# NEWTON'S 2ND LAW +

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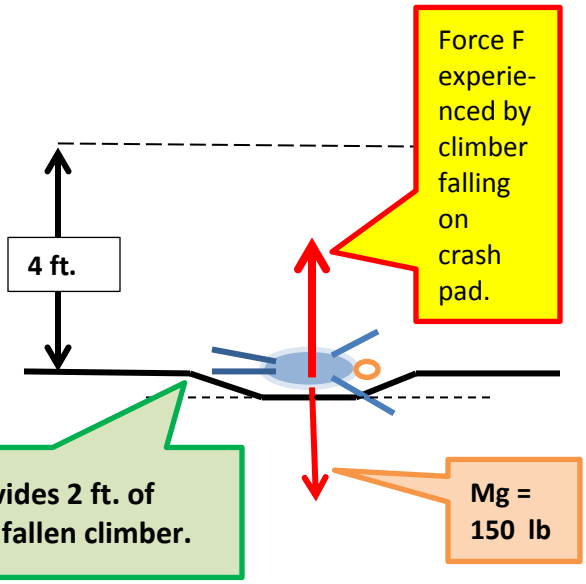
## No Need for a Mountain

Beth Rodden tackled a problem while bouldering as Randy Puro assisted With her crash pad.




VINGSAND, Norway — **Two large black mattresses bounced along the coastline, pausing every so often in front of large rocks and the glimmering sea view. The mattresses — or crash pads, as some call them —** were strapped to the backs of two American rock climbers who are among a growing group of people in the last decade have practiced and promoted a form of climbing that **relies on mattresses, rather than ropes, to catch their falls.** But in recent years, another, younger type of climbing — called bouldering — has opened the sport to a far wider group of participants and spectators. Bouldering requires no ropes because it centers on short climbs, **usually up to 18 feet** and lasting no more than five minutes. It is easier in many places to find a low rock to climb than it is to find a giant cliff.

The sport was on display in New York City this summer during a giant bouldering competition **in Central Park**. Climbers scaled routes, or problems, on artificial rocks that were brought in for the event, but several real boulders in the park can be climbed for recreation. The city also has a two-year-old indoor gym, Brooklyn Boulders, that emphasizes bouldering more than it does traditional climbing — a trend several climbing gyms across the country.

**INTRODUCTION:** **This solution is a good opportunity to understand free body diagrams and a application of Newton's second law. When stopping over a larger distance, forces are always smaller compared to stopping over short distances. Here we will see that is true for stopping over 2 ft, then 1 inch.**

**QUESTIONS:** **(a) If this climber fell 4 ft., find her velocity just as she hits the crash pad? (b) If she stops on the soft crash pad in 2 ft., find her rate of deceleration? (c) Find the force the climber experienced(F) while decelerating on the crash pad? NOTE: When setting up Newton's 2nd law, the net force on climber(see free body diagram above) is F – mg. (d) Answer questions (b) & (c) if the climber had NO crash pad and stopped in 1 inch.? (e) EXTRA EXTRA Use Energy conservation ideas to solve for (c)? HINTS: $F_{net} = ma$ , weight = mg , g = 32 ft/s$^2$ , $V^2 = V_o^2 + 2ax$ , $W = \Delta K + \Delta U$**

**ANSWERS:** **(a) 16 ft/s , (b) -64 ft/s$^2$ , (c) F = 450 lb. , (d) a = - 1536 ft/s$^2$ , F = 7350 lb. , (e) F= 450 lb.**