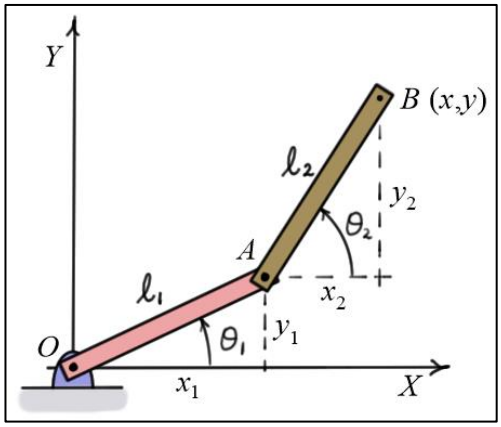
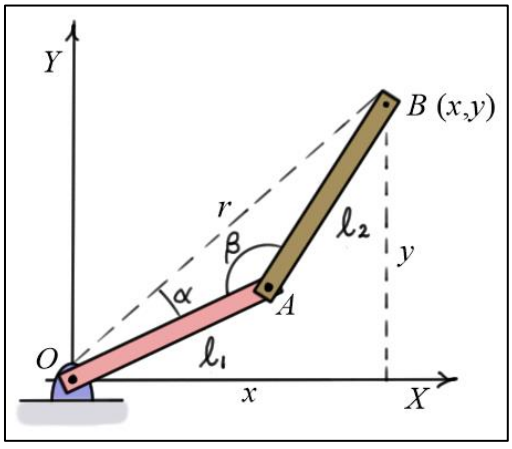
## Elementary Engineering Mathematics
## Homework #3 – Geometry & Trigonometry

1. The polar coordinates of an object *O* are $r = 2700$ (ft), $\theta = 60$ (deg). Find the Cartesian coordinates *x* and *y* of *O* using a) a calculator to evaluate the trig functions, and b) the values given for commonly used angles.
2. The polar coordinates of an object are $r = 1500$ (ft), $\theta = 210$ (deg). Find the Cartesian coordinates *x* and *y* of *O* using a) a calculator to evaluate the trig functions, and b) the values given for commonly used angles.
3. The Cartesian coordinates of an object *O* are $x = 2750$ (ft), $y = -1500$ (ft). Find the polar coordinates *r* and $\theta$ of *O*. Express $\theta$ in both degrees and radians.
4. The Cartesian coordinates of an object *O* are $x = -1250$ (ft), $y = -1500$ (ft). Find the polar coordinates *r* and $\theta$ of *O*. Express $\theta$ in both degrees and radians.
5. The angle between the line $y(x) = \frac{3}{4}x - 12$ and the *X* axis is called $\theta$. Find the $\sin(\theta)$, $\cos(\theta)$, $\tan(\theta)$, and $\theta$. Express $\theta$ in both degrees and radians.
6. The lengths and angles of a two link planar robot are $\ell_1 = 2.5$ (ft), $\ell_2 = 1.75$ (ft), $\theta_1 = 60$ (deg), and $\theta_2 = 30$ (deg). Find the Cartesian coordinates *x* and *y* of *B* using a) a calculator to evaluate the trig functions, and b) the values given for commonly used angles.



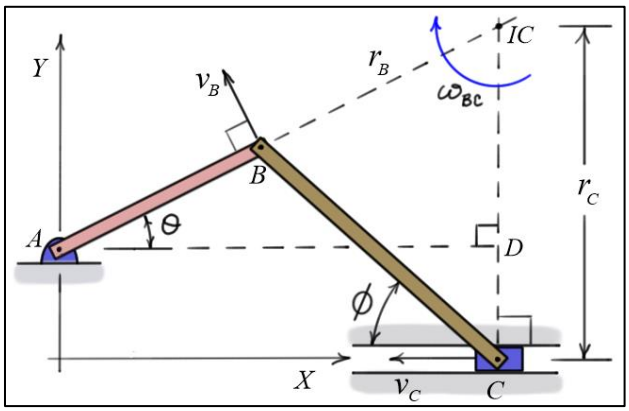

7. The lengths and angles of a two link planar robot are $\ell_1 = 2.5$ (ft), $\ell_2 = 1.75$ (ft), $\theta_1 = -30$ (deg), and $\theta_2 = 60$ (deg). Find the Cartesian coordinates *x* and *y* of *B* using a) a calculator to evaluate the trig functions, and b) the values given for commonly used angles.
8. The *XY* coordinates of the end point *B* and the lengths of the links *OA* and *AB* are $x = 3.25$ (ft), $y = 2.4$ (ft), $\ell_1 = 2.5$ (ft), and $\ell_2 = 1.75$ (ft). Find: (a) the angles $\alpha$ and $\beta$, and (b) the link angles $\theta_1$ and $\theta_2$ for the elbow-down position. Express all angles in both degrees and radians.



9. For the slider-crank mechanism, the coordinates of points *A*, *B*, and *C* and the velocity of point *B* are

$A(0,3)$ $B(3,7)$ $C(15,0)$ (inches)

$v_B = 8$ (in/s) (in the direction shown)




a) Using the right triangle *ADIC*, find the distances $r_B$ and $r_C$. Express the result in inches.

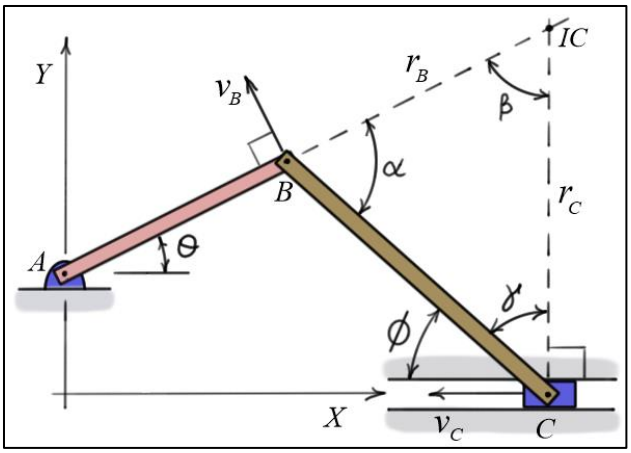
b) Find the velocity $v_C$. Express the result in inches/sec.

***Given:*** $\boxed{\dfrac{v_B}{r_B} = \dfrac{v_C}{r_C}}$

10. For the slider-crank mechanism, the coordinates of points *A*, *B*, and *C* and the velocity of point *B* are

$A(0,3)$ $B(4,7)$ $C(14,0)$ (inches)

$v_B = 10$ (in/s) (in the direction shown)




a) Find the angles $\alpha$, $\beta$, and $\gamma$ of the non-right triangle *BCIC*. Express the results in degrees.

b) Using the law of sines, find the distances $r_B$ and $r_C$.

c) Find the velocity $v_C$.

***Given:*** $\boxed{\dfrac{v_B}{r_B} = \dfrac{v_C}{r_C}}$