1. A particle moves from a point \( \vec{r}_1 = 2\hat{i} + 2\hat{j} \) (in meters) to a point \( \vec{r}_2 = 6\hat{i} - 4\hat{j} \). Find the work \( W \) done by a constant force \( \vec{F} = 4\hat{i} + 2\hat{j} \) (in newtons).

2. Find the angle between the force and the displacement

3. If the mass of the particle in the previous problem is \( m = 2 \text{ kg} \) and the initial speed at \( \vec{r}_1 \) is \( 5 \text{ m/s} \), find its speed at \( \vec{r}_2 \) (assume no work by other forces).

4. A 3 \text{ kg} block is moved along a flat horizontal surface by a constant force \( F = 30 \text{ N} \) which makes 30° with horizontal. The speed changes from 10 \text{ cm/s} to 50 \text{ cm/s} after a 2 \text{ m} displacement. Find the work done by friction.

5. A skier slides down from a hill which is 30 \text{ m} high and then, without losing speed, up a hill which is 10 \text{ m} high. What is his final speed? (a) Ignore friction. (b) Assume a small average friction force of 40 \text{ N} and the combined length of the slopes \( L = 200 \text{ m} \). The mass of the skier is \( m = 80 \text{ kg} \).

6. A mass \( m = 1 \text{ kg} \) is attached to a string \( L = 5 \text{ m} \) and freely revolves under the force of gravity. The speed at the top is \( v = 10 \text{ m/s} \)

   (a) draw clear force diagrams for the two vertical and the horizontal orientations of the string

   (b) find the speed \( V \) at the lowest point
(c) find the tension $T$ ("apparent weight") at the lowest point

7. Consider a spring with $k = 100 \, N/m$

(a) find the extension length if an $m = 1.5 \, kg$ mass is attached to the spring
(b) what is the work done by the spring if it is stretched by extra $10 \, cm$ starting from $x_0 = 5 \, cm$.
(c) find the elastic potential energy stored in the spring at the maximum extension
(d) the spring with mass $m$ attached is now released and starts oscillating (ignore gravity). Find the maximum speed $V$.
(e) (*) find the speed $v$ when $x = 10 \, cm$. 