

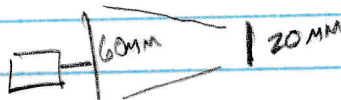
Mark 1 original

$$L = (1.225 \text{ kg/m}^3) 4\pi^2 (52 \text{ mm})^2 \cdot \left( \frac{\text{revs}}{\text{sec}} \right)$$

MOTOR:

$$15000 \text{ RPM} = 250 \text{ revs/sec}$$

\* Gear ratio



$$188.5 \text{ mm} : 62.8 \text{ mm} \quad 3:1$$

$$250 \rightarrow 83.33 \text{ rev/sec}$$

$$L = \rho \cdot G \cdot V \text{ lbs/ft}$$

where,

$$\rho = \text{air density} \approx 1.225 \text{ kg/m}^3$$

$$= 0.0023768924 \text{ slugs/ft}^3$$

$G$  = Vortex strength

$$2\pi \cdot b \cdot V_r \Rightarrow 2\pi \cdot (0.170604 \text{ ft}) \cdot V_r$$

$$b = 52 \text{ mm} = 0.170604 \text{ ft}$$

$V_r$  = rotational speed (ft/sec)

$$V_r = 2\pi \cdot b \cdot s$$

$$2\pi \cdot (0.170604 \text{ ft}) (83.33 \text{ revs/sec})$$

$$V_r = 89.32804515 \text{ ft/sec}$$

$$\rightarrow 2\pi (0.170604) (89.32804515 \text{ ft/sec})$$

$$G = 4 \rightarrow 95.7539962$$

assuming  $V$  = Air flow direction) of 1 ft/sec

$$L = (\underbrace{0.0023768924 \text{ slugs/ft}^3}_{\rho}) (\underbrace{95.7539962 \text{ ft}^3/\text{sec}}_G) (\underbrace{1 \text{ ft/sec}}_V)$$

$$\Rightarrow 0.227596946 \text{ lbs/ft} \approx 101 \text{ g/ft.}$$

$$2 \text{ ft} = 202 \text{ g} < \underline{229 \text{ g}}$$

Weight

$$\text{wheel } 11.2 \text{ g} \times 4 = 44.8$$

Battery Box  
and motor

$$\text{w/ wires } 71.7 \text{ g}$$

Nut

$$\text{Pollywheels} = 9 \text{ g}$$

$$\text{Total} = 229 \text{ g}$$

styrophone

w/ metal parts

$$+ \text{ tape and } = 103.5 \text{ g}$$

paper

$$\text{styrophone} \approx 2.2 \text{ g}$$

$$\text{tape + paper max } 20 \text{ g}$$

$$\text{metal parts} = 81.3 \text{ g}$$

## Lift of a Rotating Cylinder

$$L = \rho \cdot G \cdot V \text{ (lbs/ft)}$$

where  $\rho$  = gas density (slugs/cuft.)

$$G = 2\pi \cdot b \cdot V_r = \text{Vortex strength (sq.ft./sec)}$$

→  $b$  = radius of cylinder (ft)

$$\rightarrow V_r = 2\pi \cdot b \cdot s$$

—  $s$  = spin (revs/sec)

$$L = \rho \cdot (2\pi \cdot b \cdot (2\pi \cdot b \cdot s)) \cdot V \quad \rightarrow \text{expanded}$$

$$L = \rho \cdot (4\pi^2 b^2 s) \cdot V$$

→ simplified w/o  
 $V_r = G$