

a)

$$\frac{dv}{dt} = -k\sqrt{y}$$

$$, t=0, y=y_0$$

$$t=T, y=0.$$

$$1) \frac{dy}{dt} = \frac{dv}{dt} \cdot \frac{dy}{dv}$$

$$V = Ay^{\frac{3}{2}}$$

$$\frac{dv}{dt} = \frac{-k\sqrt{y}}{A}$$

$$\frac{dv}{dy} = A$$

$$\frac{dy}{dv} = \frac{1}{A}$$

$$2) \frac{dy}{dt} = -\frac{A}{k\sqrt{y}}$$

$$\int_0^T dt = -A \int_{y_0}^0 \frac{1}{k\sqrt{y}} dy$$

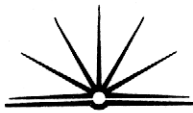
$$= \frac{A}{k} \int_0^{y_0} y^{-\frac{1}{2}} dy$$

$$= \frac{2A}{k} \left[y^{\frac{1}{2}} \right]_0^{y_0}$$

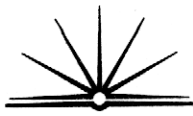
$$T - 0 = \frac{2A}{k} \left(y_0^{\frac{1}{2}} - 0 \right)$$

$$\sqrt{y_0} \left(\frac{k(T-0)}{2A} \right) = \sqrt{y_0}$$

$$\frac{k(T-0)}{2A} = 1$$



$$y_0 \left(\frac{K(T - \epsilon)}{2A} \right) = y$$



$$(iii) \quad t=0, \quad y=\frac{y_0}{2}$$

~~$t=2T$~~

$$t=2T \quad y=0$$

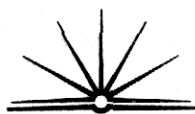
$$\frac{y_0}{2} = y_0 \left(1 - \frac{10}{T}\right)$$

$$1 - \frac{1}{2} = \frac{10}{T}$$

$$\frac{1}{2} = \frac{10}{T}$$

$$\therefore T = 5.5$$

$\therefore 5 \text{ seconds}$



$$b) z_n = \cos(\alpha + n\beta) + i \sin(\alpha + n\beta)$$

∴

$$z_0 = \cos \alpha + i \sin \alpha$$

$$z_1 = \cos(\alpha + \beta) + i \sin(\alpha + \beta) \dots \text{and so on}$$

the ext \angle of a polygon with
equal sides are always
the same all equal.

OR

$$\overrightarrow{P_0 P_1} = z_1$$

$$\overrightarrow{P_1 P_2} = z_2$$

$$\overrightarrow{P_2 P_3} = z_3$$

Since $z_1 = z_2 = z_3$ (equal distance)

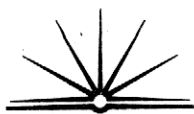
$$\therefore z_3 = z_2$$

$$0 = z_3 - z_2 = z_1 - z_0 = 0$$

$$0 = z_2 - z_1 = z_0$$

$$0 = z_1 - z_0$$

$$= z_0$$



b) (b) $\triangle OP_0P_1$.

$$P_1P_0 = OP_0 \text{ (given)}$$

\Rightarrow

$$\angle P_1OP_0 = \angle OP_1P_0 \text{ (base } \angle \text{ of } \triangle) \\ = \alpha \text{ (BOS } \triangle)$$

$$\theta_0 = 2\alpha \text{ (ext. } \angle \text{ of } \triangle)$$

$$\alpha = \frac{\theta_0}{2}$$

In $\triangle P_0P_1P_2$.

$$P_0P_1 = P_1P_2 \text{ (given)}$$

$$= OP_0$$

$$\angle P_0P_2P_1 = \angle P_1P_0P_2 \text{ (base } \angle \text{ of } \triangle) \\ = \beta$$

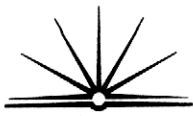
$$\theta_1 = 2\beta$$

$$\beta = \frac{\theta_1}{2}$$

Since $\theta_0 = \theta_1$ (from i)

$$\alpha = \beta$$

$$\therefore \angle P_0OP_1 = \angle P_0P_2P_1$$



b) (ii)

~~circle~~

$O P_0 P_1 P_2$ cyclic quad

$$\rightarrow \angle P_0 O P_1 = \angle P_0 P_2 P_1$$

\rightarrow \angle subtended from the same chord.

(iii)

In $\Delta P_1 P_2 P_3$,

similarly,

$$\angle P_2 P_1 P_3 =$$

$$\angle P_2 P_3 P_1 = \angle P_2 P_0 P_1$$

(base \angle 's are congruent
because \widehat{BOS} is $\angle \theta_1 = \theta_2$)

$\therefore P_0 P_1 P_2 P_3$ is cyclic quad.

$$\text{let } \angle P_3 P_2 O = \delta$$

$$\delta = \pi - \theta_2 - \angle P_0 P_2 P_1$$

$$= \pi - \theta_2 - \alpha$$

$$\angle P_3 P_1 O = \pi - \theta_0 - \angle P_2 P_0 P_1$$

$$= \pi - \theta_0 - \alpha$$

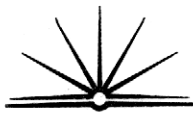
$$= \pi - \theta_2 - \alpha$$

(since $\angle P_0 P_2 P_1 = \angle P_2 P_0 P_1$)

(since $\theta_0 = \theta_2$ from (i))

(from (ii))

$$= \angle P_3 P_2 O$$



(ii) $OP_0P_1P_2P_3$ are ~~collinear~~

concurrent \rightarrow

\angle subtend from the same segment.

$$(i) z_0 = \cos \alpha + i \sin \alpha = c_1^3$$

$$z_1 = \cos(\alpha + \beta) + i \sin(\alpha + \beta)$$

$$z_2 = \cos(\alpha + 2\beta) + i \sin(\alpha + 2\beta)$$

$$z_3 = \cos(\alpha + 3\beta) + i \sin(\alpha + 3\beta)$$

$$z_4 = \cos(\alpha + 4\beta) + i \sin(\alpha + 4\beta)$$

$$z_n = c_1^3(\alpha + n\beta)$$

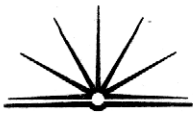
$$z_0 + z_1 + z_2 + z_3 + z_4 = c_1^3(\alpha +$$

$$= c_1^3 \alpha + c_1^3(\alpha + \beta) + c_1^3(\alpha + 2\beta) + c_1^3(\alpha + 3\beta) + c_1^3(\alpha + 4\beta) \Rightarrow$$

$$= \cancel{5c_1^3 \alpha} + \dots$$

equate real ~~and imaginary~~ parts.

$$\cancel{5 \cos \alpha} = 0.$$



Q7 b) i)

$$0 \times 0 =$$

0