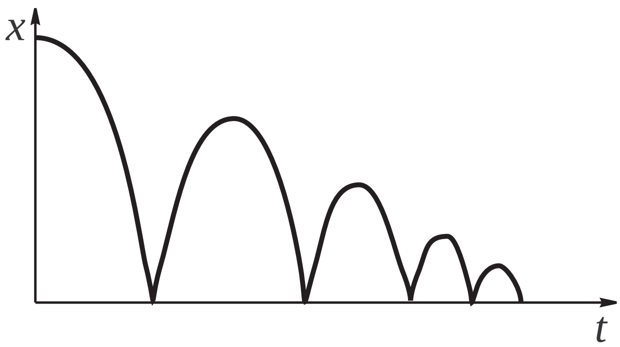
1. A ball is dropped from above the ground and bounces several times before coming to rest. Assuming the ground is the origin and the positive direction is measure upwards sketch graphs of

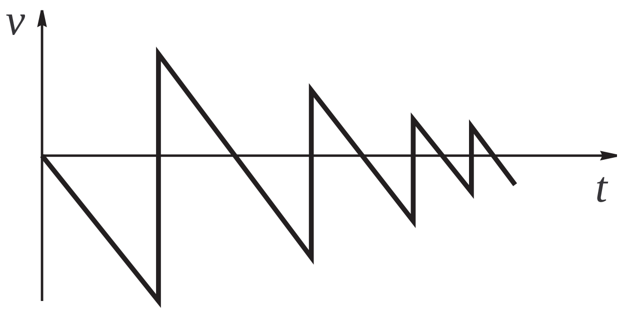
   (a) position vs. time

   The key component of this graph should be that the ball starts at the highest point right when t = 0, and from there each successive bounce is lower. Also, the time between bounces also shrinks, so the hills should get more narrow as they go along.



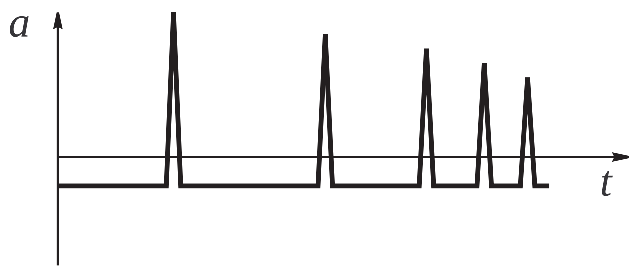
   (b) velocity vs. time

   The solution graph is assuming that we are viewing the direction towards the ground as the negative direction which should be pretty intuitive. The ball is initially dropped, hence it gains a velocity towards the ground and thus is a negative velocity. Hence the line should be starting at 0 velocity and head downwards. Now when the ball hits the ground, it is very quickly accelerated in the upwards direction, and the moment it leaves the ground it is traveling at its greatest positive velocity, thus the line should just almost straight up to a high positive velocity. Since the ball is dropping less distance as time goes on the peaks and valleys of the velocity should be less and less extreme because the ball is not moving as fast since gravity doesn't have as much distance to exert a force over.



   (c) acceleration vs. time

   Gravity exerts a constant acceleration of 9.8 downwards and hence it is a negative acceleration (again this is because in part a we decided that we were going to consider down the negative direction). The only other acceleration the ball experiences are the brief moments it smashes against the ground. These exert a quick strong acceleration in the positive direction, it would have to in order to make the velocity jump to a large positive number. Hence the graph should be a straight line at -9.8 punctuated with large but brief spikes extending up into the positive acceleration at those times corresponding to the ball hitting the ground.



2. A car is moving at a constant speed of 30 km/hr. The driver then presses harder on the accelerator causing an acceleration of 2.25 km/hr/sec, which she maintains for 4 seconds. How fast is the car moving at the end of 4 seconds?
   The velocity will increase by $2.25 \times 4 = 9$ km/hr. Thus she is moving at 39 km/hr.

3. A car travels 120 km along a road at 40 km/hr and then immediately returns along the same road at a speed of 60 km/hr.

   (a) How long does each leg of the trip take?
   $v = d/t$, so $t = d/v$. So for the away trip $t = 120/40 = 3$ hrs. For the return trip $t = 120/60 = 2$ hrs.

   (b) What is the average speed for the round trip?
   Total distance is 120 km and total time is 5 hrs, so the average speed is $120/5 = 24$ km/hr.

   (c) What is the average velocity for the round trip?
   Since the total displacement is zero, the average velocity is zero.

4. Complete the following Exercise from Hobson Ch 4 Conceptual Exercises 7,8,10,15,16

   7 After the ball is thrown the only force acting on it is gravity. Hence the net force is F = ma = 8 Newtons in the downwards direction. The net force and the acceleration are in the same direction. These will always be in the same direction.

   8 An object could be moving with unchanging speed in a straight line and still have forces acting on it. Any forces acting on it have to be equal and opposite. This implies that the net force does indeed have to be 0.

   10 Yes, the floor exerts a force equal and opposite to the force your weight exerts on the floor via gravity. The force the floor exerts points straight up towards you. You don't accelerate in that direction because the force is equal and opposite to the force your feet are exerting on the floor, hence the net force is 0.

15 $F = ma$ so $a = F/m$ = 60 N / 3 kg = 20 m/s^2. After your foot leaves the rock is no net force on the rock. Technically there is the force that gravity has pulling down the rock but this is counteracted by the normal force that the ice is exerting on the rock (see the previous question) and because the problem said to ignore friction. But the net force is 0 hence there is no acceleration. The rock will have a non-zero speed, it will have whatever speed results from the 20 m/s^2 acceleration exerted over whatever time frame your foot was in contact with the rock for.

16 Forces add, so we have 60 6 = 54 Newtons. This implies an acceleration of 54 N / 3 kg = 18 m/s^2. After your foot leaves the rock, the force of friction will remain so there will be a -6 Newton force in the opposite direction than the rock is moving.