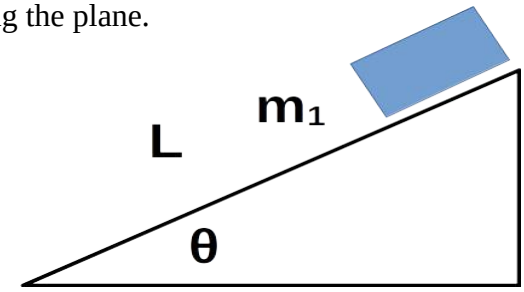
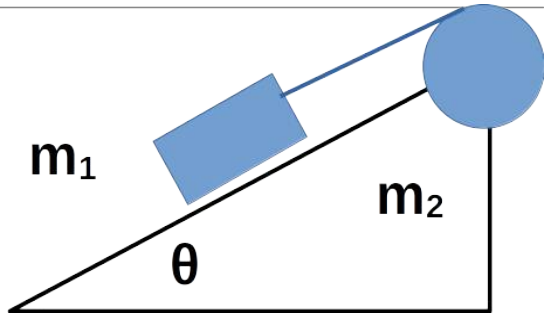
1) Consider a mass m_1 on a friction-less incline plane of length "L" along the plane.
a) Using Newtons laws, compute the
- acceleration
- the time to slide down the distance "L"
- the velocity at the bottom.

b) Repeat to find the acceleration using energy considerations.
c) Repeat to find the acceleration using Lagrange equations.



---

2) Consider a mass m_1 on a friction-less incline plane of length "L."
There is a pulley of mass m_2 with $I_2=(y)\ m_2\ R^2$.
a) Using Newtons laws, compute the acceleration.
b) Repeat to find the acceleration using energy considerations.
c) Repeat to find the acceleration using Lagrange equations
with a Lagrange multiplier.



---

3) You launch a projectile of mass m at initial velocity v_0 an angle θ from a cliff of height $h=x_0$.
Find the horizontal distance covered. Find the maximum height above the valley floor.

---

4) A M_1=40kg railway car stands on a hill with its brakes set. The brakes are released and the car rolls down to the bottom of the hill h_1=100m <u>below</u> its original position. It collides with a M_2=12kg car resting (with its brakes off) at the bottom of the track. The two cars couple together and roll up the track to a height h_2.
a) Whose fault is the collision? b) Find the final height, h_2, of the cars.

---

5) A man pulls his children on a sled with a rope with angle θ = 20 degrees with the horizontal.
The total mass of the children plus the sled is m=50kg. The coefficient of friction is μ = 0.4.
a) What tension T is necessary in the rope so that the sled moves at a <u>constant</u> velocity?
b)If the man wants the sled to accelerate at $\mathbf{a=3m/s^2}$, what is the new tension $\mathbf{T_2}$.

---

6) A race car rounds a curve of radius r=100m at a speed v=120km/hr.
a) At what angle should the curve be banked so that the car does not need any friction to make the turn?.
b) If the curve is un-banked, what is the minimum coefficient of friction necessary so that the car does not slip?

---

7) The roller-coaster at Six Flags amusement park has a loop-the-loop track with a radius of r=10m.
a) Find the minimum velocity the roller-coaster must have at the top so that it stays on the track.
b) Use energy conservation to find the velocity of the above roller-coaster when it reaches the bottom.

---

8) Assume the earth is a homogeneous sphere of mass $M_E=6x10^{24}$kg and radius $R_E=6.4x10^6$m.
(I=2/5 m r^2 for a sphere.) a) Find the kinetic energy and angular momentum due to its rotation of 1 revolution per day. b) If I apply a force $F=10^{10}$N at the equator to slow the rotation of the earth, find the resulting angular deceleration α. c) Using α from part (b), how long will it take to stop the rotation of the earth?

---

9) A bullet of mass m_1=50g strikes a wood block of mass m_2=1kg at rest hanging vertically on a string of length L=50cm. After the bullet is embedded in the wood block, the system swings to an angle of θ=30 degrees. Find the initial velocity of the bullet.

---

10) A turntable of m=20kg r=0.5m ($I=1/2\ mr^2$) is spinning at ω_0=20 rad/sec. A torque of $\tau=2$ N-m^2 is applied to <u>slow</u> the turntable. i) Find the angular deceleration α.
ii) Find the number of <u>revolutions</u> necessary to stop the turntable.