Passage VII

Consider an aqueous solution separated from pure H_2O by a membrane permeable to H_2O but impermeable to solute particles. H_2O will flow from the region of lower particle concentration (the pure H_2O) into the region of higher particle concentration (the solution). The pressure associated with this flow is the *osmotic pressure*, π, given in atmospheres (atm) by the equation

$$\pi = 0.0821 \times T \times i \times C$$

Table 1 defines the 3 variables in the equation.

Table 1	
Symbol	Definition
T	temperature, in kelvins (K), of the solution and the pure H_2O
i	number of particles (molecules or ions) formed per molecule or formula unit of a substance when it dissolves in H_2O
C	concentration (moles of a substance per liter of solution; 1 mole is 6.022×10^{23} molecules or formula units)

Table 2 lists, for 8 substances, the value of i and the *molar mass* (the mass of 1 mole of a substance).

Table 2		
Substance	i	Molar mass (g/mole)
NaCl	2	58.5
KCl	2	74.6
HCl	2	36.6
$MgCl_2$	3	95.2
K_2SO_4	3	174.0
Na_2SO_4	3	142.0
Glucose	1	180.0
Lactose	1	342.0

Figure 1 shows how π varies with C for aqueous NaCl solutions and aqueous glucose solutions at 3 temperatures.

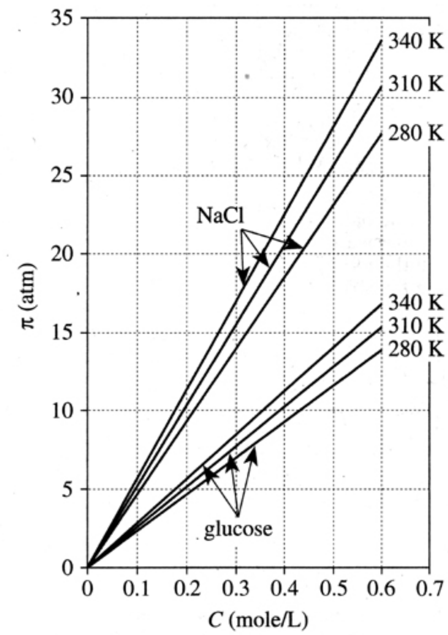

Figure 1

36. Consider a solution for which $C = 0.20$ mole/L and $\pi = 10$ atm. Based on Figure 1, this solution is most likely an aqueous solution of:

F. NaCl at 280 K.
G. NaCl at 310 K.
H. glucose at 280 K.
J. glucose at 310 K.

37. Compared to the mass of 1 molecule of glucose, the mass of 1 molecule of lactose is:

A. smaller, because lactose has a smaller molar mass than does glucose.
B. smaller, because lactose has a larger molar mass than does glucose.
C. larger, because lactose has a smaller molar mass than does glucose.
D. larger, because lactose has a larger molar mass than does glucose.

38. How does the value of *i* for HCl differ from the value of *i* for $MgCl_2$, and what is the meaning of the difference? The value of *i* for HCl is:

F. lower, which means that each HCl dissolves in H_2O to form fewer particles than does each $MgCl_2$.
G. lower, which means that each HCl dissolves in H_2O to form more particles than does each $MgCl_2$.
H. higher, which means that each HCl dissolves in H_2O to form fewer particles than does each $MgCl_2$.
J. higher, which means that each HCl dissolves in H_2O to form more particles than does each $MgCl_2$.

39. Suppose a 1 L solution is produced by dissolving 2 moles of KCl in H_2O. Based on the information provided, π, in atm, of this solution at 290 K can be calculated using which of the following expressions?

A. $0.0821 \times 290 \times 1 \times 1$
B. $0.0821 \times 290 \times 1 \times 2$
C. $0.0821 \times 290 \times 2 \times 2$
D. $0.0821 \times 290 \times 3 \times 2$

40. Suppose a new line showing how π varies for aqueous $MgCl_2$ solutions at 340 K were added to Figure 1. How would this new line compare to the lines shown in Figure 1 for aqueous NaCl solutions and aqueous glucose solutions at 340 K ?

F. The *y*-intercept would remain the same, but the slope of the line would be greater.
G. The *y*-intercept would remain the same, but the slope of the line would be smaller.
H. The *y*-intercept would be greater, but the slope of the line would remain the same.
J. The *y*-intercept would be smaller, but the slope of the line would remain the same.