Problem 3

Monday, February 5, 2024 5:39 PM

a. $A_s = 4\pi r^2$ $\quad V = \frac{4}{3}\pi r^3$

$T_s = C_m\left(\frac{V}{A_s}\right)^2$ $\quad \left(\frac{3V}{4\pi}\right)^{\frac{1}{3}} = r$

$\left(\frac{A_s}{V}\right)^2 T_s = C_m$ $\quad$ Thus $A_s = 4\pi\left(\frac{3V}{4\pi}\right)^{2/3}$

$$C_m = \left(\frac{4\pi\left(\frac{3V}{4\pi}\right)^{2/3}}{V}\right)^2 (T_s) = \boxed{11.413\ \left[\frac{min}{in^2}\right]}$$

$$\left(\frac{in^2}{in^3}\right)^2 (min) = \frac{min}{in^2}$$

b. $A_s = (2\pi r)(h)$

$A_s^* = 2(2\pi r)(r)$

$A_s^{*+} = 4\pi r^2 + 2\pi r^2 = 6\pi r^2$

$$A_s^{*+} = 4\pi r^2 + 2\pi r^2 = 6\pi r^2$$

$$A_{s'}^{*+} = 6\pi r^2 + (2\pi(2r))(r)$$

$$= 6\pi r^2 + 4\pi r^2$$

$$A_{s'} = 10\pi r^2$$

$$A_{s''} = 2\left(\pi(2r)^2 - \pi r^2\right)$$

$$= 2(4\pi r^2 - \pi r^2)$$

$$= 6\pi r^2$$

$$A_F = 16\pi r^2$$

$A = 4\pi r^2$

$A = 4\pi\left(\frac{3V}{4\pi}\right)^{2/3}$

$V = 2(\pi r^2)(r) + (\pi(2r)^2)(r)$

$= 2\pi r^3 + 4\pi r^3$

$V = 6\pi r^3$

$\frac{3V}{4\pi} = r^3$

$V = \frac{4}{3}\pi r^3$

$\left(\frac{V}{6\pi}\right)^{1/3}$

$\left(\frac{3V}{4\pi}\right)^{2/3}$

$$\left(\frac{V}{6\pi}\right)^{1/3} = r \Rightarrow A = 16\pi\left(\frac{V}{6\pi}\right)^{2/3}$$

$$t_s = Cm\left(\frac{V^2}{A^2}\right) = \boxed{2.09\,min}$$

c.

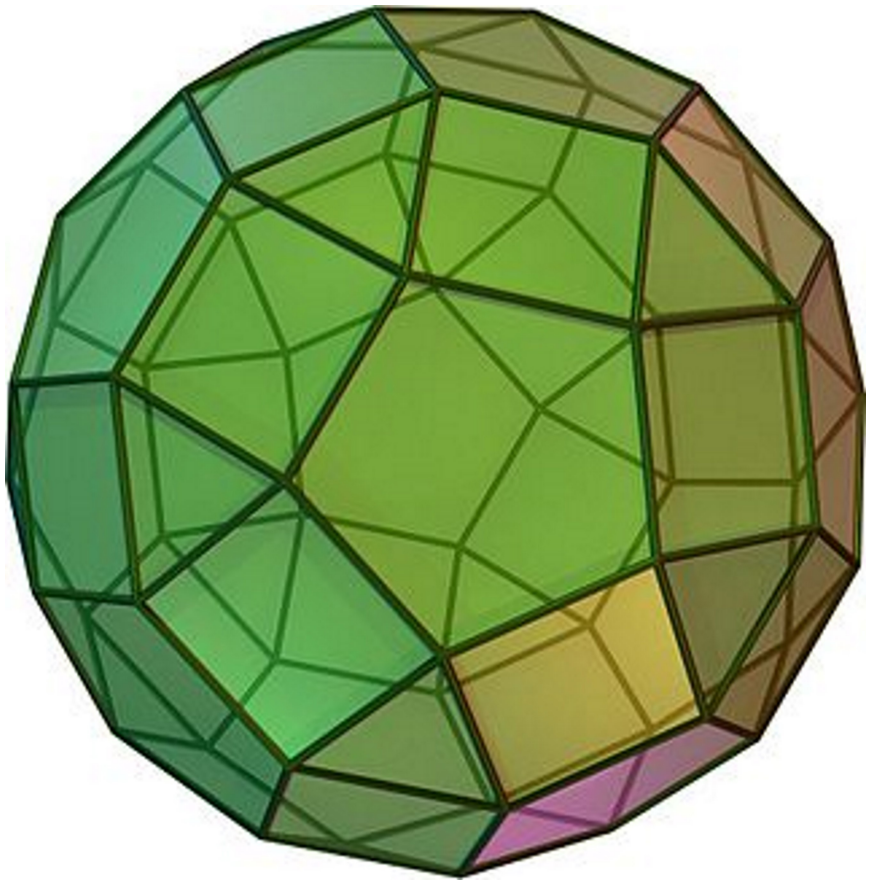
$$S_A = 4\pi^2 Rr = 16\pi^2 r^2$$

$$V = 2\pi^2 Rr^2 = 8\pi^2 r^3$$

$$\frac{V}{8\pi^2} = r^3 \Rightarrow \left(\frac{V}{8\pi^2}\right)^{1/3} = r$$

$$t_s = Cm\left(\frac{28}{16\pi^2\left(\frac{28}{8\pi^2}\right)^{2/3}}\right)^2 = \boxed{1.43\,min}$$

d.) Rhombicosidodecahedron



$$A = \left(30 + 5\sqrt{3} + 3\sqrt{25 + 10\sqrt{5}}\right)a^2 = 45.537\text{in}^2$$

$$V = \frac{60 + 29\sqrt{5}}{3}a^3 = 28\text{in}^3$$

Thus, $\boxed{a = .87626\text{ in}}$

Thus, $t_s = \left(\frac{V}{A}\right)^2 \text{Cm}$

$$t_s \approx 5.619766664762\,a^2$$

$$t_s \approx 4.315073\text{ min}$$

$t_s \approx$ [illegible]

c.)

1. Sphere

$$\dot{Q} = \frac{V}{t_s} = \frac{28}{4.5} = \boxed{6.2 \text{ in}^3/\text{min}}$$

2.) Cylinders

$$\dot{Q} = 13.4 \text{ in}^3/\text{min}$$

3.) Torus

$$\dot{Q} = 19.587 \text{ in}^3/\text{min}$$

9.) The long-named one

$$\dot{Q} = 6.4889 \text{ in}^3/\text{min}$$