M1.(a) Hypothalamus.

1

(b) 1. Water potential of blood will decrease;
2. Water moves from osmoreceptor into blood by osmosis.

2

(c) 1. Permeability of membrane / cells (to water) is increased;
2. More water absorbed from / leaves distal tubule / collecting duct;
3. Smaller volume of urine;
4. Urine becomes more concentrated.

4

(d) 115.2 / 115.3 (cm^3 $minute^{-1}$).

1

(e) Any **two** of the following for 1 mark:
Muscle / body mass
Ethnicity
Exercise
Kidney disease – do not accept 'health'.

1

[9]

M2.(a) Hydrostatic pressure / description of pressure / description of how pressure generated;
Causes ultrafiltration (*Allow description of ultrafiltration*) at Bowman's capsule / glomeruli / renal capsule;
Through basement membrane;
Enabled by small size urea molecule;

2 max

(b) Reabsorption of water / by osmosis;
At the PCT / descending LoH;

At the DCT / CD;
Active transport of ions / glucose creates gradient (in context);

Ignore references to facilitated diffusion or to selective reabsorption.

3 max

[5]

M3.(a) 1. Blood pressure / hydrostatic pressure;
2. Small molecules / named example;
3. Pass through basement membrane / basement membrane acts as filter;
4. Protein too large to go through / large so stays behind;
5. Presence of pores in capillaries / presence of podocytes;

5

(b) 1. High concentration of glucose in blood;
2. High concentration in tubule / in filtrate;
3. Reabsorbed by facilitated diffusion / active transport;
4. Requires proteins / carriers;
5. These are working at maximum rate / are saturated;
6. Not all glucose is reabsorbed / some is lost in urine;

4 max

(c) For general principle, applied to either example:

1. More water (from filtrate) reabsorbed / returned to blood / less lost in urine;
2. By osmosis;
3. From collecting duct / from end of second convoluted tubule;
4. Due to longer loop of Henle;

For loop of Henle, maximum 2 marks:

5. Sodium / chloride ions absorbed from filtrate in ascending limb;
6. Gradient established in medulla / concentration of ions increases down medulla;

For ADH, maximum 2 marks:

7. Acts on collecting duct / distal convoluted tubule / second convoluted tubule;
8. Makes cells more permeable / inserts aquaporins in plasma membranes;

Note: to score full marks, candidates must make one specific statement about Loop of Henle and one about ADH.

6 max

[15]

M4.(a) In Diabetic person:

1. Lack of insulin / reduced sensitivity of cells to insulin;
2. Reduced uptake of glucose by cells / liver / muscles;
3. Reduced conversion of glucose to glycogen;

Penalise zero / no
once only

3

(b) (i) Leaves the blood at kidney;
Taken back into blood / reabsorbed (from kidney tubule);
Reject some reabsorption

(Reabsorbed) in 1st convoluted tubule;
Kidney / named part needs to be mentioned once

2 max

(ii) Large amount / high concentration of glucose in filtrate;
Cannot all be reabsorbed / 1st convoluted tube too short to reabsorb all of glucose / saturation of carriers;

2

(c) Enzyme has specific shape to active site / active site has specific tertiary structure;
Only glucose fits / has complementary structure / can form ES complex;

2

(d) Glucose in filtrate lowers water potential;
Ignore 'urine'. Accept increase solute potential

Lower Ψ gradient / less difference in Ψ filtrate − Ψ plasma;
Ignore 'concentration'

Less water reabsorbed by osmosis;
Accept diffusion of water. Reject no water reabsorbed if implied

3

(e) 1. Glomerulus / Bowman's capsule / renal capsule;
2. Basement membrane;
3. Proteins are large (molecules) / proteins cannot normally pass through filter / proteins
can only pass through if filter damaged;

3

[15]

M5. metabolic water / from respiration;

allow condensation reactions. Ignore 'oxidation'.

aerobic / use of oxygen; ('From aerobic respiration' = 2 marks)

[2]