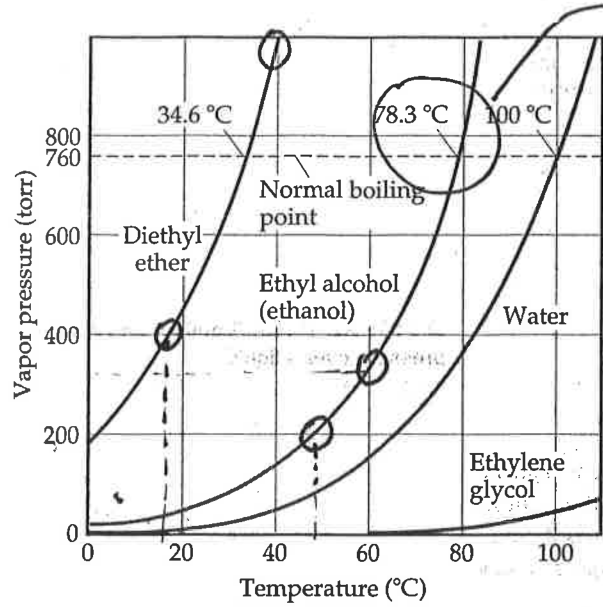
(50.) Acetone has a bp of 56°C.
How would acetone's VP at 25°C compare to ethanol's VP at 25°C?



▲ FIGURE 11.25 Vapor pressure for four liquids as a function of temperature.

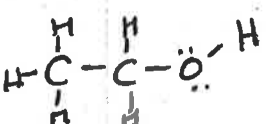
ethanol has a normal bp of 78.3°C;

ethanol requires a temp of 78°C to reach a vapor pressure of 1 atm, but acetone only needs a temp of 56°C to reach a VP of 1 atm.

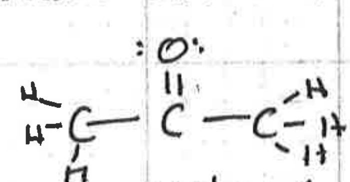
Acetone's VP curve would be to the left/above ethanol's curve; acetone would have a higher vapor pressure than ethanol at a given temperature including at 25°C.

(b) Ethanol must have stronger IMF than acetone. Higher IMF causes molecules to have lower VP at a given Temp since the molecules require more kinetic energy to escape the surrounding molecules in the liquid; a smaller fraction of molecules will have sufficient KE at a given temperature.

(recall from Chem I:



ethanol



acetone / propanone

O–H bonds are more polar than C=O bonds, so ethanol's can "Hydrogen bond" with other ethanols. But acetone can not.)

(54 on next page)

(55) using Fig. 11.25 (above / page 444)

(a) ethanol's bp if P = 200 torr: 47 to 49 °C ? (book says 48°C)

(b) Pressure required for ethanol to boil @ 60°C: about 330 mmHg (book says 340)

(c) Diethyl ether's bp @ 400 torr: ≈16 °C (book says 17 °C)

(d) Pressure if diethyl ether boils @ 40°C: about 1000 mmHg

(54) b) At higher altitude, why does it take longer to cook egg in boiling H_2O.

As altitude increases, atmospheric pressure decreases. Boiling occurs when a liquid's vapor pressure becomes equal to atmospheric pressure, so at lower atmospheric pressure, a lower vapor pressure is needed for H_2O to boil, so the H_2O doesn't need to reach as high a temperature to boil. Since the H_2O will boil at a lower temperature, the egg will need to sit in the boiling H_2O longer to finish cooking.

(56.) b) 100.0 °C is the normal boiling point of H_2O; this is the temperature required for H_2O's VP to reach 1 atm, or 760.0 mmHg.

c) Altitude 5000 ft : barometric pressure = 633 torr.

(Appendix B, p. 1058)

T(°C)	P	T(°C)	P	T(°C)	P	T(°C)	P
0	4.58	21	18.65	35	42.2	92	567.0
5	6.54	22	19.83	40	55.3	94	610.9
10	9.21	23	21.07	45	71.9	96	657.6
12	10.52	24	22.38	50	92.5	98	707.3
14	11.99	25	23.76	55	118.0	100	760.0
16	13.63	26	25.21	60	149.4	102	815.9
17	14.53	27	26.74	65	187.5	104	875.1
18	15.48	28	28.35	70	233.7	106	937.9
19	16.48	29	30.04	80	355.1	108	1004.4
20	17.54	30	31.82	90	525.8	110	1074.6

so H_2O will need to reach ≈ 95°C to get a VP of ≈ 633 torr.

bp = 95°C

(d) Altitude: 500 ft below sea level, P_{atm} = 774 torr.

so H_2O will need to reach ≈ 100°C to 101 °C to boil.

(e) Compare KE of H_2O molecules at boiling points:

The molecules at 101 °C have higher average kinetic energies than those at 95°C, though the difference is not huge...

KE is directly proportional to the Kelvin temperature.

$$\frac{KE(101\,°C)}{KE(95\,°C)} = \frac{374\,K}{368\,K} = 1.02.$$

Not a huge difference, but enough to make a difference in egg cooking times....