by madviking

okay because i'm bored but have a degree in chemical engineering i'm gonna do this like a fucking nerd becuase i never have gotten one of the last questions correct but i'm also stupid so bear with me here.

so i don't know the formula for the volume of an oblong uh football shape thing. but i do know the formula for the volume of a cylinder. i suppose we can approximate a football as a slightly smaller cylinder. let's just say a football's volume is equal (roughly) to that of a cylinder with 2/3rds the radius:

$v_f = pi*r_f^2*l = pi*4/9*r_c^2*l$

also i know the ideal gas law from spending several thousand dollars for my degree:

$pv = nrt$

v in the ideal gas law is volume so we can substitute that shit in:

$p*(pi*4/9*r_c^2*l) = nrt$

the r the trivia gods have given us is in L*atm/(mol*K) which is fine. but it means we're gonna have to convert shit:

l = 11 inches = 0.28 m
$r_c = ⅔*r_f = ⅔*21$ inches/(2*pi) = ⅔*0.53 m/2*pi = 0.057 m
13 psi = 0.88 atm = 1.88 atm*
70°F = 290 K***
15 oz = 0.43 kg

okay so all we don't know is the number of moles of air inside the football, i.e. n. isolating for n and substituting:

$n = p*pi*(4/9)*r_c^2*l / (r*t) = 1.88$ atm * pi * (4/9) * (0.057 m)^2*0.28 m / (290 * 0.08206 Latm/molK)

(*edit: lol needed to convert m^3 to L*)

i'm pretty sure this gives you:

n = 1.0e-4 moles of air

multiplying n by molar mass gives you plain old mass:

$M = n \cdot mm_{air} = 1.0\text{e-}4 \text{ mol} * 28.9645 \text{ g/mol} = 0.0029 \text{ g(!!!)} = 2.9\text{e-}6 \text{ kg}$

since the question wanted the ratio of the ~~mass~~ weight (why) of the ball over the mass of the air inside the ball:

answer = 0.43 kg / 2.9e-6 kg = **150,000** (sigfigs yall)

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these fuckers have the nerve to report pressures as shitty gauge pressure** *instead of* absolute pressure *afjeorghserhga*

**$p_{abs} = p_{gauge}$ + 1 atm*

**fun fact: there's no such thing as "degrees Kelvin". kelvin, as an absolute temperature scale, doesn't really have degrees just absolute temperature.*