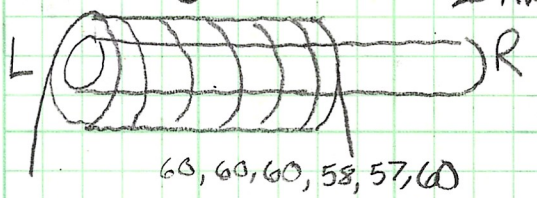
Making Coil

* Using 22 AWG wire, 20 AWG is better (solid for both)

20 AWG: $\frac{I_{max}}{7A}$
22 AWG: 11 A



60, 60, 60, 58, 57, 60

Looking down tube from L, coil is wound CW.

Total resistance of coil:
$R_{coil} = 1.1\Omega$

# of layers: IIII

$$B = I\mu_0\left(\frac{N}{\ell}\right)$$ ← for 1 layer

$$B_T = 6I\mu_0\left(\frac{N}{\ell}\right)$$

$$A = \pi\left(\frac{D_2}{2}\right)^2 = 16\pi\ \mu m^2$$

$$F = (N \cdot I)^2 \cdot \frac{\mu_0 A}{2g^2}$$ (60 turns, 7A)

where "A" is cross-sec'n'l area of inside of solenoid
"g" is length of gap between solenoid & projectile.
$\mu_0 =$

Diameter of...

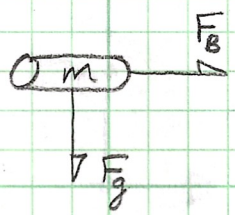
- Projectile: $d = 4mm$
- Barrel – inner: $D_1 = 6mm$
  outer: $D_2 = 8mm$
- Magnet wire: $d_w = 0.645mm$

Electrical tape thickness:
$d_t = 0.2mm$

$$F_B = \sum F_n = 0.348 + 0.172 + 0.102 + 0.0677 + 0.0481 + 0.0359 = 0.426\ \mu N$$

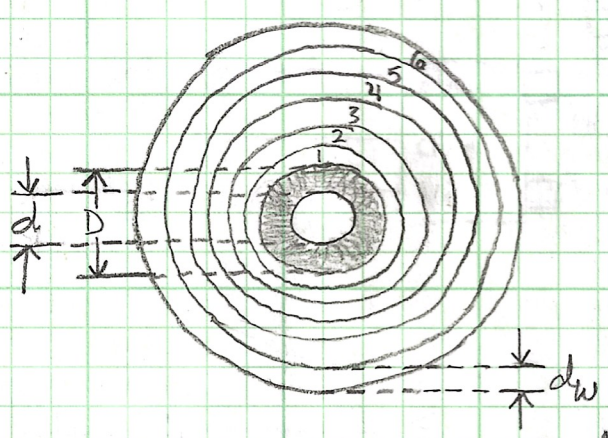
Ignoring friction & normal forces

FBD



$m = 3g$

$$F_B = ma \Rightarrow a = \frac{0.426\mu N}{0.003kg} = 142\times10^{-6}\ m/s^2$$



Let $G = 2(d_w + d_t)$

$g_1 = D_2 - d = 4mm$

$g_2 = g_1 + 2(d_w + d_t) = 5.69mm$

$g_3 = g_2 + G = 7.38mm$

$g_4 = g_3 + G = 9.07mm$

$g_5 = g_4 + G = 10.76mm$

$g_6 = g_5 + G = 12.45mm$ ← just assume discrepancy is due to inaccurate "given" data + ignore issue.

Should be:

$g_6 = 20mm = g_1 + g_2 + g_3 + g_4 + g_5$

$\Rightarrow 16mm = g_2 + g_3 + g_4 + g_5$

$= g_2 + g_3 + (g_3 + G) + (g_3 + G + G)$

$= (g_1 + G) + 3(g_1 + G + G) + 3G$

$16mm = 4g_1 + 10G \Rightarrow G = 0.1mm$