

QUESTIONSHEET 1

- (a) decreasing pH/increasing acidity;
increasing carbon dioxide concentration;
increasing temperature; **max 2**
- (b) during respiration pH of tissues falls/temperature increases/CO₂ tension rises;
oxygen tension falls since used up in tissues;
thus release of oxygen from haemoglobin to tissues is made easier/haemoglobin is on curve B in tissues;
converse at alveoli/haemoglobin on curve A and so oxygen uptake is easier; **max 3**
- (c) becomes saturated at very low oxygen levels;
can take advantage of low oxygen tensions in its environment;
will allow rapid release of oxygen if oxygen tension falls;
acts as an oxygen store; **max 2**
- TOTAL 7**
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QUESTIONSHEET 2

- (a) fetal haemoglobin must onload oxygen;
from maternal haemoglobin;
across the placenta;
thus at pO₂ when maternal haemoglobin is offloading oxygen (in placenta);
fetal haemoglobin must be unloading it (in placenta); **max 3**
- (b) (i) erosion/reduction of tissue layers in placenta/between maternal and fetal blood;
increase in maternal blood supply to placenta giving larger exchange surface area;
foramen ovale/hole in wall from right atrium to left atrium (allowing rapid shunting of oxygenated blood
from right to left side of fetal heart);
ductus arteriosus/shunt from pulmonary arch to aortic arch (allowing direct passage of oxygenated blood
from right side of heart to aorta); **max 2**
- (ii) has greater affinity for oxygen than adult haemoglobin;
higher oxygen tensions in atmosphere than placenta;
thus in air would be unable to unload oxygen to tissues; **max 2**
- TOTAL 7**
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QUESTIONSHEET 3

- (a) A = aorta; B = hepatic portal vein; C = (anterior) mesenteric/intestinal artery; D = renal artery;
E = renal vein; F = hepatic vein; G = posterior/inferior vena cava; **7**
- (b) (i) B would contain a higher concentration of absorbed food substances than C;
higher concentration of glucose;
higher concentration of amino acids/other valid example; **max 2**
- (ii) B would have a higher glucose concentration than F (since glucose stored as glycogen in liver);
B would have a higher amino acid content than F (since extra amino acids deaminated in liver);
F would have a higher urea concentration than B (due to deamination); **max 2**
- (iii) D would have a higher urea concentration than E (since urea is excreted);
D would have a higher uric acid/ammonia concentration than E (due to excretion); **2**

TOTAL 13

QUESTIONSHEET 4

- (a) A = left atrium; B = left ventricle; C = right ventricle; D = right atrium; 4
- (b) 1: aortic arch + away;
 2: pulmonary arch + away;
 3: vena cava + to;
 4: pulmonary vein + to; 4
- (c) (i) when closed prevent backflow from ventricles during (ventricular) systole/contraction;
 open to allow blood flow from atria to ventricles during diastole/atrial systole; 2
- (ii) when closed prevent backflow from arches to ventricles during ventricular relaxation/diastole;
 open to allow blood into arches during ventricular contraction/systole; 2
- (iii) T is a papillary muscle which opens the valve/prevents the valve from inverting;
 S is a tendon that attaches the valve flap to the muscle; 2
- TOTAL 14**
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QUESTIONSHEET 5

- (a) (i) it will contract and relax (rhythmically) of its own accord/without any nervous system input; 1
- (ii) A = sino-atrial node/pacemaker;
 B = atrio-ventricular node;
 C = bundle of His/ventricular bundles;
 D = Purkinjé/Purkyne fibers/conduction fibers; 4
- (b) (i) sinoatrial node generates impulses in right atrium;
 and they have to pass across to the left atrium; 2
- (ii) impulses can only get to the ventricles via the atrioventricular node;
 this delays the passage of the impulse/has a 0.1 second delay/has high electrical resistance which causes delay; 2
- (iii) because Purkyne fibers leave the bundles at the apex to branch through the ventricle walls
 /impulses are carried to the apex in the bundle of His ; 1
- (c) stimulation by the sympathetic nervous system increases activity (of heart muscle);
 stimulation of parasympathetic nervous system decreases activity;
 or (regulation by autonomic nervous system = 1 mark only)
 stimulation by adrenaline increases activity; max 2

TOTAL 12

QUESTIONSHEET 6

- (a) (i) plasma (minus plasma proteins);
white blood cells/named example; 2
- (ii) plasma proteins;
red blood cells; 2
- (iii) Any four of: oxygen/glucose/amino acids/lipids or named example/salts/vitamins/hormones or named example/
any other example;;; 4
- (b) (i) lymph is the fluid formed from the arterial end of the capillaries/that drains back into the venous end of the capillaries;
when lymph is bathing the cells/exchanging metabolites with the cells it is called tissue fluid; 2
- (ii) blood pressure at arterial end of capillary bed forces lymph out through capillary walls;
solute potential/osmotic pressure exerted by plasma proteins tends to draw water back into the blood;
but blood pressure is higher than osmotic pressure and so more fluid leaves blood than returns;
water/glucose/amino acids can leave the capillaries but proteins cannot/ref to differentially permeable capillary wall; max 3
- (iii) blood pressure at venous end of capillary bed has fallen;
now less than the osmotic pressure of the plasma proteins/solute potential;
thus osmotic pressure now draws back lymph into the capillaries/venous end;
some lymph drained back via lymph ducts/thoracic duct; max 3

TOTAL 16**QUESTIONSHEET 7**

- (a) (i) net blood pressure forcing fluid out = $4.4 - 1.1 = 3.3$ kPa;
net solute pressure drawing fluid back in = $3.3 - 1.2 = 2.1$ kPa;
thus more fluid leaves than is drawn back; 3
- (ii) net blood pressure forcing fluid out = $1.7 - 1.1 = 0.6$ kPa;
net solute potential drawing fluid back in = $3.3 - 1.2 = 2.1$ kPa;
thus more fluid drawn back than leaves; 3
- (iii) there is more protein in the blood since it is retained by the differentially permeable capillary wall; 1
- (b) loss of plasma proteins in urine will lower solute potential of blood;
this enhances lymph formation at arterial end of capillary bed;
and reduces return of lymph at venous end;
thus lymph accumulates in the tissues/oedema; max 3

TOTAL 10

QUESTIONSHEET 8

- (a) Curve 1: myoglobin;
Curve 2: fetal;
Curve 3: normal haemoglobin; 3
- (b) (i) fetal haemoglobin has greater affinity for oxygen than maternal haemoglobin;
at any partial pressure of oxygen fetal haemoglobin will become more saturated than maternal haemoglobin/
ensures oxygen passes from mother to fetus; 2
- (ii) acts as an oxygen store/will only release its oxygen when partial pressure in tissues/muscles very low;
e.g. in sudden exercise/emergency; 2
- TOTAL 7**
-

QUESTIONSHEET 9

- (a) A: aorta/aortic arch;
B: pulmonary artery/arch;
C: septum;
D: posterior/inferior vena cava;
E: right ventricle;
F: left ventricle; 6
- (b) atria contract/atrial systole occurs;
forces blood into ventricles;
semilunar valves (in veins) prevent back flow;
ventricles contract/ventricular systole occurs;
forces blood into aorta/pulmonary artery;
atrio-ventricular valves shut preventing back flow into atria;
atria and ventricles then relax so heart fills with blood;
semilunar valves (in arches) are closed at this stage; max 5
- TOTAL 11**
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QUESTIONSHEET 10

- (a) smooth endothelium to reduce resistance to blood flow;
elastic fibres to allow blood surge/withstand high pressures;
elastic fibres to provide damping effect/smooth flow;
smooth muscle to enable vasoconstriction/vasodilation; max 2
- (b) (i) blood is composed of plasma and cells;
tissue fluid formed from plasma;
tissue fluid does not contain red blood cells/has no/very little proteins; max 2
- (ii) fetal haemoglobin has higher oxygen affinity;
oxygen dissociation curve lies to the left of the maternal curve; 2
- TOTAL 6**

QUESTIONSHEET 11

- (a) by diffusion;
by active/facilitated transport;
by cytoplasmic streaming/cyclosis;

3

(b)

Chemical	Origin to destination
Urea	liver to kidney;
Insulin	pancreas to liver;
Alcohol	stomach to liver; small intestine to liver;
ADH	posterior pituitary to kidney;
glucose	small intestine to liver; stomach to liver; liver to all tissues;
FSH	anterior pituitary to ovaries;

9

- (c) released (to blood) from red bone marrow;
carried suspended in blood/plasma;
escapes/passes through capillary walls/via fenestrations in capillary walls/ref diapedesis;
aided by histamine making capillaries more 'leaky';
move by amoeboid action through tissues;
attracted to site of infection by chemotaxis;

max 3

TOTAL 15

QUESTIONSHEET 12

- (a) (i) A = endothelium/simple squamous epithelium/pavement epithelium;
B = smooth muscle; elastic tissue; 3
- (ii) contains elastic tissue to absorb pulse/energy of pulse/withstand high pressure;
contains much (smooth) muscle to withstand high blood pressure/allow vasoconstriction (in smaller arteries);
narrow lumen to maintain high pressure;
smooth/non-stickable endothelium so blood flows past easily/little friction; max 3
- (b) (i) vein has a wider/wide lumen;
vein contains less smooth muscle;
vein contains little/no elastic tissue;
vein usually contains valves; 4
- (ii) blood is at much lower pressure in veins;
so less need for (smooth) muscle/elastic tissue;
no pulse and so no need for elastic tissue;
valves prevent backflow of blood (due to gravity effects/contraction of atria);
wide lumen allows lower pressure; max 3
- (c) microscopic in size;
smallest capillaries are about 7µm in diameter;
lined by endothelium/simple squamous epithelium/pavement epithelium;
ref to gaps/fenestrations in epithelium;
no muscle/only a very small amount of muscle; max 3

TOTAL 16**QUESTIONSHEET 13**

- (a) (i) A = lymphocyte; B = neutrophil; C = monocyte; 3
- (ii)
- | Function | White cells |
|--|----------------------------|
| production of antibodies | lymphocytes; |
| phagocytosis of bacteria | neutrophils;
monocytes; |
| secretion of histamine, serotonin, heparin | basophils; |
| phagocytosis of antigen-antibody debris | eosinophils; |
- 5
- (b) released from lymph nodes into lymph/blood(supply of lymph node);
passes through lymphatic system/vessels to join blood stream;
near heart/via thoracic duct/into (left) subclavian vein;
carried in blood to site of infection;
released to tissues through 'leaky' capillary walls/fenestrations;
(Reject diapedesis for lymphocytes) max 3

TOTAL 11

QUESTIONSHEET 14

- (a) (i) less oxygen/lower oxygen tension at higher altitude/oxygen tension falls as altitude increases;
more red cells present means more haemoglobin is available;
and so more oxygen can be picked up/transported/efficiency of oxygen transport is increased;
ref to low pO₂ stimulates erythropoietin secretion;
erythropoietin stimulates red cell formation; **max 3**
- (ii) all the same sex; **2**
different sexes have different red cell counts;
- all the same age group/no children; **2**
different age groups have different counts/children have different counts;
- all healthy; **2**
illness can alter the red cell count;
- (could also have: same ethnic origin; counts differ in different races;
similar diets; diet affects red cell count;
allow any other valid suggestions)
- TOTAL 9**
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QUESTIONSHEET 15

- (a) lower oxygen tension/less oxygen available;
at high altitude/up mountains;
llama haemoglobin can onload oxygen more efficiently/at lower oxygen tensions than humans can;
yet still release it to the respiring tissues effectively; **max 3**
- (b) (i) lower oxygen tension stimulates kidneys to release more renal erythropoietic factor;
thus more erythropoietin formed;
thus red cell production increases/red cell production becomes faster than red cell destruction(recycling);
but takes several weeks before an appreciable rise is seen/no appreciable effect for at least three weeks; **max 3**
- (ii) renal dialysis patients have (severe kidney) disease;
fail to produce enough renal erythropoietic factor; **2**
- (iii) plasma proteins are made in the liver ; **2**
not enough plasma proteins/erythropoietin precursor formed by diseased liver;
- TOTAL 10**