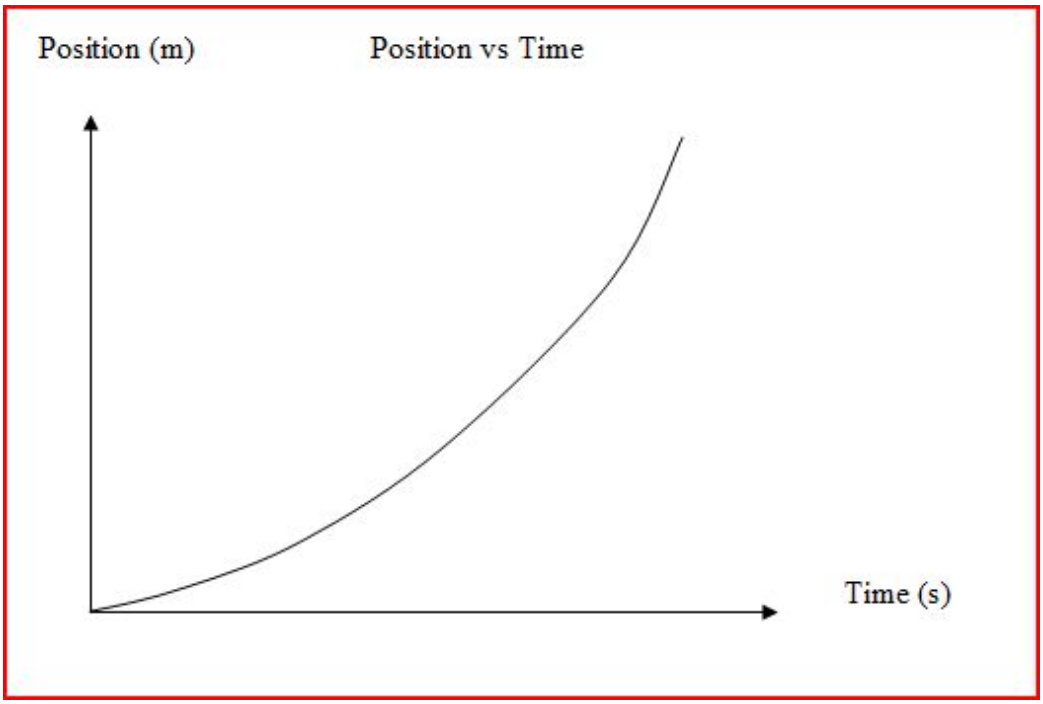
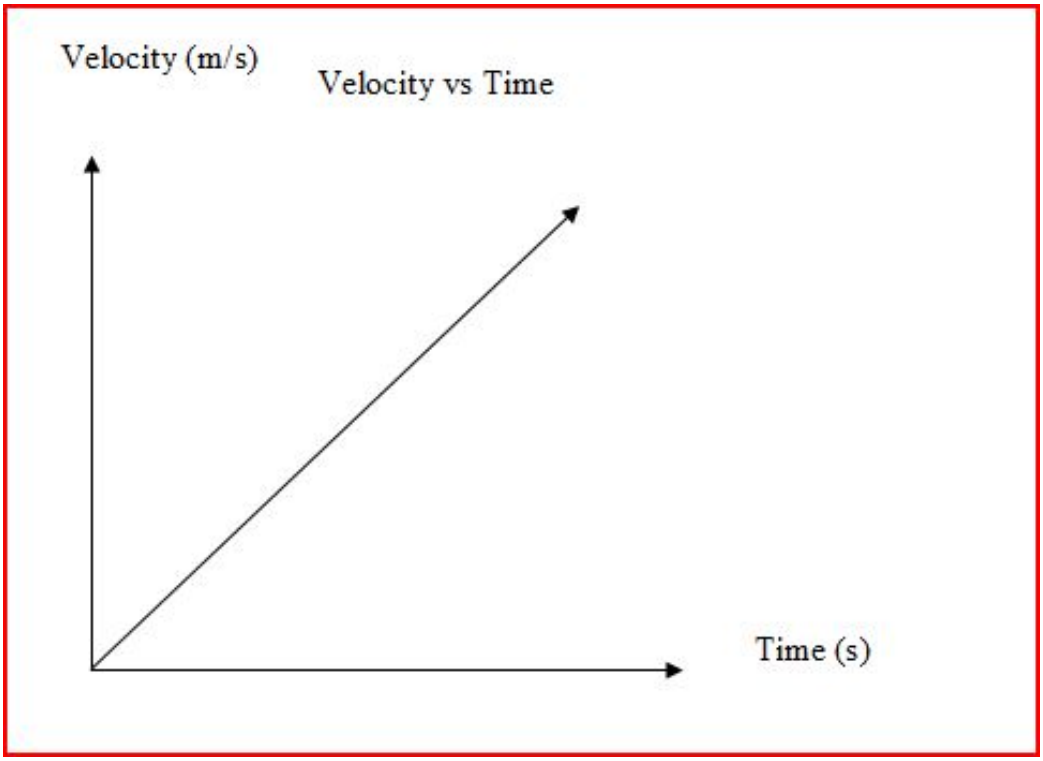
Questions:

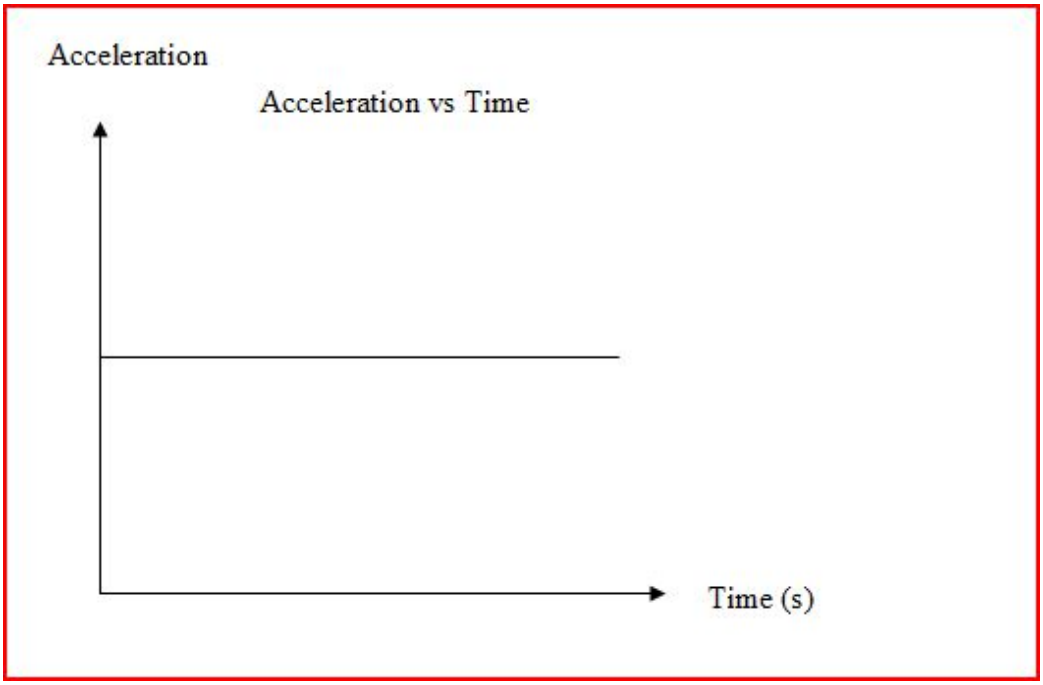
1. Imagine you drop a stone from the top of the Ladner Clock Tower. Sketch the position, velocity and acceleration graphs of the stone. Make sure to label your axes and state your assumptions. You do not have to come up with algebraic expressions for your functions, but you should explain their features (for example, the slope of the velocity graph).



The position graph is a curve because position is increased exponentially. Velocity is distance over time, so if velocity is increasing the distance over time is increasing, causing position over time to increase at a greater rate, covering more distance per second, making it exponential.



Velocity is linear because acceleration change in velocity, so velocity increases $9.8m/s$ per second.



Acceleration is a flat line because it doesn't change. It is always $9.8m/s$ because that is the acceleration of gravity.

2. In physics, *jerk* is defined to be the rate of change of acceleration with respect to time.

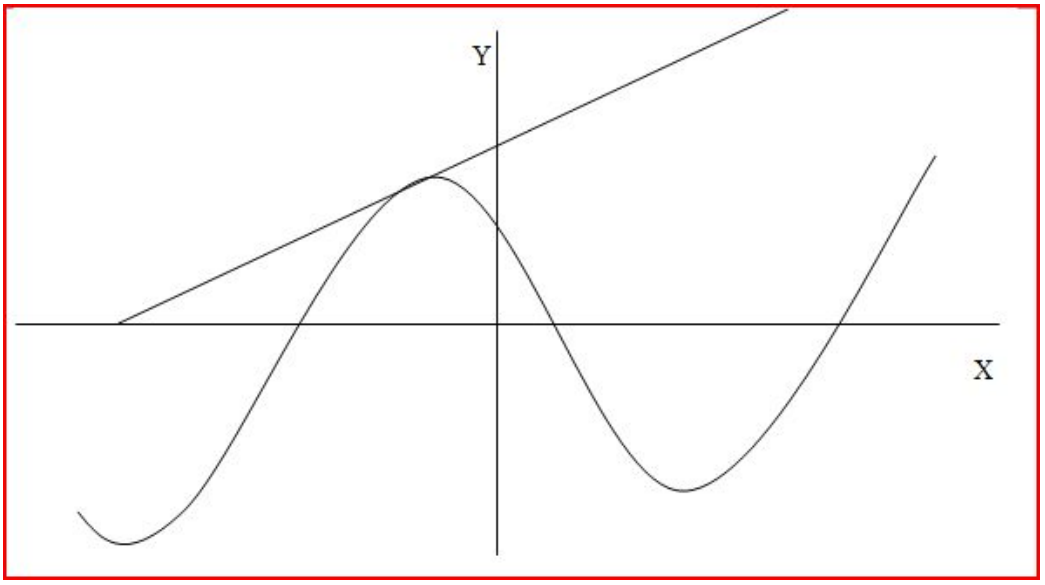
   (a) Describe, using a picture, how to calculate the instantaneous jerk of an object given the graph of its acceleration with respect to time. If acceleration is measured in m/s^2, what are the units of jerk?

$$j = a/t \tag{1}$$
$$a = m/s^2 \tag{2}$$
$$j = m/s^2/t \tag{3}$$
$$t = s \tag{4}$$
$$j = (m/s^2)/s \tag{5}$$
$$j = m/s^3 \tag{6}$$

So the units for jerk is

$$j = m/s^3 \tag{7}$$

So to find the instanteous jerk of an object on the graph a tangent line can be used.



(b) If an object has constant, positive jerk, what does the graph of its position with respect to time look like? Describe your answer as accurately as possible, and then justify it in one or two paragraphs.

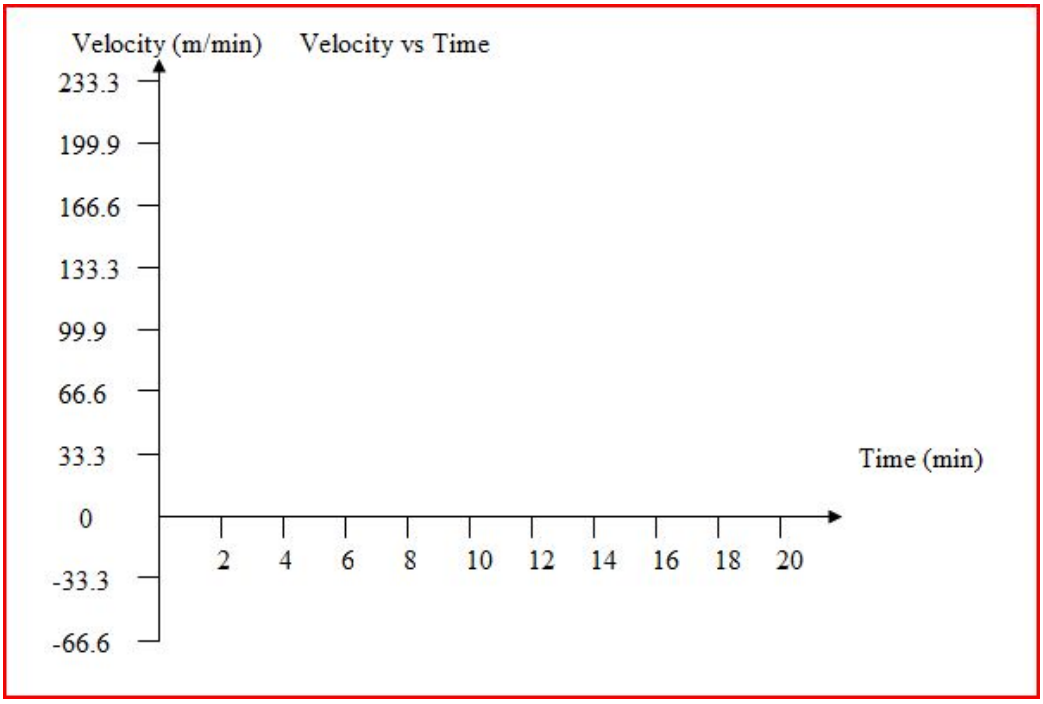
(c) **[Bonus]** Describe what constant jerk feels like on the human body.

Roller coasters and buses are some key examples of constant jerk happening in our every day life. It is basically having acceleration directed one way then another. The body doesnt expect the acceleration to change directions in such a short period of time therefore jerking happens. At these points weightlessness and inversion might be felt. Constant jerking is when this happens over and over during a period of time. An example: When a bus stops suddenly you jerk foward, but as it starts to drive again, your body isnt ready and you jerk backwards. The cycle repeats everytime the bus suddenly stops.

3. One warm sunny Australian day, I was riding my kangaroo to work and I started tabulating the velocity I was going at during various points in my trip. (This particular model has a speedometer in its pouch.)

time (min)	Velocity (km/h)
0	5
2	-3
4	3
6	3
8	9
10	13
12	11
14	10
18	-8
20	-2

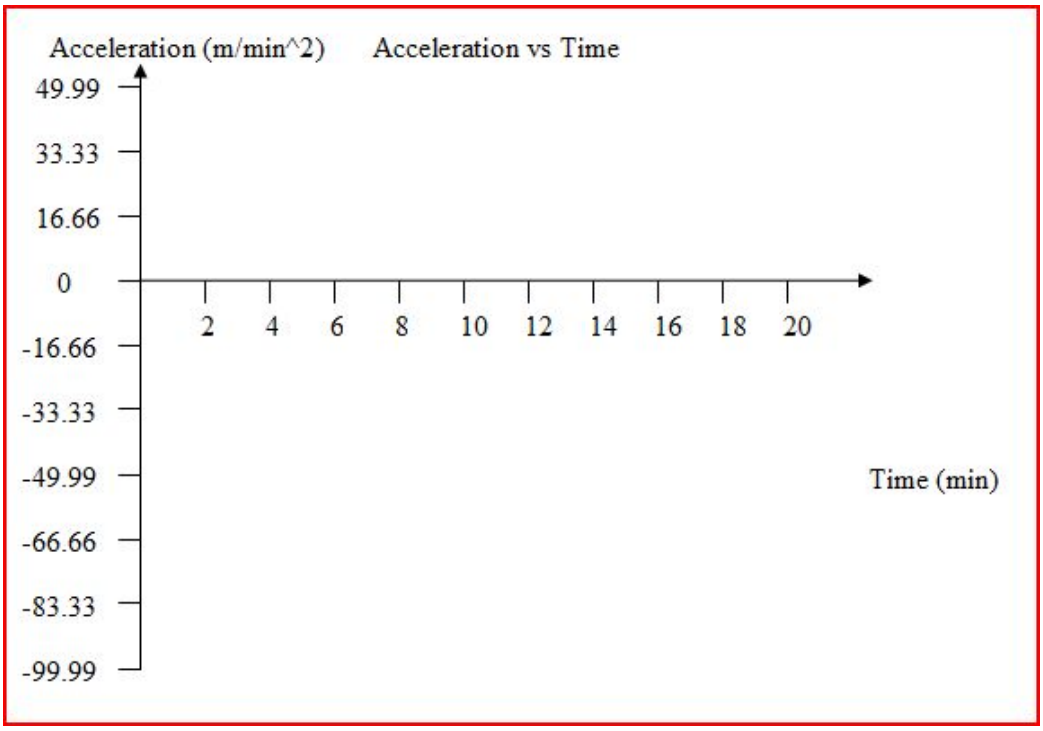
(a) Sketch a graph of my velocity as a function of time.



(b) Based on the graph, sketch a graph of my acceleration as a function of time

(c) Sketch a graph of my position as a function of time.

(d) **[Bonus]** Come up with a one paragraph story of my trip on this particular day that matches the given data.
I was riding my kangaroo on the main road at $5km/h$ to work which was located west of my house when suddenly I forgot my suitcase at home. I went back home which was east of my workplace to grab it. When I returned to the main road four minutes later, it was crowded with other businessman riding their kangaroo. I realized it was rush hour so I decided to take a detor through the short roads after waiting moving slowly for four minutes. It was no surprise my kangaroo ran faster and faster. But it couldn't keep getting faster because so it slowed down a bit. Four minutes after slowing down, I realized I dropped my suitcase on the way so I asked my kangaroo to go back east to grab it. On the way back my kangaroo got really tired so we travelled at a very slow pace in the last two min of my story.


Acceleration (m/min^2)
Acceleration vs Time
49.99
33.33
16.66
0
-16.66
-33.33
-49.99
-66.66
-83.33
-99.99
2
4
6
8
10
12
14
16
18
20
Time (min)