James J. Griffin 11/2c/03A(a)

A gas filled balloon of volume, 1 m^3, at temperature, T_i = 300K, is cooled under a constant pressure, $P_i = P_f$ =1.0 atm., to a temperature of minus 273K, just 0.3 K above absolute zero (-273.3K). Its final volume is,

most nearly, V_f =

a) 1.0 m^3

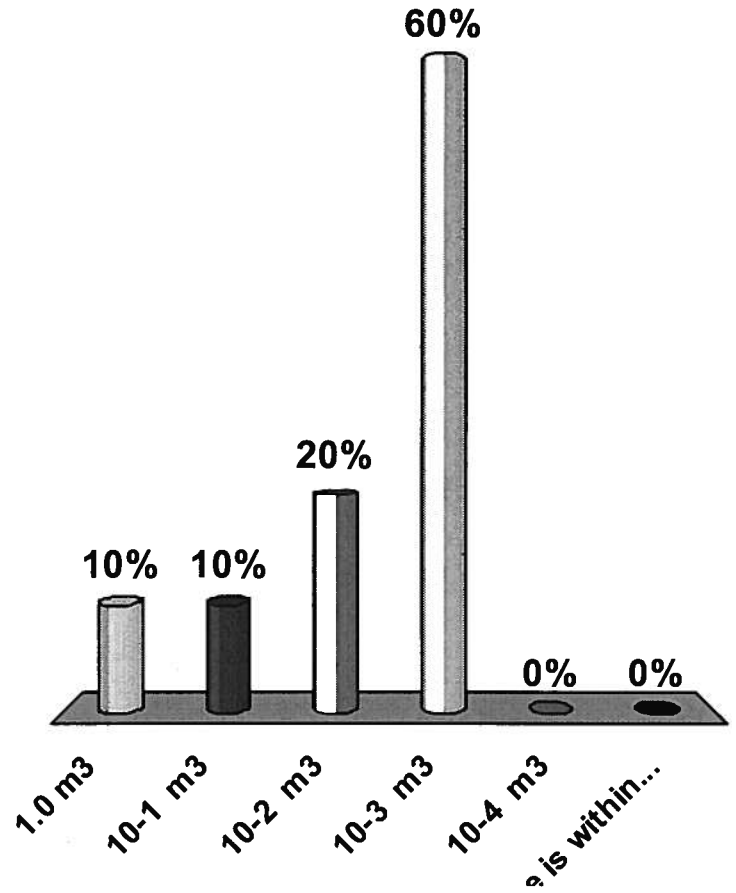
b) 10^{-1} m^3

c) 10^{-2} m^3

✔ d) 10^{-3} m^3

e) 10^{-4} m^3

f) None is within a factor of 2.



James Griffin W/Kc/08 A(b)

The correct answer is (d) $V_f = 10^{-3}$ m^3 ; as follows.

- **Since T_A decreased from 300K to 0.3K (a factor of 0.3/300 = 1/1000 = 10^{-3}), V_i must decrease (at constant P) by the same factor: Thus, $V_f = 10^{-3}$ m^3; and answer (d) is correct.**

Or do it the long way:

- **Write the Ideal Gas Law twice,**
- **$P_f V_f = N k_B T_f$**
- **$P_i V_i = N k_B T_i$**
- **And divide one equation by the other to obtain:**
- **$P_f V_f / P_i V_i = N k_B T_f / N k_B T_i = T_f / T_i$. Then**
- **$V_f = (T_f / T_i)*(P_i / P_f) V_i = (0.3/300)*(1.0/1.0)(1\ m^3)$**
  $= 10^{-3}$ m^3 ·····answer d)