Problem 1: Ball thrown into the air. This problem concerns a ball thrown directly upwards, and then not touched again until it has fallen back to its initial height.

The easiest way to solve this problem is to work it backwards. When I throw the ball upwards, I know that after it leaves my hand the only force acting on it is gravity. So I can immediately draw my last two graphs: the acceleration must be $g = -9.8\frac{m}{s^2}$, and the force is the weight of the ball: $m * g$. Since neither changes during the problem, both graphs will just be horizontal lines.

With my acceleration graph already known, finding the velocity and position graphs is easy. According to the book, when we deal with a problem in which acceleration is constant, then we can find velocity vs. time and position vs. time according to $v(t) = v_{initial} + a * t$ and $y(t) = y_{initial} + v * t + \frac{1}{2}a * t^2$

Since we know the acceleration $a = g = -9.8\frac{m}{s^2}$ and the initial position $y_{initial} = 0$ the only thing we still have to find is the initial velocity $v_{initial}$.

The initial velocity is found by ovserving that the ball takes 1.5 seconds to slow to a stop. Since it's accelerating at $-9.8\frac{m}{s^2}$, that means in 1.5 seconds it loses $1.5s * 9.8\frac{m}{s^2} = 14.7\frac{m}{s}$ in coming to a complete stop. So the initial velocity is $14.7\frac{m}{s}$.

The last thing we need to know before drawing our graphs is how high the ball travels, since the problem asks us to draw position and time axes with the appropriate scales on our position graph. There are two ways to do this, both of which will give correct answers.

The first way is the most intuitive. The ball starts upward at a velocity of $14.7\frac{m}{s}$ and reaches its peak with a velocity of zero, $1.5s$ later. Since the acceleration is constant in this problem, we can then find the average velocity to be $\frac{14.7\frac{m}{s}+0\frac{m}{s}}{2} = 7.35\frac{m}{s}$. So we can find the distance travelled by multiplying the average velocity by the time spent travelling $7.35\frac{m}{s} * 1.5s = 11.025m$.

The second way is to use our equation for the height of the ball, $y(t) = y_{initial} + v * t + \frac{1}{2}a * t^2$ and substitute the values which we have determined for the various variables in the equation to find the position of the ball at time $t = 1.5s$ $y(1.5s) = 0m + 7.35\frac{m}{s} * 1.5s + \frac{1}{2} - 9.8\frac{m}{s^2} * (1.5s)^2 = 11.025m$.

Problem 2: Pushing a box down the hall Once again, this problem is easier to solve if we work backwards (this is often the case in physics problems). The problem statement tells us that the box moves at a steady speed of $0.5\frac{m}{s}$. Pushing the box down a straight hall, we also know that the direction of the box's velocity doesn't change – it slides directly down the hall, without turning any corners. Since acceleration is the change in the box's velocity (speed and direction), we know that the box experiences no acceleration.

Since the box is experiencing no acceleration, it follows that the net force experienced by the box must be zero, since force equals mass times acceleration. Therefore, in addition to our $50N$ of force pushing the box down the hall and the $15kg * 9.8\frac{m}{s} = 147N$ force of gravity on the box, there must be a force or sum of forces which cancels these two forces out – a force in the horizontal direction with magnitude $50N$ opposing the push, and an upwards force with magnitude $147N$ opposing gravity.

Now all we have to do is identify the forces which cause these cancellations. The upward force is just the force the floor exerts holding the box up, whereas the sideways force opposing our push is the force of friction between the floor and the box.

Part b) asks about the net force on the box. To do this, we will repeat the reasoning we used in part a). Since the box is moving in a straight line, its direction does not change. Since the problem statement tells us that the speed remains constant, it follows that the velocity (speed and direction) remains constant, so the box experiences no acceleration.

For any object, the relationship between the net force experienced and the acceleration of that object is given by $F_{net} = mass * acceleration$. Since we know that the box is experiencing no acceleration, we know that the sum of all forces acting on the box must be zero.