5. [9 points] Tammy Toppel is directing a performance art piece at the community center. She fills a large cone with sand and cuts a small hole in the bottom. Gerd Hömf was hired from a temp agency to stand behind the scenes and steadily lift the cone with an elaborate pulley system, letting the sand slowly spill onto the stage.

   a. [2 points] The filled cone starts with a total mass of 40 kilograms and spills sand at a constant rate of $1/2$ a kilogram per second once it is lifted. Tammy wants Gerd to lift the cone at a constant rate of r meters per second. Find a formula for the mass $M(h)$, in kilograms, of the cone when it is h meters above the stage.

Answer: $M(h) =$ _____

   b. [4 points] Gerd lifts the cone until it reaches a height of 20 meters above the stage. Write an integral which represents the work (measured in Joules) done by Gerd while lifting the cone. The integral may include the rate r at which Gerd lifts and g the acceleration (in m/s^2) due to gravity.

Answer: _____

   c. [3 points] There's one catch: Gerd's contract strictly prohibits him from exerting more than $500g$ Joules of work, where g is the acceleration due to gravity. At what rate r (in m/s) should Tammy ask Gerd to lift in order to not violate his contract and to get the cone lifted as quickly as possible?

Answer: $r =$ _____