PHYSICS 341, Assignment # 4
Due: Monday, October 16, 2017

(1) Two blocks with masses $m_1 = 15$kg and $m_2 = 30$kg are connected by an inextensible, massless string that passes over a frictionless pulley. Each block sits on a different slope where $\mu_1 = 0.4$ and $\mu_2 = 0.2$ are the respective coefficients of kinetic friction for the left- and right-hand slopes. The length of the left-hand slope (AC) is 4.0 metres, the length of the right-hand slope (CB) is 3.0 metres and the base of the triangle (AB) is 5.0 metres in length.
(a) What is the acceleration of the masses?
(b) How long does it take the blocks to move 1.0 metre if they start from rest?
(c) What is the tension in the string?

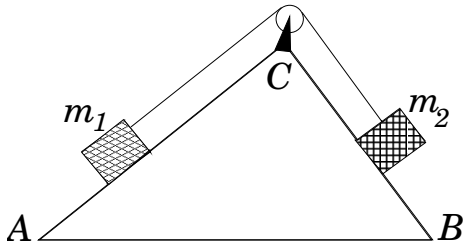

Figure 1: A double inclined Atwood's machine.

(2) A particle of mass m moves along the x-axis starts out at rest at position $x = x_0$ at time $t = t_0 > 0$. Find the velocity and position of the particle for times $t \geq t_0$ when the force is given by the following:
(a) $F_x = f_0 + F_0/t$
(b) $F_x = F_0 e^{-kt}$
(c) $F_x = F_0 \sin \omega t$
where f_0, F_0, k and ω are all constant.

(3) A particle moves under the influence of an external force:

$$F = \frac{\kappa}{(t+\tau)^2}$$

where κ and τ are constants. If at $t = 0$ the particle velocity is v_0:
(a) compute the motion of the particle.
(b) At what time (if ever) does the particle come to rest?
(c) What is the final velocity of the particle?
(d) What is the distance travelled by the particle as $t \to \infty$?

(4) An object with a mass m slides across a frictionless horizontal surface. At time $t = 0$ it has an initial velocity $v = v_0$ and its initial position is $x = 0$. A drag force F_d acts on the object and depends both linearly and quadratically on the velocity:

$$F_d = -k_1 v - k_2 v^2$$

where k_1 and k_2 are constant coefficients.
(a) Neglecting the gravitational force, find the instantaneous velocity, $v(t)$, and position, $x(t)$, of the object.
(b) Will the object eventually come to rest at a finite distance from where it enters? If so where does it stop?

(over)

(5) A particle is shot vertically upward with an initial speed of v_0. A retarding force acts on the particle, and is linear in the velocity, $F_r = -c_1 v$, where c_1 is a constant.
(a) How long does it take for the particle to reach its maximum height?
(b) Show for very small values of c_1, that this time approaches the time you would expect for the object to reach its maximum height when there is no retarding force. (Hint: Use a Taylor series expansion.)

NOTE: MidTerm Exam #1 will take place Oct 20, 2017 in class