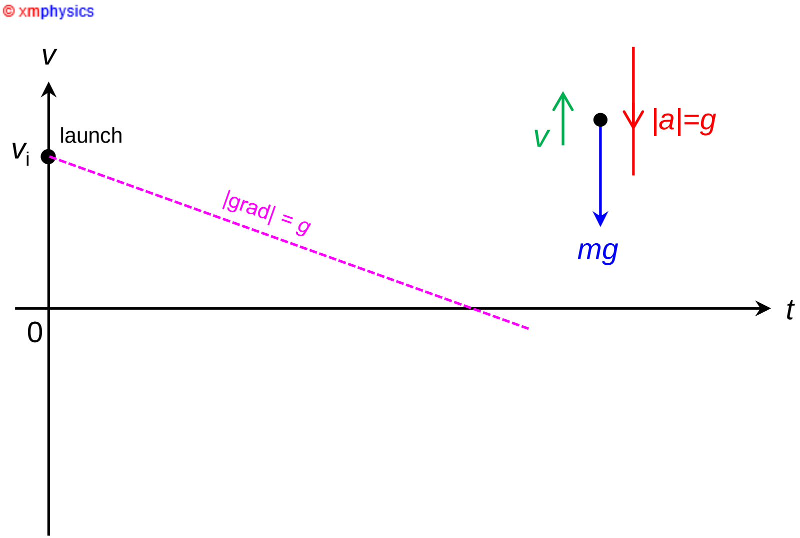
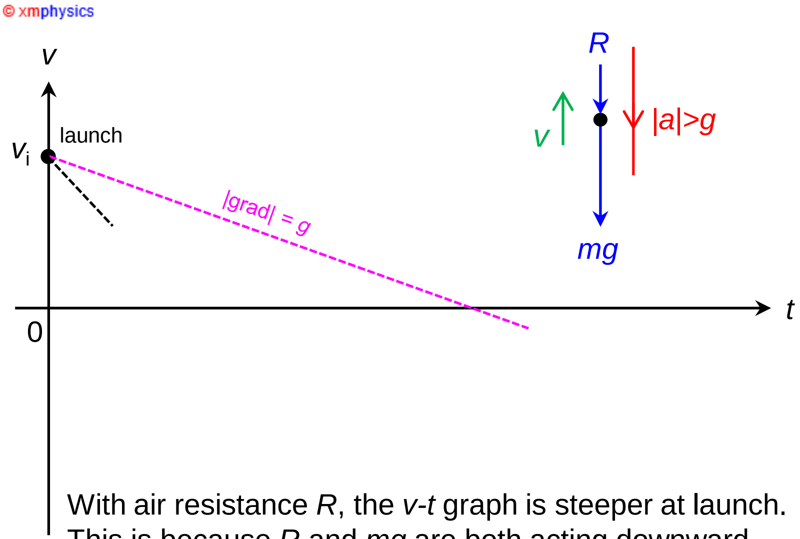
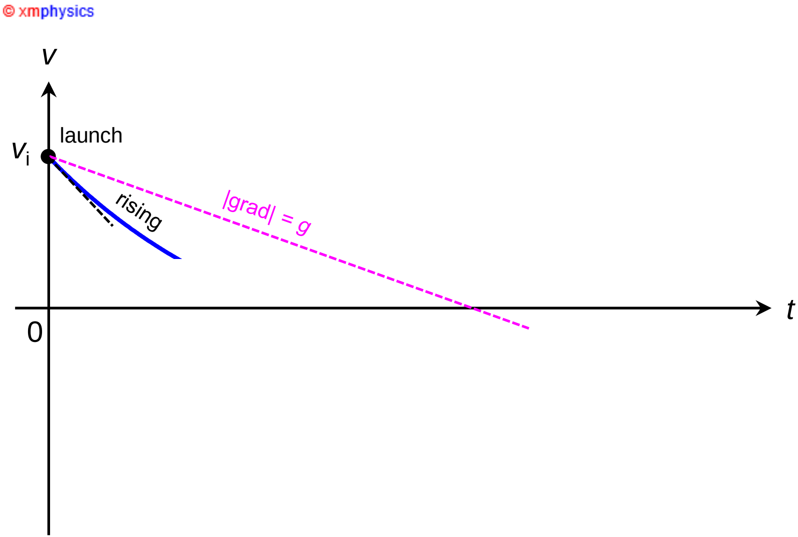
Vertical throw with air resistance



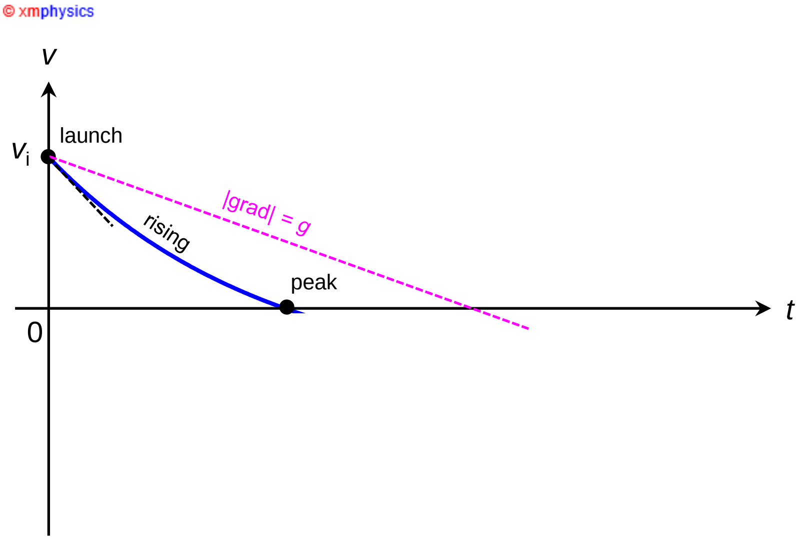
If there were no air resistance, the balloon would be slowing down at constant rate of 9.81 m s^{-2}. And the *v*-*t* graph would be the magenta line.



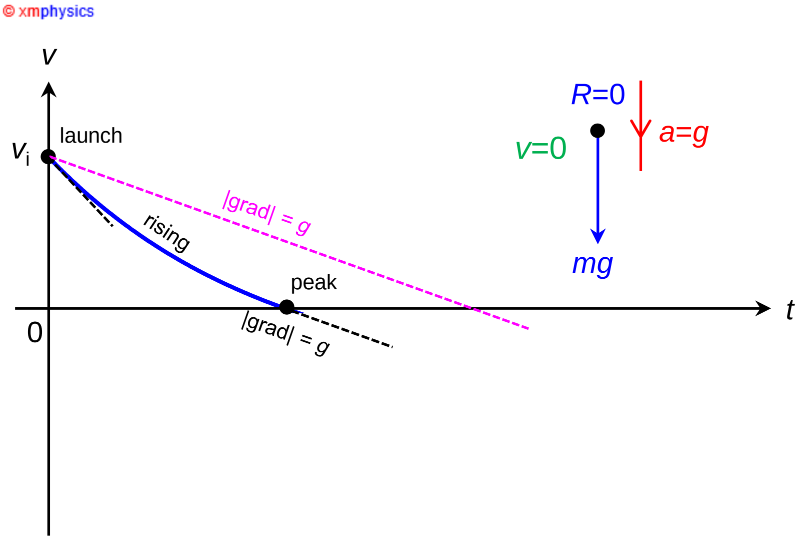
With air resistance *R*, the *v*-*t* graph is steeper at launch. This is because *R* and *mg* are both acting downward, combining to make *mg*+*R* total retardation force, resulting in the balloon slow downing at a rate higher than 9.81 m s^{-2}.



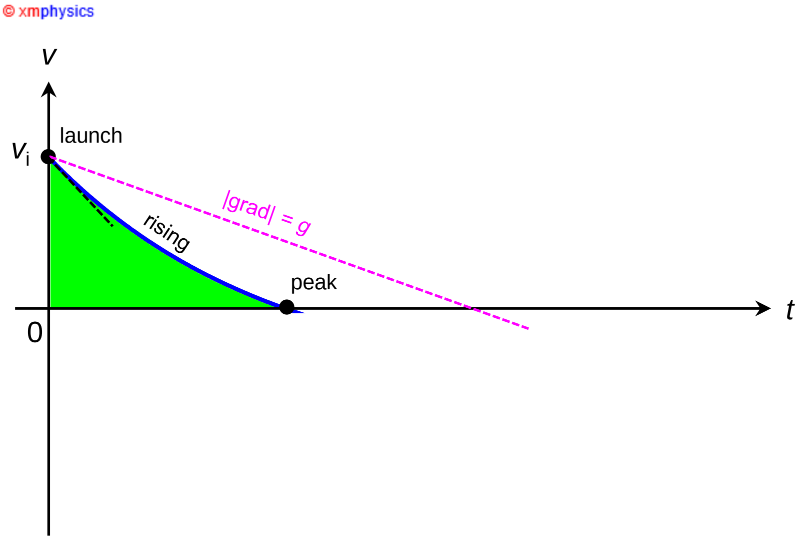
Remember that drag force is dependent on speed. As the balloon loses speed, R decreases. As $mg+R$ decreases, the speed drops towards 0 at decreasing rate.



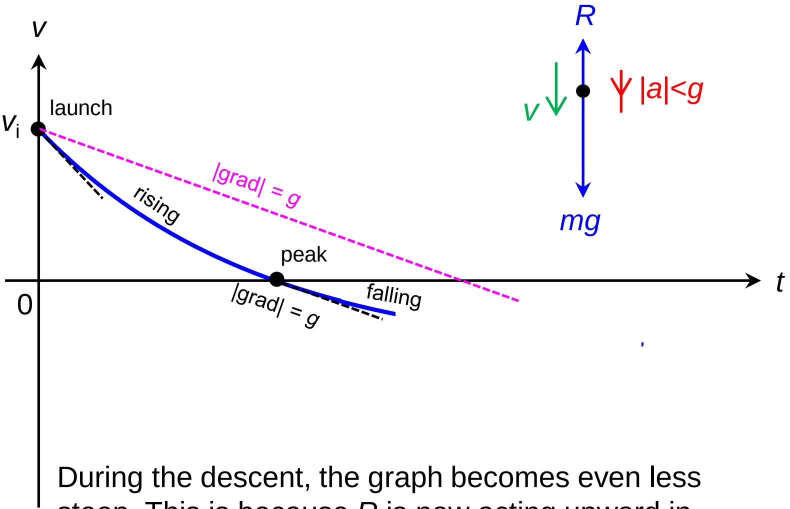
Balloon reaches peak when v drops to 0.



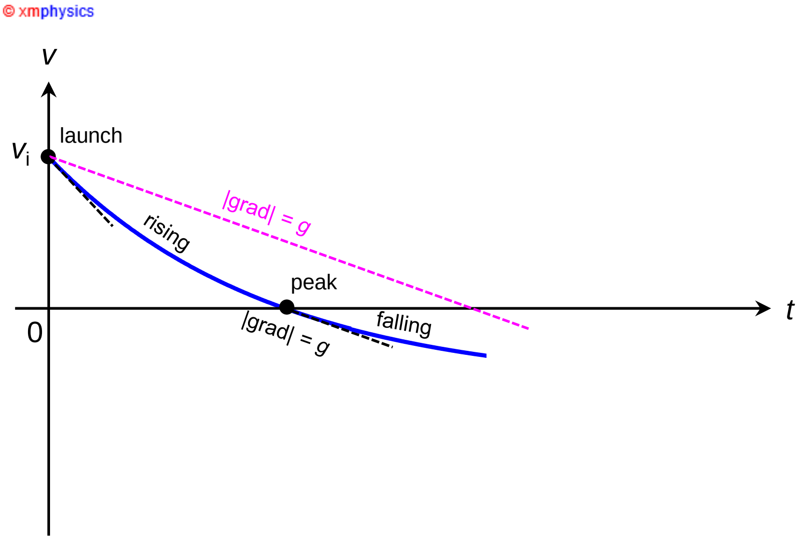
Since R is zero when v=0, the gradient at this instant is 9.81 m s^{-2}.



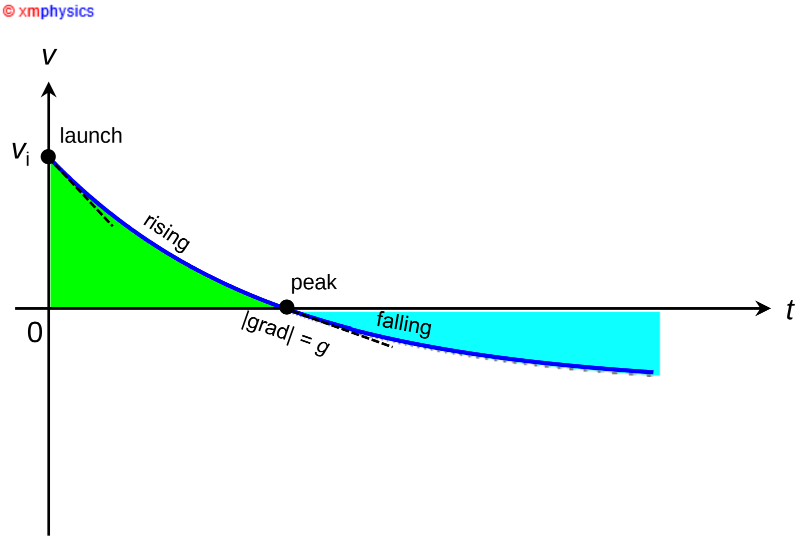
The green area corresponds to the upward distance travelled by the balloon.



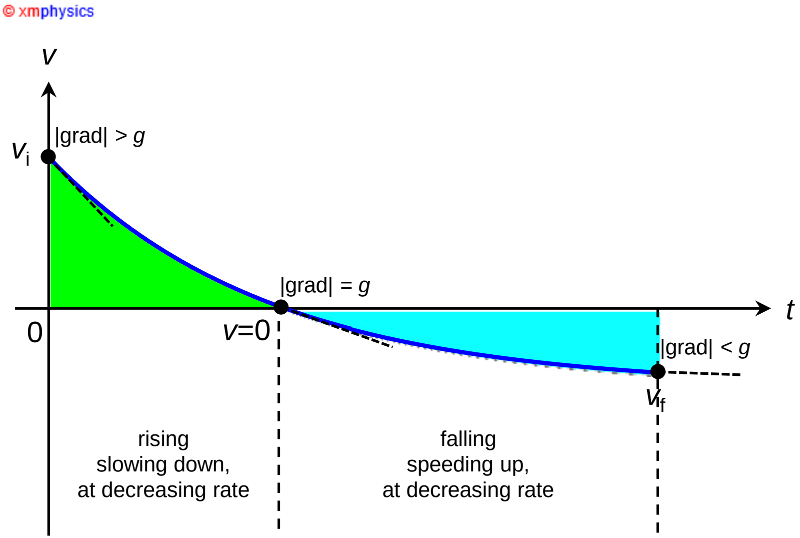
During the descent, the graph becomes even less steep. This is because *R* is now acting upward in opposite direction to *mg*, reducing the net force to *mg*−*R*, resulting in the balloon speeding up at a rate lower than 9.81 m s^{-2}.



Remember that drag force is dependent on speed. As the balloon gains speed, R increase. As $mg - R$ decreases, the balloon gains speed at decreasing rate.



The graph ends when the blue area matches the green area, when the downward distance matches the upward distance.



Great job! Now, sit back and admire.