Unit V – Problem 8 – Physiology: Renal Physiology Cases (Answers)

- **Question 1:**

  - **a. The glomerular filtration rate** = $\frac{urine\ concentration\ of\ inulin\ x\ urine\ flow}{plasma\ concentration\ of\ inulin} = \frac{0.4\ x\ 2}{0.01}$ = 80 ml/min
  - **b. The renal plasma flow** = $\frac{urine\ concentration\ of\ PAH\ x\ urine\ flow}{plasma\ concentration\ of\ PAH} = \frac{10\ x\ 2}{0.05}$ = 400 ml/min
  - **c. The renal blood flow** = $\frac{Renal\ plasma\ flow}{1-Hematocrit} = \frac{400}{(1-0.45)}$ = 727 ml/min
  - **d. Filtration Fraction** = $\frac{GFR}{RPF} = \frac{80}{400}$ = 0.2
  - **The renal clearance of X** = $\frac{urine\ concentration\ of\ X\ .\ urine\ flow}{plasma\ concentration\ of\ X} = \frac{15\ x\ 2}{1}$ = 30 ml/min
  - **The filtration rate of X** = GFR x plasma concentration of X = 80 x 1 = 80 mg/min
  - **The rate of reabsorption of X** = filtered load – excretion
    = 80 – (15 x 2)
    = 50 mg/min

    Excretion = urine concentration x urine flow

- **Question 2:**

  - **The GFR** = $\frac{urine\ excretion\ of\ inulin}{plasma\ concentration\ of\ inulin} = \frac{2.4}{20}$ = 0.12 L/min x 10^3 = 120 ml/min
  - **The filtered load of glucose** = GFR x plasma concentration of glucose = 0.12 x 20= 2.4 mmol/min
  - **The glucose Tm (transport maximum)** = filtered – excreted = 2.4-0.3 = 2.1 mmol/min
  - **The renal threshold of glucose** (Renal threshold$_x$ = $\frac{T_{mx}}{GFR} = \frac{2.1}{0.12}$ = 17.5 mmol/l)

- **Question 3 (QUESTION IS WRONG: CALCULATE THE EXTRACTION RATIO):**

  - **Extraction ratio** = $\frac{Arterial\ concentration\ of\ a\ substance - venous\ concentration\ of\ a\ substance}{arterial\ concentration\ of\ a\ substance}$
    = $\frac{12-9}{12}$ = 0.25

- **Question 4:**

  - **Fractional Na^+ excretion** = $\frac{Excretion\ of\ Na}{Filtered\ Na}$
    = $\frac{(urine\ Na\ concentration\ x\ urine\ flow)}{(GFR\ x\ plasma\ concentration\ of\ Na)}$

Note: as the urine flow is not given, we need to cancel it from the equation. Remember that GFR is equal to = $\frac{Urine\ concentration\ of\ creatinine\ x\ urine\ flow}{plasma\ concentration\ of\ creatinine}$. by putting this in the equation above = $\frac{U_{Na}.V}{\frac{U_C.V}{P_C}.P_{Na}}$

Note: V (which is the urinary flow) will be canceled, resulting in the following equation

= $\frac{U_{Na}}{\frac{U_C}{P_C}.P_{Na}} = \frac{33}{\frac{90}{7.5}.135}$ = 0.02 %

24-hour urine flow = 2.16 L
Convert it to dl/min
(2.16 ÷ 24 ÷ 60) X (10)
= 0.015 dl/min

- **Question 5:**

- **Estimate the renal plasma flow** = ERPF = $\frac{Urine\ conc\ of\ PAH\ x\ Urine\ flow}{Plasma\ conc\ of\ PAH} = \frac{25\ .0.015}{6} = 625$ ml/min
- **Calculate the extraction ration of PAH** = $\frac{Arterial-venous}{Arterial} = \frac{6-1.2}{6} = 0.8$
- **Find the actual (total) renal plasma flow** = $\frac{ERPF}{Extraction\ ration} = \frac{625}{0.8} = 781$ ml/min