InkBiology

ANSWER BOOK

Blood vessels and tissue fluid: what leaks out and what comes back

Animal transport and cardiovascular biology · Unit B09

AQA 3.3.4.2 · OCR A 3.1.2 (c)-(g) · Edexcel A Topic 1.3-1.5 · CAIE 8.1

6 questions · 20 marks

NAVY EDITION

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SECTION A · Short, 1 to 2 marks

A1 **A1** it is a vein, or a venule merging into one. **A1** roughly 8 mmHg, which is a very low pressure. [2]

SECTION B · Standard, 3 to 5 marks

B1 **M1** net pressure is the hydrostatic pressure minus the oncotic pressure, and the oncotic pressure is still 3.3 kPa at the venule end because the proteins never left. **A1** arteriole end: 4.6 - 3.3 = 1.3 kPa net outwards. **A1** venule end: 3.3 - 2.3 = 1.0 kPa net inwards. **A1** the outward net pressure exceeds the inward one by 0.3 kPa, so more fluid leaves than returns directly. [4]

B2 **B1** at the arteriole end the hydrostatic pressure of about 4.6 kPa pushing outwards exceeds the oncotic pressure of about 3.3 kPa pulling inwards. **B1** water and small solutes are forced out through the gaps between the endothelial cells by ultrafiltration, while plasma proteins and red blood cells are too large to leave. **B1** hydrostatic pressure falls along the capillary to about 2.3 kPa, lost to friction against the wall and to the fluid that has already left. **A1** the oncotic pressure has not changed, because the proteins responsible are still inside, so it now exceeds the hydrostatic pressure and water returns down the water potential gradient. [4]

B3 **B1** elastic tissue in the artery wall stretches during ventricular systole and stores energy as it does so. **B1** during diastole it recoils and pushes the blood on, so arterial pressure never falls to zero between beats and the flow is smoothed rather than arriving in slugs. **B1** arterioles are narrow and heavily muscled, and resistance to flow rises steeply as the radius falls, so halving the radius raises the resistance sixteen-fold. **A1** millions of arterioles in parallel take the mean pressure from about 90 mmHg down to about 35 mmHg and damp out the difference between systolic and diastolic. [4]

B4 **B1** about a tenth of the fluid leaving the capillary does not return at the venule end, and is normally collected by the blind-ended lymph capillaries. **B1** with the drainage blocked that surplus fluid has nowhere to go, so it accumulates in the tissue as oedema. **A1** lymph capillaries also take up plasma proteins that have escaped from the blood, so protein now builds up in the tissue fluid, raising its oncotic pressure and drawing back still less water. [3]

B5 **B1** blood in the veins of the leg is returned largely by contraction of the surrounding skeletal muscle squeezing the veins, and standing still removes that muscle pump. **B1** blood therefore pools in the leg veins and the hydrostatic pressure in the capillaries of the ankle rises. **A1** more fluid is forced out at the arteriole end than can be drawn back at the venule end or drained by the lymphatics, so fluid collects in the tissue. [3]