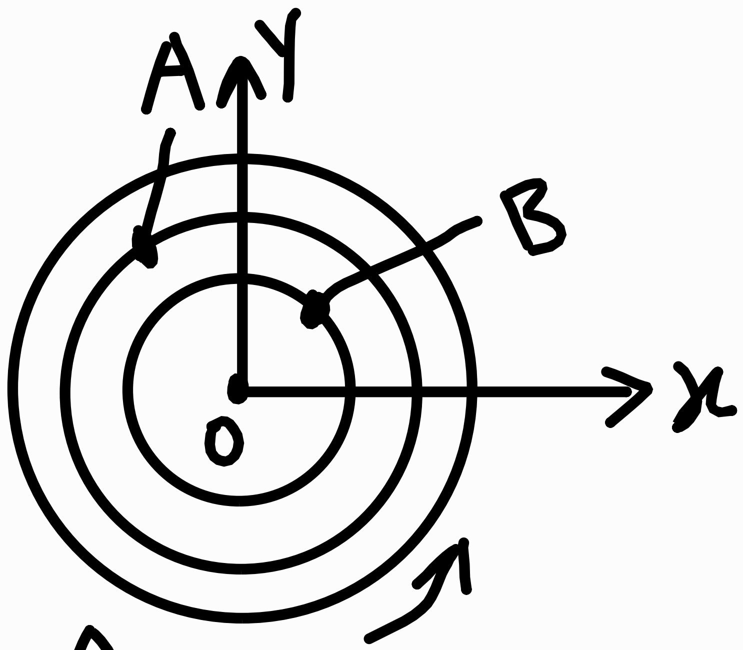
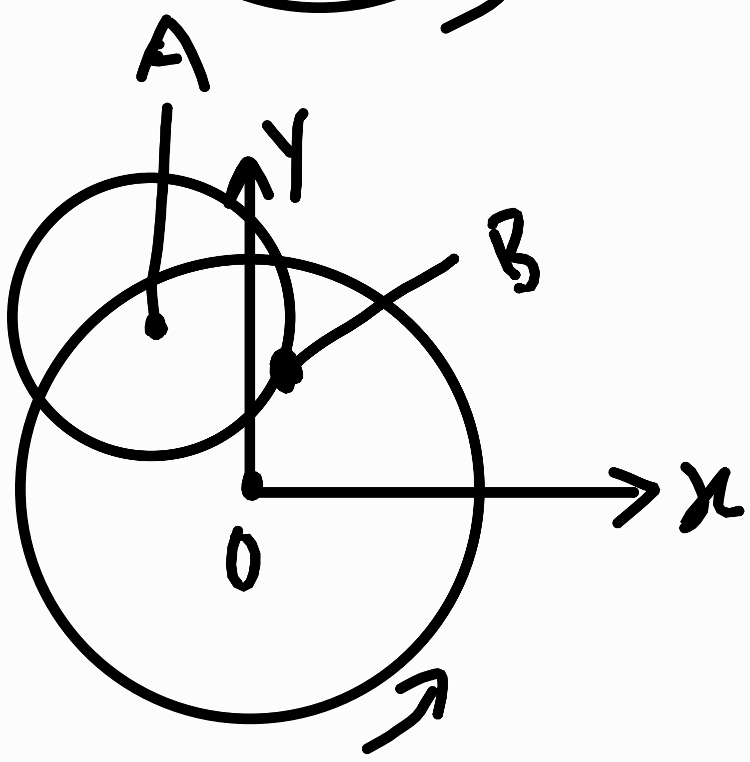
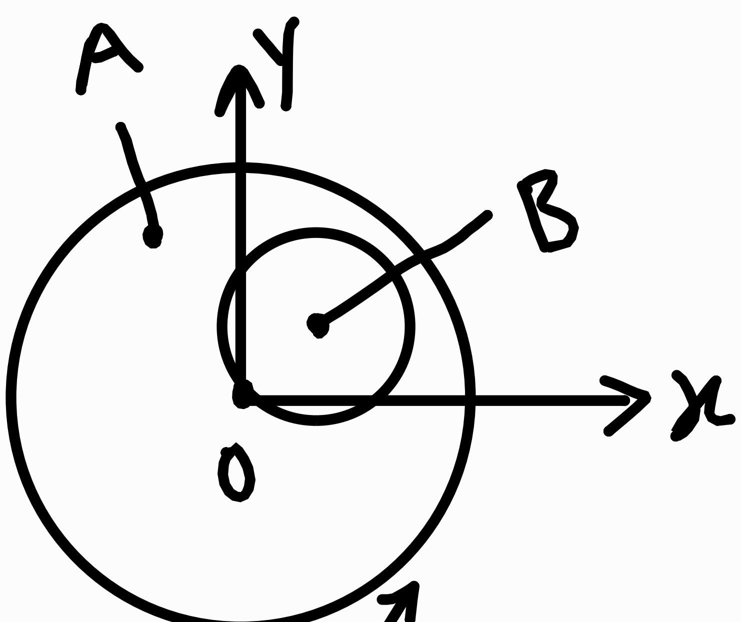
1a)



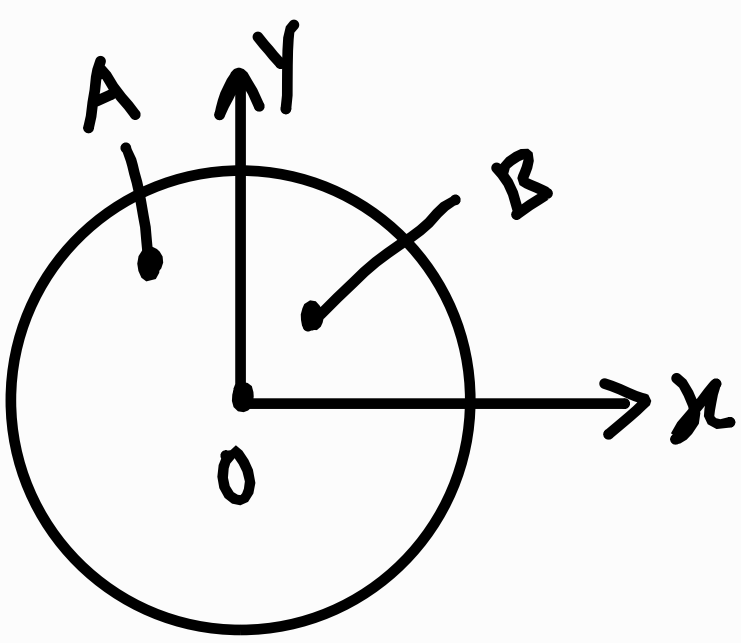
b)



c)



d)



2a) $\vec{r}_A = x_A \underset{\sim}{i} + y_A \underset{\sim}{j}$

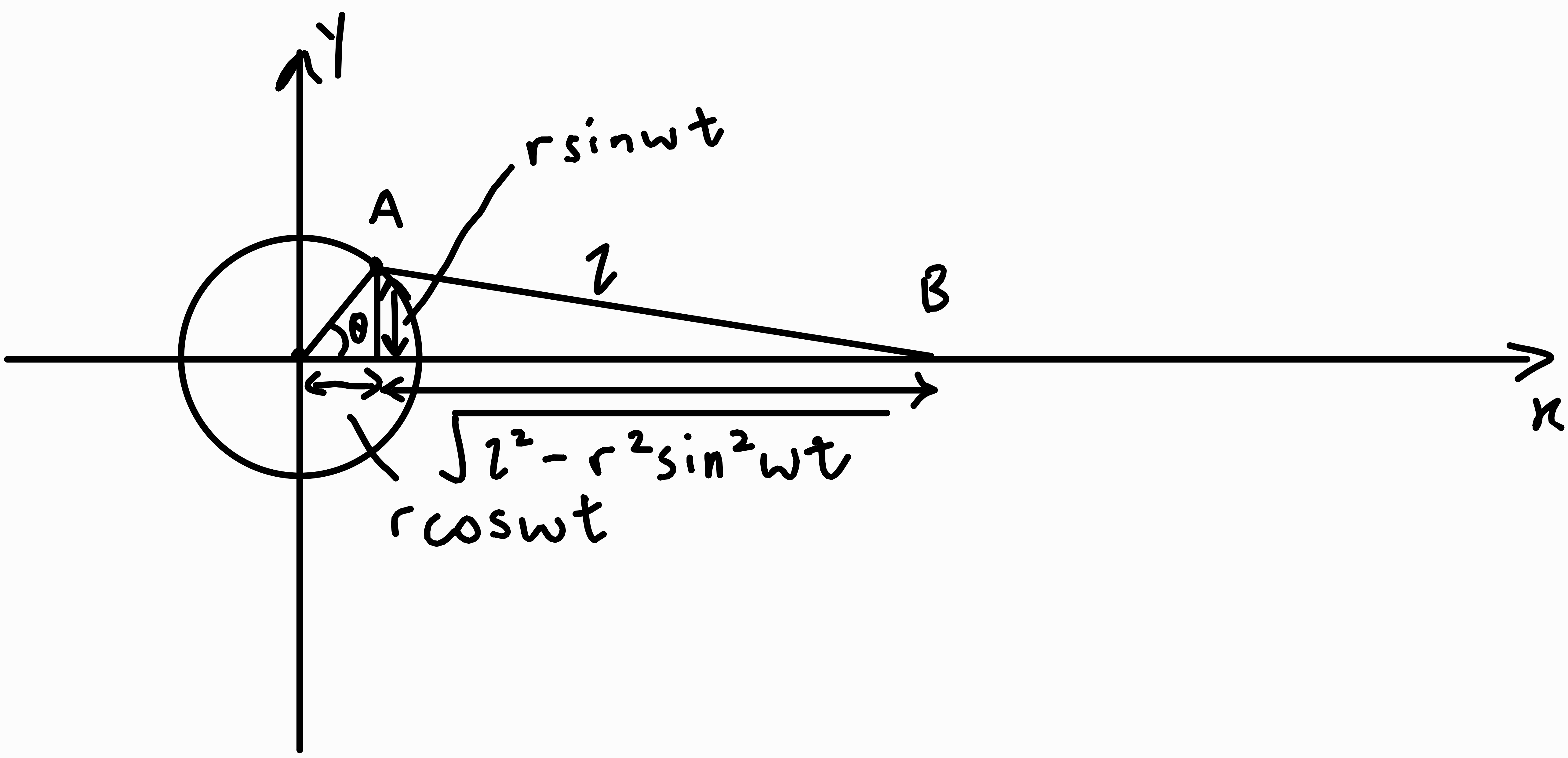
b) $\vec{r}_{BA} = l \angle \theta = l(\cos\theta \underset{\sim}{i} + \sin\theta \underset{\sim}{j})$

c) $\vec{r}_{CB} = l \angle \phi = l(\cos\phi \underset{\sim}{i} + \sin\phi \underset{\sim}{j})$

d) $\vec{r}_{CA} = \vec{r}_{CB} + \vec{r}_{BA}$

3a) $\vec{OA} = r(\cos wt \underset{\sim}{i} + \sin wt \underset{\sim}{j})$

$\vec{OB} = \left(r\cos wt + \sqrt{l^2 - r^2\sin^2 wt}\right) \underset{\sim}{i}$



3b) $\underset{\sim}{v} = \dfrac{d\underset{\sim}{x}}{dt} = rw(-\sin wt\,\underset{\sim}{i} + \cos wt\,\underset{\sim}{j})$

$= -rw(\sin wt\,\underset{\sim}{i} - \cos wt\,\underset{\sim}{j})$

$\underset{\sim}{a} = \dfrac{d\underset{\sim}{v}}{dt} = rw^2(-\sin wt\,\underset{\sim}{j} - \cos wt\,\underset{\sim}{i})$

$= -rw^2(\cos wt\,\underset{\sim}{i} + \sin wt\,\underset{\sim}{j})$

c) $\overrightarrow{OB} = \left(r\cos wt + \sqrt{l^2\left(1 - \dfrac{r^2\sin^2 wt}{l^2}\right)}\right)\underset{\sim}{i}$

$= \left(r\cos wt + l\sqrt{1 - \dfrac{r^2\sin^2 wt}{l^2}}\right)\underset{\sim}{i}$

$\simeq \left(r\cos wt + l\left(1 - \dfrac{r^2\sin^2 wt}{2l^2}\right)\right)\underset{\sim}{i}$

$\simeq \left(r\cos wt + l - \dfrac{r^2\sin^2 wt}{2l}\right)\underset{\sim}{i}$

$\simeq \left(r\cos wt + l - \dfrac{r^2}{4l}(1 - \cos 2wt)\right)\underset{\sim}{i}$

$\underset{\sim}{v} = \dfrac{d\underset{\sim}{x}}{dt} = \left[-rw\sin wt - \dfrac{r^2}{4l}(-2w\sin 2wt)\right]\underset{\sim}{i}$

$= \left[-rw\left(\sin wt + \dfrac{r\sin 2wt}{2l}\right)\right]\underset{\sim}{i}$

$v = -rw\left(\sin wt + \dfrac{r}{2l}\sin 2wt\right)$

3c)

$$v = -r\omega\left(\sin\omega t + \frac{r}{2l}\sin 2\omega t\right)$$

$$a = \frac{dv}{dt} = -r\omega^2\left(\cos\omega t + \frac{2r}{2l}\cos 2\omega t\right)$$

$$= -r\omega^2\left(\cos\omega t + \frac{r}{l}\cos 2\omega t\right)$$

4) $\underset{\sim}{r} = 8t^2\underset{\sim}{i} + (t^3+5)\underset{\sim}{j}$

$$\underset{\sim}{v} = \frac{d\underset{\sim}{r}}{dt} = 16t\underset{\sim}{i} + 3t^2\underset{\sim}{j}$$

when $t=3$,

$$v = \sqrt{[16(3)]^2 + (3\times 3^2)^2}$$

$$= 55.07267925$$

$$\approx 55.1$$

$$\underset{\sim}{a} = \frac{d\underset{\sim}{v}}{dt} = 16\underset{\sim}{i} + 6t\underset{\sim}{j}$$

when $t=3$,

$$a = \sqrt{16^2 + (6\times 3)^2}$$

$$= 24.08318916$$

$$\approx 24.1$$

4) Let $r(t) = x(t)\underset{\sim}{i} + y(t)\underset{\sim}{j}$

$$x(t) = 8t^2$$

$$y(t) = t^3 + 5$$

$$\frac{x}{8} = t^2$$

$$t = \sqrt{\frac{x}{8}}$$

$$y(t) = \sqrt{\frac{x}{8}}^{\,3} + 5$$

$$= (0.125x)^{\frac{3}{2}} + 5$$