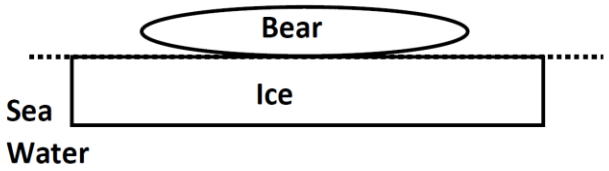
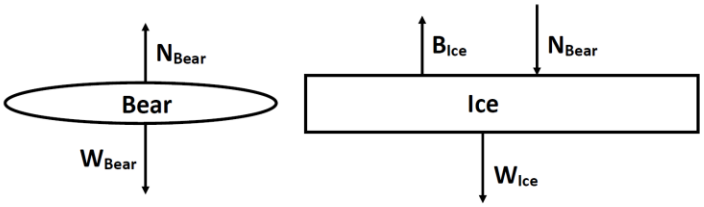
16. The density of ice is 917 kg/m^3, and the density of seawater is 1025 kg/m^3. A swimming polar bear climbs onto a piece of floating ice that has a volume of 5.2 m^3. What is the weight of the heaviest bear that the ice can support without sinking completely beneath the water?



Draw free body diagrams for both bear and ice



Sum of forces on the bear gives

$$\sum \boldsymbol{F_{Bear\,y} = N_{Bear} - W_{Bear} = m_{Bear} a_y = 0}$$

$$\boldsymbol{N_{Bear} = W_{Bear}}$$

Sum of forces on the ice gives

$$\sum \boldsymbol{F_{Ice\,y} = B - N_{Bear} - W_{Ice} = m_{Ice} a_y = 0}$$

$$\boldsymbol{B = N_{Bear} + W_{Ice} = W_{Bear} + W_{Ice}}$$

$$\boldsymbol{B = W_{Bear} + W_{Ice} = \rho_{fluid} g V_{Ice}}$$

$$\boldsymbol{W_{Bear} = \rho_{fluid} g V_{Ice} - W_{Ice}}$$

Weight of the ice can be found from

$$\boldsymbol{W_{Ice} = \rho_{Ice} g V_{Ice}}$$

$$\boldsymbol{W_{Bear} = \rho_{fluid} g V_{Ice} - W_{Ice} = \rho_{fluid} g V_{Ice} - \rho_{Ice} g V_{Ice} = (\rho_{fluid} - \rho_{Ice}) g V_{Ice}}$$

$$\boldsymbol{W_{Bear} = (\rho_{fluid} - \rho_{Ice}) g V_{Ice} = \left(1025\ {}^{kg}/_{m^3} - 917\ {}^{kg}/_{m^3}\right)\left(9.80\ {}^{m}/_{s^2}\right)(5.2\ m^3)}$$

$$\boldsymbol{W_{Bear} = \left(108\ {}^{kg}/_{m^3}\right)\left(9.80\ {}^{m}/_{s^2}\right)(5.2\ m^3) = 5504\ N}$$

$$\boxed{\boldsymbol{W_{Bear} = 5500\ N}}$$

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