

Titration suivi par pH-métrie

Titration d'une solution aqueuse d'acide éthanoïque par une solution aqueuse d'hydroxyde de sodium

In [1]:

```
# Import des bibliothèques

import matplotlib.pyplot as plt
import numpy as np
from scipy import stats
```

In [2]:

```
Vb = np.array([0,1,2,3,4,5,6,7,8,9,10,11,12,12.2,12.4,12.6,12.8,13,13.2,13.4,
               13.6,13.8,14,14.2,14.4,14.6,14.8,15,16,17,18,19,20,21,22,23,24,25])

pH = np.array([3.21,3.60,3.88,4.07,4.24,4.38,4.51,4.64,4.78,4.93,5.11,5.28,5.60,5.69,5.78,
               5.95,6.03,6.28,6.75,7.08,9.32,10.26,10.68,10.83,10.94,11.1,11.17,
               11.29,11.47,11.60,11.70,11.83,11.90,11.95,12.00,12.02,12.08,12.10])
print (len(Vb))
print (len(pH))
```

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In [3]:

```
def derivee(x,y):
    dery=[]
    for i in range (len(x)-1):
        deryi=(y[i+1]-y[i])/(x[i+1]-x[i])
        dery.append(deryi)
    return dery
```

In [4]:

```
derpH=derivee (Vb,pH)
print (derpH)
```

```
[0.39000000000000001, 0.27999999999999998, 0.19000000000000004, 0.16999999999999993,
0.13999999999999998, 0.12999999999999999, 0.12999999999999999, 0.14000000000000005,
0.14999999999999997, 0.18000000000000006, 0.16999999999999993, 0.31999999999999994,
0.45000000000000005, 0.44999999999999996, 0.85000000000000026, 0.39999999999999982,
1.2500000000000004, 2.3500000000000007, 1.6499999999999995, 11.200000000000004,
4.699999999999997, 2.1000000000000007, 0.75000000000000044, 0.54999999999999943,
0.80000000000000036, 0.34999999999999993, 0.59999999999999982, 0.18000000000000015,
0.12999999999999999, 0.09999999999999964, 0.13000000000000007, 0.07000000000000028,
0.04999999999999989, 0.05000000000000007, 0.01999999999999957, 0.06000000000000005,
0.01999999999999957]
```

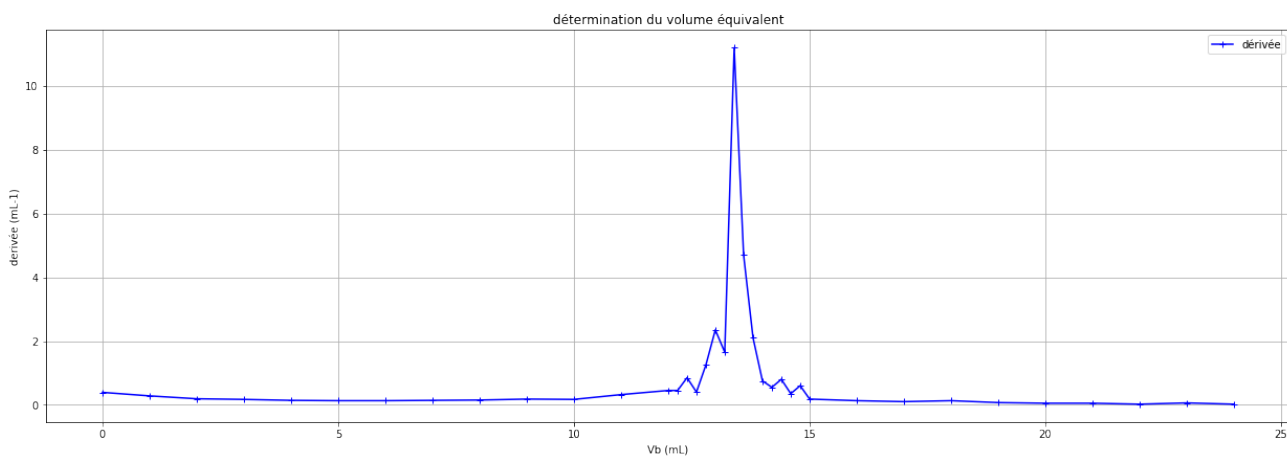
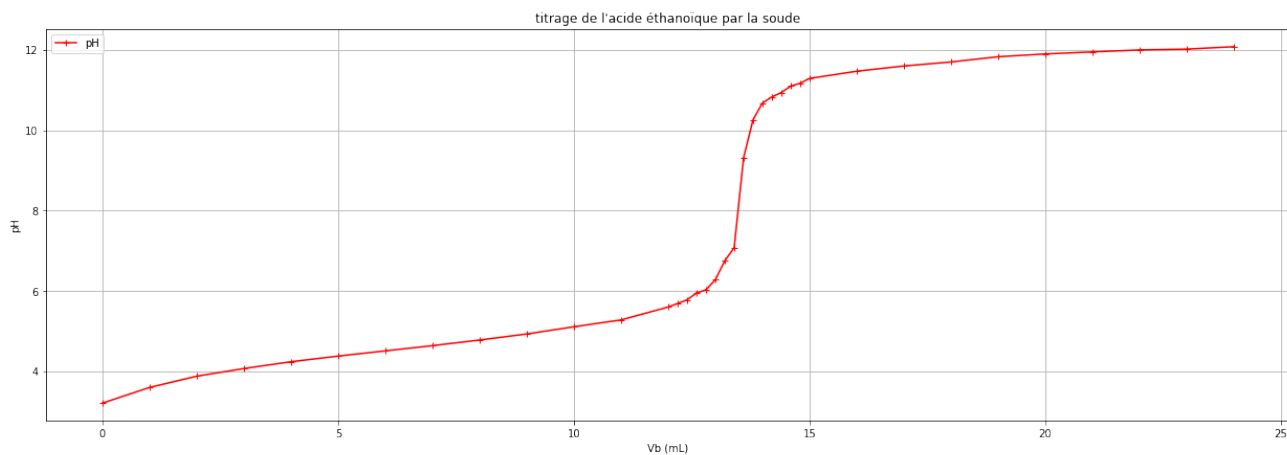
In [5]:

```
Vb = np.delete(Vb,-1)
pH = np.delete(pH,-1)
print(Vb)
print(pH)
```

```
[ 0.  1.  2.  3.  4.  5.  6.  7.  8.  9. 10. 11. 12. 12.2
 12.4 12.6 12.8 13.  13.2 13.4 13.6 13.8 14.  14.2 14.4 14.6 14.8 15.
 16.  17.  18.  19.  20.  21.  22.  23.  24. ]
[ 3.21  3.6   3.88  4.07  4.24  4.38  4.51  4.64  4.78  4.93  5.11  5.28
  5.6   5.69  5.78  5.95  6.03  6.28  6.75  7.08  9.32 10.26 10.68 10.83
 10.94 11.1  11.17 11.29 11.47 11.6  11.7  11.83 11.9  11.95 12.  12.02
 12.08]
```

In [14]:

```
plt.figure(figsize=(12,10))
plt.gcf().subplots_adjust(left =0.125, bottom = 0.2, right = 1.5, top = 1.5, wspace = 0.5,↳
↳hspace = 0.5)
plt.subplot(2,1,1)
plt.plot(Vb,pH,"r+-", label="pH")
plt.xlabel("Vb (mL)")
plt.ylabel("pH")
plt.grid()
plt.title("titrage de l'acide éthanoïque par la soude")
plt.legend()
plt.subplot(2,1,2)
plt.plot(Vb,derpH,"b+-",label="dérivée")
plt.xlabel("Vb (mL)")
plt.ylabel("dérivée (mL-1)")
plt.grid()
plt.title("détermination du volume équivalent")
plt.legend()
plt.show()
```



In [7]:

```
# détermination du volume équivalent

Vbe = Vb[(derpH.index(max(derpH)))]
print ("Vbe=", Vbe, "mL")
```

Vbe= 13.4 mL

In [8]:

```
# Evolution des quantités de matières des réactifs et produits dans le vase réactionnel
cb = 0.1 # concentration de la solution titrante d'hydroxyde de sodium
na=np.array([])
nb=np.array([])
nc=np.array([])
for i in range (len(Vb)):
    if Vb[i]<=Vbe:
        nai = cb*Vbe-cb*Vb[i] # qté de matière d'acide éthanoïque en mmol
        nbi = 0 # qté de matière des ions hydroxyde en mmol
        nci = cb*Vb[i] # qté de matière des ions éthanoate en mmol
```

```

na = np.append(na,nai)
nb = np.append(nb,nbi)
nc = np.append(nc,nci)
else:
    nai = 0 # qté de matière d'acide éthanoïque en mmol
    nbi = cb*(Vb[i]-Vbe) # qté de matière des ions hydroxyde en mmol
    nci = cb*Vbe # qté de matière des ions éthanoate en mmol
    na = np.append(na,nai)
    nb = np.append(nb,nbi)
    nc = np.append(nc,nci)
print (na)
print (nb)
print (nc)

```

```

[1.34 1.24 1.14 1.04 0.94 0.84 0.74 0.64 0.54 0.44 0.34 0.24 0.14 0.12
 0.1 0.08 0.06 0.04 0.02 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. ]
[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0.02 0.04 0.06 0.08 0.1 0.12 0.14 0.16
 0.26 0.36 0.46 0.56 0.66 0.76 0.86 0.96 1.06]
[0. 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1. 1.1 1.2 1.22
 1.24 1.26 1.28 1.3 1.32 1.34 1.34 1.34 1.34 1.34 1.34 1.34 1.34 1.34
 1.34 1.34 1.34 1.34 1.34 1.34 1.34 1.34 1.34]

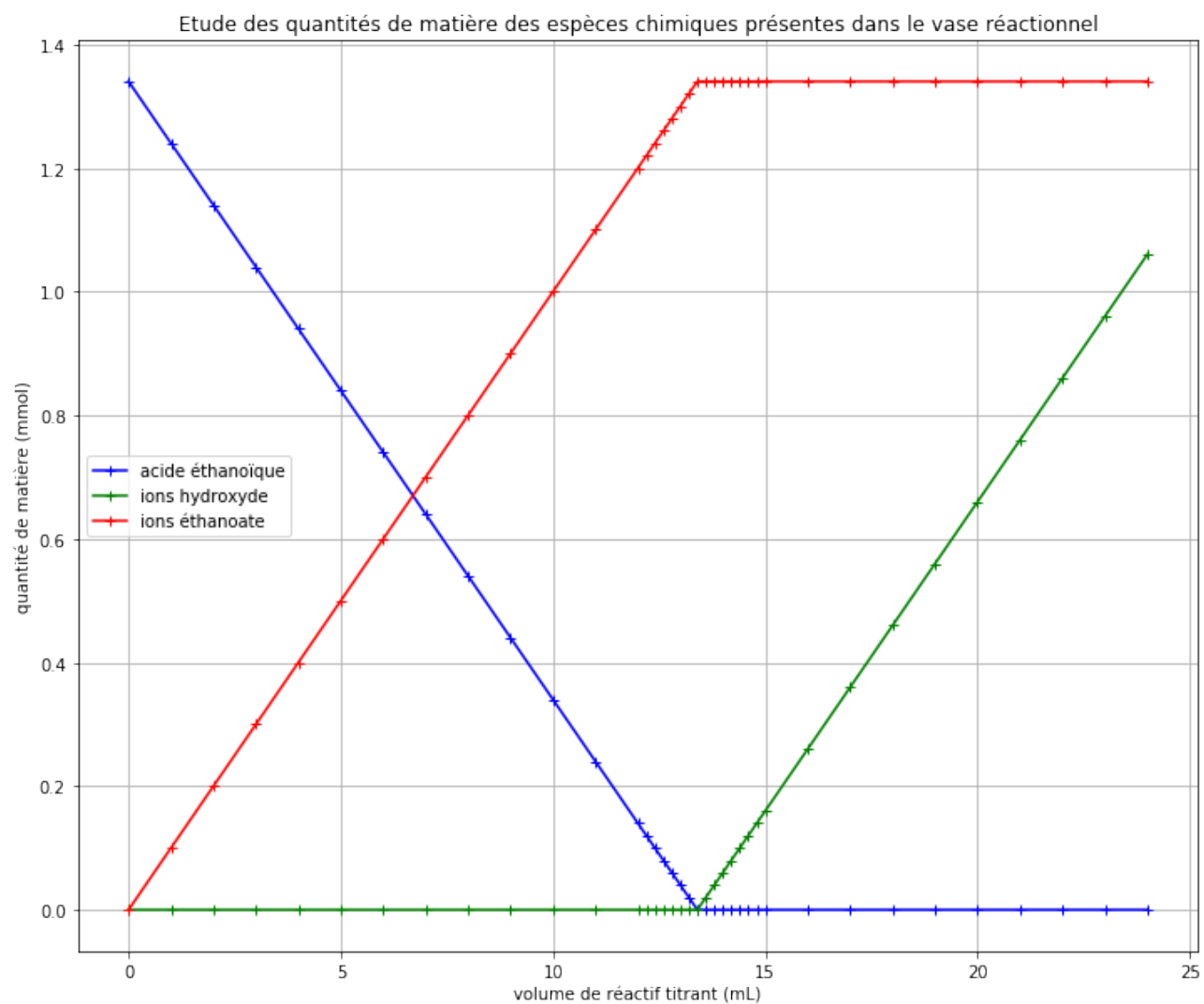
```

In [15]:

```

plt.figure(figsize=(12,10))
plt.plot(Vb,na,"b+-",label="acide éthanoïque")
plt.plot(Vb,nb,"g+-",label="ions hydroxyde")
plt.plot(Vb,nc,"r+-",label="ions éthanoate")
plt.xlabel("volume de réactif titrant (mL)")
plt.ylabel("quantité de matière (mmol)")
plt.title("Etude des quantités de matière des espèces chimiques présentes dans le vase_
→réactionnel")
plt.legend()
plt.grid()
plt.show()

```



In []: