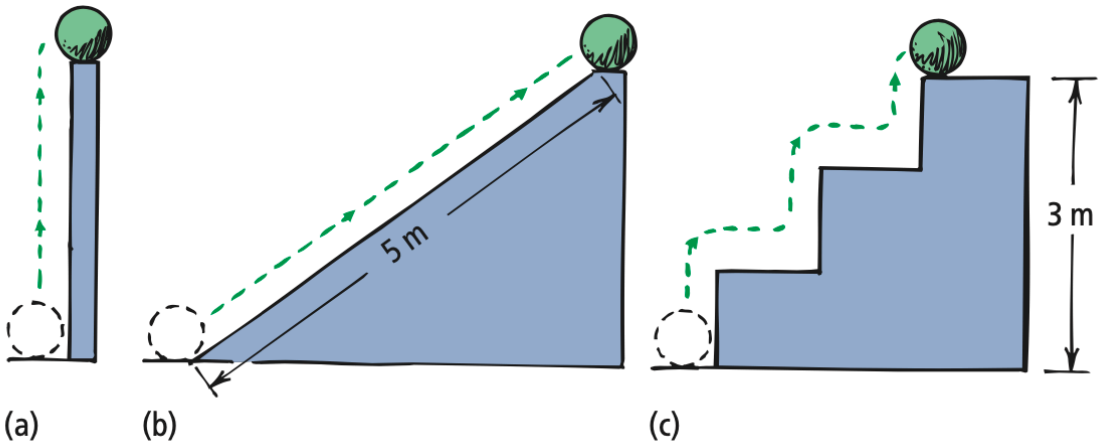
Ch. 7 HW Energy

Extra Credit Option: Each student may obtain up to +5 points extra credit from this HW set to be added towards Exam II. (see Syllabus "Extra Credit' for details)

1) **(15 pts)** A ball that weights 5 N is lifted / pushed in three different scenarios.



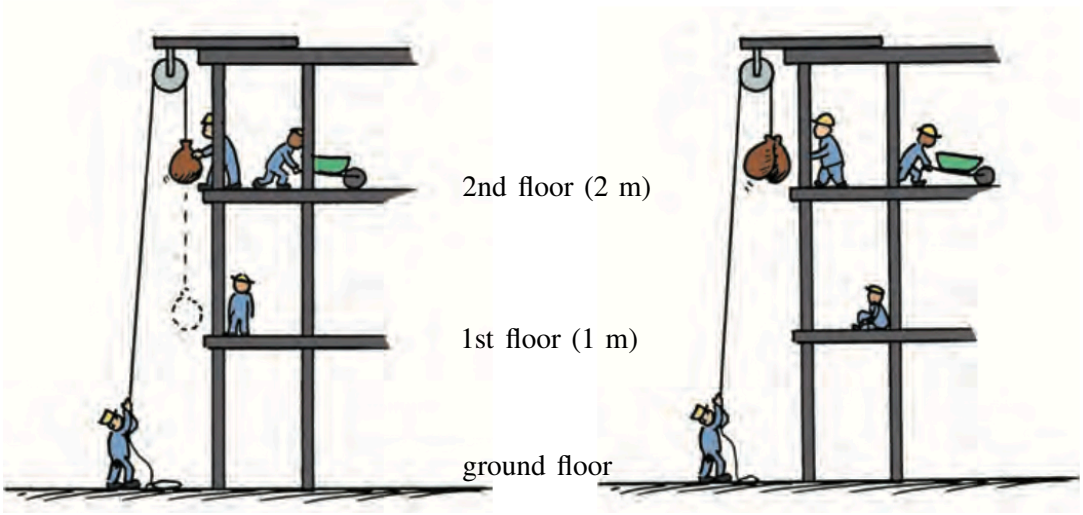
(a) **(3 pts)** What is the work done to lift the ball in figure (a) ?

(b) **(3 pts)** What is the work done to lift the ball in figure (b) ?

(c) **(3 pts)** What is the work done to lift the ball in figure (c) ?

(d) **(6 pts)** What is the gain in potential energy in each case ?

2) **(20 pts)** In figure (a), Bob *steadily* pulls on the rope to lift a 20-kg load of gravel from to from the ***1st*** to a ***2nd*** floor. In figure (b), he lifts a load load of gravel *twice* as massive from the ***ground*** floor to a ***2nd*** floor.



(a) **(2 pts)** What is the weight of the gravel and the tension force on the rope in each case ? (*Hint*: thee gravel is raised *steadily*, think Newton's 1st law)

(b) **(5 pts)** Calculate the *work done by Bob* in the scenario of figure (a)

(c) **(5 pts)** Calculate the *work done by Bob* in the scenario of figure (b)

(d) **(5 pts)** What is the gain in potential energy relative to the ground floor in each case ?

(e) **(3 pts)** If the rope is cut in each case, what is the speed of the gravel bag right before it hits the ground floor ?

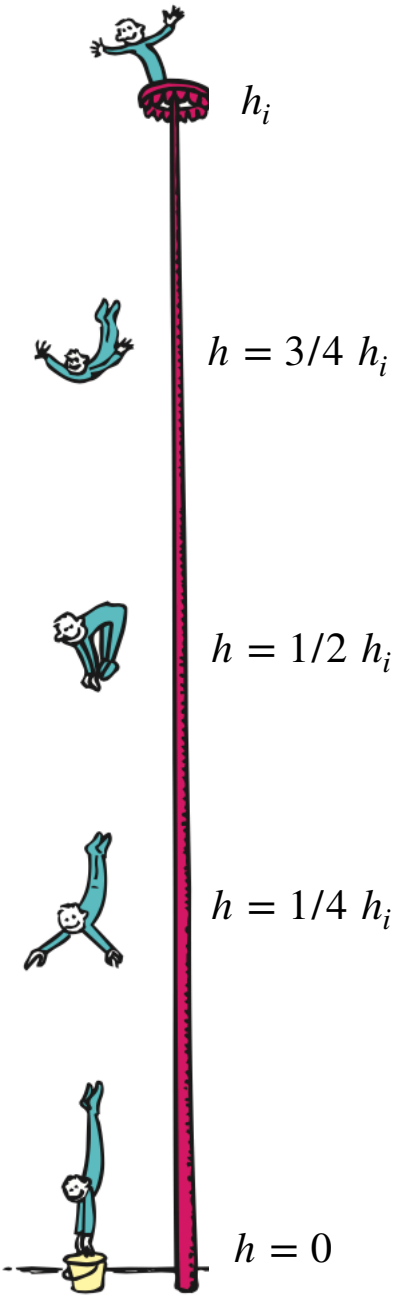
3) **(20 pts)** A circus diver at the top of a pole of a height h_i has a potential energy of $U = 15{,}000$ J . As he dives, his potential energy is converted to kinetic energy K.

(a) **(5 pts)** What is the potential and kinetic energy at 3/4 of the initial height ?

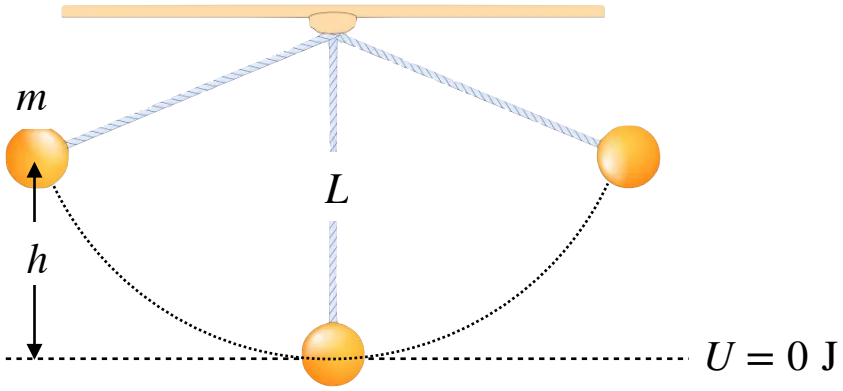
(b) **(5 pts)** What is the potential and kinetic energy at half of the initial height ?

(c) **(5 pts)** What is the *potential* and *kinetic* energy at at 1/4 of the initial height ?

(d) **(5 pts)** What is the potential and kinetic energy right before hitting the ground floor ?



4) **(20 pts)** A pendulum of mass m and length $L = 1$ m is released from *rest* at a height of $h = 0.75$ m (*hint*: think of K.E. + P.E. at each point)



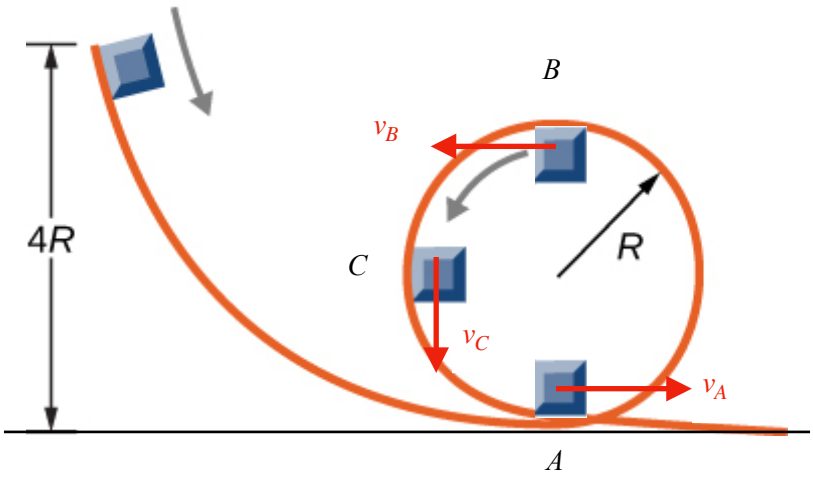
(a) **(5 pts)** calculate is the *total energy* of the pendulum right before it is released from *rest* ?

(b) **(5 pts)** calculate the *potential* and *kinetic* energy of the pendulum at its lowest point ?

(c) **(5 pts)** calculate is the *speed* of the pendulum at its lowest point ?

(d) **(5 pts)** what is the *total energy* and *speed* of the pendulum once it has reached the other end point ? Explain.

5) **(15 pts)** A box of mass m released from *rest* at initial height $4R$ rolls down a frictionless roller coaster with loop of radius R (*not drawn to scale*)

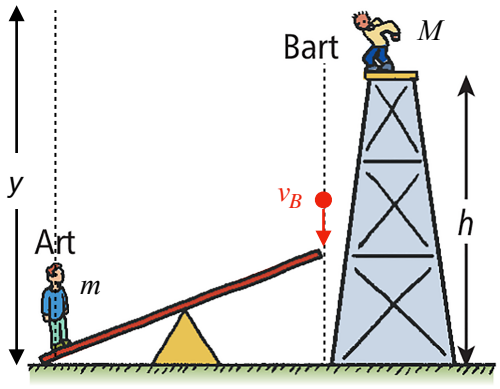


a) **(5 pts)** show that the general expression for the speed of the box at point A in terms of the loop radius R is given by $v_A = \sqrt{8gR}$

b) **(5 pts)** show that the general expression for the speed of the box at point B in terms of the loop radius R is given by $v_B = \sqrt{4gR}$

c) **(5 pts)** show that the general expression for the speed of the box at point C in terms of the loop radius R is given by $v_C = \sqrt{6gR}$

6) **(15 pts)** Art, of mass m stands on the left of a seesaw. Bart, of mass M jumps from a height h onto the right end of the seesaw, thus propelling Art into the air to an arbitrary height, y.

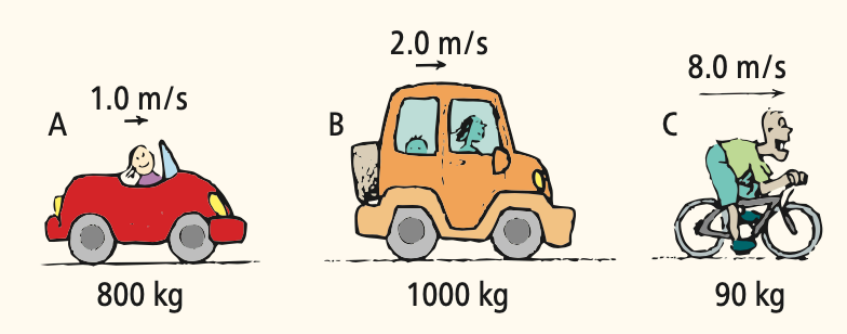


a) **(5 pts)** show that the general expression for the *speed* of Bart (v_B) *half-way* ($h/2$) from his fall is given by $v_B = \sqrt{gh}$

b) **(5 pts)** show that the general expression for the maximum height (y) Art can reach in terms of M, m and h is given by $y = \frac{M}{m}h$

c) **(5 pts)** what is the *speed* of Art once he has reached maximum height y ? Explain

7) **(15 pts)** The mass and speed of the three vehicles, A, B, and C, are shown. Rank from greatest to least their

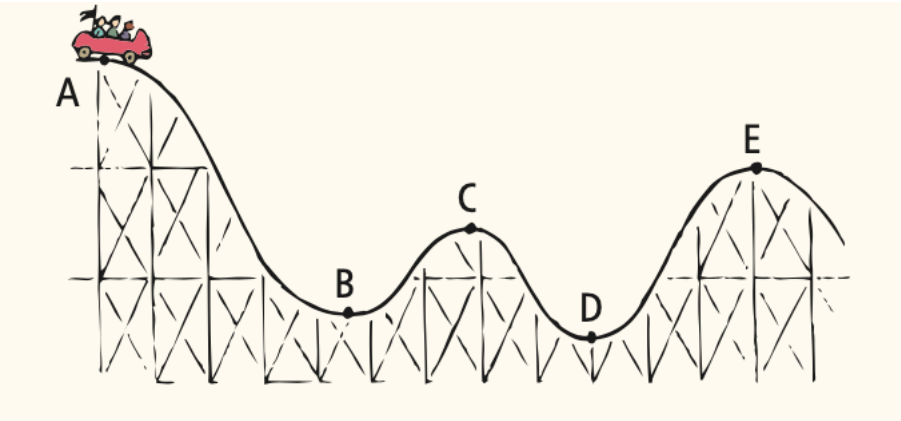


(a) **(5 pts)** momentum

(b) **(5 pts)** kinetic energy

(c) **(5 pts)** work needed to bring them up to their respective speeds from rest

8) **(15 pts)** The roller coaster ride starts from rest at point A. Rank from greatest to least at each point:



(a) **(5 pts)** Speed

(b) **(5 pts)** Kinetic energy

(c) **(5 pts)** Potential energy