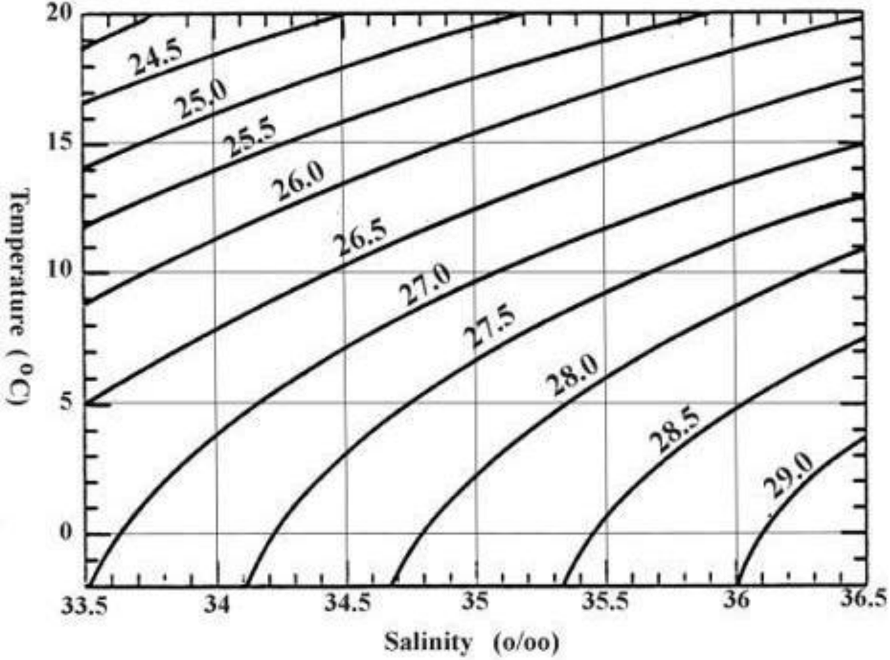
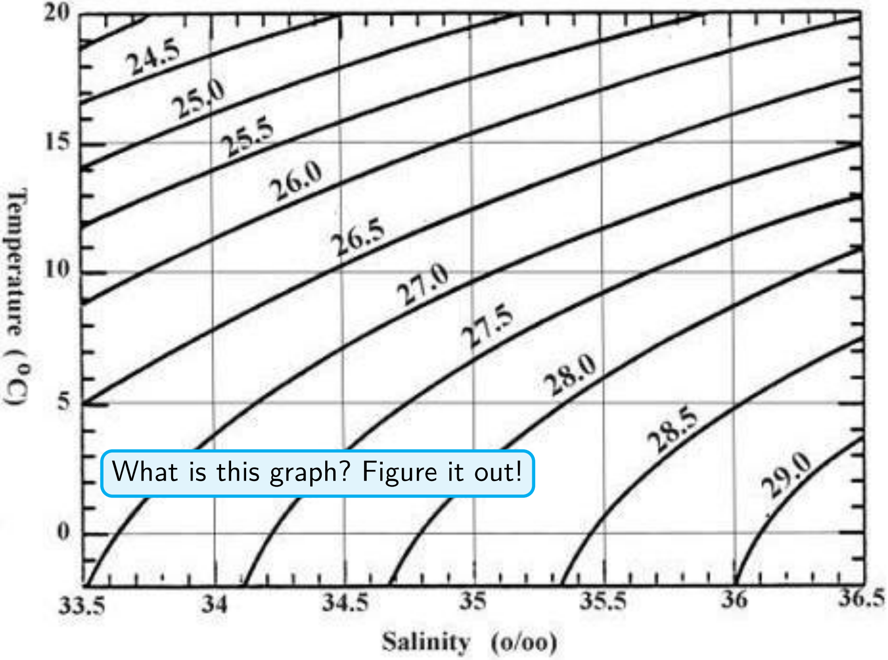
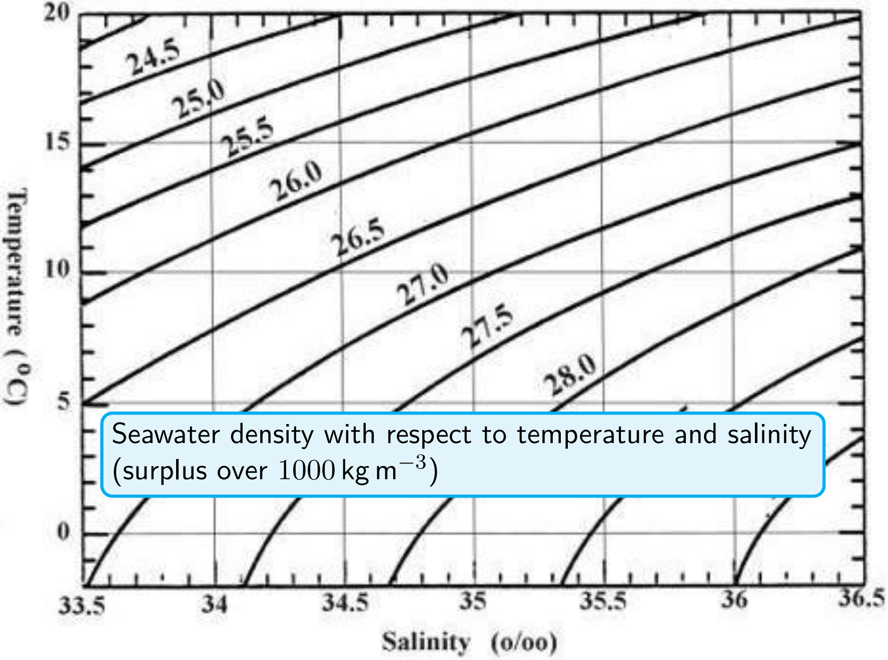


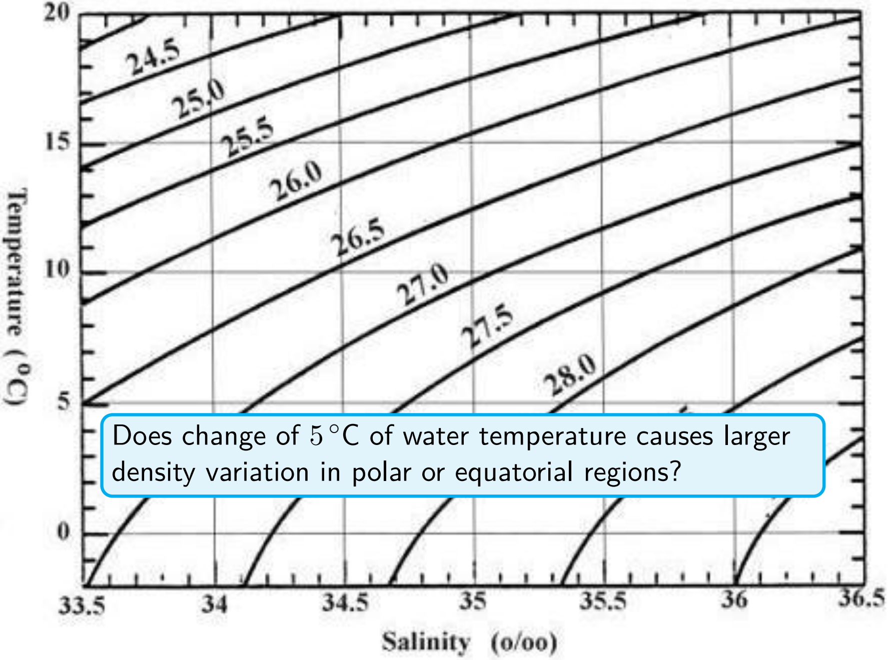
20
15
10
5
0
33.5
34
34.5
35
35.5
36
36.5
Salinity (o/oo)
Temperature (°C)
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0



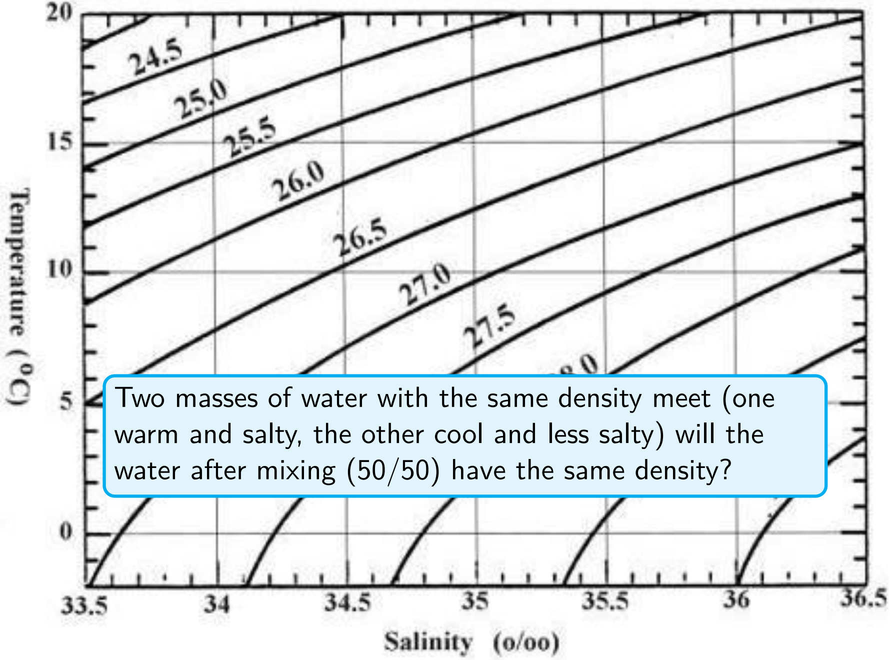
Temperature (°C)
Salinity (o/oo)
20
15
10
5
0
33.5
34
34.5
35
35.5
36
36.5
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
What is this graph? Figure it out!



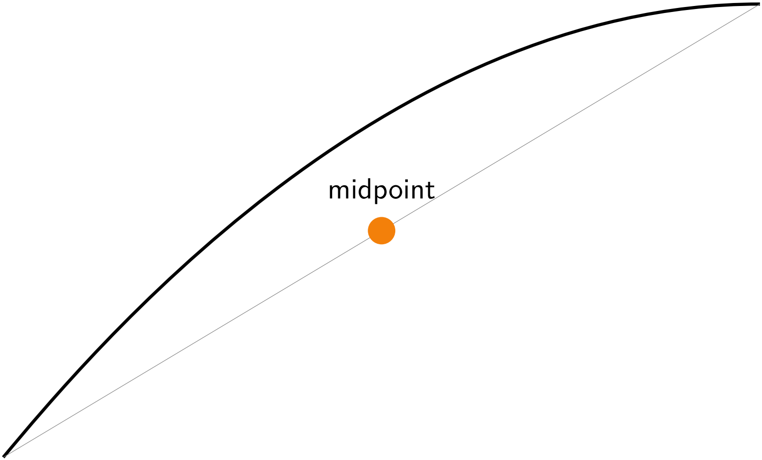
Seawater density with respect to temperature and salinity (surplus over $1000\,\mathrm{kg\,m^{-3}}$)



Does change of $5\,^{\circ}$C of water temperature causes larger density variation in polar or equatorial regions?



Two masses of water with the same density meet (one warm and salty, the other cool and less salty) will the water after mixing (50/50) have the same density?


midpoint

Question

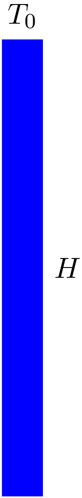
Formula for density change with small salinity and temperature variation.

$\rho = \rho_0[1 + \beta(S - S_0) - \alpha(T - T_0)]$

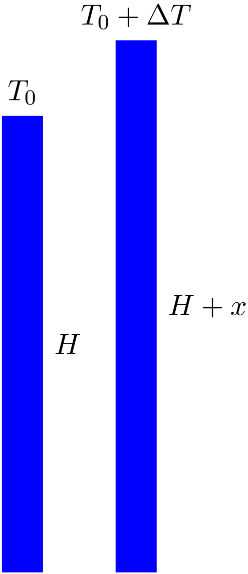
In the expression above S is salinity, T is temperature, β is the haline coefficient and α is the thermal coefficient. S_0 och T_0 are reference values that you can choose freely and $\rho_0 = \rho(S_0, T_0)$. The values of α and β depends on what values you chopse forr S_0 and T_0. If we chose S_0=34.6 and T_0 ==0.5C then $\rho_0 = \rho(S_0, T_0)$=1027,8 kg/m^3, $\alpha \approx$ 5.77*10^{-5} C^{-1} and $\beta \approx 7.84 * 10^{-4}$.

When the temperature increase the density decrease – that means that1 kg of warm water occupies a larger space than 1 kg of cold water. A large part of the sea level rise that we are observing today (and that we will see in the future) is caused by the increase in temperature of water at depth in the ocean. If water which is 4000m deep (with S_0, T_0, ρ_0,β and α as given in exercise 3) is heated by 1C, how much will the sea level then rise?

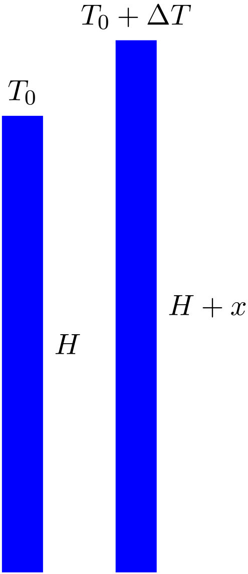
Answer



Answer

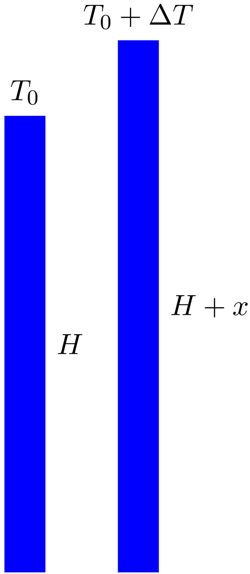


Answer



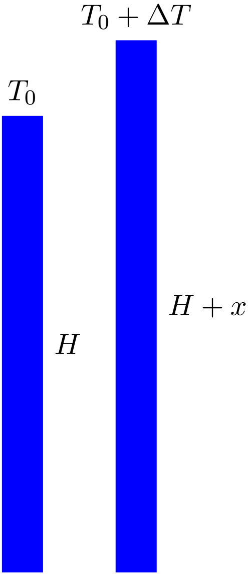
$$m = \rho_0 \cdot V_0$$

Answer



$$m = \rho_0 \cdot V_0 = \rho_1 \cdot V_1$$

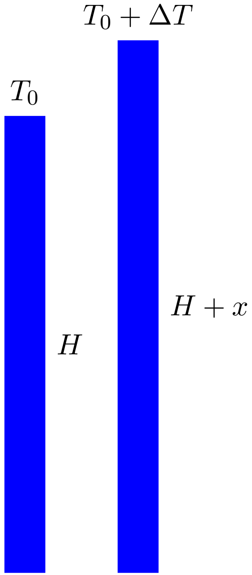
Answer



$$m = \rho_0 \cdot V_0 = \rho_1 \cdot V_1$$

$$\frac{\rho_0}{\rho_1} = \frac{V_1}{V_0}$$

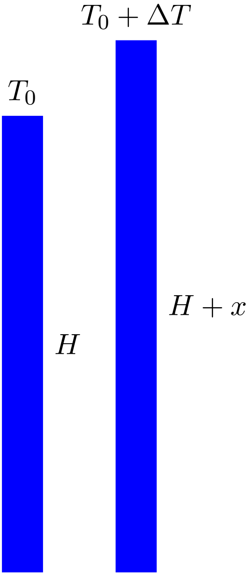
Answer



$$m = \rho_0 \cdot V_0 = \rho_1 \cdot V_1$$

$$\frac{\rho_0}{\rho_1} = \frac{V_1}{V_0} = \frac{H + x}{H}$$

Answer

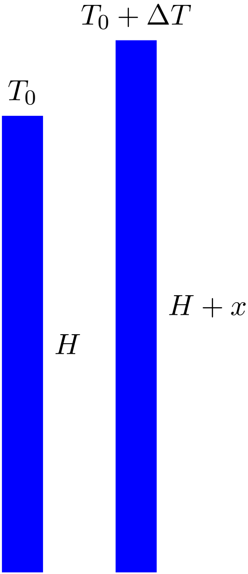


$$m = \rho_0 \cdot V_0 = \rho_1 \cdot V_1$$

$$\frac{\rho_0}{\rho_1} = \frac{V_1}{V_0} = \frac{H + x}{H}$$

$$\begin{aligned} \rho_1 &= \rho_0 \left[1 + \beta(S - S_0) - \alpha(T - T_0) \right] \\ &= \rho_0 \left[1 - \alpha(\Delta T) \right] \end{aligned}$$

Answer



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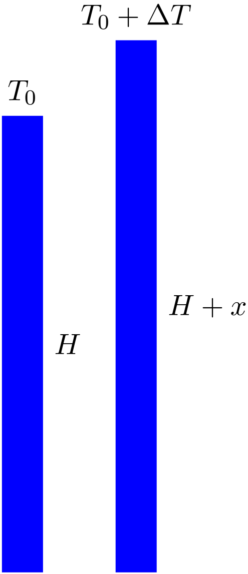
$$1 + \alpha \Delta T = 1 + \frac{x}{H}$$

Answer



$$m = \rho_0 \cdot V_0 = \rho_1 \cdot V_1$$

$$\frac{\rho_0}{\rho_1} = \frac{V_1}{V_0} = \frac{H + x}{H}$$

$$\begin{aligned}\rho_1 &= \rho_0 \left[1 + \beta(S - S_0) - \alpha(T - T_0)\right] \\ &= \rho_0 \left[1 - \alpha(\Delta T)\right]\end{aligned}$$

$$1 + \alpha \Delta T = 1 + \frac{x}{H}$$

and finally the answer is,

$$x = H \alpha \Delta T$$