**Q1:** Draw the form(s) of the amino acid lysine that would exist at pH 10.8.

In what relative percentage will these forms exist? Why?

***pKa1= 2.18 , pKa2 = 8.95 , and pKa3=10.53***

**Q2:** You have titrated the a.a. -glutamic acid- with strong acid:

1. Draw a reasonable titration curve, label the axis and significant transitions
2. Calculate the isoelectric point ***pKaα-COOH= 2.19 , pKaα-amino = 9.67 , and pKaR-COOH=4.25***

**Q3:** What is the net charge of the following amino acids:

1. Glutamate at pH 10 ***pKa1= 2.19 , pKa2 = 4.25 , and pKa3=9.67***
2. Lysine at pH 1.5 ***pKa1= 2.18 , pKa2 = 8.95 , and pKa3=10.53***
3. Serine at pH 5.8 ***pKa1= 2.21 , pKa2 = 9.15***
4. Isoleucine at pH 1.0 ***pKa1= 2.36 , pKa2 = 9.68***

**Q4:** **Choose the correct answer:**

**A)** The amino acid arginine contains a guanidino R-group and has pKa values of 2.2, 9.0, and 12.5. A sample of arginine is titrated from pH=1.0 to pH=14.0 with NaOH.

**1.\_\_\_\_\_ At pH=2.2,**

a) all of the amino acid molecules will be in the fully protonated form.

b) half of the amino acid molecules will be in the fully protonated form.

c) all of the amino acid molecules will be in the zwitterion form.

d) half of the amino acid molecules will be in the zwitterion form.

**2.\_\_\_\_\_ At pH=12.5,**

a) half the amino acid molecules have a -2 charge.

b) all the amino acid molecules have a -2 charge.

c) half the amino acid molecules have a -1 charge.

d) all the amino acid molecules have a -1 charge.

**3.\_\_\_\_\_ For arginine molecules at pH=14,**

a) all the ionizable groups will be charged.

b) all the guanidino groups will be charged.

c) all the amino groups will be charged.

d) all the carboxyl groups will be charged.

**4\_\_\_\_\_ What is the isoelectric point of arginine?**

a) 5.60

b) 7.00

c) 7.90

d) 10.75

**5.\_\_\_\_\_ A solution with a pH of 2.2 contains 6.0 mmol of arginine. If 12.0 mmol of NaOH is added to the solution, what will be the pH after the NaOH has completely reacted with the arginine?**

a) 14.00

b) 12.50

c) 10.75

d) 5.60

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**B)** The amino acid tyrosine contains a phenolic R-group and has pKa values of 2.2, 9.0, and 10.2. A sample of tyrosine is titrated from pH = 1.0 to pH = 14.0 with NaOH.

**1.\_\_\_\_\_ At which pH will all the amino acid molecules be in their fully protonated form?**

a) 1.0

b) 2.2

c) 5.6

d) 9.0

**2.\_\_\_\_\_ At which pH will half the amino acid molecules be in their zwitterion form?**

a) 5.6

b) 9.0

c) 9.6

d) 10.2

**3.\_\_\_\_\_ At which pH will all the amino acid molecules have a -1 charge?**

a) 12.0

b) 10.2

c) 9.6

d) 5.6

**4.\_\_\_\_\_ For a solution of tyrosine molecules at pH = 10.2**

a) all the α-carboxyl groups will be uncharged.

b) all the α-amino groups will be uncharged.

c) all the phenolic R-groups will be uncharged.

d) all the ionizable groups will be uncharged.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Reagents | 1 | 2 | 3 | 4 | 5 | 6 |
| H2O (ml) | 1.0 | 0.9 | 0.8 | 0.6 | 0.2 | ------ |
| BSA volume (ml) | ----- | 0.1 | 0.2 | 0.4 | 0.8 | 1.0 |
| Bradford reagent (ml) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| A595 |  | 0.08 | ? | ? | ? | ? |

**Q4:** Below is a table prepared by a biochemistry student to construct a standard curve for protein analysis. The Bradford assay was used with bovine serum albumin (BSA, 0.1mg/ml ), as standard protein . Complete the table by filling in the approximate A595 that will be obtained for each tube. Assume the procedure was conducted correctly.

**Q5:** Calculate the absorbance and the transmission at 260 nm and 340 nm of the following solutions in a 1 cm cuvette.

**a)** 2.2 x10-5 M NADH

**b)** 7 x 10-6  M NADH plus 4.2 x 10-5 M ATP.

|  |  |  |
| --- | --- | --- |
| **am** | | |
|  | **260nm** | **340nm** |
| **NADH** | 15000 | 6220 |
| **ATP** | 15400 | 0.0 |

**Q6:** Calculate the concentration of ATP and NADPH in solutions with absorbance’s:

**a)** 0.15 at 340 nm and 0.9 at 260 nm.

**b)** Zero at 340 nm and 0.750 at 260 nm.

**c)** 0.22 at 340 nm and 0.531 at 260 nm.

|  |  |  |
| --- | --- | --- |
| **am** | | |
|  | **260nm** | **340nm** |
| **NADPH** | 15000 | 6220 |
| **ATP** | 15400 | 0.0 |