Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

$C = 8000 \times 1.5 \div 100 =$ **120** mL/min

it estimates the GFR

2.2

5×0.125

$=$ **0.625** mmol/min

2.3

$0.03 \times 40 = 1.2$; $24/1.2 = 20$

$\log_{10} 20 = 1.30$

$pH = 6.1 + 1.30 =$ **7.40**

2.4

$140 - (100 + 12) =$ **28**

high: an added acid such as lactate or ketones

3.1

(a) $6.1 + \log_{10}(12/0.72) =$ **7.32**

(b) expected $1.5 \times 12 + 8 = 26 \pm 2$; 24 is in range, so compensation is as expected

(c) the acid stimulates breathing, which blows off CO_2 and raises the pH

(d) $135 - (98 + 12) =$ **25**, high, from **ketones**

3.2

(a) below this level all filtered glucose is carried back; above it the carriers are full, so the extra stays in the urine

(b) they block glucose reabsorption in the proximal tubule, so glucose is lost in the urine even at normal levels

(c) glucose in the tubule holds water by osmosis (osmotic diuresis)

3.3

(a) the **thick ascending limb** of the loop of Henle, the **NKCC2** (Na^+–K^+–$2Cl^-$) carrier

(b) this segment takes back about 25% of the filtered Na^+; blocking it also weakens the salty gradient in the medulla, so less water is taken back

(c) more Na^+ reaches the collecting duct, where it is taken in in exchange for K^+; the volume loss also raises aldosterone, which adds to K^+ loss

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(d) it blocks aldosterone receptors in the collecting duct, so less Na^+ is taken back and less K^+ is lost