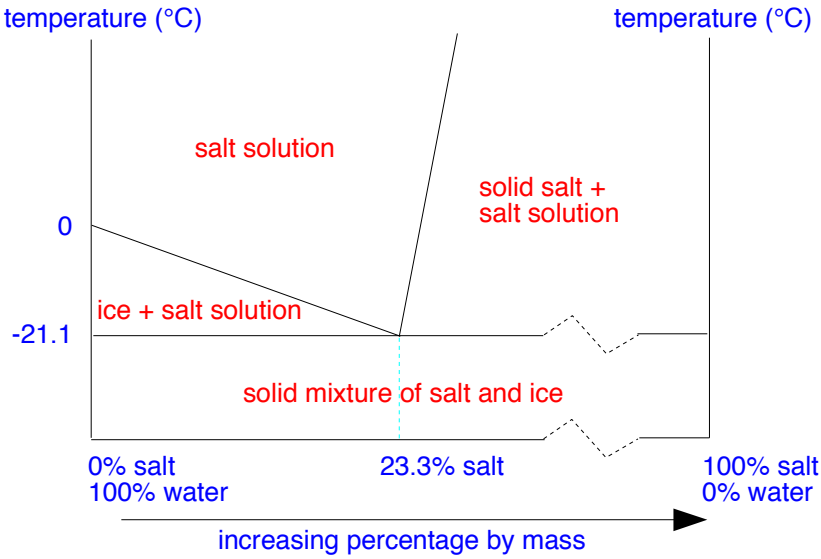
SOLID-LIQUID PHASE DIAGRAMS - SALT SOLUTION

1. a)



b) Line a represents the effect of increasing amounts of salt on the freezing point of water.

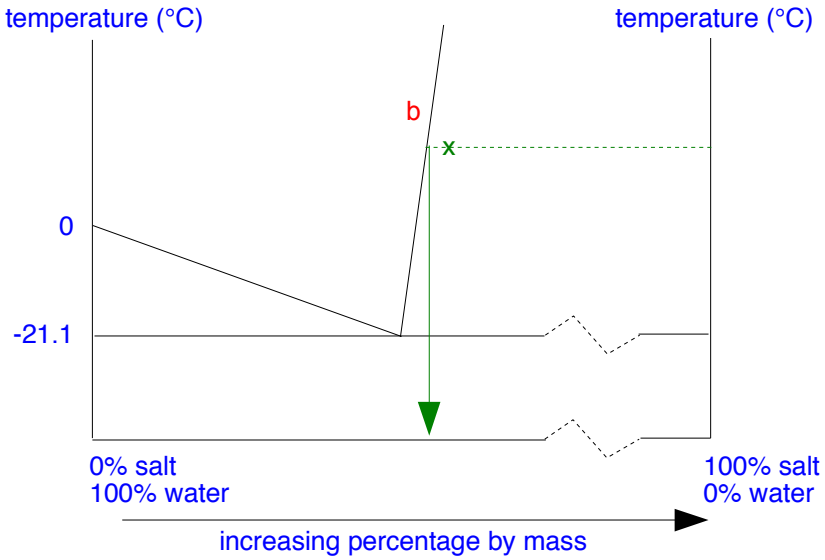
c) (i) At atmospheric pressure, the water will boil at a temperature somewhere over 100°C and so there won't be a solution present beyond this.

(ii) The water will reach its critical temperature, above which it can't exist as a liquid.

2. a) This is the eutectic composition. As the temperature falls, nothing will happen to the solution until the temperature reaches -21.1°C, when it will all become solid. No other lines are crossed in the phase diagram for a mixture of this composition.

b) (i) 60°C. You are told that the solution is saturated at this temperature. If the temperature falls even a tiny fraction of a degree below this, then you will get some salt precipitated, and the mixture will move into the "solid salt + salt solution" region of the phase diagram.

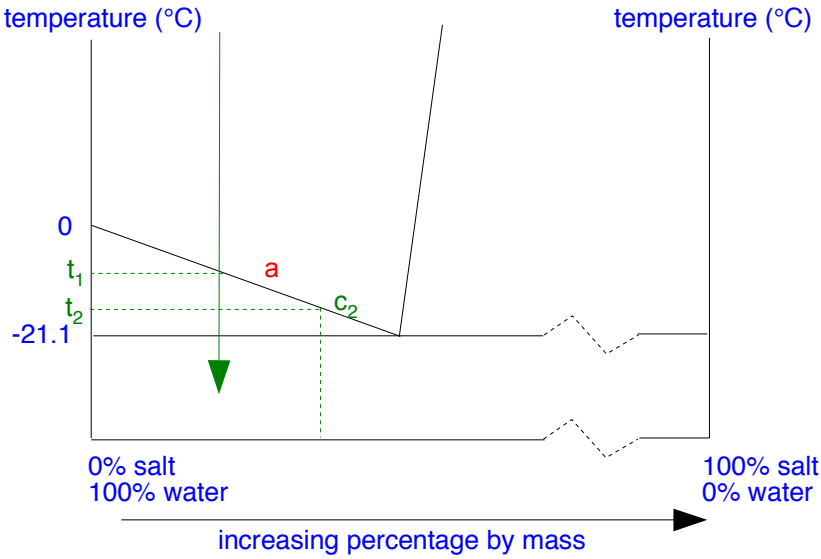
(ii) (See next page)



Plot the point for the overall composition (27%) and the temperature (20°C) on the phase diagram, and draw a tie-line across to meet line b. Check the composition of the solution from the bottom axis.

(iii) -21.1°C

c)



The solution would cool with nothing visible happening until the temperature fell to t_1. At that point the water would begin to freeze, and ice would appear. As the temperature continues to fall (say to t_2), more ice would appear and the solution would become more concentrated. You could work out the new concentration by looking at point c_2.

When the temperature finally fell to -21.1°C, the whole of the mixture would solidify, giving you a mixture of solid salt and ice which would remain for the rest of the cooling.