#1
A patient with type 1 diabetes was evaluated at his yearly physical, and the following measurements were obtained:

plasma concentration of glucose:	200 mg/dL
urine concentration of glucose:	10 mg/ml
urine flow rate:	1728 ml in 24 hr
urine concentration of protein:	200 mg in 24 hr
inulin clearance:	90 ml/min
creatinine clearance:	105 ml/min

a) What is the plasma concentration of glucose in mg/ml?

$$200\,\frac{mg}{dL} \cdot \frac{1\,dL}{100\,ml} = 2\,\frac{mg}{ml}$$

b) What is the urine flow rate in ml/min?

$$1728\,\frac{ml}{24hr} \cdot \frac{1hr}{60min} = 1.2\,ml/min$$

c) Determine the filtered load of glucose (in mg/min).

$$\text{filtered load} = P_{glu} \cdot GFR = 2\,\frac{mg}{ml} \cdot 90\,\frac{ml}{min} = 180\,mg/min$$

d) Determine how much glucose was excreted (in mg/min).

$$\text{amount excreted} = U_{glu} \cdot \dot{V} = 10\,\frac{mg}{ml} \cdot 1.2\,ml/min = 12\,mg/min$$

e) Determine how much glucose was reabsorbed or secreted (in mg/min).

$$\text{amount excreted} = \text{filtered load} - \text{amount reabsorbed}$$

rearrange:

$$\text{amount reabsorbed} = \text{filtered load} - \text{amount excreted} = 180\,mg/min - 12\,mg/min$$

$$= 168\,mg/min$$

#2

amount of inulin excreted in urine:	15 mg/min
urine concentration of inulin:	15 mg/ml
plasma concentration of inulin:	0.2 mg/ml
creatinine clearance:	85 ml/min

Using the above information, calculate the GFR.

numerator is amount excreted

$$GFR = \text{clearance of inulin} = CL_{inulin} = \frac{U_{inulin} \cdot \dot{V}}{P_{inulin}}$$

$$= \frac{15 \text{ mg/min}}{0.2 \text{ mg/ml}} = 75 \text{ ml/min}$$

#3

The following measures were made from a patient.

glomerular filtration rate:	120 ml/min
urea excreted in urine:	15.0 mg/min
urine flow rate:	1.5 ml/min
urine concentration of urea:	10.0 mg/ml
plasma concentration of urea:	0.2 mg/ml
urine concentration of inulin:	8 mg/ml
plasma concentration of inulin:	0.1 mg/ml

a) Determine the renal clearance of urea.

numerator is amount excreted

$$CL_{urea} = \frac{U_{urea} \cdot \dot{V}}{P_{urea}}$$

$$= \frac{15 \text{ mg/min}}{0.2 \text{ mg/ml}} = 75 \text{ ml/min}$$

b) Determine the filtered load of urea.

$$\text{filtered load} = P_{urea} \cdot GFR$$
$$= 0.2 \text{ mg/ml} \cdot 120 \text{ ml/min} = 24 \text{ mg/min}$$

c) Is urea reabsorbed or secreted?

filtered load is greater than amount excreted (24 mg/min > 15 mg/min), therefore urea is net reabsorbed.

#4

urea clearance:	75 ml/min
plasma concentration of inulin:	0.25 mg/ml
urine concentration of inulin:	20 mg/ml
urine flow rate:	1.25 ml/min
urine concentration of creatinine:	0.8 mg/ml
plasma concentration of creatinine:	0.009 mg/ml

Use the above information to determine creatinine clearance.

$$C_{L_{cr}} = \frac{U_{cr} \cdot \dot{V}}{P_{cr}} = \frac{0.8\,mg/ml \cdot 1.25\,ml/min}{.009\,mg/ml} = 111\,ml/min$$

#5

urine flow rate:	0.9 ml/min
plasma concentration of creatinine:	0.6 mg/dL
urine concentration of creatinine:	0.7 mg/ml
GFR:	90 ml/min

a) Convert plasma concentration of creatinine to mg/ml.

$$\frac{0.6\,mg}{dL} \cdot \frac{1\,dL}{100\,ml} = 0.006\,mg/ml$$

b) Use the above information to determine creatinine clearance.

$$C_{L_{cr}} = \frac{U_{cr} \cdot \dot{V}}{P_{cr}} = \frac{0.7\,mg/ml \cdot 0.9\,ml/min}{0.006\,mg/ml}$$

$$= 105\,ml/min$$

c) Calculate the filtered load of creatinine (in mg/ml).

$$\text{filtered load} = P_{cr} \cdot GFR = 0.006\,mg/ml \cdot 90\,ml/min = 0.54\,mg/min$$

d) Calculate the amount of creatinine that was either reabsorbed or secreted (in mg/ml).

$$\text{amount excreted} = U_{cr} \cdot \dot{V} = 0.63\,mg/min$$

Filtered load is less than amount excreted,

So creatinine is net secreted,

$$\text{amount excreted} = \text{filtered load} + \text{amount secreted}$$

Rearrange:

$$\text{amount secreted} = \text{amount excreted} - \text{filtered load}$$

$$= 0.63\,mg/min - 0.54\,mg/min$$

$$= 0.09\,mg/min$$