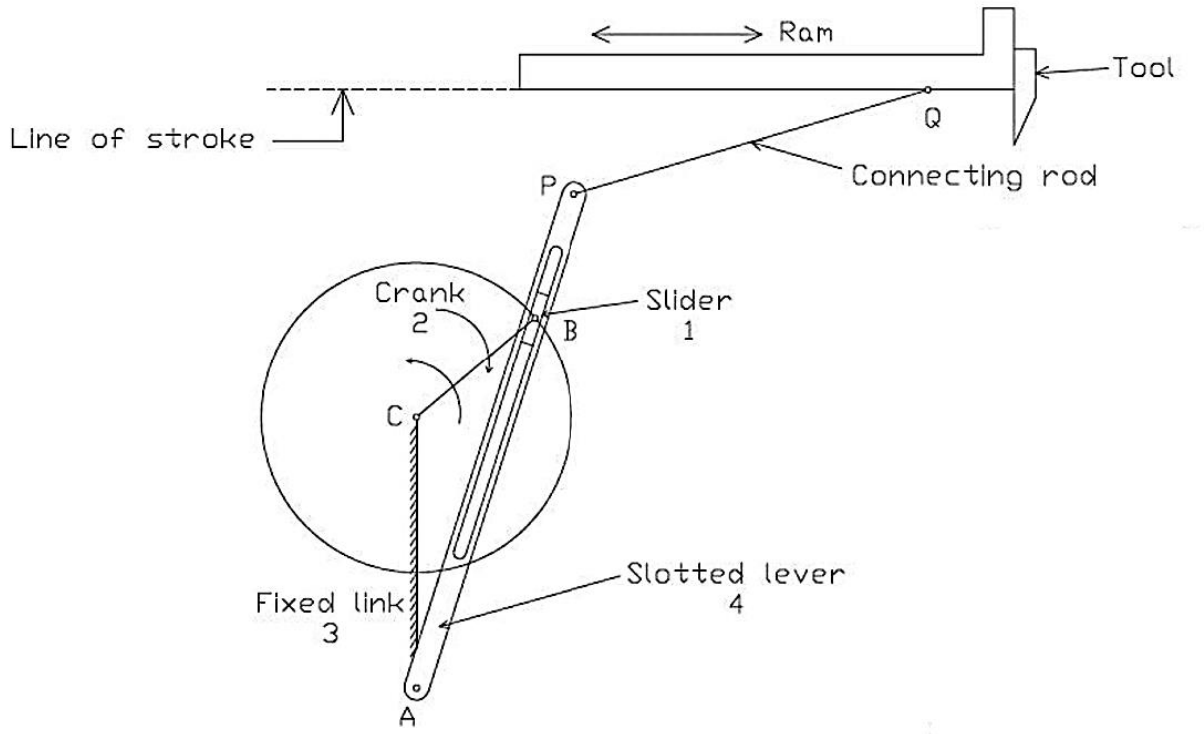
Scale

Space diagram 1 cm = 5 cm

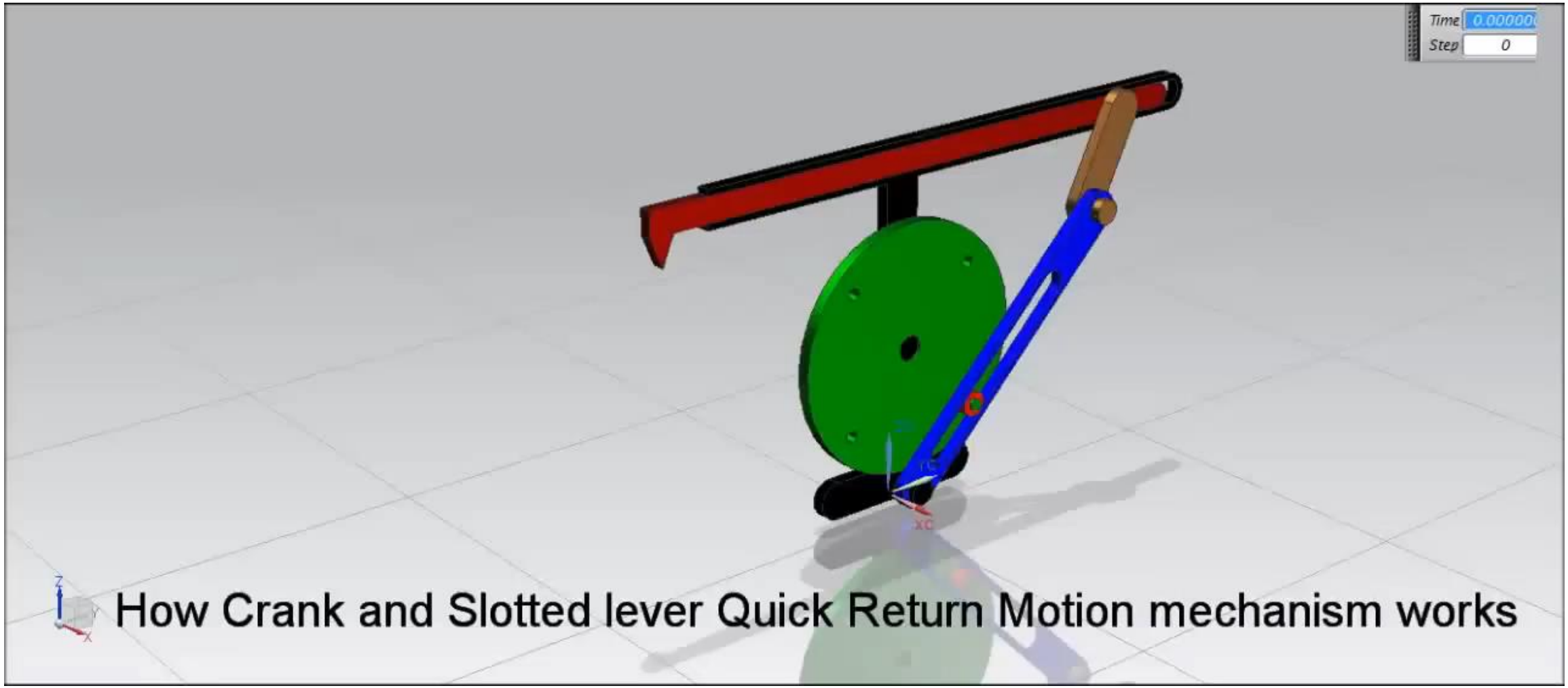
Velocity vector diagram 1 cm = 1 m/s



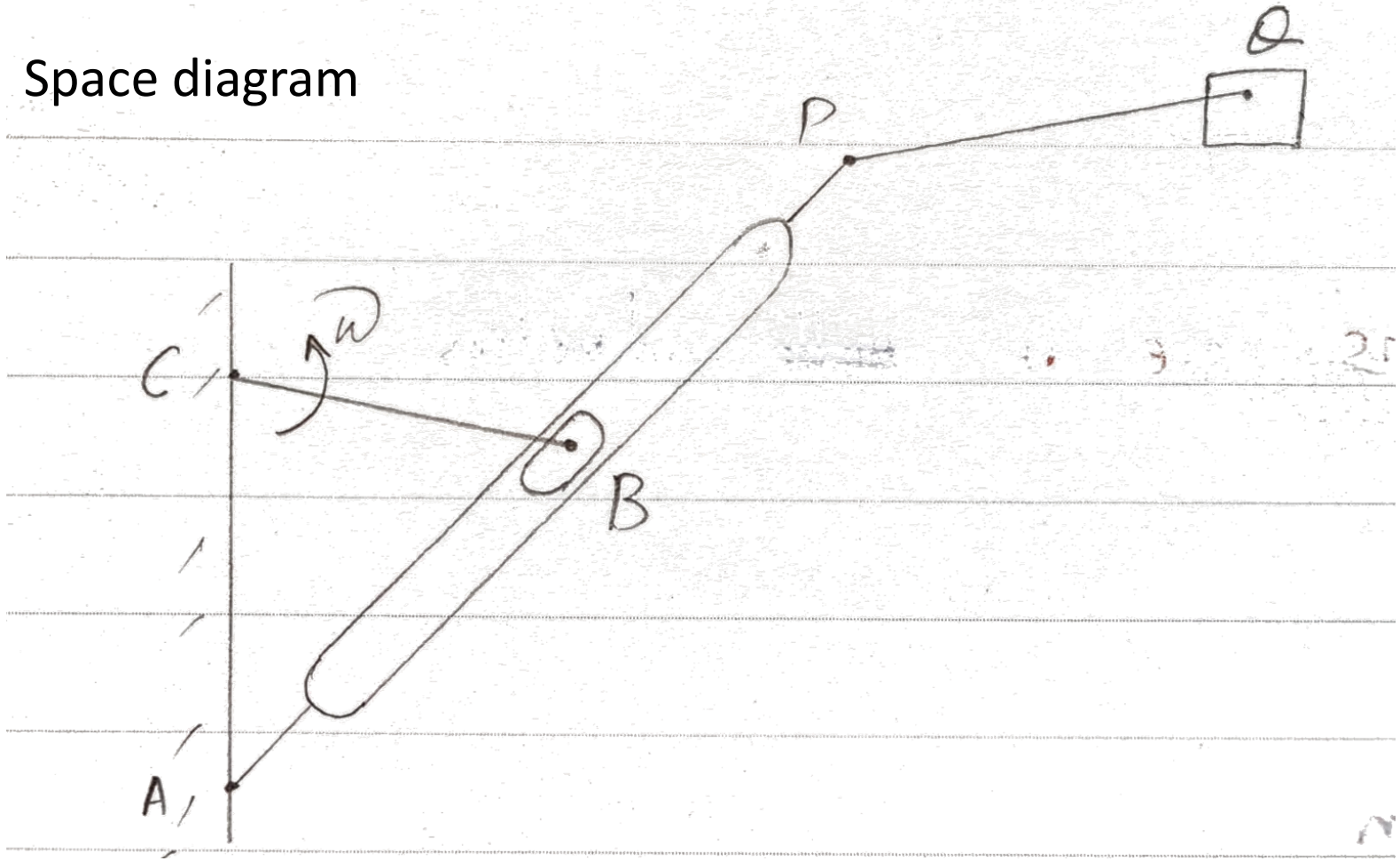
Crank-slotted lever mechanism



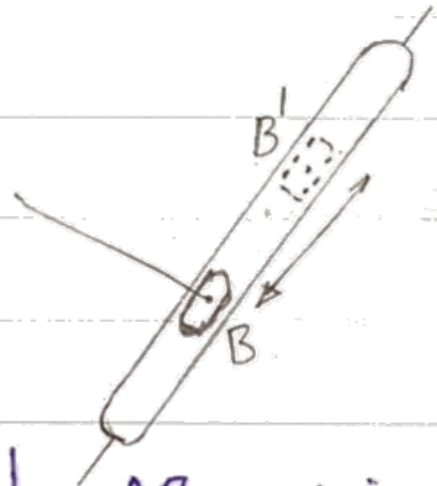
Given the crank CB rotates with uniform angular velocity ω about C in anti-clock wise direction and dimensions of all the links.


Time 0.000000
Step 0
How Crank and Slotted lever Quick Return Motion mechanism works

Space diagram

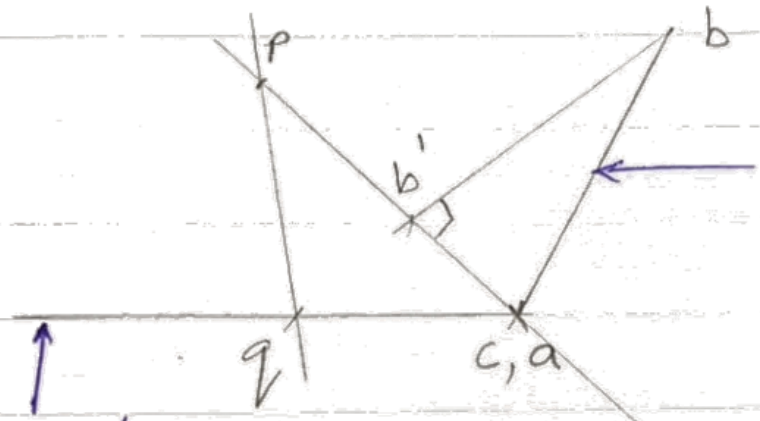


Slider B motion in slotted link.



B' is on link AP coinsiding with B.
BB' gives the linear motion of slider B inside the slot.

VVD



line perpendicular to CB.

$v_b = CB \times \omega$

line parallel to velocity direction of q.

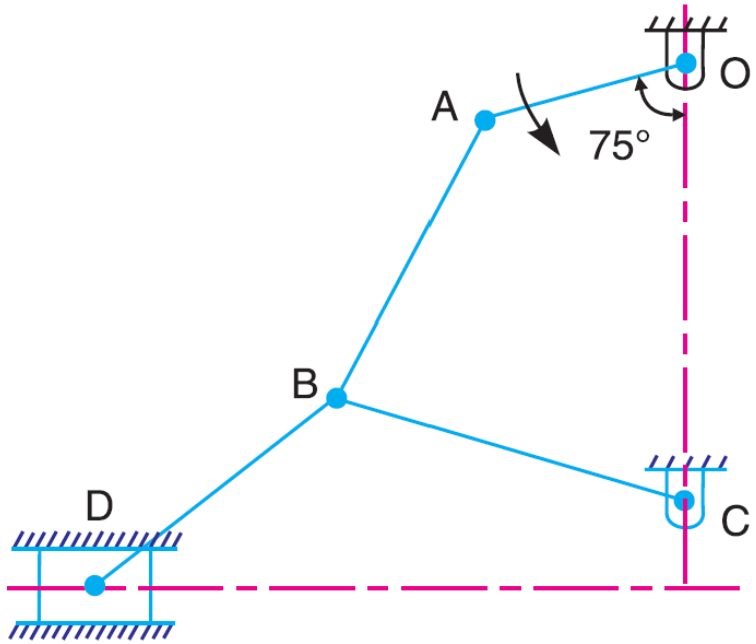
line perpendicular to AP

line bb' - line parallel to link AP.
Describes the motion of slider B.

$$\frac{AB'}{AP} = \frac{ab'}{ap} \Rightarrow ap = \frac{AP}{AB'} \times ab'$$

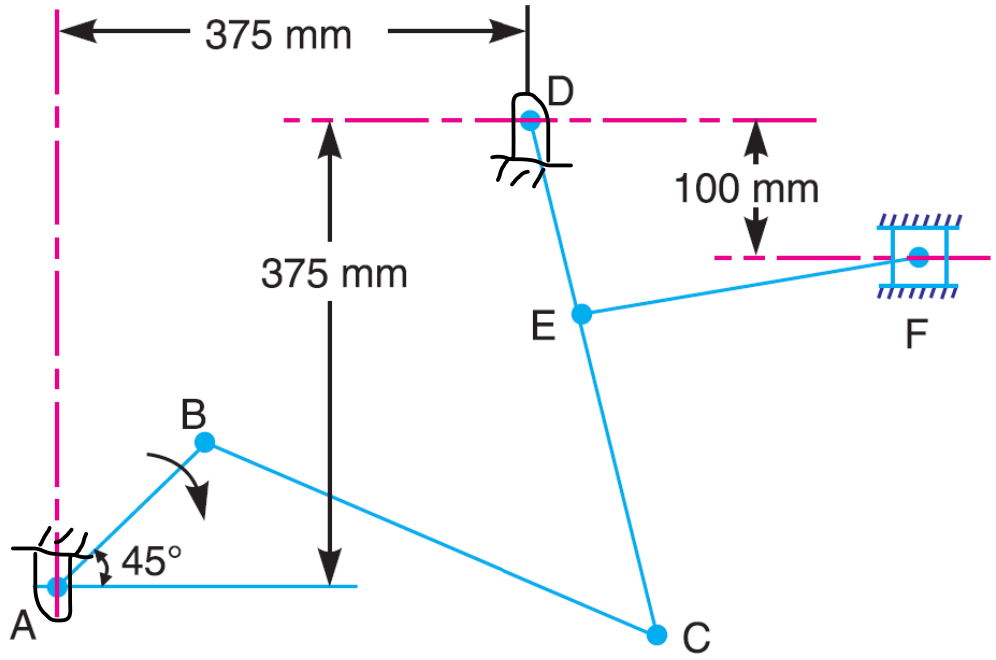
The angular velocity of the crank OA is 600 rev/min. Determine the linear velocity of the slider D and the angular velocity of the link BD, when the crank is inclined at an angle of 75° to the vertical.

The dimensions of various links are : OA = 28 mm ; AB = 44 mm ; BC = 49 mm ; and BD = 46 mm. The centre distance between the centres of rotation O and C is 65 mm. The path of travel of the slider is 11 mm below the fixed point C. The slider moves along a horizontal path and OC is vertical.



The crank AB makes an angle of 45° with the horizontal and rotates about A in the clockwise direction at a uniform speed of 120 rev/min. The lever DC oscillates about the fixed point D, which is connected to AB by the coupler BC. The block F moves in the horizontal guides, being driven by the link EF. Determine: ***1.*** *velocity of the block F,* ***2.*** *angular velocity of DC*

AB = DE = 150 mm ; BC = CD = 450 mm ; EF = 375 mm.



The crank OA is 100 mm long and rotates clockwise about O at 120 rev/min. The connecting rod AB is 400 mm long.

At a point C on AB, 150 mm from A, the rod CE 350 mm long is attached. This rod CE slides in a slot in a trunnion at D. The end E is connected by a link EF, 300 mm long to the horizontally moving slider F.

*For the mechanism in the position shown, find **1.** velocity of F, **2.** velocity of sliding of CE in the trunnion, and **3.** angular velocity of CE.*