Result:

```
[[ 6.74131162   1.96121171   1.75570435   6.25258238]
 [ 6.12503037   4.09658641   4.20709993  -4.23907523]
 [-2.55467518  -4.41435184  -4.27715344   2.22083898]]
[[12.34049255]
 [-6.46072936]
 [-6.55358903]
 [-6.40755834]]
[[0.00632205]
 [0.99535632]
 [0.991426  ]
 [0.00725331]]
```

Q4.a)

Neuron1:

$$= sigmoid(x_1 * w_{0,1,0} + x_2 * w_{1,1,0} + x_3 * w_{2,1,0}) = \frac{1}{1 + e^{-(x_1 * w_{0,1,0} + x_2 * w_{1,1,0} + x_3 * w_{2,1,0})}}$$

$$= \frac{1}{1 + e^{-(x_1 * 6.74131162 + x_2 * 6.12503037 + x_3 * -2.55467518)}}$$

Neuron2:

$$= sigmoid(x_1 * w_{0,1,1} + x_2 * w_{1,1,1} + x_3 * w_{2,1,1}) = \frac{1}{1 + e^{-(x_1 * w_{0,1,1} + x_2 * w_{1,1,1} + x_3 * w_{2,1,1})}}$$

$$= \frac{1}{1 + e^{-(x_1 * 1.96121171 + x_2 * 4.09658641 + x_3 * -4.41435184)}}$$

Neuron3:

$$= sigmoid(x_1 * w_{0,1,2} + x_2 * w_{1,1,2} + x_3 * w_{2,1,2}) = \frac{1}{1 + e^{-(x_1 * w_{0,1,2} + x_2 * w_{1,1,2} + x_3 * w_{2,1,2})}}$$

$$= \frac{1}{1 + e^{-(x_1 * 1.75570435 + x_2 * 4.20709993 + x_3 * -4.27715344)}}$$

Neuron4:

$$= sigmoid(x_1 * w_{0,1,3} + x_2 * w_{1,1,3} + x_3 * w_{2,1,3}) = \frac{1}{1 + e^{-(x_1 * w_{0,1,3} + x_2 * w_{1,1,3} + x_3 * w_{2,1,3})}}$$

$$= \frac{1}{1 + e^{-(x_1*6.25258238 + x_2*-4.23907523 + x_3*2.22083898)}}$$

Output:
$$= sigmoid(neuron_1 * w_{0,2,0} + neuron_2 * w_{1,2,0} + neuron_3 * w_{2,2,0} + neuron_4 * w_{3,2,0})$$
$$= \frac{1}{1 + e^{-(neuron_1*w_{0,2,0} + neuron_2*w_{1,2,0} + neuron_3*w_{2,2,0} + neuron_4*w_{3,2,0})}}$$
$$= \frac{1}{1 + e^{-(neuron_1*12.34049255 + neuron_2*-6.46072936 + neuron_3*-6.55358903 + neuron_4*-6.40755834)}}$$

$$= \frac{1}{1 + e^{-(\frac{1}{1+e^{-(x_1*6.74131162+x_2*6.12503037+x_3*-2.55467518)}}*12.34049255 + \frac{1}{1+e^{-(x_1*1.96121171+x_2*4.09658641+x_3*-4.41435184)}}*-6.46072936 + \frac{1}{1+e^{-(x_1*1.75570435+x_2*4.20709993+x_3*-4.27715344)}}*-6.55358903 + \frac{1}{1+e^{-(x_1*6.25258238+x_2*-4.23907523+x_3*2.22083898)}}*-6.40755834)}}$$

Q4.b)

1) $x_1 = 0$, $x_2 = 0$, $x_3 = 1$

$$Output = \frac{1}{1 + e^{-(\frac{1}{1+e^{-(0*6.74131162+0*6.12503037+1*-2.55467518)}}*12.34049255 + \frac{1}{1+e^{-(0*1.96121171+0*4.09658641+1*-4.41435184)}}*-6.46072936 + \frac{1}{1+e^{-(0*1.75570435+0*4.20709993+1*-4.27715344)}}*-6.55358903 + \frac{1}{1+e^{-(0*6.25258238+0*-4.23907523+1*2.22083898)}}*-6.40755834)}}$$

$$= \frac{1}{1 + e^{-(\frac{1}{1+e^{(2.55467518)}}*12.34049255 + \frac{1}{1+e^{(4.41435184)}}*-6.46072936 + \frac{1}{1+e^{(4.27715344)}}*-6.55358903 + \frac{1}{1+e^{-(2.22083898)}}*-6.40755834)}}$$

$$= \frac{1}{1 + e^{-(0.88991030667 - 0.07725532975 - 0.08973205238 - 5.78029241631)}}$$

$$= \frac{1}{1 + e^{5.05736949177}}$$

$$= 0.00632205091$$

2) $x_1 = 0$, $x_2 = 1$, $x_3 = 1$

$$Output = \frac{1}{1 + e^{-(\frac{1}{1+e^{-(0*6.74131162+1*6.12503037+1*-2.55467518)}}*12.34049255 + \frac{1}{1+e^{-(0*1.96121171+1*4.09658641+1*-4.41435184)}}*-6.46072936 + \frac{1}{1+e^{-(0*1.75570435+1*4.20709993+1*-4.27715344)}}*-6.55358903 + \frac{1}{1+e^{-(0*6.25258238+1*-4.23907523+1*2.22083898)}}*-6.40755834)}}$$

$$= \frac{1}{1 + e^{-(\frac{1}{1+e^{-(3.57035519)}}*12.34049255 + \frac{1}{1+e^{(0.31776543)}}*-6.46072936 + \frac{1}{1+e^{(0.07005351)}}*-6.55358903 + \frac{1}{1+e^{(2.01823625)}}*-6.40755834)}}$$

$$= \frac{1}{1 + e^{-(5.36759395856)}}$$

$$= 0.99535632152$$

3) $x_1 = 1, x_2 = 0, x_3 = 1$

$$Output = \frac{1}{1 + e^{-(\frac{1}{1+e^{-(1*6.74131162+0*6.12503037+1*-2.55467518)}}*12.34049255 + \frac{1}{1+e^{-(1*1.96121171+0*4.09658641+1*-4.41435184)}}*-6.46072936 + \frac{1}{1+e^{-(1*1.75570435+0*4.20709993+1*-4.27715344)}}*-6.55358903 + \frac{1}{1+e^{-(1*6.25258238+0*-4.23907523+1*2.22083898)}}*-6.40755834)}}$$

$$= \frac{1}{1 + e^{-(\frac{1}{1+e^{-(1*6.74131162+1*-2.55467518)}}*12.34049255 + \frac{1}{1+e^{-(1*1.96121171+1*-4.41435184)}}*-6.46072936 + \frac{1}{1+e^{-(1*1.75570435+1*-4.27715344)}}*-6.55358903 + \frac{1}{1+e^{-(1*6.25258238+1*2.22083898)}}*-6.40755834)}}$$

$$= \frac{1}{1 + e^{-(\frac{1}{1+e^{-(4.18663644)}}*12.34049255 + \frac{1}{1+e^{(2.45314013)}}*-6.46072936 + \frac{1}{1+e^{(2.52144909)}}*-6.55358903 + \frac{1}{1+e^{-(8.47342136)}}*-6.40755834)}}$$

$$= \frac{1}{1 + e^{-(4.7504103802)}}$$

$$= 0.99142600372$$

4) $x_1 = 1, x_2 = 1, x_3 = 1$

$$Output = \frac{1}{1 + e^{-(\frac{1}{1+e^{-(1*6.74131162+1*6.12503037+1*-2.55467518)}}*12.34049255 + \frac{1}{1+e^{-(1*1.96121171+1*4.09658641+1*-4.41435184)}}*-6.46072936 + \frac{1}{1+e^{-(1*1.75570435+1*4.20709993+1*-4.27715344)}}*-6.55358903 + \frac{1}{1+e^{-(1*6.25258238+1*-4.23907523+1*2.22083898)}}*-6.40755834)}}$$

$$= \frac{1}{1 + e^{-(\frac{1}{1+e^{-(10.31166681)}}*12.34049255 + \frac{1}{1+e^{-(1.64344628)}}*-6.46072936 + \frac{1}{1+e^{-(1.68565084)}}*-6.55358903 + \frac{1}{1+e^{-(4.23434613)}}*-6.40755834)}}$$

$$= \frac{1}{1 + e^{(4.91901799585)}}$$

$$= 0.00725330728$$