Assumptions

1. Subject will reach points at event seconds
2. Speed is adjusted if points limit velocity and acceleration

A smoothing filter is applied to identify points where the route turn is beyond a threshold. This creates a constraint for where output points will be to create smooth animation.

Algorithm

1. Given a list of locations on a route $polyline$
2. Create a $smoothRoute = smooth(polyline)$ where every location is changing route direction by $SmoothRouteThreshold$
3. Create a $speedGraph$ where locations and roads have a speed, roads have max and locations have a minimum
4. Interpolate each location to location with 1/s connection locations

Constraints

- $SmoothRouteThreshold$ Maximum direction change between two points
- $SpeedGraph$ Every point and edge has a desired speed

Equations

EDIT: these all changed after hacking

Calculate the accelaration

- Accelera iteration $a(t) = min(MAX_A, MAX_V - v(t-1))$
- Accelera iteration $a(t) = MAX_A$ if $d(t) * v(t) < D$
- Decelera iteration $a(t) = MIN_A$ if $d(t) * v(t) > D$
- Constant iteration $a(t) = 0$ if $v(t) == MAX_V$

Update the subject

- Velocity iteration $v(t) = v(t-1) + a(t)$
- Position iteration $p(t) = p(t-1) + \frac{v(t)+v(t-1)}{2\Delta t}$
- Distance iteration $d(t) = D - p(t)$

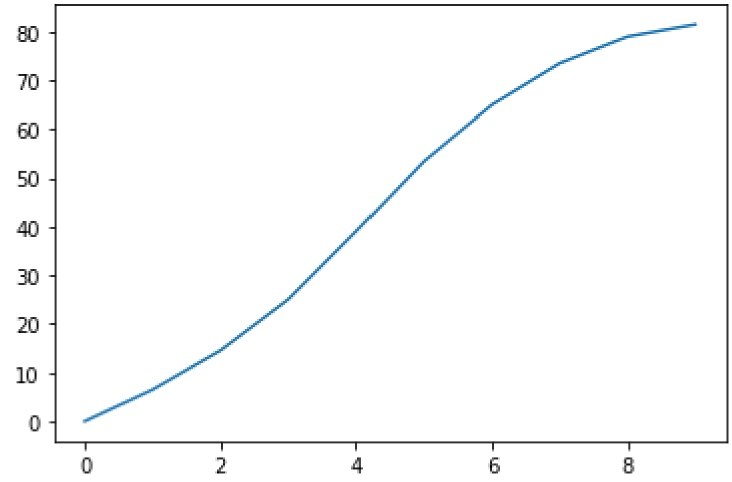
In [13]:

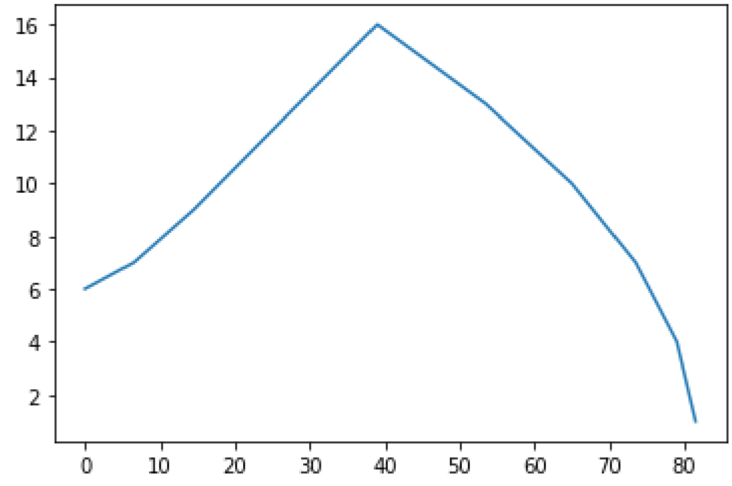
```
def distanceToStop(velocity, acceleration):
    distanceToStop = velocity
    while (velocity > 0):
        velocityNext = velocity + acceleration
        distanceToStop += (velocity + velocityNext) / 2.0
        velocity = velocityNext
    return distanceToStop
```

In [15]:

```
import matplotlib.pyplot as plt
import numpy as np

# input with all units the same
# keep integers
distance = 80.86
maxAcceleration = 4
minAcceleration = -3
maxVelocity = 27


endVelocity = 0
t = [0]
a = [0]
v = [6]
p = [0]
for i in range(1, 2000):
    # Remaining distance
    remainingDistance = distance - p[i-1]
    if (remainingDistance <= 0):
        break
    t.append(i)

    # Calculate acceleration
    aNow = min(a[i-1]+1, maxAcceleration)
    if (v[i-1] == maxVelocity):
        aNow = 0
    elif (v[i-1] > maxVelocity):
        aNow = -1

    stoppingDistance = distanceToStop(v[i-1], minAcceleration)
    slowDownFactor = stoppingDistance / remainingDistance
    if (slowDownFactor*slowDownFactor > 0.70):
        aNow = 0

    print("stoppingDistance:%s remainingDistance:%s slowDownFactor:%s" %
(stoppingDistance, remainingDistance, slowDownFactor))
    if (stoppingDistance >= remainingDistance):
        aNow = minAcceleration

    if (v[i-1] + aNow < endVelocity):
        aNow = max(aNow+1, 0)

    a.append(aNow)

    # Calculate speed
    v.append(v[i-1] + a[i])

    # Calculate position
    pDelta = (v[i] + v[i-1]) / 2.0
    p.append(p[i-1] + pDelta)


plt.plot(t, p)
plt.show()
plt.plot(p, v)
plt.show()

zipped = zip(t, a, v, p)
for values in zipped:
    print ("t:%s\ta:%s\tv:%s\tp:%s" %(values[0], values[1], values[2], values[3]))
```

```
stoppingDistance:12.0 remainingDistance:80.86 slowDownFactor:0.14840465
001236705
stoppingDistance:14.5 remainingDistance:74.36 slowDownFactor:0.19499731
038192578
stoppingDistance:22.5 remainingDistance:66.36 slowDownFactor:0.33905967
450271246
stoppingDistance:36.0 remainingDistance:55.86 slowDownFactor:0.64446831
3641246
stoppingDistance:58.0 remainingDistance:41.86 slowDownFactor:1.38557095
0788342
stoppingDistance:40.5 remainingDistance:27.36 slowDownFactor:1.48026315
7894737
stoppingDistance:26.0 remainingDistance:15.86 slowDownFactor:1.63934426
2295082
stoppingDistance:14.5 remainingDistance:7.359999999999999 slowDownFacto
r:1.970108695652174
stoppingDistance:6.0 remainingDistance:1.8599999999999994 slowDownFacto
r:3.2258064516129044
```





```
t:0     a:0     v:6     p:0
t:1     a:1     v:7     p:6.5
t:2     a:2     v:9     p:14.5
t:3     a:3     v:12    p:25.0
t:4     a:4     v:16    p:39.0
t:5     a:-3    v:13    p:53.5
t:6     a:-3    v:10    p:65.0
t:7     a:-3    v:7     p:73.5
t:8     a:-3    v:4     p:79.0
t:9     a:-3    v:1     p:81.5
```

In [ ]:

In [ ]:

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