Give an account of

(a) the kidney and excretion [11]

(b) osmoregulation and the kidney [5]

(a) Any eleven from

- blood entering glomerulus is under high hydrostatic pressure
- because the afferent arteriole is wider than the efferent arteriole
- consequently ultrafiltration occurs from the glomerulus to Bowman's capsule
- composition of the filtrate is the same as plasma minus plasma proteins
- because some molecules are too big to pass through the basement membrane/the basement membrane acts as the filter
- the lining of the capsule is otherwise leaky due to the structure of podocytes
- water potential/solute potential of plasma is lower than that of the filtrate due to the presence of the plasma proteins
- which causes a solute potential (osmotic) gradient from filtrate to blood
- the hydrostatic pressure in blood must be high enough to overcome this osmotic gradient
- throughout the rest of the nephron/tubule toxic substances remain in the filtrate, while useful substances are reabsorbed
- within the proximal tubule glucose/salts/amino acids are reabsorbed by active transport (selectively reabsorbed)
- microvilli/brush border in the proximal tubule increase the surface area for this reabsorption
- and numerous mitochondria provide the energy for active transport
- water potential gradient is from proximal convoluted tubule to capillary network/hydrostatic pressure within capillary network is greatly reduced
- so that water leaves by osmosis
- small proteins are reabsorbed by pinocytosis
- the loop of Henlé produces a high osmotic gradient in the medulla (lowers the water potential in the medullary tissue)
- which allows water to be reabsorbed from the collecting ducts as they pass through the medulla
- salts actively reabsorbed from distal convoluted tubule/urea or creatinine absorbed into the distal convoluted tubule [11]

(b) Any five from

- water potential/concentration of blood is monitored by osmoreceptors in the hypothalamus
- low water potential/concentrated blood causes secretion of ADH
- ADH is then released into the blood from the pituitary gland
- in the kidney ADH increases the permeability of the collecting ducts (and distal tubule)/opening aquaporins
- so that increased amounts of water can be reabsorbed
- results in a concentrated urine
- drinking water raises the water potential of the plasma [if the blood is dilute the loss of water in the urine lowers the water potential of the plasma]
- when the water potential of plasma returns to normal/is high the levels of ADH secretion is reduced [5]

Allow reverse argument for osmoregulation, beginning with high water potential in blood and resulting in a large volume of dilute urine.