Base Kinematics Equations:

a) $D = V_i t + {}^{1}/_{2}\, at^2$
b) $\frac{(V_i + V_f)}{2} = \frac{D}{t}$
c) $a = \frac{(V_f - V_i)}{t}$
d) $V_f^2 = V_i^2 + 2aD$

Base Force Equations

1) $F = ma$
2) $F_{applied} = F_{accel} + F_{friction}$

The problem has two compound questions contained in it. I say "compound questions" because each question requires multiple steps.

Question #1: what is the initial force applied?

Question #2: what is the friction force?

For Question #1:

We want to find the force applied. Remember the force applied will be the force required to accelerate the skate board plus the force of friction. Since we don't know the force of friction we have to start by finding the force required to accelerate the skate board. The basic force equatioin is number 1 above, and since we don't have the acceleration, we will need to find it. We can get it using equation a) above.

What we know:
M=0.5kg, D=1m, Vi=0m/s, t=8.5s, and we need to find a

$$D = V_i t + {}^{1}/_{2}\, at^2$$
$$(1m) = \left(0{}^{m}/_{s}\right)(8.5s) + {}^{1}/_{2}\, a(8.5s)^2$$
$$(1m) = {}^{1}/_{2}\, a(8.5s)^2$$
$$2 \times (1m) = a(8.5s)^2$$
$$2m = a(8.5s)^2$$
$$a = \frac{2m}{(8.5s)^2}$$
$$a = \frac{2m}{72s^2}$$
$$a = 0.028{}^{m}/_{s^2}$$

Now that we have the acceleration of the skate board we can find out what force was required to accelerate it. Remember this is not the total applied force since friction was acting on the skateboard at the same time.

$$F_{accel} = ma$$
$$F_{accel} = (0.5kg)\left(0.028 m/_{s^2}\right)$$
$$F_{accel} = 0.014N$$
$$F_{accel} = 1.4 \times 10^{-2}N$$

Now we need to find the force of friction. To do this we use the second half of the problem, after the force of acceleration was removed and all that was acting on the skate board was friction. To do this we need to know the initial velocity after the acceleration force was removed. We get this from the first part of the problem.

What we know:
M=0.5kg, D=1m, Vi=0m/s, t=8.5s, and we need to find Vf. We can use equation b) from above.

$$\frac{(V_i + V_f)}{2} = \frac{D}{t}$$
$$\frac{\left(0 m/_{s^2} + V_f\right)}{2} = \frac{1m}{8.5s}$$
$$\frac{V_f}{2} = \frac{1m}{8.5s}$$
$$V_f = \frac{2 \times 1m}{8.5s}$$
$$V_f = \frac{2m}{8.5s}$$
$$V_f = 0.24 m/_s$$

So Vf from question 1 is Vi for question 2. Now we can find the acceleration for question 2 using equation d).

What we know:
M=0.5kg, D=1.25m, Vi=0.24m/s, Vf=0m/s, and we need to find a

$$V_f^2 = V_i^2 + 2aD$$
$$(0 m/_s)^2 = (0.24 m/_s)^2 + 2a(1.25m)$$
$$0 = 0.058 {m^2}/_{s^2} + a(2.5m)$$
$$-(2.5m)a = 0.058 {m^2}/_{s^2}$$
$$a = \frac{0.058 {m^2}/_{s^2}}{-2.5m}$$
$$a = -0.23 m/_{s^2}$$

Now we can get the force of friction. Notice the sign of the acceleration is negative. That means it's acting in the opposite direction to the initial force of acceleration.

$$F_{friction} = ma$$
$$F_{friction} = (0.5kg)\left(-0.023 m/_{s^2}\right)$$
$$F_{friction} = -0.012N$$
$$F_{friction} = -1.2 \times 10^{-2}N$$

Again notice the negative sign. This says the force of friction is acting in a direction opposite to the initial force applied.

Now back to question #1 and determine the applied force.

$$F_{applied} = F_{accel} + F_{friction}$$
$$F_{applied} = (1.4 \times 10^{-2}N) + (1.2 \times 10^{-2}N)$$
$$F_{applied} = 2.6 \times 10^{-2}N$$

So the force applied is $2.6 \times 10^{-2}N$ and the force of friction is $1.2 \times 10^{-2}N$

Hope this all makes sense. This is a pretty big problem.