"More Potato Gun Practice" p. 28

1. $44 psi \left(6895 \frac{pa}{psi}\right) = 303,380 pa$

2. $P = \frac{F}{A}$ $\quad 303,380 pa = \frac{F}{0.000177 m^2}$

$F = 53.5 N$ $\quad \pi(0.0075m)^2$

3. $W = Fd = 53.5N(3.05m) = 163j$

4. $W = KE = \frac{1}{2} m v^2$

$163j = \frac{1}{2}(0.005kg) v^2$

$v = 255 m/s$

5. $v = \frac{d}{t} = \frac{0.1m}{0.0006s} = 167 m/s$

6. $\frac{KE_{out}}{KE_{in}} = Efficiency$ $\quad KE_{out} = \frac{1}{2} m v_{out}^2$

$KE_{out} = 69.4j$

$Efficiency = \frac{69.4j}{163j} = 0.43 = 43\%$

7. Actual pressure = gauge pressure + atmospheric pressure

$= 303,380 pa + 101,357 pa$

$P_{actual} = 404,737 pa$

8. $P_1 V_1 = P_2 V_2$

$(404,737 pa)\, 3l = P_2 (5l)$

$P_2 = 242,842 pa$

9. Temperature drops when air expands. Cooling causes molecules to slow down, so they should push with less force. Therefore, they should exert less
10. pressure.

10. $P_1 V_1^{1.4} = P_2 V_2^{1.4}$

$(404,737 pa)(3l)^{1.4} = P_2 (5l)^{1.4}$

$P_2 = 178,592 pa$

11. $V_{cylinder} = (\pi r^2)\,height$ (height = length)

area, from #2

$V_{barrel} = (0.000177\,m^2)(3.05\,m) = 0.000540\,m^3$

12. New Volume $= 3l + 0.000540\,m^3$

$= 0.003\,m^3 + 0.000540\,m^3$

$= 0.00354\,m^3$

$= 3.54l$

$(404,737\,pa)(3l)^{1.4} = P_2(3.54l)^{1.4}$

doesn't matter what units are, as long as they're the same

$P_2 = 289,613\,pa$

13.

13. "Average pressure" = $\frac{\text{Pressure Before expansion} + \text{Pressure after expansion}}{2}$

$= \frac{404,737\text{pa} + 289,613\text{pa}}{2}$

Average Pressure $= 347,175\text{pa}$

Average Gauge Pressure = Ave Pressure − Atmosph. Pressure

$= 347,175\text{pa} - 101,357\text{pa}$

Ave Gauge Pressure $= 245,818\text{pa}$

$P_{AVE} = \frac{F_{AVE}}{A}$

$245,818\text{pa} = \frac{F_{AVE}}{0.000177\text{m}^2}$

$F_{AVE} = 43.5\text{N}$