Cart on a Track

A cart of mass m = 1.2 kg is placed on a horizontal track. The cart rolls with very little friction, and is attached to the left end of the track by a spring with negligible mass, spring constant k = 20.0 N/m, and un-stretched length 25.0 cm.

(A) The cart is moved 7.5 cm to the left of its equilibrium position, and is then released from rest. Draw a sketch of the position x along the track of the cart relative to its equilibrium position as a function of the time t after it is released, and use this to find the function $x(t)$.

(B) Draw energy bar charts (with realistic values) showing the kinetic and spring potential energies of the cart:

a. When it is released
b. When it passes through its equilibrium position
c. When it stops moving.

(C) Instead of moving the mass to the left, a second student pushes it toward the left so that it is released at its equilibrium position with a speed v = 0.2 m/s. Draw a sketch of the position x of the mass relative to its equilibrium position as a function of the time t after it is released, and use this to find the function $x(t)$.

(D) A third student thinks it would be fun to push the mass toward the left with the same speed as in (C), but release it 5.0 cm to the left of its equilibrium position. Draw a sketch of the position x of the mass relative to its equilibrium position as a function of the time t after it is released. Use the general form $x(t) = C\cos(\omega t) + S\sin(\omega t)$ to determine the function $x(t)$.