p60 – F12-27

tangential velocity

$$v_t = 0.0625t^2$$

$$a_t = \dot{v}_t = 2(0.0625)t = 0.125t$$

at $t = 10$,

$$a_t = 0.125(10) = 1.25 \text{ m/s}^2$$

normal component

$$a_n = \frac{v^2}{\rho} = \frac{(0.0625t^2)^2}{40} = 9.76 \times 10^{-5} t^4$$

at $t = 10$,

$$a_n = 9.76 \times 10^{-5} (10)^4$$

$$a_n = 0.976 \text{ m/s}^2$$

magnitude of acceleration

$$a = \sqrt{a_t^2 + a_n^2}$$

$$= \sqrt{1.25^2 + 0.976^2}$$

$$a = 1.59 \text{ m/s}^2$$

P. 60 F12-28

$$V = \frac{300}{s}$$

$$\frac{ds}{dt} = \frac{300}{s}$$

$$300\int_0^t dt = \int_0^s s\,ds$$

$$300t = \frac{s^2}{2}$$

$$s^2 = 600t$$

$$s = (600t)^{1/2}$$

at $t = 3$

$$s = (600.3)^{1/2} = 42.43\ m$$

$$a_t = \frac{dV}{dt};\quad V = \frac{300}{(600t)^{1/2}} \Rightarrow \frac{dV}{dt} = -\frac{1}{2}\cdot\frac{300}{\sqrt{600}}t^{-3/2}$$

at $t=3$, $a_t = -\frac{1}{2}\cdot\frac{300}{\sqrt{600}}\cdot(3)^{-3/2} = -1.1785\ m/s^2$

$$a_n = \frac{v^2}{\rho} = \left[\frac{300}{(600t)^{1/2}}\right]^2\cdot\frac{1}{100} = 0.5\ m/s^2$$

(evaluate at $t = 3s$)

$$a = \sqrt{0.5^2 + (-1.1785)^2} = 1.28\ m/s^2$$

12 – 118

tangential
~~normal~~ components

$$v = 0.2t^2$$

at $t = 3s$, $v = 0.2(3)^2 = 1.8\ m/s$

normal acceleration

$$a_n = \frac{v^2}{\rho}$$

at $t = 3s$, $v = 1.8\ m/s$

$$a_n = \frac{1.8^2}{50} = 0.065\ m/s^2$$

tangential acceleration

$$a_t = \dot{v} = 2(0.2)t = 2(0.2)(3) = 1.2\ m/s^2$$

magnitude of acceleration

$$a = \sqrt{a_t^2 + a_n^2} = \sqrt{1.2^2 + 0.065^2}$$

$$= 1.201\ m/s^2$$

P 12 – 131

from A to B

$$\frac{dV}{dt} = -0.08V$$

$$dt = \frac{dV}{-0.08V} \Rightarrow \int_0^t dt = \int_{30}^{V} \frac{dV}{-0.08V}$$

$$t = \int_{30}^{V} -12.5\, V^{-1}\, dV = -12.5 \left[\ln V\right]_{30}^{V}$$

$$= -12.5\left[\ln V - \ln 30\right] = \ln\left(\frac{V}{30}\right)^{-12.5} \quad \text{—(1)}$$

$$a_t\, ds = V\, dV$$

$$-0.08V\, ds = V\, dV$$

$$-0.08\, ds = dV$$

$$\int_0^{S} ds = -12.5 \int_{30}^{V} dV$$

$$S = -12.5\left[V - 30\right] \quad \text{— (2)}$$

at B, $S = 100$

$$100 = -12.5\,(V - 30)$$

$$V = \frac{100}{-12.5} + 30 = 22 \text{ m/s}$$

from equation (1) travel time from A to B,

$$t = \ln\left(\frac{22}{30}\right)^{-12.5} = 3.87 \text{ s}$$

Now we analyze B to C.

we know travel time $= 15 - 3.87 = 11.12$ s

velocity at C;

$$11.12 = \ln\left(\frac{V}{22}\right)^{-12.5}$$

~~$\left(\frac{V}{22}\right)^{-12.5} = e^{11.12}$~~

$$11.12 = -12.5\left[\ln V - \ln 22\right]$$

$$\ln V = -\frac{11.12}{12.5} + \ln 22 = ~~3.048~~ 2.120$$

$$V = e^{~~3.048~~ 2.120} = 9.03 \text{ m/s}.$$

at C;

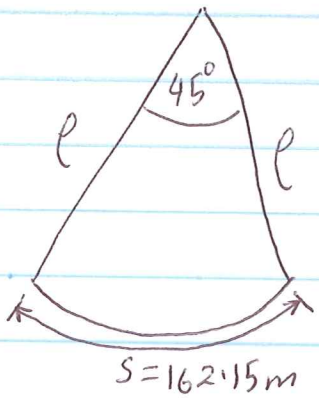
$$a_t = -0.08(9.03) = -0.723 \text{ m/s}^2$$

distance from B to C

from Eqn (2)

$$S = -12.5(V_c - V_B) = -12.5(9.03 - 22)$$

$$= 162.15 \text{ m}$$



$S = \ell\theta$, where θ is in radians

$45^\circ = \frac{45\,\pi}{180} = \pi/4$ radians

$162.15 = \ell \cdot \frac{\pi}{4}$

$\ell = 162.15 \cdot \frac{4}{\pi} = 206$ m

at C; $a_n = \frac{v_c^2}{\ell} = \frac{9.03^2}{206} = 0.3958\ m/s^2$

$a = \sqrt{(-0.723)^2 + 0.3958^2} = 0.8242\ m/s^2$