1) A 25.0-kg box is released on a 27° incline and accelerates down the incline at 0.30 m/s². Find the friction force impeding its motion. What is the coefficient of kinetic friction?

$F_{Fr} = \mu_S F_N$
Force along the incline = 25 kg * 0.3 m/s² = 7.5 N
Tangential Force F_T = 25 kg * 9.81 m/s² * sin(27°) = 111.34 N
Normal Force F_N = 25 kg * 9.81 m/s² * cos(27°) = 218.52 N

$F_{Net} = F_T - F_{Fr}$ = m * a
$F_{Fr} = F_T$ - m * a = 111.34 N - 7.5 N = **103.84 N**
$\mu_S = F_{Fr} / F_N$ = **0.4752**

2) The block shown in the figure has mass m = 7.0 kg and lies on a fixed smooth frictionless plane tilted at an angle theta θ = 22.0° to the horizontal.
a) Determine the acceleration of the block as it slides down the plane.

m * g * sin(22.0°) = m * a
a = 9.81 m/s² * sin(22.0°) = **3.675 m/s²**

b) If the block starts from rest 12.0 m up the plane from its base, what will be the block's speed when it reaches the bottom of the incline?

$v^2_{final} = v^2_{init}$ + 2 * a * h
v_{final} = sqrt(0 + 2 * a * 12m) = **9.391 m/s**

3) A block is given an initial speed of 4.5 m/s up the 22.0° plane shown in the figure above
a) How far up the plane will it go?

m * g * s * sin(θ) = m * v²/2
s = 4.5² m/s / (2 * 9.81 m/s² * sin(22°)) = **2.755m**

b) How much time elapses before it returns to its starting point? Ignore friction.

t = 2 * v / (g * sin(θ))
t = 2 * 4.5 m/s / (9.81 m/s² * sin(22°)) = **2.449s**

4) The crate shown in the figure above lies on a plane tilted at an angle θ = 25.0° to the horizontal, with coefficient of kinetic friction μ_k= 0.19.
a) Determine the acceleration of the crate as it slides down the plane.

a = g * [sin(θ) - μ_k * cos(θ))]
= 9.81 m/s² * [sin(25°) - 0.19 * cos(25°)] = **2.456 m/s²**

b) If the crate starts from rest 8.15 m up along the plane from its base, what will be the crate's speed when it reaches the bottom of the incline?

$v^2_{final} = v^2_{init} + 2 * a * s$
$v_{final} = sqrt(2 * 2.456\ m/s^2 * 8.5m) =$ **6.462 m/s**

5) A crate is given an initial speed of 3.0 m/s up the 25.0° plane shown in the figure. Assume coefficient of kinetic friction $\mu_k = 0.12$.
a) How far up the plane will it go?

Work against Friction = $F_N * s * \mu_k$ = $m * 9.81\ m/s^2 * cos(25°) * s * 0.12$
Work against Gravity = $m * g * s * sin(\theta) = m * 9.81\ m/s^2 * s * sin(25°)$
$1/2\ m * v^2 = m * 2 * g * s * (sin(\theta) + \mu_k * cos(\theta))$
$s = 3.0^2\ m/s / [\ 2 * 9.81\ m/s^2 * ((sin(25°) + 0.12 * cos(25°))] =$ **0.863m**

b) How much time elapses before it returns to its starting point?

Deceleration of crate on incline = $g * sin(\theta) = 9.81\ m/s^2 * sin(25°) = 4.146\ m/s^2$
Deceleration of crate along incline = $\mu_k * g * cos(\theta) = 0.12 * 9.81\ m/s^2 * cos(25°)$ $= 1.067\ m/s^2$

Net deceleration of crate on incline = $4.146\ m/s^2 + 1.067\ m/s^2 = 5.213\ m/s^2$
$t_1 = v / a = 3\ m/s / 5.214\ m/s^2 = 0.575s$

Acceleration after subtracting friction = $4.146\ m/s^2 - 1.067\ m/s^2 = 3.079\ m/s^2$
$s = ½ * a * t^2$
$t_2 = sqrt(\ 2 * s / a) = sqrt(\ 2 * 0.863m / 3.079\ m/s^2) = 0.749s$

$t = t_1 + t_2 = 0.575s + 0.749s =$ **1.324s**