QUESTIONSHEET 1

(a) decreasing pH/increasing acidity;
increasing carbon dioxide concentration;
increasing temperature; **max 2**

(b) during respiration pH of tissues falls/temperature increases/CO_2 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

QUESTIONSHEET 2

(a) fetal haemoglobin must onload oxygen;
from maternal haemoglobin;
across the placenta;
thus at pO_2 when maternal haemoglobin is offloading oxygen (in placenta);
fetal haemoglobin must be onloading 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

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 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

QUESTIONSHEET 5

(a) (i) it will contract and relax (rhythmically) of its own accord/without any nervous system imput; **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 partal 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

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;

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(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 pO_2 stimulates erythropoietin secretion;
erythropoietin stimulates red cell formation; **max 3**

(ii) all the same sex;
different sexes have different red cell counts; **2**

all the same age group/no children;
different age groups have different counts/children have different counts; **2**

all healthy;
illness can alter the red cell count; **2**

(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

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 <u>more</u> renal erythropoietic factor;
thus <u>more</u> 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 ;
not enough plasma proteins/erythropoietin precursor formed by diseased liver; **2**

TOTAL 10