Model Answers: Easy

1a

(a) Ultrafiltration is:

- Separation of large/insoluble particles from blood plasma/aqueous solution; [1 mark]
- At/under high pressure; [1 mark]

[Total: 2 marks]

1b

(b) The composition and role of the basement membrane in ultrafiltration is:

- Composition - collagen and glycoproteins form a mesh; [1 mark]
- Role - mesh separates large particles from small/dissolved ones / e.g. sieves out large proteins; [1 mark]

[Total: 2 marks]

1c

(c) The adaptations of the proximal convoluted tubule help as follows:

1.	Microvilli on the inner surface	increase surface area for selective reabsorption
2.	Many mitochondria in epithelial cells	release energy from respiration for active processe
3.	Tightly-packed cells in the epithelium	prevent diffusion of solutes out of the PCT between c solutes to pass through epithelial cells

[Total: 3 marks]

1d

(d) The afferent and efferent arterioles differ:

- Afferent: blood flows into the glomerulus / efferent: blood flows out of the glomerulus; [1 mark]
- Afferent is wider / at higher pressure than efferent; [1 mark]

[Total: 2 marks]

2a

(a) The correct order through which blood passes through each vessel is:

D → C → F → A → E → B; [3 marks]

1st	D	renal artery
2nd	C	afferent arteriole
3rd	F	glomerulus

4th	A	efferent arteriole
5th	E	capillaries alongside nephron
6th	B	renal vein

- 6 correct; [3 marks]
- 4 or 5 correct; [2 marks]
- 2 or 3 correct; [1 mark]
- 0 or 1 correct; [0 marks]

[Total: 3 marks]

2b

(b) Negative feedback is:

Any **two** from the following:

- A change/adjustment to water levels; [1 mark]
- In response/opposition to an external stimulus in the opposite direction; [1 mark]
- To maintain equilibrium / steady-state / control of water level around a set point / ideal level; [1 mark]

[Total: 2 marks]

2c

(c) The name of the hormone that controls the level of water that is excreted via the kidney is:

- Anti-diuretic hormone / ADH; [1 mark]

[Total: 1 mark]

2d

(d) ADH affects the collecting ducts of the kidney as part of osmoregulation by...

Any **three** of the following:

- ADH molecules bind to receptor proteins in the cells lining the collecting duct; [1 mark]
- This activates a signalling cascade that leads to the phosphorylation of the aquaporin molecules; [1 mark]
- This activates the aquaporins, causing the vesicles to fuse with the luminal membranes of the collecting duct cells; [1 mark]
- This increases the permeability of the collecting duct membrane to water; [1 mark]

[Total: 3 marks]

3a

(a) (i) Organ X is the...

- Pancreas; [1 mark]

(a) (ii) Hormone Y is...

- Glucagon; [1 mark]

[Total: 2 marks]

The pancreas is responsible for detecting changes in blood glucose; specifically it is the cells of the Islets of Langerhans that do this, but as the question has asked you to name the organ this detail is not required.

3b

(b) (i) The definition of second messenger is...

- A second messenger is released when signalled to by a hormone, and which brings about a response by the cell; [1 mark]

(b) (ii) The sequence of events leading up to the formation of cAMP are...

Any **three** from the following:

- Glycogen binds to cell surface receptors on the liver cells...; [1 mark]
- ...causing conformational/shape change of the receptor; [1 mark]
- This activates the G-protein; [1 mark]
- Leading to stimulation of adenylyl cyclase; [1 mark]
- Which causes the formation of cAMP; [1 mark]

[Total: 4 marks]

3c

(c) The benefit to the cell of having the signal amplified in this way is...

Any **two** of the following:

- A large number of enzymes can be activated in a short period of time; [1 mark]
- A large number of glucose molecules are released / a large quantity of glycogen is broken down; [1 mark]
- From just a small quantity of glucagon / only a small amount of glucagon needs to be synthesised (by the alpha cells of the pancreas); [1 mark]

[Total: 2 marks]

It is important you are familiar with and can use key terms such as 'amplification' and 'enzyme cascade'.
3d
(d) The chemical reactions that occur on the strip in the presence of glucose are...

- Glucose oxidase catalyses a reaction in which glucose is oxidised to form gluconic acid and hydrogen peroxide; [1 mark]
- Peroxidase then catalyses a reaction between the hydrogen peroxide and a colourless chemical in the pad to form a brown compound and water; [1 mark]

[Total: 2 marks]