1. A block of mass $m$ starts from rest and slides along a frictionless loop-the-loop. What should be its initial starting height such that it pushes against the top of the loop with a force equal to its weight?

2. A student is pulling on a rope to drag his backpack to school across the ice. He pulls with a force of 22.9 N at an angle of $35^\circ$ to the horizontal to drag his backpack a horizontal distance of 129 m. Determine the work done on the backpack.

3. Find the escape speed of a rocket from the moon. Ignore the rotational motion of the moon. The mass of the moon is $M = 7.36 \times 10^{22} \, \text{kg}$. The radius of the moon is $R = 1.74 \times 10^6 \, \text{m}$. The universal gravitational constant is $G = 6.7 \times 10^{-11} \, \text{Nm}^2/\text{kg}^2$.

4. A 55 kg athlete leaps into the air from a crouching position. Her center of mass rises 60 cm as her feet leave the ground and then it continues another 80 cm to the top of the leap. What is the average power she develops, assuming the force on the ground is constant?
Answers

1. Drop from a height of $R$ above the top of the loop or $3R$ from the bottom.

2. 2.42 $kJ$

3. 2.38 $km/s$

4. 1.42 $kW$