1. b (it must be greater than either 5, the eastward component, or 10 m, the southward component, and less than 15 m, the sum of the two components, 10 m and 5 m)

2. (a) There are two forces acting on the box: the gravitational force pulling straight downward and a normal force pushing away from the inclined surface.

   Since we know the net force must be parallel to the surface, we only need to calculate the forces parallel to the surface. Of the forces that are acting, only the gravitational force has a component parallel to the surface (the normal force is perpendicular to the surface).

   The magnitude of the gravitational force is $F_g = (9.8 \text{ N/kg})(10 \text{ kg}) = 98$ N.

   The component directed down the inclined surface is 59 N. You can get this via trigonometry (multiply by sine or cosine of the angle). Based upon the picture, the gravitational force is closer to the surface perpendicular than to the parallel, so the parallel component of the gravitational force must be the smaller of the two components.

   Since the only force acting parallel to the surface is this component of the gravitational force, the net force must also be 59 N and be directed down the surface.

   (b) From Newton's second law, the change in velocity is the net force (59 N down the incline) per mass (10 kg) times the time (3 seconds). This gives a change in velocity of 17.7 m/s down the incline.

   This means that in three seconds the velocity will change by 17.7 m/s down the incline. Since it started at 7.0 m/s up the incline, that means three seconds later it has a velocity of 10.7 m/s down the incline (add 17.7 m/s down to 7.0 m/s up).

   Since the net force is constant (not varying), the average velocity should be midway between 7.0 m/s upward and 10.7 m/s downward. That would mean the average velocity is 1.85 m/s downward.

   From the definition of average velocity, this must be the displacement divided by the time. Multiply by the 3 seconds to get a displacement of 5.55 m downward.

(c) If there is friction, then the acceleration will be different. To find the friction, you must first find the normal force, which you then multiply by the coefficient (0.1 in this case). Once you find the friction, the process is the same as what we did in parts (a), (b) and (c).

To find the normal force, apply Newton's second law to the direction perpendicular to the surface. Since the object doesn't accelerate in that direction, the net force in that direction must be zero. Since the friction force is parallel to the surface, not perpendicular, the only two forces we need to concern ourselves with is the normal force (pointing away from the surface) and a component of the gravitational force (pointing into the surface).

Using the logic from part (a), the component of F_g perpendicular to the surface is found to be 78.3 N. That means that the normal force must by 78.3 N out of the surface.

Now we can find the friction force by multiplying that by 0.1 to get 7.83 N.

In this case, the friction force is directed down the incline, since the object is sliding up the incline. The total force parallel to the surface is now the sum of the friction force (7.83 N down the incline) and the component of the gravitational force parallel to the surface (59 N down the incline). That means the net force is 66.83 N down the incline.

We want to find how far the object moves before stopping. At that point, the velocity is zero (for an instant). That means the change in velocity is 7.0 m/s down the incline.

Knowing that, we can use Newton's second law to find the time (since we know the change in velocity, the net force and the mass). I get a time of 1.0474 s.

Since the net force remains unchanged during this time, the average velocity is midway between the initial (7.0 m/s up the incline) and the final (0 m/s) velocities. That gives an average velocity of 3.5 m/s up the incline.

From the definition of average velocity (displacement divided by time), we can find the displacement. I get a displacement of 3.666 m up the incline.