

BOILING POINT ELEVATION PROBLEMS (nonelectrolytes)

Table of K_b values for solvents

Solvent	K_b ($^{\circ}\text{C}/\text{molal}$)	Solvent	K_b ($^{\circ}\text{C}/\text{molal}$)
Water	0.52	Benzene	2.67
Ethanol	1.20	Carbon tetrachloride	5.02
Chloroform	3.85	Acetic Acid	2.93

1. What is the boiling point elevation when 11.4 g of ammonia (NH_3) is dissolved in 200 g of H_2O ?
2. How many grams of benzoic acid ($\text{C}_7\text{H}_6\text{O}_2$) must be dissolved in 78.1 g of ethanol to raise the boiling point by 4.00°C ?
3. If 67.7 g of urea ($\text{CH}_4\text{N}_2\text{O}$) is dissolved in 833 g of chloroform, what is the elevation in boiling point?
4. How many grams of camphor ($\text{C}_{10}\text{H}_{16}\text{O}$) are needed to raise the boiling point of 43.5 g of benzene by 2.10°C ?
5. If 1800 g of ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) is added to 1900 g of water, what is the elevation in boiling point?
6. If the boiling point of 69.6 g of carbon tetrachloride must be raised by 10.2°C , how many grams of pyridine ($\text{C}_5\text{H}_5\text{N}$) must be dissolved in the carbon tetrachloride?
7. What is the boiling point elevation when 31.5 g of menthol ($\text{C}_{10}\text{H}_{20}\text{O}$) is dissolved in 258 g of acetic acid?
8. How much will the boiling point of 25.0 g of acetic acid be raised if 2.69 g of picolinic acid ($\text{C}_6\text{H}_5\text{N}_2$) is dissolved in the acetic acid?
9. Styrene glycol ($\text{C}_8\text{H}_{10}\text{O}_2$) is a plasticizer. How many grams of styrene glycol must be dissolved in 98.7 g of benzene to raise the boiling point by 8.57°C ?
10. What is the boiling point elevation when 43.5 g of the dye magenta-I ($\text{C}_{20}\text{H}_{20}\text{ClN}_3$) is dissolved in 1650 g of ethanol?

ANSWERS TO PROBLEMS 1-10:

- 1) 1.74°C 2) 31.7 g 3) 5.21°C 4) 5.17 g 5) 7.95°C 6) 11.2 g 7) 2.29°C 8) 3.00°C 9) 43.8 g
10) 0.094°C

FREEZING POINT DEPRESSION PROBLEMS (nonelectrolytes)

Table of K_f values for solvents

Solvent	K_f ($^{\circ}\text{C}/\text{molal}$)	Solvent	K_f ($^{\circ}\text{C}/\text{molal}$)
Water	-1.86	Benzene	-5.12
Ethanol	-1.99	Naphthalene	-7.00
Chloroform	-4.68		

11. How many grams of silver would have to be dissolved in 1120 g of ethanol to lower the freezing point by 0.25°C ?
12. What is the freezing point depression when 85.3 g of oxygen gas is dissolved in 1500 g of water?
13. Ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) is the principal ingredient in antifreeze. How many grams of ethylene glycol will be needed to lower the freezing point of 2100 g of water by 20°C ?
14. How many grams of diphenyl ($\text{C}_{12}\text{H}_{10}$) must be dissolved in 655 g of benzene to lower the freezing point by 3.20°C ?
15. Perylene ($\text{C}_{20}\text{H}_{12}$) is a constituent of coal tar. How many grams of perylene must be dissolved in 66.9 g of chloroform in order to lower the freezing point by 2.75°C ?
16. How much will the freezing point of 1050 g of benzene be lowered if 31.1 g of orcinol ($\text{C}_7\text{H}_8\text{O}_2$) is dissolved in the benzene?
17. What will the freezing point depression if 42.0 g of ibuprofen ($\text{C}_{13}\text{H}_{18}\text{O}_2$) is dissolved in 975 g of naphthalene?
18. If 13.4 of the pharmaceutical drug scopolamine ($\text{C}_{17}\text{H}_{21}\text{NO}_4$) is dissolved in 50.3 g of water, how much will the freezing point be lowered?
19. How many grams of pyrazole ($\text{C}_3\text{H}_4\text{N}_2$) must be added to 451 g of benzene to lower the freezing point by 5.00°C ?
20. If you lower the freezing point of 16.8 g of chloroform by 2.50°C by using chlorine gas, how many grams of chlorine gas must be dissolved in the chloroform?

ANSWERS TO PROBLEMS 11-20:

- 11) 15.2 g 12) 3.31°C 13) 1.4 kg 14) 63.0 g 15) 9.91 g 16) 1.22°C 17) 1.46°C 18) 1.64°C
19) 29.9°C 20) 0.637 g